# HEAT TRANSFER STUDIES IN A VERTICAL TUBE OF CLOSED-LOOP THERMOSIPHON

A THESIS

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*the requirements for the award of the degree*
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*in*

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*by*

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# A B S T R A C T

Closed loop thermosiphons provide an efficient and economical means of heat transfer in diverse fields of application. The rate of heat transfer and thermally induced flow in these systems interact with each other and depend upon a number of design and operating parameters in a very complex manner. The prediction of these rates is the main requirement for the design of units using a closed-loop thermosiphon system.

The study of natural convective flow and heat transfer in confined spaces has been conducted by many workers in the past. These studies are mostly on vertical channels forming open thermosiphons. The fluids used were invariably air or gas with Prandtl number around 0.7. Very few studies on heat transfer in single phase natural convective flow of liquids in closed-loop circulation systems seems to have been reported.

The hydrodynamics and heat transfer in thermosiphon roboilers have been studied by a number of investigators over the past two decades. A critical review of the published

work reveals that most of the studies have been conducted for uniform wall temperature heating conditions with saturated liquids. Some studies at high heat fluxes are also confined to saturated boiling and very limited range of other important parameters. No systematic study seems to be available in the literature which gives the exclusive effect of inlet degree of subcooling and submergence on the performance of thermosiphon reboilers.

In the present work, a systematic experimental study of heat transfer in the vertical tube of closed-loop thermosiphons, both single as well as two-phase systems, has been carried out under low values of uniform wall flux heating conditions.

The experimental apparatus used for the study on single phase systems consisted of a vertical copper tube as test section connected to a large capacity vessel and a jacketted pipe forming a closed-loop circulation system. The test section was of 19.05 mm inside diameter, 1.58 mm wall thickness and 940 mm heated length. The electrical heating element-nichrome wire, in porcelain beads, was uniformly wound over the tube. A stabilized A.C. electrical input to the heater was regulated through autotransformers and measured by calibrated wattmeters. The tube wall temperatures were measured by ten copper-constantan thermocouples whose beads were embedded in the wall thickness at locations 100 mm apart starting from the lower end of the heated length. The mixed mean liquid temperatures were measured by means of copper-constantan thermocouple probes inserted at the two ends of the heated tube. Three liquids-water, ethylene glycol and glycerol were used as test liquids for single phase natural circulation studies. Experimental data were generated imposing constant heat flux ranging from $1.77 \times 10^3$ to $1.066 \times 10^4$ W/m$^2$. As a consequence of changing inlet temperature to the test section and heat flux, wide range of variation in physical properties was observed in terms of pertinent dimensionless groups. The values of Gr.Pr ranged from $9.07 \times 10^4$ to $2.11 \times 10^7$, and the corresponding values of Re due to induced flow from 0.39 to 445.

The test section of single vertical tube thermosiphon reboiler consisted of an electrically heated stainless steel tube of 21.44 mm inside diameter, 2.03 mm wall thickness and 1440 mm heated length. The uniform wall heat flux was obtained from the measured electrical input. In order to get the local heat transfer coefficients, the tube wall temperatures were measured by sixteen copper-constantan thermocouples whose beads were spot welded on the tube surface at locations 100 mm apart starting from the lower end. The inlet and exit liquid temperatures were measured by means of copper-constantan thermocouple probes separately. The upper end of the test section was connected to a vapour-liquid separator, the vapour line from which led to a total condenser. The liquid line from the separator and condensate line from condenser were connected to a jacketted vertical tube which served as cold leg. The lower ends of test section and cold leg were joined together through a horizontal tube forming a closed-loop circulation system. The experiments were conducted with five test liquids-acetone, ethyl acetate, propan-2-ol, water and toluene having wide range of boiling points and thermophysical properties. The uniform heat fluxes in the range of $3.0 \times 10^3$ to $2.4 \times 10^4$ $W/m^2$ were used. The degrees of subcooling at the test section inlet were varied over a wide range for all test liquids. During the experimentation submergence levels around 100,80 and 50 percent were maintained.

The experimental data of single phase systems were used to obtain wall and liquid temperature distributions along the tube length at various levels of heat flux and inlet liquid temperatures for all the three test liquids investigated. The heat transfer coefficients were computed from imposed heat flux and the resulting local values of temperature difference and their variation along the tube length have been discussed. The values of heat transfer coefficient have been found to increase with heat flux due to the higher levels of temperature setup and increased induced flow rates of the liquids. At the same heat flux, the transfer coefficients show a decreasing order for water, ethylene glycol and glycerol. As a result of data analyses, dimensionless correlations to predict local and average heat transfer coefficients have been developed.

For local heat transfer coefficients,

$$Nu = 1.14(Gr.Pr)^{0.388}\left(\frac{Re}{Gr^{0.66}}\right)^{0.863}$$

For average heat transfer coefficients,

$$(Nu)_{avg} = 0.049(Gr.Pr)_{avg}^{0.584}(Re)_{avg}^{-0.131}(\ell/d)^{-0.622}$$

In natural circulation boiling of liquids, the experimentally obtained wall and liquid temperature distributions along the tube length revealed the varying lengths of effective boiling and non-boiling sections. In between, the point of onset of boiling for all the test liquids under various operating conditions were identified and discussed. The non-boiling region was identified by the linearly varying liquid and wall temperatures along the tube length under the conditions of constant heat flux. The zone of transition from nonboiling through subcooled boiling to fully developed saturated boiling was marked by the attainment of maximum wall temperature followed by a sudden decrease in its value and subsequently becoming almost constant.

The heat transfer coefficient remained almost invariant with length over the non-boiling section of the tube. It jumped to much higher values at the onset of boiling conditions and became constant in fully developed boiling region of the tube length. The variation of h with z was found to be similar for all systems and was affected by heat flux, inlet liquid subcooling and submergence.

The onset of fully developed boiling required a minimum degree of wall superheat for a given liquid and heat transfer surface. Based on the analytical study of Yin and Abdelmessih [90] the following expression for wall superheat as a function of q has been developed

$$(T_W - T_S)^2 = (a - bq)^2 \frac{2\sigma T_S}{k_L \lambda \rho_V} q$$

The constants a and b in the equation are as under:

| System | a | b |
|---|---|---|
| Acetone | 24.35 | $0.296 \times 10^{-3}$ |
| Ethyl acetate | 23.40 | $0.831 \times 10^{-3}$ |
| Propan-2-ol | 19.89 | $0.477 \times 10^{-3}$ |
| Water | 16.42 | $0.106 \times 10^{-3}$ |
| Toluene | 15.84 | $0.343 \times 10^{-3}$ |

The distance along the heated tube required for the onset of fully developed boiling of a liquid depends upon wall heat flux, inlet liquid subcooling and submergence. An empirical correlation for predicting this length has been developed in the following form:

$$\left[\frac{z_{OB}}{L} \times 100\right] = C_4 (Pe_B)^{n_4} (K_{sub})^{n_5} S^{n_6}$$

The values of constant $C_4$ and exponents $n_4$, $n_5$ and $n_6$ for all the five test liquids have been evaluated and are as under:

| System | $C_4$ | $n_4$ | $n_5$ | $n_6$ |
|---|---|---|---|---|
| Acetone | 0.095 | -0.2890 | 0.260 | 1.450 |
| Ethyl acetate | 0.266 | -0.1630 | 0.340 | 0.995 |
| Propan-2-ol | $0.51 \times 10^{-3}$ | 0.4430 | 0.068 | 1.993 |
| Water | $0.54 \times 10^{-3}$ | 0.0014 | 0.133 | 2.405 |
| Toluene | $1.55 \times 10^{-3}$ | 0.4370 | 0.120 | 1.740 |

The heat transfer coefficient in fully developed boiling region has been found to be strongly dependent on heat flux due to the dominant role of nucleate boiling mechanism in the experimental conditions of present investigation. The effect of inlet liquid subcooling and submergence on the magnitude of $h_B$ was observed to be negligible. However, the length of tube over which fully developed boiling occurred was found to increase with the decrease in the values of inlet liquid subcooling and submergence. Thus, the boiling heat transfer coefficient averaged out over the fully developed boiling section of the tube has been expressed as a function of q in the following power law relationship:

$$h_B = c\, q^n$$

The values of c and n are as under:

| System | c | n |
|---|---|---|
| Acetone | 45.31 | 0.387 |
| Ethyl acetate | 75.18 | 0.332 |
| Propan-2-ol | 54.36 | 0.351 |
| Water | 17.51 | 0.556 |
| Taluene | 37.29 | 0.381 |

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The variation of $h_B$ with q also showed a good agreement with the experimental data from earlier studies of similar nature.

The rate of heat transfer in nonboiling region of the reboiler tube was found to be mainly governed by natural convective flow of liquids in the similar manner as in the case of single phase thermosiphon. However, the net flow of liquid through the reboiler tube was higher than that in the single phase thermosiphon due to the liquid vapourization in the upper section. The average values of heat transfer coefficient for all the five test liquids were best correlated in terms of same dimensionless groups, used in single phase thermosiphon, by the following equation with a maximum deviation of ± 30 per cent

$$\left[Nu_{NB}\right]_{avg} = 0.0126(Gr.Pr)_{avg}^{0.481} (Re)_{avg}^{0.064} \left(\frac{z_{OB}}{d}\right)^{-0.23}$$

A correlation for boiling heat transfer coefficient has also been developed in terms of suitable dimensionless groups.

$$Nu_B = 6.142(Pe_B)^{0.462} \left(\frac{1}{X_{tt}}\right)^{0.0134} (Pr)^{1.014} \left(\frac{\nu_{H_2O}}{\nu_L}\right)^{1.743}$$

The data points of all the five liquids were found to be well within ± 30 per cent deviation from the equation.

Although, the correlation has been developed based on experimental data at very low values of heat flux and small vapour fractions, its form is fairly general and may be extended to other ranges of parameters.

None of the earlier correlations, available in literature, has been found to agree well with the experimental data of present investigation.

# C O N T E N T S

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# NOMENCLATURE

| | | |
|---|---|---|
| A | heat transfer area | $m^2$ |
| a | cross sectional area of heated tube | $m^2$ |
| C | specific heat | J/kg °C |
| D | outside diameter of heated tube | m |
| d | inside diameter of heated tube | m |
| F | condenser flow rate | kg/sec |
| h | heat transfer coefficient | $W/m^2$ °C |
| I | current | amperes |
| k | thermal conductivity | W/m °C |
| L | total heated length | m |
| $\ell$ | chosen length for average coefficient | m |
| m | circulation rate | kg/sec |
| P | pressure | $N/m^2$ |
| Q | heat input | W |
| q | heat flux | $W/m^2$ |
| $r_c$ | radius of cavity, critical condition | m |
| S | submergence | per cent |
| T | temperature | °C (K) |
| $T_1$ | inlet temperature of cooling water to condenser | °C |
| $T_2$ | outlet temperature of cooling water from condenser | °C |
| $T_{sc}$ | condensate temperature in condenser vessel | °C |
| $\Delta T$ | temperature difference | °C |
| $\Delta T_f$ | temperature drop across the liquid film | °C |

| | | |
|---|---|---|
| $\Delta T_{sub}$ | degree of subcooling, $(T_s - T_L)$ | $^oC$ |
| $\Delta T_w$ | temperature drop across the wall thickness | $^oC$ |
| V | voltage | volts |
| x | vapour fraction | |
| z | distance along the test section | m |

GREEK LETTERS

| | | |
|---|---|---|
| $\alpha$ | thermal diffusivity, $k/\rho C$ | $m^2/s$ |
| $\beta$ | coefficient of volume expansion, $-\frac{1}{\rho}(\frac{\partial\rho}{\partial T})$ | $^oC^{-1}$ |
| $\delta^*$ | superheated layer thickness | m |
| $\lambda$ | latent heat of vapourisation | J/kg |
| $\rho$ | density | $kg/m^3$ |
| $\nu$ | kinematic viscosity, $\mu/\rho$ | $m^2/s$ |
| $\mu$ | dynamic viscosity | $Ns/m^2$ |
| $\sigma$ | surface tension | N/m |

SUBSCRIPTS

| | |
|---|---|
| avg | average |
| B | boiling |
| exptl | experimental |
| $H_2O$ | water |
| in | inlet liquid condition |
| L | liquid |
| out | outlet liquid condition |
| NB | non-boiling |
| OB | onset of boiling |

pred	predicted

s	saturation

TP	two-phase

v	vapour

w	wall

z	refers to position along the heated length

DIMENSIONLESS GROUPS

Gr	Grashof number, $(\frac{gd^3\beta\ \Delta T}{\nu^2})$

$K_{sub}$	subcooling number, $(1 + \frac{\rho_L}{\rho_v}\frac{\Delta T_{sub}}{T_s})$

Nu	Nusselt number, $(\frac{hd}{k})$

$Pe_B$	Peclet boiling number, $(\frac{q}{\rho_v}\frac{\rho_L C_L}{\lambda\ k_L}\sqrt{\frac{\sigma}{\rho_L-\rho_v}})$

Pr	Prandtl number, $(\frac{C\ \mu}{k})$

Ra	Rayleigh number, (Gr.Pr)

Re	Reynold's number, $(\frac{dm}{a\mu})$

$X_{tt}$	Lokhart-Martinelli parameter, $\left[(\frac{1-x}{x})^{0.9}(\frac{\rho_v}{\rho_L})^{0.5}(\frac{\mu_L}{\mu_v})^{0.1}\right]$

# CHAPTER 1

# INTRODUCTION

Thermosiphons are characterized as those thermal systems which have the intrinsic function of removing heat from a prescribed source and transporting heat and mass over a specific path and finally rejecting the heat and/or mass to a prescribed sink. In such systems, flow occurs as a result of thermal buoyancy forces, either locally or in an overall sense. Thus, a thermosiphon may be defined as 'a prescribed circulating fluid system driven by thermal buoyancy forces' [56]. The thermosiphons are generally categorized based on

a. the nature of boundaries - open or closed to mass flow,

b. the regime of heat transfer - purely natural convection or mixed natural and forced convection,

c. the number and type of phases present - single or two-phase state, and

d. the nature of body force - gravitational or rotational.

Of these, closed loop vertical thermosiphons (recirculating type) are of vital importance to industrial applications.

Closed loop thermosiphons essentially consist of a U-tube type of system with movement of fluid due to density differences in the hot and cold legs. This class of systems, involving either purely natural convective single phase flow or boiling resulting in two-phase flow (thermosiphon reboiler), have inherent qualities of providing high heat transfer rates apart from their mechanical simplicity and economical operation.

The design of such systems require the fundamental information on the rate of heat transfer and the resulting flow, and their interaction with pertinent process parameters.

## 1.1 SINGLE PHASE CLOSED LOOP THERMOSIPHON

Heat transfer during natural convective flow of fluids has been widely used for simultaneous extraction and transportation of thermal energy in power plants and process industries. Some of the common examples are found in boilers (particularly during start-up), transformers and engine cooling, liquid-cooled turbines and the sensible heating section of thermosiphon reboiler tubes. Recently, the application of natural convective flow has been included in research and development in such diverse fields as nuclear, solar and geo-thermal energy. In nuclear reactors, under certain normal or emergency operating conditions - upon loss of forced flow as in the case of pump failure - the heat is transferred from the reactor core by the natural convective flow of the coolant fluid. Heat transport from a solar heat collector to its point of extraction also takes place by the circulation of the transfer medium through a natural circulation loop. The extraction and transportation of geo-thermal energy has also recently employed down-hole heat exchangers working on the principle of natural convective flow.

In an effort to develop design equations, a number of studies on natural convective flow and heat transfer in confined spaces have been reported. Most of the studies conducted were on vertical channels of widely different geometries forming open thermosiphons. The fluids used were invariably air or gas with Prandtl number around 0.7. Very few studies, regarding heat transfer in single phase closed loop thermosiphons have been reported todate. These studies too, are for low Prandtl number fluids, and thus, do not reveal the heat dissipating characteristics of liquids in such systems.

Therefore, the present work was planned with a view to investigate experimentally the heat transfer to high Prandtl number liquids in natural convective flow through a vertical tube of a thermosiphon loop. The object of the study was to obtain the thermal response of heat transfer coefficient to various parameters affecting the process from the measured wall and liquid temperature distributions along the tube length at different levels of heat flux. Also, based on experimental results, it was aimed to develop generalized empirical correlations predicting the local as well as average heat transfer coefficients.

## 1.2 THERMOSIPHON REBOILER

Thermosiphon reboilers find wide applications in chemical and petrochemical industries because of their operation in the nucleate boiling regimes with attractively high heat fluxes. The hot leg in these units is a one pass heat exchanger (Fig.1.1) with process fluid to be vapourized in the vertical tubes. These units are generally hung on the towers, thus minimising foundation, structural and plot area requirements. The discharge lines are directly connected to the tower with a minimum pressure drop and vapour line costs. In evaporator services, the resistance to some types of fouling and ease of cleaning when fouled, makes it a preferred unit.

Design of thermosiphon reboilers also require the knowledge of its interacting hydrodynamic and heat transfer aspects. Hydrodynamics and heat transfer phenomenon in these units are complicated owing to the presence of two phases (liquid and vapour). In such units, various steady and fluctuating flow modes are encountered depending upon several operating parameters such as heat flux, inlet liquid temperature, liquid level in the reboiler tubes, tube geometry and orientation and physical properties of flowing fluids. Various flow patterns Fig.(1.1) affect the hydrodynamic conditions near the heated wall resulting in different frictional pressure drops and modes of heat transfer. Because of the changing modes of heat transfer along the length, sound theoretical analysis of these systems is rather difficult,

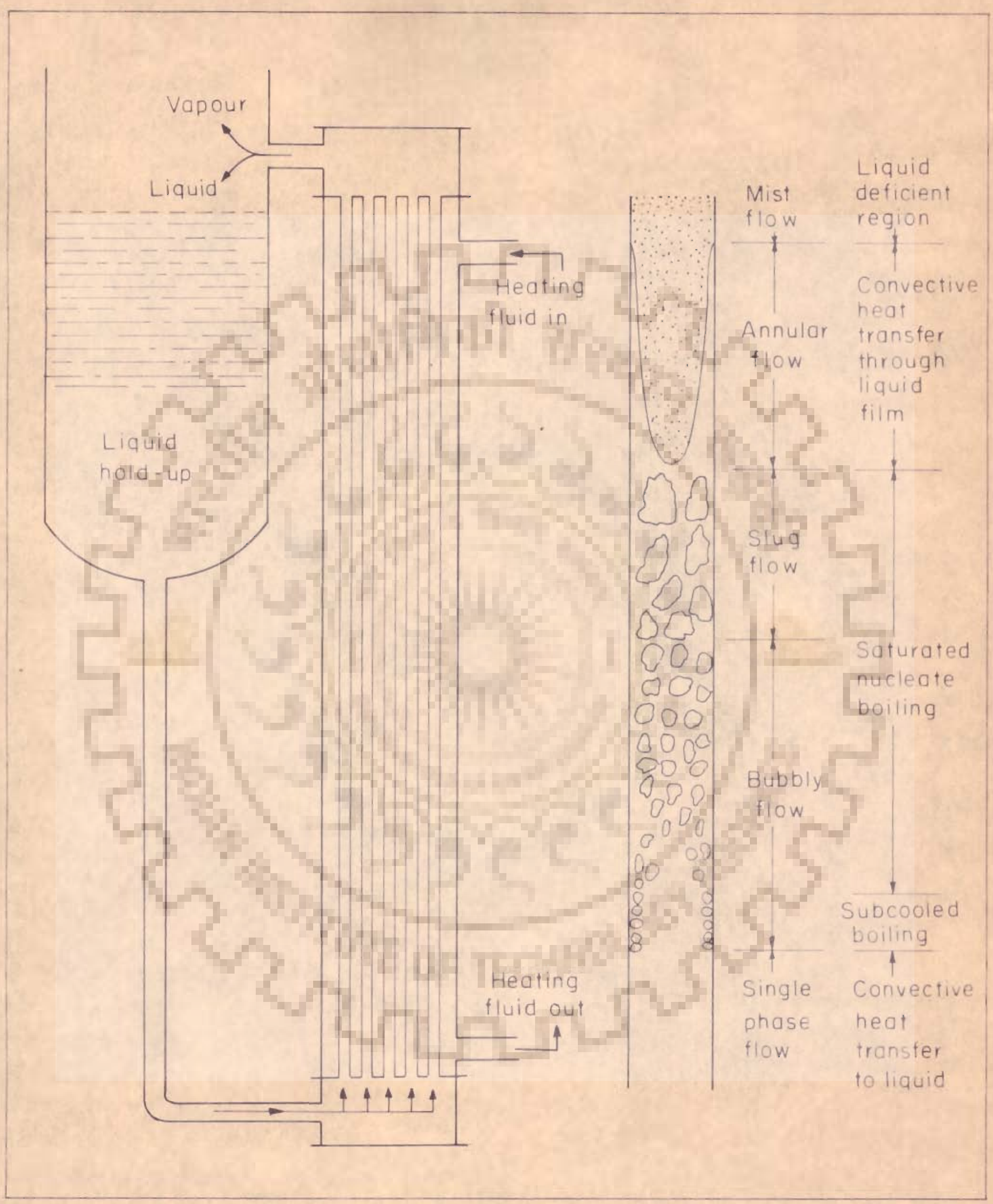



Fig.1.1 Typical thermosiphon reboiler and regimes of heat transfer along a tube

Therefore, a fair amount of empiricism becomes unavoidable in the studies on thermosiphon reboilers.

During the last two decades, a number of experimental studies have been conducted to investigate the hydrodynamic and heat transfer aspects of natural circulation boiling of liquids in vertical tubes. Most of these studies are under the conditions of uniform wall temperature heating with saturated liquids. A few studies for constant wall flux heating are also reported for high values of heat flux and low values of inlet liquid subcooling. Based on their own data, some of the investigators have proposed empirical correlations for computing circulation rate, pressure drop and heat transfer coefficient. Most of the proposed correlations for heat transfer coefficient assume convective mechanism and accordingly contain $X_{tt}$ as a major correlating parameter. The nucleate boiling contributions are accounted for, through various correction factors, using film temperature difference as the main operating variable and surface tension as the main transport property.

Recently, some work regarding the performance of thermosiphon reboilers with respect to the height of liquid level in the reboiler tube has been reported. These qualitative studies indicate that submergence has a considerable effect on the location of point of onset of boiling, which in turn, governs its performance. No systematic study seems to be available, depicting the exclusive effect of inlet degree of subcooling and submergence for low values of heat flux on the performance of thermosiphon reboilers.

The present experimental investigation was, therefore, undertaken to study the heat transfer to liquids in a single vertical tube thermosiphon reboiler. The main objectives of the present work were:

1. To measure the wall and liquid temperature distributions along the heated tube length imposing various low values of heat flux, wide ranges of inlet liquid subcooling and different levels of submergence.

2. To obtain the variation of heat transfer coefficient along the tube length under the effect of above mentioned parameters.

3. To identify the conditions of onset of boiling and relate them to the relevant parameters.

4. To study the effect of heat flux, inlet liquid subcooling and submergence on heat transfer coefficients.

5. To develop, as a result of data analyses, generalized correlations for predicting heat transfer coefficients.

# CHAPTER 2

## LITERATURE REVIEW

The subject of heat transfer to buoyancy induced flow in vertical tubes has been of considerable interest to research workers in the past. Hydrodynamics and heat transfer are the two major aspects of such systems which have been investigated with a view to provide reliable methods of their design on industrial scale. The studies reported in the literature are mostly experimental in nature and have resulted in a number of empirical and semi-empirical correlations. Keeping in view the aims of present investigation, the following sections review the literature.

### 2.1 SINGLE PHASE THERMOSIPHON SYSTEMS

The study of natural convective flow and heat transfer in confined spaces has been conducted by many workers. The first extensive investigation on natural convective flow in vertical ducts was carried out by Elenbaas [34]. Based on his theoretical and experimental work, Elenbaas established the heat dissipating characteristics of vertical ducts having such cross-sectional geometries as the equilateral triangle, square, rectangle and circle with uniform surface temperatures. Chato[13] investigated the natural convective flow in a vertical three channel configuration with non-uniform heat inputs both analytically and experimentally. The results of the study showed the existence of a metastable regime in which two metastable flow patterns could occur for a given set of heat input rates. The studies on the development of natural convective flow in heated vertical open tubes- include those of Dyer[31,32,33] Kageyama and Izumi[59] and Davis and Perona[23]. These studies are extensions of the work carried out by Bodia and Osterele[10] on natural convective flow in vertical channel formed by two parallel plates. Dyer used a finite difference technique to solve the equations governing the flow in a vertical circular duct imposing uniform wall temperature and constant wall flux heating conditions with and without flow restrictions at the bottom. The theoretical analysis yielded relationships between Nusselt number and the Rayleigh number for Prandtl numbers around 0.7. Dyer also obtained experimental data with air that agreed satisfactorily with the theoretical relationship. Kageyama and Izumi[59] reported on the development of flow in uniform heat flux circular duct for a Prandtl number of 0.72. From the theoretical analysis, Davis and Perona[23] calculated the velocity and temperature distributions throughout the tube for free convective flow of a gas ($Pr = 0.7$) in a heated vertical open tube with constant wall temperature as well as constant heat flux at the tube wall. Using these velocity and temperature profiles, a graphical correlation was proposed between dimensionless tube length and the dimensionless rates of volumetric flow and heat dissipation. Recently, Churchill [18] developed a general correlating equation, based on earlier theoretical and experimental results, for buoyancy induced convection in vertical channels. The equation relating Nusselt number with Rayleigh number accounts low Prandtl number values of air. The applicability of the correlation has been claimed for round tubes and channels formed by parallel plates both for uniform wall temperature and constant wall flux heating. The equation has also been claimed to predict approximate values for other geometries with appropriate characteristic lengths.

Heat transfer studies on natural convective flow in closed loop systems, despite their advantageous applications in many industrial situations, has received the least attention. Holman and Boggs [47] applied constant wall flux heating to Freon-12 near critical state in a closed loop natural circulation system to judge its heat dissipation characteristics. The investigation covered a range of temperatures from 150 to 400 $^{o}$F and pressures from 500 to 950 psi. Separate correlations for predicting Nusselt numbers have been reported for reduced volumes less and greater than one. Results also showed that there was no appreciable increase in the heat transfer coefficient in the critical region over that experienced in the superheat region. Lapin [65] conducted constant wall flux heating and cooling of water and mercury in a closed loop thermosiphon system and compared his experimental data with a one dimensional constant flux analysis for similar system. He presented a correlation in dimensionless form for tubulent experimental results. Recently Madejski and **Mikielewicz** [68] outlined a new application of natural convective flow in closed loop systems as heat exchanger fins. The authors constructed a recuperator using constant diameter closed loop thermosiphons as liquid fins and showed experimentally that such fins when filled with NaK eutectic have an apparent conductivity ranging from 50 to 100 times the thermal conductivity of the NaK for the same range of operating conditions. Values of about 150 to 250 were obtained when mercury was used as circulating fluid.

## 2.2 THERMOSIPHON REBOILERS

The successful design and operation of a thermosiphon reboiler requires the prediction of flow and heat transfer **rates**. The design variables for such systems include-circulation rates, pressure drops, flow instabilities, geometry and orientation of the heating surfaces and tube side heat transfer coefficients. These design variables have considerable effect of various operating parameters-pressure, heat input, inlet degree of subcooling, submergence and type of fluid used. Numerous studies to this effect have been conducted in past to predict these design-variables imposing wide ranges of operating parameters. Several design methods have also been recommended in the literature [35,36,37,51,52,53,57,66] but those due to

Fair [35,36,37] and Hughmark [51,52,53] have received wide acceptance as they deal with various aspects of vertical thermosiphon reboilers in detail. Murti [72] and a review on thermosiphon reboilers by Mckee [70] reviewed the earlier design methods.

2.2.1 Hydrodynamics

Hydrodynamics deals with the induced single and two phase flow inside the tubes and their interactions with heat transfer resulting in pressure drop and flow instabilities.

Initially Badger et al [4] recommended an empirical correlation for the prediction of liquid velocities in terms of specific volumes of liquid and vapour and submergence ratio. Johnson [57] proposed a model predicting recirculation rates, modifying Kern's method [61] by including the existence of a liquid zone and using the two-phase pressure drop correlation of Martinelli and Lokhart [67] for vapourization zone. The model had also been compared with measured experimental values of Piret and Isbin [76]. Fair [35] earlier used Kern's method to give a suitable design method for thermosiphon reboilers. The problems involved in estimating circulation rates were discussed by Hughmark [5,52] and prediction of circulation rate was considered in conjunction with two-phase pressure drop, which was calculated by means of a polynomial in terms of Froude number and volume fraction liquid.

In practice, reboiler tubes partly contain purely single phase (liquid) and partly two-phase (liquid and vapour) flowing within. This two-phase region is more generally described by the flow regimes present in it. The presence of these flow regimes, Fig.(1.1), greatly add to the complexity of the hydrodynamic and heat transfer characteristics of the reboiler. Much of the understanding for identification of these flow regimes has been gained through visualisation studies.

A thorough knowledge of the various types of flow regimes, conditions of their onset and regions of occurrence, is essential for a sound design. As such there is no completely satisfactory method for the prediction of the flow regimes in vertical co-current two-phase flow. Griffith and Wallis [43], Govier et al [42] and Collier [21] presented charts for the identification of flow regimes existing in the pipe for the given flow conditions. Orkiszewski [74], based on a large amount of experimental data on co-current two-phase vertical flow and on the results of Griffith and Wallis [43], Duns and Ros [30] and Nicklin et al [73], formulated some useful correlations for the identification of flow regimes using dimensionless numbers. Most of the correlations proposed from time to time are generally based on the experimental data obtained under isothermal conditions. Recently, Chexal and Bergles [16] studied the stability characteristics of a single channel vertical thermosiphon reboiler. The test section consisted of electric-resistance heated glass tubing. The glass tubing was 70 percent optically transparent, hence visual observation of the two-phase flow process was possible. Seven steady and fluctuating flow modes were observed for a wide ranges of inlet subcooling and heat flux. Flow regime maps were developed in terms of these coordinates for both water and Freon-113 for a variety of inlet and exit valve settings.

Based on the above studies, the resulting pressure drops have been studied for different regimes of two-phase flow. To this effect, majority of the correlations developed are either semi-empirical or generally derived from momentum and energy balances. Also a narrow flow region had been covered in these correlations. The pioneering work was due to Martinelli and coworkers [67,69] with the generalised correlation of Lokhart-Martinelli as a standard for comparison. In the subsequent studies it was found that the graphical correlations due to Martinelli and co-workers were best suited for turbulent flow systems regardless of the type of flow pattern and also particularly for pipe sizes in the range of usual heat exchanger tubing dimensions. Chisholm and Laird [17] suggested that Lokhart-Martinelli correlations may be represented in the form of a polynomial in Lokhart-Martinelli parameter, $X_{tt}$, for turbulent-turbulent region. For vertical tubes, Davis [24] obtained an improved data fit by using a modified parameter expressed mainly in terms of $X_{tt}$. Hughmark [50] developed polynomial type of correlation for two-phase frictional pressure drop, considering a homogeneous model and taking Froude and Reynold numbers as parameters. Recently, a number of studies have been carried out with friction factors suitably defined for two phase flow, so that the two phase frictional pressure drop may be expressed by conventional Fanning equation. Typical definition to this effect is due to Govier and Omer [41]. They pointed out that plots of such a form do give a systematic spread of data above the single phase lines and allow easy comparison of trends. Having established a valid criterion for comparing two-phase flow correlations for friction loss, Dukler et al [28,29] developed methods for the calculation of frictional pressure drop and acceleration terms from a similarity analysis considering slip and no slip between the phases. It was observed that this analysis reveals more reliable estimates than that given by Lokhart-Martinelli method. Anderson and Russel [3] recommended Dukler's method as a general approach and also find favour in Hughmark's method [49]. Considering basic mechanical energy equations and making use of flow regime knowledge and a large amount of empirical data, Orkiszewski [74] established correlations for frictional pressure gradient, two-phase density and acceleration terms in each flow regime. DeGance and Atherton [26] rearranged these equations for their direct use for computation purposes.

Dynamic hold up of vapour and liquid in the heated zone of the reboiler tube create problems in estimating the static head effects. Initial studies to this effect assumed no slip between the phases but actually the vapour flows faster than liquid. Hughmark [49] developed a correlation for hold up assuming a homogeneous model which was considered as satisfactory by Dukler et al [28,29]. Martinelli and co-workers [67,69] presented a graphical correlation for the calculation of holdup. This work was based on the assumptions of homogeneous flow conditions and on the results of holdup measurements in small horizontal pipes. Chislom and Laird [17] expressed this graphical correlation in terms of a polynomial in $X_{tt}$ to be used directly in computations. The use of this correlation was found to be limited by liquid massflow rates equal to or higher than 50 lbs/sec-ft$^2$. Dukler [28,29], based on his experimental data found that these correlations had individual limited applicabilities which DeGance and Atherton [25,26] elaborated. Recently Takeda [86] conducted experimental holdup studies in natural circulation vertical annular spaces and presented a correlation with major parameters as heat flux, length of boiling region and modified terminal velocity of a single bubble.

2.2.2 Heat Transfer

Boiling heat transfer inside vertical tubes take place by following two modes:

(i) Heat transfer due to nucleate boiling, and

(ii) Heat transfer due to convective flow.

These modes are due to the various flow patterns which occur inside the tubes of a thermosiphon reboiler. As shown in Fig.1.1, the single phase region represents heat transfer by convection and if the temperature difference between the tube wall and the saturation temperature of the liquid reaches the limit for the nucleate boiling, then the phenomenon of subcooled boiling (surface boiling) takes place at the tube wall with the collapse of bubbles into the subcooled liquid. Once the liquid attains the saturation temperature, fully developed nucleate boiling sets in with the vapour existing as the second phase. Beyond this, the quantity of vapour along the tube length continuously increases due to the heat input, resulting in flow patterns suggesting convective mechanism.

Heat transfer in single phase region of a thermosiphon reboiler tube has been approximated by well developed forced convective equations [5,52,72]. Studies to this effect are very limited because of the fact that most of the experimental investigations performed are for saturated liquids entering the reboiler tubes, thereby neglecting the single phase region.

The point of onset of nucleation along the tube length and its required superheat depends upon a number of operating parameters. Numerous studies to this effect, for forced convection boiling in vertical tubes, have been reported predicting superheat through semiempirical approach. These studies include the effect of various physical parameters- surface roughness, size and geometry of nucleation sites, role of surface tension and wettability. Some of the experimental studies have also been reported for the influence of prior boiling and effect of dissolved gases. Experimental evidence for the presence of two boiling incipience points, depending on the direction (increasing or decreasing) of change in heat flux, has also been shown[46].

The widely accepted approach for the prediction of incipient boiling has been the one which is based on the Gibb's equilibrium theory of bubble in a uniformly superheated liquid and the one dimensional steady or transient heat conduction equation. Hsu[48] developed analytical expressions for the size range of active nucleation sites for constant heat flux at the wall. Bergles and Rohsenow[8] developed a criterion of incipient boiling for systems that have a wide range of cavity sizes which should be applicable to commercially finished surfaces. They concluded that only a small additional increase in wall temperature is necessary to activate a considerable range of cavity sizes when bubbles originating from cavities of a particular radius start to grow. Sato and Matsumura[79] proposed an analytical expression equivalent to that of Hsu's for the prediction of incipient nucleate boiling of water at atmospheric pressure. Based on the analysis of Hsu[48], Bergles and Rohsenow[8] and Anderson and Davis [2] derived an equation for the prediction of subcooled incipient boiling of water in forced convection. They concluded that the criterion used in their analysis appears satisfactory for determining an upper limit of the liquid superheat required to initiate nucleate boiling when a wide range of cavity sizes exist. All these studies successfully predicted the boiling incipience for the decreasing heat flux conditions. Recently, Yin and Abdel-Messih[90] investigated the phenomenon of liquid superheat during incipient boiling in a uniformly heated forced convection channel. Experimental data were obtained using Freon 11 as the test medium. Based on certain assumptions and existing theories, an analytical method predicting both points of boiling incipience, was developed. The method proposed the following equation:

$$\left(\frac{\delta^*}{r_c}\right)^2 = \frac{(T_w - T_s)^2 \, k_L \, \lambda \, \rho_v}{2q \, \sigma \, T_s} \qquad \ldots (2.1)$$

Using the generated experimental data, they computed the values of $(\delta^*/r_c)$ for both incipient conditions and finally correlated them as linear functions of heat flux. In view of the basic assumptions involved in the analysis, the applicability of Eq.(2.1) have been recommended to water and other organic liquids of low surface tension in both pool and flow boiling systems.

Ünal[88] considered the effect of pressure on the boiling incipience under subcooled flow boiling of water in a vertical tube. Maximum bubble diameters at this point were observed experimentally and correlated.

As regards to the fully developed flow boiling, numerous studies justifying either of the two modes have been reported.

Below the point of maximum heat flux, as defined by a transition from nucleate to film boiling, film coefficients are generally correlated on the following basis:

$$q = m(T_w - T_s)^n \qquad \ldots (2.2)$$

$$\therefore \quad h_b = m(T_w - T_s)^{n-1} \qquad \ldots (2.3)$$

where m and n are nearly constant and depends upon the characteristics of material being boiled, system pressure and nature of the heat transfer surface. Based on the above value of nucleate pool boiling coefficient, $h_b$, the expression for nucleate boiling with flowing fluid have been recommended by Fair[35,36] in the following form:

$$h_N = \alpha \, h_b \qquad \ldots (2.4)$$

where $\alpha$ is the correction factor which accounts for the variation of nucleate boiling heat transfer coefficient in the respective flow regimes. Chen[15] developed a correlation from experimental data for nucleation with flow conditions using Forster and Zuber's analysis[38] for nucleate pool boiling. Chen's correlation contains suppression factor 's' to include the suppression effect of the moving fluid on the boiling rate.

$$h_N = 0.00122 \left[ \frac{k_L^{0.79} \; C_L^{0.45} \; \rho_L^{0.49} \; g_c^{0.25}}{\sigma^{0.5} \; \mu_L^{0.29} \; \lambda^{0.24} \; \rho_v^{0.24}} \right] (T_w - T_s)^{0.24} \, (\Delta P)^{0.75} \, s \qquad \ldots (2.5)$$

It was also postulated that 's' could be represented as a function of the local two-phase Reynold's number. Hughmark[52] mentioned that experimental heat transfer data did not agree with this postulate and suggested a value of 's' as 0.25 to better fit the data when nucleation apparently occurred. Gel'perin[40] correlated the experimentally observed heat transfer coefficients for boiling zone with corresponding heat fluxes in the following form,

$$h_B = a\, q^{0.64} \qquad \ldots (2.6)$$

where $a = a_1 (\frac{L}{d})^{0.2}$ and $a_1$ depends on physicochemical properties of the liquid.

Most of the studies on flow boiling heat transfer in vertical tubes assumed convective mode for correlating purposes. Piret and Isbin[76] investigated six fluids:water, carton tetrachloride, isopropyl and butyl alcohols, 35 wt% and 50 wt% $K_2CO_3$ at atmospheric pressure in a 1" nominal copper tube with 46.5" heated length. They proposed a modified Dittus Boelter equation to correlate average inside heat transfer coefficient. In Reynold's number they used logmean mean velocity assuming a homogeneous flow.

$$Nu = 0.0086 (Re_m)^{0.8} (Pr)^{0.6} \left(\frac{\sigma_{H_2O}}{\sigma_L}\right)^{0.33} \qquad \ldots (2.7)$$

Guerrieri and Talty[44] studied heat transfer to boiling of cyclohexane, methyl alcohol, benzene, pentane, and heptane at atmospheric pressure, in two single tube natural-circulation vertical reboilers which were light oil-heated brass tubes 0.75" ID by 6 ft long and 1" ID by 6.5 ft long respectively. Inside wall and boiling stream temperatures were measured at 6" intervals along the tubes. Film coefficients have been expressed as a function of Lokhart-Martinelli parameter $X_{tt}$.

$$\frac{h_{TP}}{h_L} = 3.4\left(\frac{1}{X_{tt}}\right)^{0.45} \qquad \ldots (2.8)$$

Wall temperatures were found generally to decrease from the bottom to the top of the tube. Stream-temperature distribution displayed the expected maximum at some intermediate point. The boiling film coefficients has also been presented in terms of a nucleate boiling correction factor. Dengler and Addoms [27] stressed convective boiling mechanism by conducting forced convective boiling studies in a 1" ID by 20 ft long vertical copper tube using water as test liquid. Radioactive tracers have been used to measure liquid fractions along the tube. They presented the ratio of local two-phase coefficient to the liquid-phase coefficient as a function of the reciprocal of the Lokhart-Martinelli parameter.

$$\frac{h_{TP}}{h_L} = 3.5\left(\frac{1}{X_{tt}}\right)^{0.5} \qquad \ldots (2.9)$$

They observed and discussed the suppression of nucleate boiling by forced convection either externally induced or vapour induced. Lee et al [66] used a reboiler consisting of seven tubes in a bundle. The tubes were of 1" OD, 14 gauge 10 feet long made of admiralty metal. The investigation was carried out for seven liquids and data were presented for a pressure range of 2 to 120 psia. Overall coefficients were expressed as functions of overall temperature differences. The average inside-film coefficient and the maximum flux were presented in terms of dimensionless groups graphically. The maximum flux was found for each fluid and system pressure. Vapour locking was reported above maximum flux for each liquid. Recommendations for a maximum overall coefficient of 500 BTU/hr.ft$^2$ $^o$F, and the need for giving particular attention to reboiler entrance and exit piping had been given. Johnson[57] measured circulation rates and overall temperature driving forces for a 15-in. shell reboiler containing 96 1-in., 12 gauge, 8-ft long tubes. One tube was equipped with a temperature probe to obtain local boiling steam temperatures. The systems investigated were water and a hydrocarbon having a normal boiling point of 80.8$^o$C. The Lockhart-Martinelli parameter was used to calculate friction and expansion losses for the two phase zone. Overall coefficients, driving forces fluxed, flow, and vapourization rates were tabulated. Typical temperature profiles were shown for six runs on the hydrocarbon. Bennett et al[6] carried out experimental studies on heat transfer to two-phase steam-water mixtures in the liquid dispersed region in an annulas. They pointed out that below 15 percent dryness, the mechanism of heat transfer was probably governed by considerations of nucleate boiling whilst at higher steam qualities (upto app.55-65%.) a forced convective mechanism was suggested. Beyond 65 percent dryness, the heat transfer rate decreases. In the absence of a fundamental knowledge of the hydrodynamics of the system, attempts have been made to correlate the data in the forced convective region by a modified form of the Guerrieri and Talty [44] equation.

$$\frac{h_{TP}}{h_L} = 0.64\left(\frac{Q}{A}\right)^{0.11}\left(\frac{1}{X_{tt}}\right)^{0.74} \quad \ldots (2.10)$$

where Q/A is in Btu/hr-ft$^2$.

Ladiev [63] carried out experiments in three tubes 1500 mm long and 24, 28 and 52 mm diameter. Special attention was given to maintain identical conditions in all tubes. Heat transfer experimental results were correlated graphically for water at atmospheric pressure. The apparent liquid level in the tube had a significant effect on heat transfer, which decreased with an increase in the level. The sharp reduction in heat transfer at boiling in vertical tubes with inherent circulation was associated with inadequate flow in the upper part of the tube. Increase in tube diameter had no significant effect on heat transfer rate but circulation velocity decreased. Under vacuum, the general character of heat transfer was retained but its absolute level was lower than that at atmospheric pressure.

Claire [19] obtained fundamental information regarding heat transfer in a pilot evaporation plant. The coefficients of heat transfer for brass tubes and stainless steel tubes of different lengths (6-ft and 4-ft) and 2.0 in. and 1.5 in o.d. are compared. Tests with water boiling at atmospheric pressure indicated that the heat transfer was at maximum when the level of water was maintained at about 1/3 of the tube height. For clean tubes the value of U was always higher for brass tubes than for stainless steel tubes.

Bergles et al [7] carried out experiments on water at low pressures (below 100 psia) to investigate the effects of tube length, inlet temperature, tube diameter, and pressure on the critical heat flux. The results were related to the instabilities of the slug-flow regime. Critical heat fluxes for water were normally considered to start around $0.4x10^6$ Btu/hr $ft^2$, however, the authors have shown values of half this amount under low pressure conditions.

Beaver and Hughmark [5] conducted experiments on twelve fluids in a 3/4 in. by 8 ft. long carbon steel tubes, heated electrically, to investigate the reliability of using developed correlations in vacuum operations. It was concluded that for wall minus saturation temperature difference less than $15^{o}F$, single phase coefficients dominate and can be predicted by a modified Dittus-Boelter equation (Sieder-Tate modification):

$$Nu = 0.023(Re)^{0.8}(Pr)^{0.4}(\mu_L/\mu_w)^{0.14} \quad \ldots (2.11)$$

For temperature differences greater than $15^{o}F$ nucleation sets in and local inside coefficients can be predicted by existing two-phase correlations.

Shellene et al [82] carried out plant tests on a highly instrumented 110 $ft^2$ reboiler having a 14-in. shell, containing 70 3/4 in., 13 gauge, 3 7/8 in. 12 gauge, 8 ft long tubes. The reboiler was operated in conjunction with an existing distillation column and, except for instrumentation, was identical to a typical commercial unit. Steam was used as the heat source and the process fluids were benzene, water, isopropyl alcohol, methyl ethyl ketone, glycerine, and various aqueous solutions of the alcohol, ketone and glycerine. The particular pressure was slightly above atmospheric. Of particular interest in the work was the exploration of the onset of unstable operation. It was found that the addition of flow resistance to the inlet line extended the stable operating range, and the allowable pressure drop across the tubes decreases as the heat flux increases. Adding flow resistance to the vapour return line results in a decrease in the maximum flux. The authors recommend to keep the return line flow area atleast equal to the total flow area of the tubes. Maximum heat fluxes were tabulated for the various fluids with accompanying temperature differences and per cent vaporization. Other data were presented as heat flux versus log mean temperature difference and mass velocity versus pressure drop.

Takeda et al. [86] measured the axial distribution of vapour holdup and boiling heat transfer coefficient in the annuli of a natural circulation vertical tube evaporator for pure liquids (water, methanol) and liquid mixtures (10 mole percent methanol-water, 50 mole percent methanol-water, $H_2O-C_{12}H_{25}C_6H_4-SO_3\,Na$ (1 gm/lit.). Vapour hold up in the annuli was expressed in terms of heat transfer rate and length of boiling region. The effect of vapour holdup on the boiling heat transfer coefficients was analysed to give an empirical dimensionless equation.

Calus et al [11] carried out experimental work on a single tube natural circulation reboiler to investigate heat transfer to single component liquids. One copper and one stainless steel tube each equipped with a single steam jacket, and one stainless steel tube equipped with a six-compartment steam jacket were used. All the tubes had nominal dimensions of 0.5 inch. diameter and 48 in.height. Three workers worked independently to obtain the length mean and local point coefficients of heat transfer for water, isopropanol, n-propanol and their azeotropes. Two-phase heat transfer coefficients for all five liquids were correlated by a single equation:

$$\frac{h_{TP}}{h_L} = 0.065\left[\frac{1}{X_{tt}}\right]\left[\frac{T_s}{\Delta T_f}\right]\left[\frac{\sigma_{H_2O}}{\sigma_L}\right]^{0.9} \qquad \ldots (2.12)$$

All the length mean coefficients from runs with a two-phase mixture quality of between 0.02 and 0.68 at the tube exit are correlated well within the ± 20 percent accuracy limits. The same equation correlated point heat transfer coefficients from runs with a quality in the range of 12 percent to 50 percent within ± 30 percent accuracy limits. The dimensionless groups $(\frac{T_s}{\Delta T_f})$ and $(\frac{\sigma_{H2O}}{\sigma_L})$ were powerful correlating factors. The latter group accounts for the differences in the nucleating properties of the various single component liquids and its correlating effectiveness indicated that nucleation was one of the mechanism present in flow boiling.

Calus et al [12] obtained heat transfer data from a natural circulation single tube reboiler for binary liquid mixtures of isopropanol, n-propanol, and glycerine each with water. Two tubes, one of copper and one of stainless steel, were used to obtain length mean heat transfer coefficients. Also one stainless steel tube was used to obtain local coefficients. All the three tubes had nominal dimensions of 0.5 in. diameter and 4 ft. length. It was found, in correlating the experimental data, that the single component correlation [11] was adequate, provided that the surface tension used in it is that of the binary liquid of the interfacial concentration, $\sigma_L^*$, and that the temperature driving force is the difference between the wall temperature and the saturation temperature of the mixture of interfacial concentration. The latter was found by correcting the apparent temperature difference $\Delta T_f$ with the correction factor F. The length mean coefficients corresponding to a combination of flow boiling regimes, excluding the purely bubbly-nucleate and dry wall regions, were correlated by the equation

$$\frac{h_{TP}}{h_L} = 0.065\left(\frac{1}{X_{tt}}\right)\left(\frac{T_s}{\Delta T_f}\right)\left(\frac{\sigma_{H2O}}{\sigma_L^*}\right)^{0.9} F^{0.6} \quad \ldots (2.13)$$

where

$$F = 1 - (y^* - x)\left(\frac{C_L}{\lambda}\right)\left(\frac{\alpha}{D_m}\right)^{0.5}\left(\frac{dT}{dx}\right),$$

$D_m$ = mass diffusivity

$y^*$ = weight fraction of the more volatile component in the vapour phase in equilibrium with liquid phase composition, x.

75 to 95 per cent of the data points, depending upon the

type of mixture, were within ± 20 percent accuracy limits. The same equation correlated the local coefficients within ± 30 percent accuracy limits, if data points for nucleate boiling or dry wall regimes were rejected. The factor F was a powerful parameter with binary mixtures having a highly non-ideal vapour-liquid equilibrium relationship. In the case of binary mixtures of low relative volatility this factor is very close to unity.

Nearly all the correlations for two phase coefficients assumed the convective mechanism proposed by Dengler and Addoms. Mesler [71] made critical analysis of Dengler and Addom's experimental data and found severe inconsistencies. He observed that the analysis given by Dengler and Addoms was not correct and his data could be better explained by nucleate boiling mechanism. Based on this finding, he critically examined the similar data of other authors and found a support to his analysis. Later, Chaudhari and Mesler [14] proposed analytical linear models relating basic parameters of nucleate boiling as heat flux, q, and $\Delta T$. They included mass velocity also to take into account the effect of convection. Models were also successfully compared with the experimental data of various authors appeared earlier in the literature.

Most of the studies reported in the literature, as mentioned above, are for 100 percent submergence. Ladiev [63] and Claire [19] reported qualitatively the effect of submergence on the overall heat transfer performance of reboilers.

They concluded that the performance of the reboilers improve when submergence was decreased. Claire [19] recommended an optimum value of submergence as 33 percent for best overall performance of thermosiphon reboilers. Smith [84] also explained the attractive performance of the reboilers with respect to submergence. Johnson et al [58] conducted studies on an industrial size of reboiler employing a wide ranges of submergence under vacuum. Through the effect of submergence on the resulting length of boiling and nonboiling zones, they recommended that optimum practical operating conditions for vacuum reboilers are 50 percent liquid driving head and 50 percent vapourization.

Shah [81] explained some trouble shooting methods with respect to the design and operational difficulties generally encountered in thermosiphon reboilers.

# CHAPTER 3

## EXPERIMENTAL SET-UP AND EQUIPMENT

### 3.1 SINGLE PHASE CLOSED LOOP THERMOSIPHON SYSTEM

The experimental set-up used for the study of heat transfer in the vertical tube of a closed loop thermosiphon system is shown schematically in Figure 3.1. The natural circulation loop consisted of two vertical tubes whose bottom ends were connected together by a horizontal pipe while the top ones through a large capacity vessel. The heated tube (hot leg) served as test section and the other jacketed pipe formed the cold leg of the thermosiphon.

The test section consisted of a copper tube of 19.05 mm inside diameter, 1.58 mm wall thickness and 940 mm heated length. The tube was heated externally by an electrical heating element which was 22 gauge nichrome wire, having an electrical resistance of 3.48 ohms/m. The porcelain beads of proper size over the element were used for electrical insulation. The heating element was uniformly wound on the tube and the terminals were screwed to especially designed brass rings. Each ring was held on the tube by means of three screws which were insulated

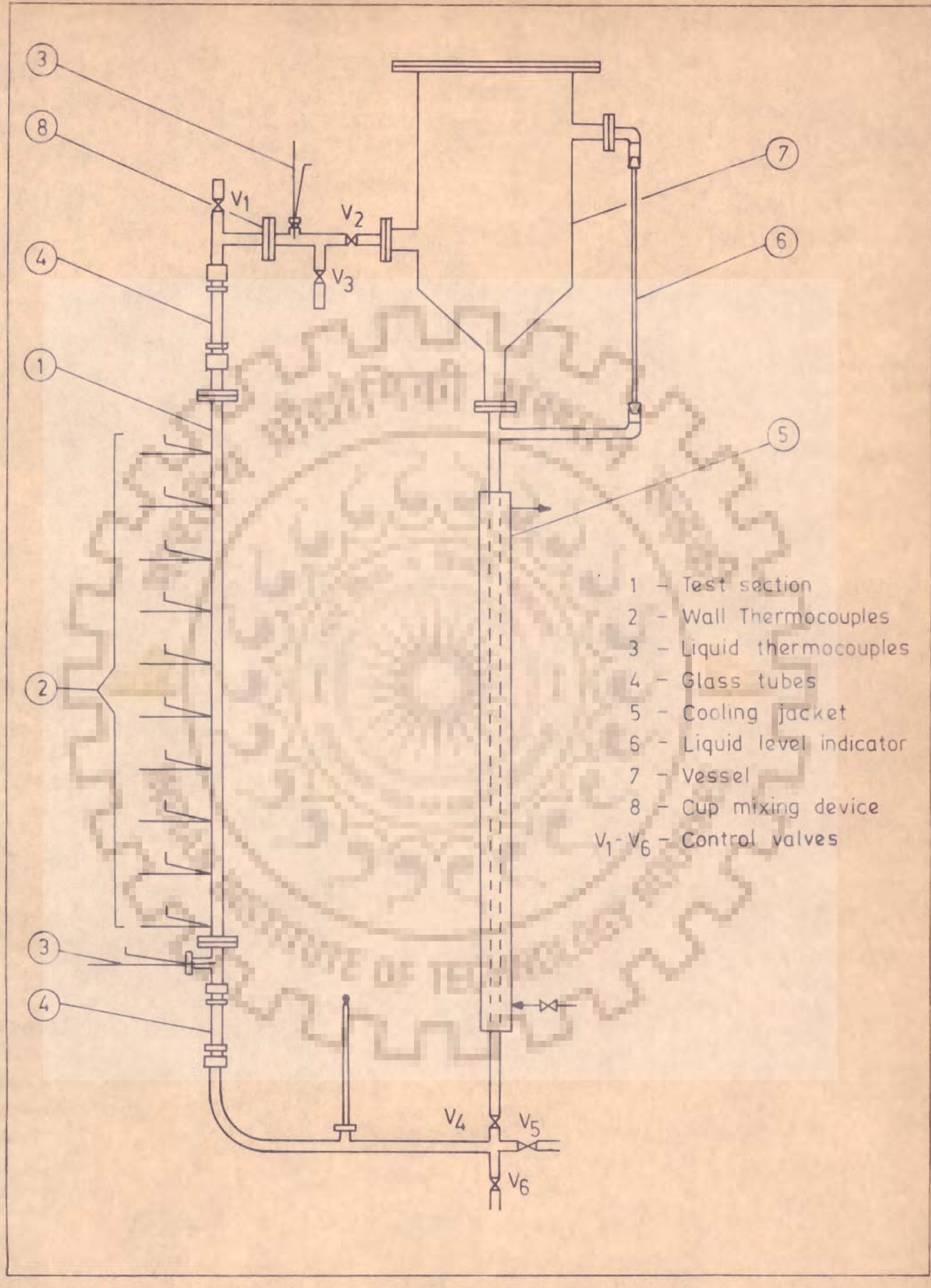



Fig.3.1 Experimental set up for studies on single phase closed loop thermosiphon

by placing mica sheet between their tips and the tube. The electrical power to the heater was supplied from a stabilized 220 volts A.C. source. It was regulated by means of autotransformer and measured by calibrated wattmeter. All the electrical connections were made by thick copper wires to minimize the resistance of electrical wiring and thus ensuring the conversion of all the electrical energy into heat only in the heating element over the tube.

One of the objectives in the present work was to measure local heat transfer coefficients at various positions along the tube with the thermally induced flow of liquids. It was, therefore, necessary to obtain the wall and liquid temperature distribution along the test section length at imposed uniform heat flux. The temperatures of the heat transfer surface were measured by ten copper-constantan thermocouples fixed at intervals of 100 mm starting from the lower end of the heated section. Thermocouple beads were embedded in the tube wall thickness and the leads were wound along the circumference before taking them out to the e.m.f. measuring system. The temperatures so obtained were directly taken as the inside surface temperature because the temperature drop between the thermocouple bead location and the inner surface of the tube was negligible (Appendix D). The inlet liquid temperature was measured by a calibrated copper-constantan thermocouple probe inserted just before the lower end of the heating section. In order to get the bulk temperature of heated liquid emerging out of test section, a cup mixing device was provided in the exit line just before the thermocouple probe. All the thermocouples were connected to a reference junction and a d.c. potentiometer through a twelve point selector switch. The reference junction was maintained at $0^{o}C$ by dipping it in melting ice bath. The potentiometer was a precision instrument provided with a sensitive spot reflecting galvanometer which made it possible to measure the thermocouple e.m.f. upto 0.001 mV with an accuracy of 0.01 per cent.

The upper and lower ends of the test section were connected to two sections of glass tubes having same inside diameter through gland and nut arrangements. The glass tubes were carefully aligned with the test section to make the axes of all the three tubes coincide. The glass tube sections were provided for visual observation of flowing liquid and ensuring the absence of any disturbance caused by escape of air bubbles in the loop. This was important during the start-up of experiments particularly of high heat flux values. The exit end of the loop after cup mixing device (in the upper horizontal pipe) was connected to a cylindrical vessel of 282 mm inside diameter and 425 mm long with a conical bottom and a flanged top cover. The vessel helped in attaining the steady performance by providing a liquid reservoir in the circulation loop and dampening out any temperature fluctuations by absorbing the thermal transients.

The conical bottom of the tank was connected to the inlet end of thermosiphon loop through a jacketed vertical tube of same inside diameter as the test section. The cooling water to the jacket was supplied from a constant level tank. The inlet temperature of the test liquid was controlled by regulating the water flow rate to the jacket.

The set-up was thoroughly lagged with glass wool and wrapped with thin aluminium sheet to minimise the heat losses to the surroundings.

## 3.2 THERMOSIPHON REBOILER

The experimental unit to generate the data on natural circulation boiling of liquids in a vertical tube was constructed as a modified version of the set-up described in section 3.1. A photographic view of the unit is shown in Photo 3.1 and the schematic diagram is given in Fig.3.2. The experimental facility comprised mainly of the following:-

- Natural circulation loop
- Power supply system
- Instrumentation.

### 3.2.1 Natural Circulation Loop

The thermosiphon reboiler loop was essentially a U-tube shape circulation system with liquid boiling in an electrically heated vertical tube which served as test section. The vapourising liquid flowed upwards through a glass section and entered into a vapour-liquid separator. The liquid drained down the bottom of the separator while vapours went to a water cooled

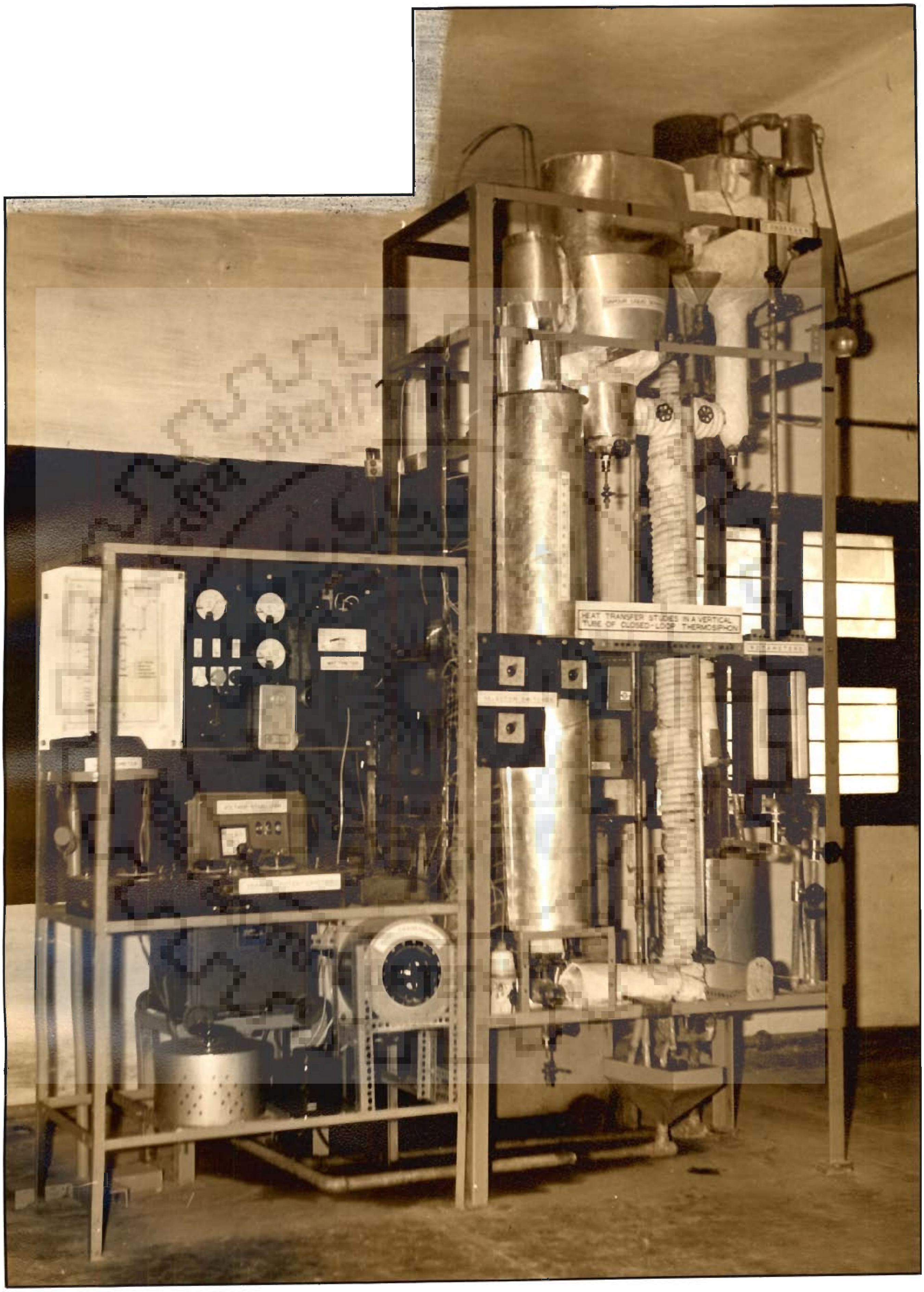



Photo. 3.1 Overall view of the experimental Thermosiphon Reboiler unit

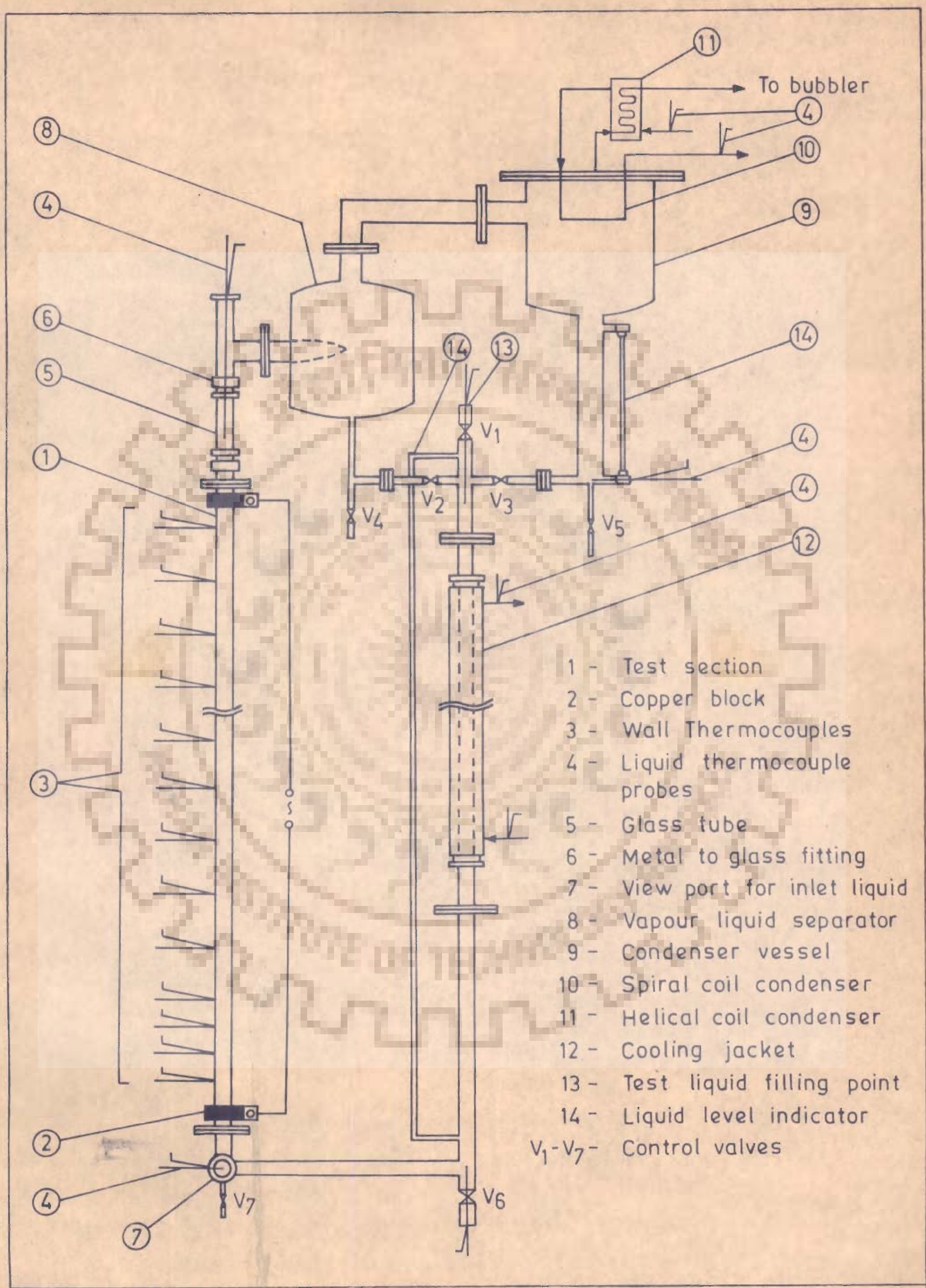



Fig. 3.2 Schematic diagram of the thermosiphon reboiler

condenser. The condensed liquid joined the other liquid coming from separator into the top of a downflow pipe through which the total liquid circulated back to the inlet of the test section.

The details of heat transfer section are shown in Fig.3.3. The test section was made of a stainless steel(304 AISI) tube 21.44 mm I.D. and 25.50 mm O.D. The total length of the tube was 1550 mm out of which, a length of 1440 mm was tapped between two thick copper clamps for electrical heating by connecting them to a stabilized low voltage power supply system. The clamps were carefully designed and fabricated to provide a good electrical contact with negligible contact resistance. Copper constantan thermocouples made from 24 SWG wires with glass fibre sleeve insulation were spot welded on the outer surface of the tube at intervals of 50 mm upto a length of 200 mm from the bottom and 100 mm over the remaining length. The two ends of the tube were provided with flanged joints using thick gaskets of pressed asbestos. Thus the flanges screwed to the test section were insulated electrically from their respective pairs with the help of backelite backflanges and insulating rings around the bolts as depicted in Fig.3.3.This arrangement proved to be very effective in isolating the heat transfer section electrically from rest of the set-up. The flanges at the lower end connected the tube to an inlet liquid view port as detailed in Fig.3.4. Through this view port the liquid coming out of the downflow pipe could be observed visually to ensure the complete absence of

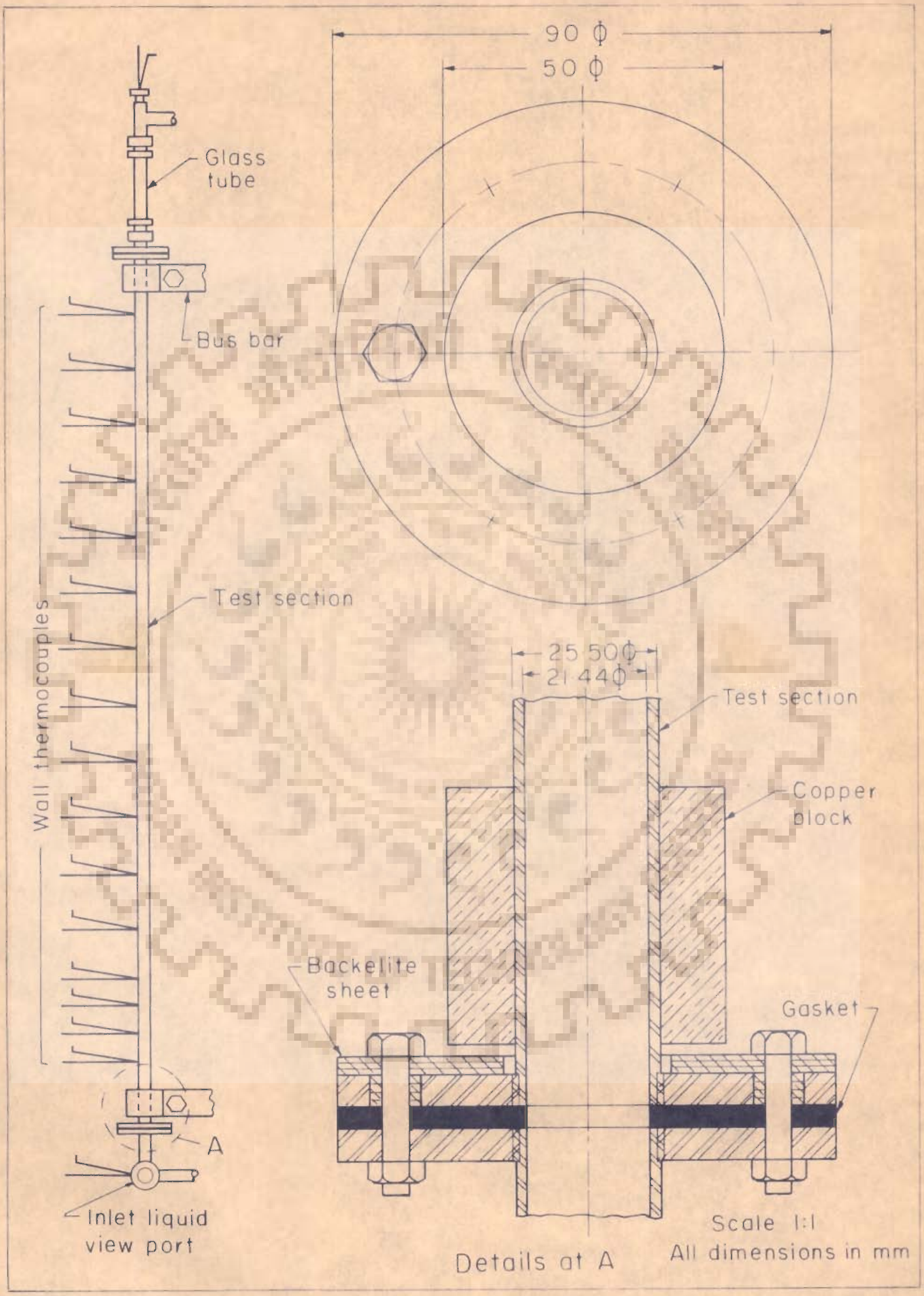



Fig.3.3 Details of heat transfer section

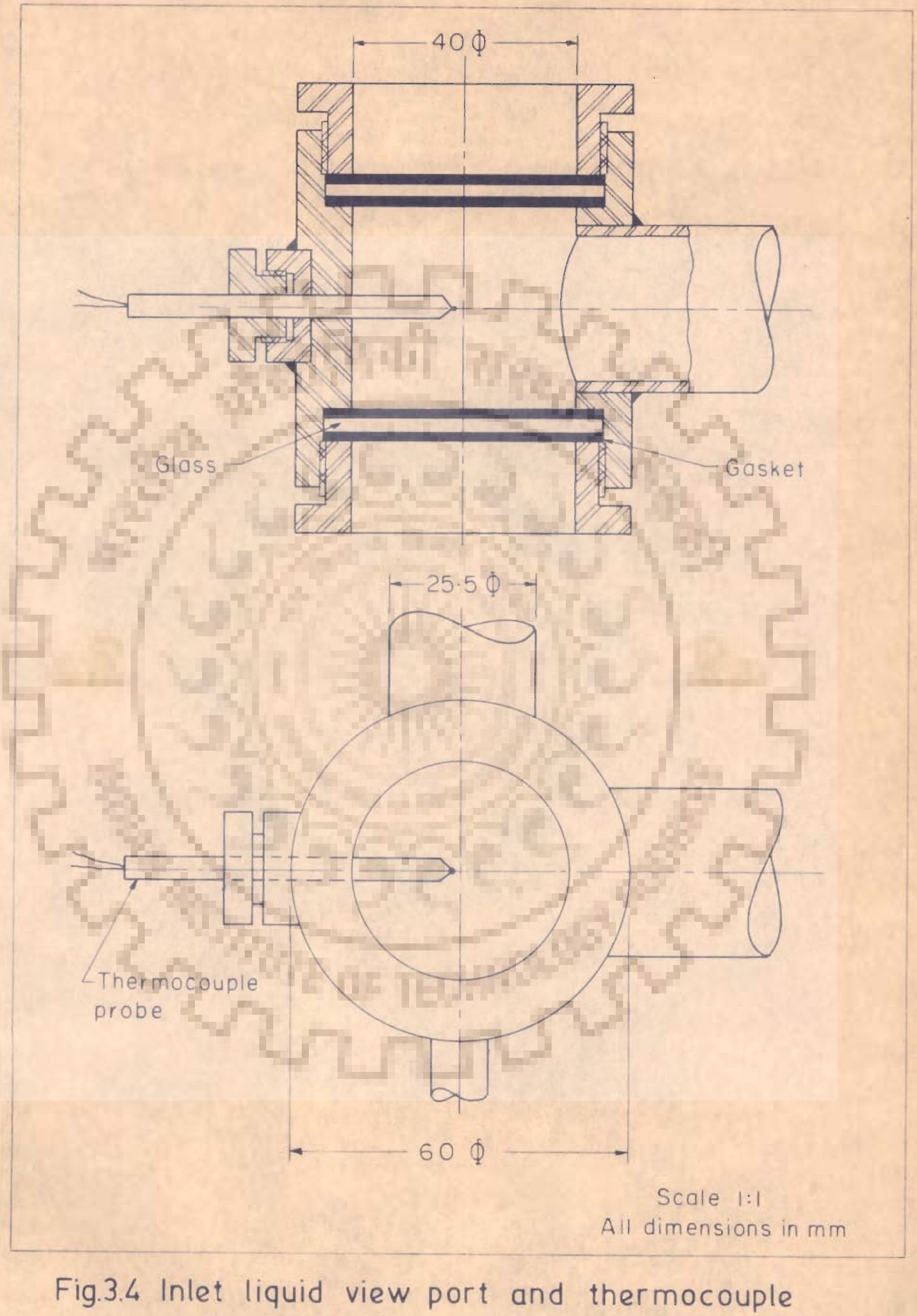



Fig.3.4 Inlet liquid view port and thermocouple probe assembly

any air or vapor bubbles before its entry to the test section. A copper constantan thermocouple probe was also fitted in the view port cavity to sense the liquid temperature. To the upper end of the test section was fitted a glass tube of the same I.D. through a glass to metal joint assembly as shown in Fig.3.5. The glass section of about 160 mm length helped in the visual observation of the boiling liquid emerging out of the test section. In order to measure the temperature of boiling liquid, another copper constantan thermocouple probe was inserted into the exit line leading to the vapour liquid separator.

The vapour liquid separator was a cylindrical vessel of 240 mm I.D. and 240 mm long having dished end covers. The inlet line of 38 mm I.D. was connected tangentially at the middle of the cylindrical wall. The bottom end of the vessel was connected to the top end of liquid-downflow pipe by means of 12.5 mm tube through a control valve. A 38 mm I.D. pipe served as vapour line and connected the top end cover of the separator to the condensers.

The complete condensation of vapours from the separator was achieved by two water cooled surface condensers connected in series. Figure 3.6 shows the flow arrangement and layout of their components. The condenser to which the vapours enter first consisted of a cylindrical vessel 250 mm I.D. and 260 mm long with a flanged top cover and a dished bottom. A spiral coil fitted just below the top cover provided a surface for condensation. The condensed liquid drained down the bottom of the condenser vessel through a vertical pipe 50 mm I.D. and

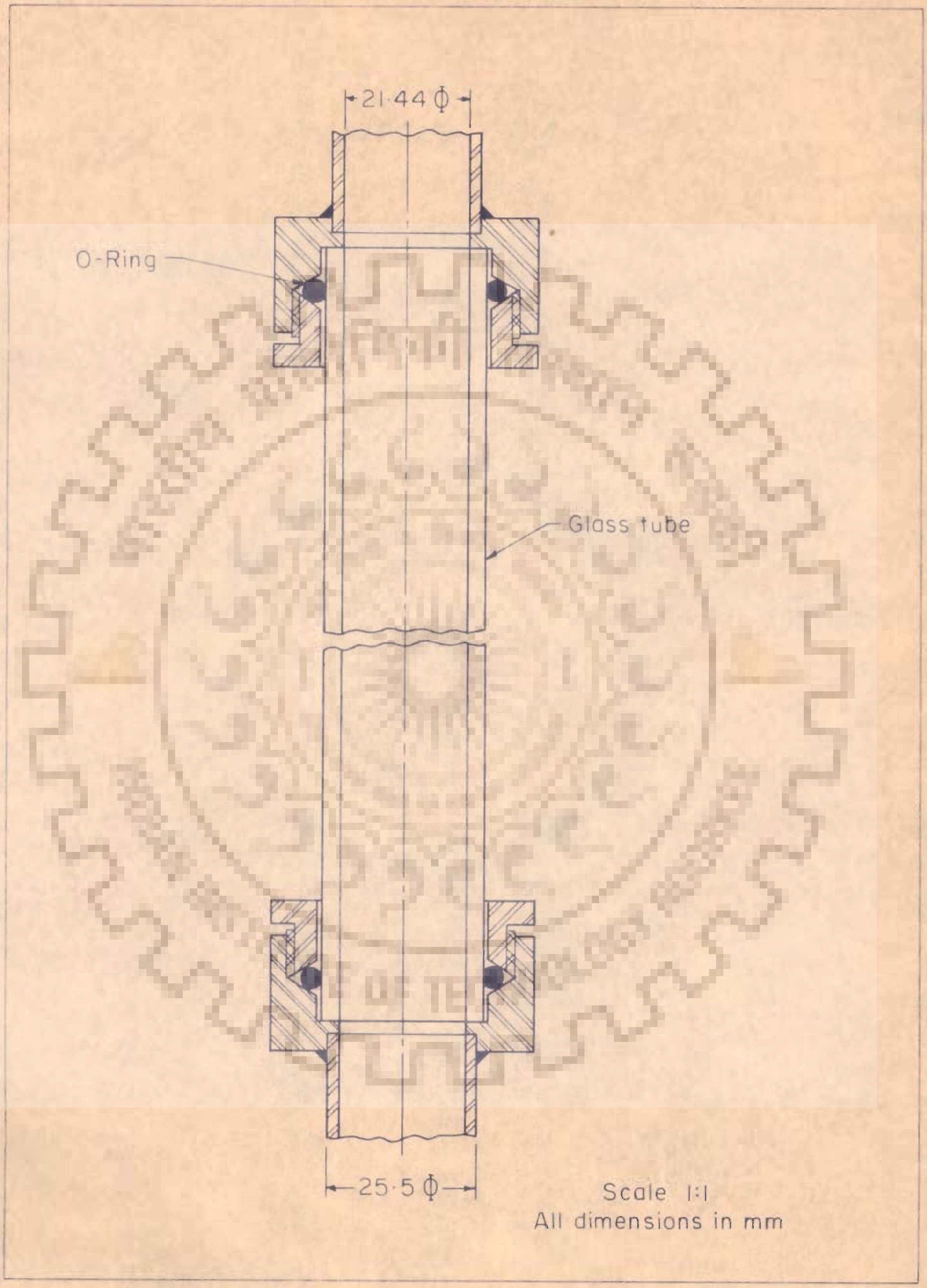



Fig.3.5 Metal to glass joint assembly

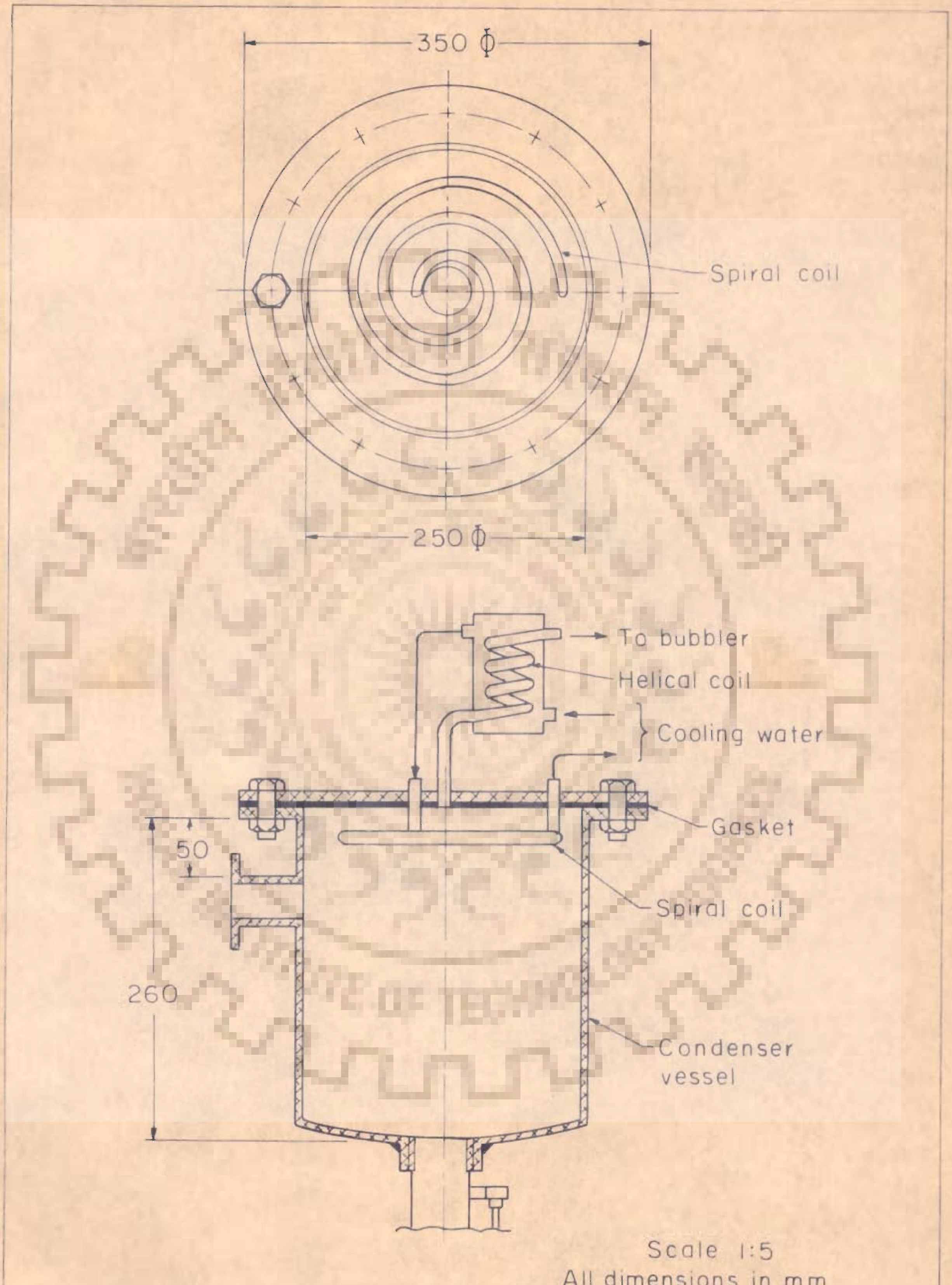



Fig.3.6 Condenser details

320 mm long fitted to the dished bottom. The lower end of the condensate collecting pipe was connected to the top end of liquid downflow pipe by means of 12.5 mm tube through a control valve. The liquid level in this pipe was indicated by a level indicator attached with it. The uncondensed vapours and non-condensibles, if any, from this condenser entered a small helical coil which was placed in a vessel 100 mm I.D. and 150 mm long. The cooling water was circulated through the vessel submerging the coil. The exit end of this second condenser was connected through a flexible tube to a glass tube with its free end dipped into the test liquid placed in a beaker. This arrangement helped in observing visually the removal of last traces of dissolved air from the test liquids. The cooling water to the condensers was supplied by means of a centrifugal pump from a small storage tank to which the fresh water supply was maintained. The water entered first to the second condenser from where it went to the spiral coil and finally to the drain. In order to estimate the total rise in the cooling water temperature, thermocouple probes were fitted at the inlet point to the second condenser and exit from the spiral coil. A thermocouple probe was also inserted in the lowermost section of condensate collecting pipe.

The liquid lines from the separator bottom and that from the condensate collecting pipe were connected to a vertical liquid downflow pipe 27 mm I.D. and about 1600 mm long. A length of 880 mm of the pipe was jacketed by means of another pipe having 52 mm I.D. with stuffing box arrangements at the ends. Cooling water from a constant level tank was circulated through the jacket. The temperature of the test liquids leaving the downflow pipe and entering the test section were adjusted and controlled at a desired value by regulating the water flow rate to the jacket. A level indicator was provided with the downflow pipe to measure the liquid submergence. Thermocouple probes were inserted into the downflow pipe from its top and bottom ends to measure the temperatures of the test liquid at these locations. The temperature rise of the cooling water was also estimated by thermocouple probes fitted at its inlet and exit locations in the jacket. The lower end of the downflow pipe was connected to the inlet liquid view port by a horizontal tube. Over this tube a nichrome wire heating element with porcelain beads as electrical insulator was wound uniformly to form a 700 W preheater. The preheater helped further in maintaining the desired inlet liquid temperature particularly close to the saturation values.

The test section, vapor liquid separator, condensers and all the connecting lines were thermally insulated by first winding with asbestos ropes, then lagging with thick layer of glass wool and finally wrapping with thin aluminium sheet in order to reduce the heat losses to a negligibly small value.

### 3.2.2 Power Supply System

A line diagram showing the details of the electrical circuit for supplying a stabilized, variable low voltage electric current to the test section is given in Fig.3.7. 220 volts A.C. single phase power was supplied to an automatic servo-motor controlled voltage stabilizer through a double pole switch and a 28A single phase autotransformer. The auto-transformer was helpful in adjusting the stabilizer input whenever the line voltage changed beyond the specified limit of 180-260 volts. The output of the voltage stabilizer was fed to a power transformer through another 28A autotransformer. The low tension output tapping of the transformer was connected to the copper clamps provided on the test section by means of thick bus bars suitable for the high current. The bus bars were bolted to the clamps and transformer tappings using 12.5 mm brass bolts to ensure a good electrical contact. Across the copper clamps, was connected a voltmeter of 0-10 volts range. To one of the bus bars, a calibrated 1000:5 current transformer was fitted to which an ammeter of 0-5A was connected.With the above mentioned arrangement the stabilized power input to the test section was varied by varying the primary voltage to the power transformer with the help of second autotransformer. The electrical energy converted to heat in the wall of the test section could be precisely known from the voltmeter and ammeter readings. The power to the liquid preheater (auxiliary heater) was regulated by a 10A auto-transformer and indicated by a wattmeter.

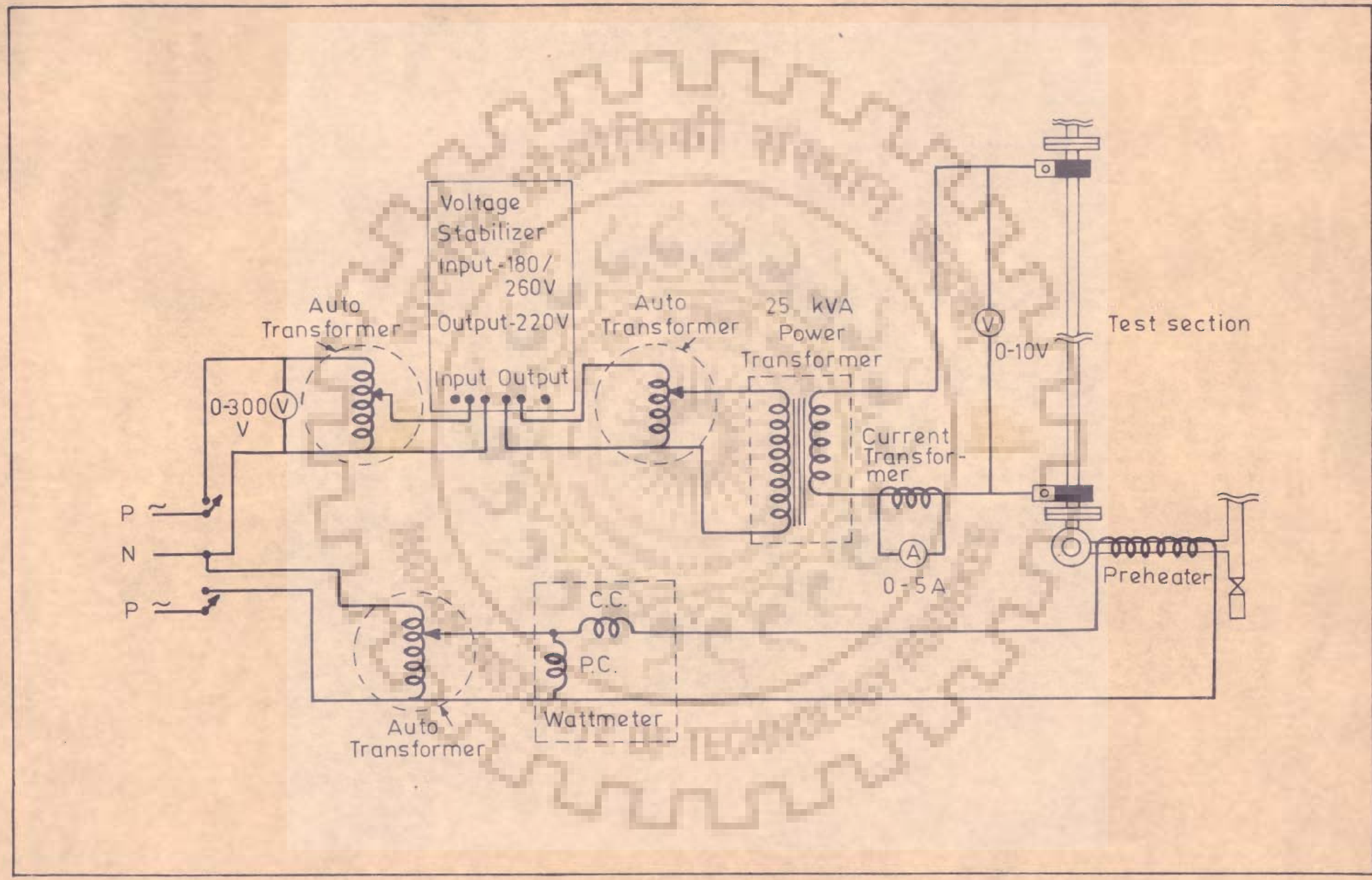



Fig. 3.7 Line diagram of Stabilized power supply

Indicating lights, voltmeters and ammeters were fitted at suitable locations for operational convenience.

### 3.2.3 Instrumentation

The experimentation required the measurement of the following:

- Temperature
- Electrical energy to the test section
- Flow rate

A photographic view of the instrument panel housing all the instruments used for measuring temperature and electrical power is shown in Photo 3.2.

The temperatures were sensed by means of copper constantan thermocouples made out of 24 SWG wires placed in glass fibre sleeve insulation. For measuring the surface temperatures, the thermocouples were attached as described in Section 3.2.1. The liquid temperatures were monitored by thermocouple probes. A thermocouple probe was made by placing the thermocouple into a 3 mm bore stainless steel tube, with its bead just projecting out at one end while the lead wires taken out through the other. The ends were sealed by an adhesive. The e.m.f. of all the thermocouples were measured the same way as discussed in Section 3.1. Three 12-point selector switches with silver and gold plated studs were used in this case to accommodate large number of thermocouples. In order to block any A.C. pick-up by the thermocouples, their leads were twisted over each other before connecting them to the selector switches which had built in shield arrangement.

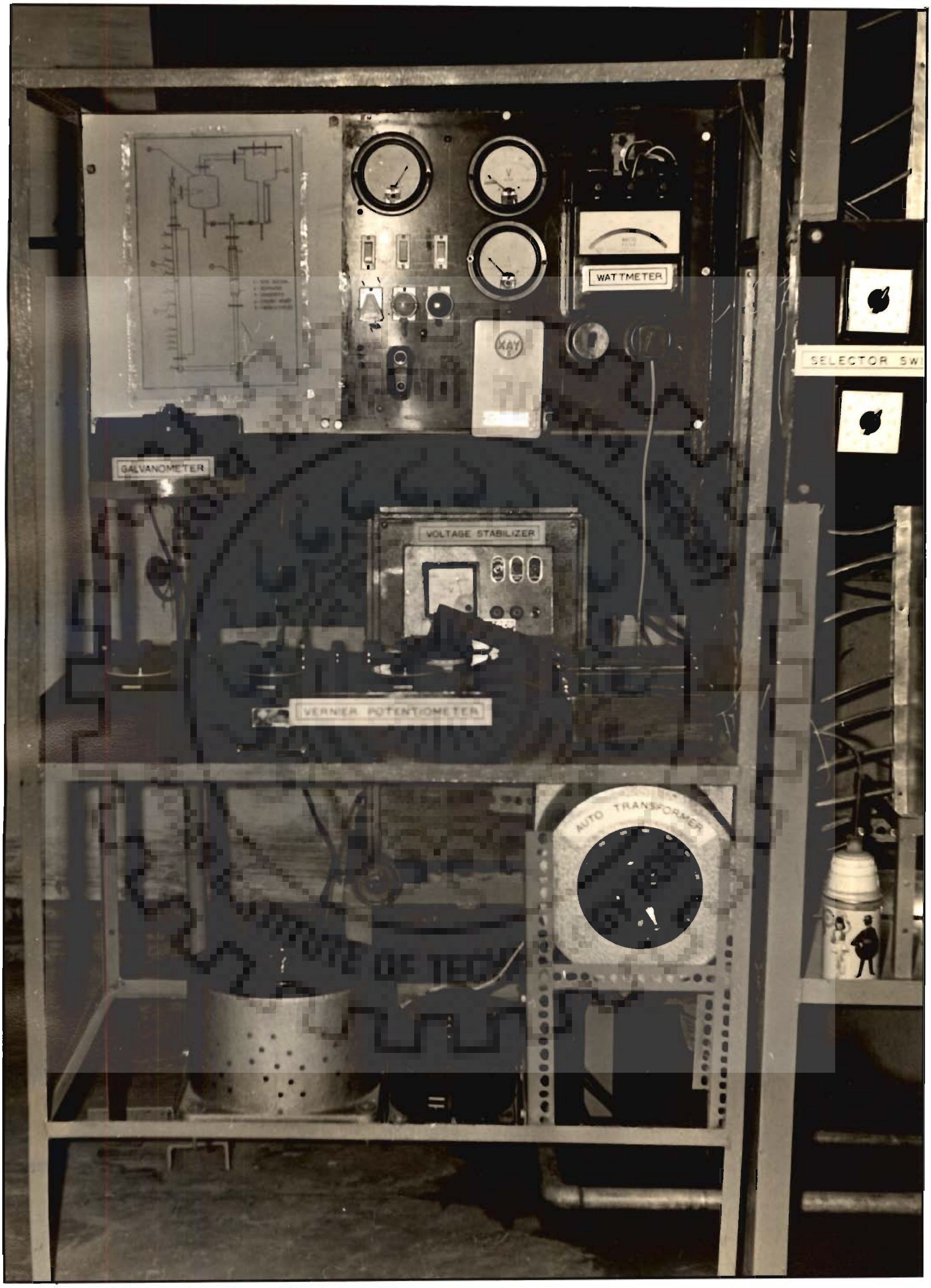



Photo. 3.2 Instrument Panel

The electric power input, which got converted into heat in the test section wall, was obtained as product of voltage across the tube and current flowing through it. The voltage was measured by a voltmeter of 0 to 10 volts range having an accuracy class index 1.0 per cent. An ammeter of 0 to 5 amperes range having an accuracy class index 1.00 percent measured the current with the help of a current transformer.

The flow rates of cooling water to the condensers and jacket were measured by two calibrated rotameters of 0 to 10 litres per minute range.

C H A P T E R 4

# EXPERIMENTAL PROCEDURE

## 4.1 CALIBRATION OF MEASURING DEVICES

All the devices and instruments used for the measurement of temperatures, electrical energy input to the test sections and liquid flow rates were calibrated before their installation on the experimental set-ups.

### 4.1.1 Thermocouples

The thermocouple beads were carefully prepared to avoid the formation of any secondary junction, and checked for continuity. They were calibrated against a standard mercury-in-glass thermometer of 0.1°C least count by measuring their e.m.f. with the help of precision potentiometer and its accessories. The performance of all the wall and liquid thermocouples of both the set-ups, after their installation in position, were also examined. This was done by circulating a liquid through the set-up at constant temperature for sufficient time till the thermal equilibrium between the liquid and tube wall was attained under fully insulated condition. The readings of thermocouples as well as thermometer placed in the liquid were recorded. The maximum deviation between the readings of thermocouples and the thermometer was observed to be 0.15 percent, while in most cases the difference in the readings of various thermo-couples in the same set-up did not exceed 0.1°C as reported in Table A-1 of Appendix A.

4.1.2 Electrical Instruments

The wattmeter used for the measurement of electrical energy input to the test section in single phase thermosiphon system was calibrated against a substandard instrument, BS-89, Precision Grade, supplied by M/S Cambridge Instrument Co. Ltd., England. The calibration readings as given in Table A-2 of Appendix A, show a maximum deviation of 1.7 per cent.

The calibration of ammeter and voltmeter which measured the power input to the electrically heated tube of thermosiphon reboiler, was done with the help of a sub-standard A.C. test-set manufactured by M/S Cambridge Instrument Co.Ltd., England. The total measurement uncertainty of the system employed for calibration of the instruments was within 0.1 per cent. The calibration results are given in Tables A-3 and A-4 of Appendix A.

4.1.3 Rotameters

The rotameters measuring the flow rates of cooling water to condenser and jacket were calibrated by direct measure-ment of liquid volume collected over a known period of time corresponding to various float positions. The measured values of flow rates against those indicated are reported in Table A-5 of Appendix A.

## 4.2 OPERATING PROCEDURE

After fabrication and assembly of the experimental units, the entire set-up was hydraulically tested to ensure the absence of leaks. The set-ups were flushed with water and cleaned thoroughly. The electrical and thermocouple connections were then made and the performance of measuring system was examined. The electrical insulation of heaters from the apparatus was ensured to avoid any short circuiting or formation of bypass circuit. The units were lagged to prevent heat losses and thus were ready for experimentation.

Some preliminary experiments on both the set-ups were invariably performed using water with forced convection to check the heat balance and standardization of the apparatus. The main experiments were conducted with distilled water and other organic liquids. While changing over from one test liquid to the other, the circulation system was freed completely from the previous liquid by draining and blowing out with compressed air. The set-up was flushed with water and drained. It was then connected to a vacuum pump to suck out the liquid from all sections of the unit. The heaters were also kept on with very low heat input adjusted to facilitate the removal of last traces of the liquid. The set-up was rinsed with the liquid to be charged for further experimentation.

4.2.1 Single Phase Closed Loop Thermosiphon System

For preliminary experimentation with forced convection using set-up shown in Fig.3.1, a water supply line from constant level tank was temporarily connected to the unit through control valve $V_5$. The valves $V_1$, $V_2$, $V_4$ and $V_6$ were closed. A flexible hose pipe leading to drains was connected through valve $V_3$ which was kept open. Water was allowed to flow at a desired flow rate. The test heater was switched on and an electrical input was adjusted. The flow rate was measured and wattmeter reading noted. The readings of wall and liquid thermocouples were recorded after a steady state condition was established. Similar runs were taken at various other flow rates, covering the entire range available. Data at high flow rates could not be taken because the rise in liquid temperature became very small, introducing a large error even when the heater was adjusted at its maximum capacity. A maximum deviation of about 2 per cent in heat balance indicated negligible heat losses and satisfactory performance of various measurement systems.

In order to generate the data on heat transfer in single phase thermosiphon, the valves $V_3$ and $V_5$ were closed and the water supply disconnected. The valves $V_1$, $V_2$ and $V_4$ were opened and the loop was filled with distilled water upto a level corresponding just sufficient to submerge the upper horizontal pipe connecting the test section and the separator vessel. Valve $V_1$ was then closed and the heaters were switched on. The liquid temperature was raised to its boiling point and it was boiled for several hours to drive out any air entrapped in the circulation system. This was an important precaution particularly for the initial runs with a test liquid, as the dry test surface always entraps a very thin film of air. This air on heating takes the shape of tiny air bubbles which leave the surface on further heating and join the liquid. Thus, there sets in, microconvection near the heat transfer surface in addition to the convections due to density differences. The additional turbulence so caused forms a major source of error and can be avoided by removing the last traces of air from the system. When the release of air bubbles ceased, cooling water to the jacket was allowed to flow and the desired heat flux adjusted. The system was then left to attain equilibrium conditions. The readings of wattmeter, wall thermocouples and liquid thermocouples were recorded under steady state conditions. Similar runs were taken at various values of heat flux with water, ethylene glycol and glycerol of high purity. The experimental data so collected have been tabulated in Table C-1 of Appendix C. The range of various parameters covered in the study are given in Table 5.1 of Chapter 5.

4.2.2 Thermosiphon Reboiler

The standardization runs on the roboiler test section were taken by supplying water to it from a constant level tank through valve $V_1$ (Fig.3.2), closing valves $V_2$, $V_3$, $V_6$ and $V_7$. The hot water flowed out of the separator to drains through valve $V_4$ which was kept open. The experiments were conducted following similar procedure as discussed in Section 4.2.1.The readings of ammeter and voltmeter measuring the electrical power input to the test section were recorded. The water flow rate was maintained constant with the help of rotameter provided in the line and was measured by collecting a known quantity and noting the time required. The wall and liquid thermocouple readings were noted after they became constant indicating the steady state conditions. The heat balance calculations based on these data at various water flow rates indicated negligible heat losses to the surroundings and satisfactory performance of measuring devices employed.

After collecting the forced convective heat transfer data, the water supply was disconnected and valve $V_4$ was closed. Valves $V_2$ and $V_3$ were opened. A thermocouple was fitted through valve $V_6$ as shown in Fig.3.2. The reboiler was filled with distilled water upto the top of the test section and a thermocouple probe was fitted through valve $V_1$. The test surface was energized and the circulation of coolant water to the condensers was resumed. The jacket was emptied to avoid any subcooling of the liquid so that the saturated boiling conditions are obtained. The set-up was kept under operation for many hours followed by aging in order to obtain the stable tube wall nucleating characteristics. This is a very important precaution for the reproducibility of experimental data. A few runs were conducted to check the overall heat balance under the conditions of boiling. The water flow rates to the condensers and jacket were adjusted to give appreciable temperature rise. The readings of electrical energy input, cooling water flow rates and all the thermocouples were taken when a thermal equilibrium was established. A good agreement between the electrical energy supplied to the test section and heat energy removed in the condensers and the jacket ensured negligible heat losses from the set-up and reliable measurements on the condensers and the jacket.

During the start up of reboiler operation for conducting a series of runs, the test liquid was boiled off for about 4 to 6 hours to drive out the dissolved air completely, which was indicated by the disappearance of the air bubbles in the bubbler. A desired heat flux was then adjusted and cooling water flow rate to the condenser was regulated to give a maximum temperature rise consistent with no loss of vapour due to inadequate condensation. This increased the accuracy of heat balance around the condenser. The electrical power to the preheater was also adjusted just to raise the liquid temperatures to the desired value close to saturation but without the generation of vapour bubbles which could be observed through the inlet liquid view port. The liquid level in the down flow pipe was adjusted and the reboiler was allowed to operate. With the layout designed for a closed system operation and with stabilized power supply, the unit once charged and started could be continued running for sufficient time to attain thermal equilibrium. After the steady state conditions were achieved, the readings of ammeter, voltmeter and rotameters were noted and the e.m.f. of all the surface and liquid thermocouples were measured. The liquid level in the down flow pipe was observed and noted from the level indicator provided for the purpose. The heat flux was changed to another value and necessary adjustments made to maintain almost the same value of inlet degree of subcooling and liquid submergence. All the above mentioned observations were made after the steady state conditions had reached. Similar runs were conducted at various heat fluxes maintaining approximately the same liquid submergence and close values of inlet degree of subcooling. The effect of inlet liquid subcooling was investigated by varying the test liquid temperature entering the test section with the help of cooling jacket and preheater. The experimental data were generated at three different levels of liquid submergence varying heat fluxes and inlet liquid subcooling as mentioned above. The experimental data so collected have been tabulated in Table C-2 of Appendix C.

At the end of experimentation, the power to the test section was cut off and the coolant water flow rates to the condensers and the jacket were maintained till all the vapours condensed and liquid cooled.

# CHAPTER 5

## OBSERVATIONS AND CALCULATIONS

### 5.1 STANDARDIZATION OF THE SET-UPS

The preliminary runs carried out with forced convective heat transfer yielded the experimental data which were utilized in checking the heat balance and standardization of the set-ups. The directly measured electrical energy input to the test sections were compared with the computed heat gain by the liquid flowing through the tube to determine the heat losses, which were observed to be less than 2 per cent. The average values of heat transfer coefficient were computed by

$$h_{avg} = \frac{q}{(T_W - T_L - \Delta T_W)_{avg}} \qquad \text{... (5.1)}$$

The temperature drop ($\Delta T_W$), between the thermocouple bead and the inside surface, could be estimated using appropriate conduction equations and was found to be negligibly small (Appendix D) as compared to the temperature drop between the heating surface and the liquid. The Nusselt number was computed from the heat transfer coefficient, so determined, using arithmetic mean of ($T_W$ - $T_L$) at various thermocouple locations equally spaced along the tube length.

The experimentally obtained Nusselt numbers were compared with those calculated using Sieder and Tate equation with correction suggested by Kern and Othmer[55] as applicable to the experimental conditions.

$$Nu = 1.86(Re.Pr. \frac{d}{L})^{1/3} (\frac{\mu_L}{\mu_w})^{0.14} \chi \qquad ... (5.2)$$

where

$$\chi = \frac{2.25[1+0.010(Gr)^{1/3}]}{\log Re}$$

The comparison between the experimental Nusselt numbers and those predicted by Eq.(5.2) is shown in Fig.5.1 for both the experimental set-ups.A maximum deviation of about ±15 per-cent indicates that the overall measurement is quite reliable and the experimental data generated on the set-ups are of acceptable standard.

## 5.2 SYSTEMS AND PARAMETERS STUDIED

### 5.2.1 Single Phase Closed Loop Thermosiphon

The main objective of the experimental programme with single phase thermosiphon was to study the variation of heat transfer coefficient during natural convective flow of high Prandtl number liquids through the vertical tube of the closed loop thermosiphon. Since the development of flow and other important parameters effecting the rate of heat transfer could be varied only through the thermophysical and transport properties of the systems involved, it was thought desirable

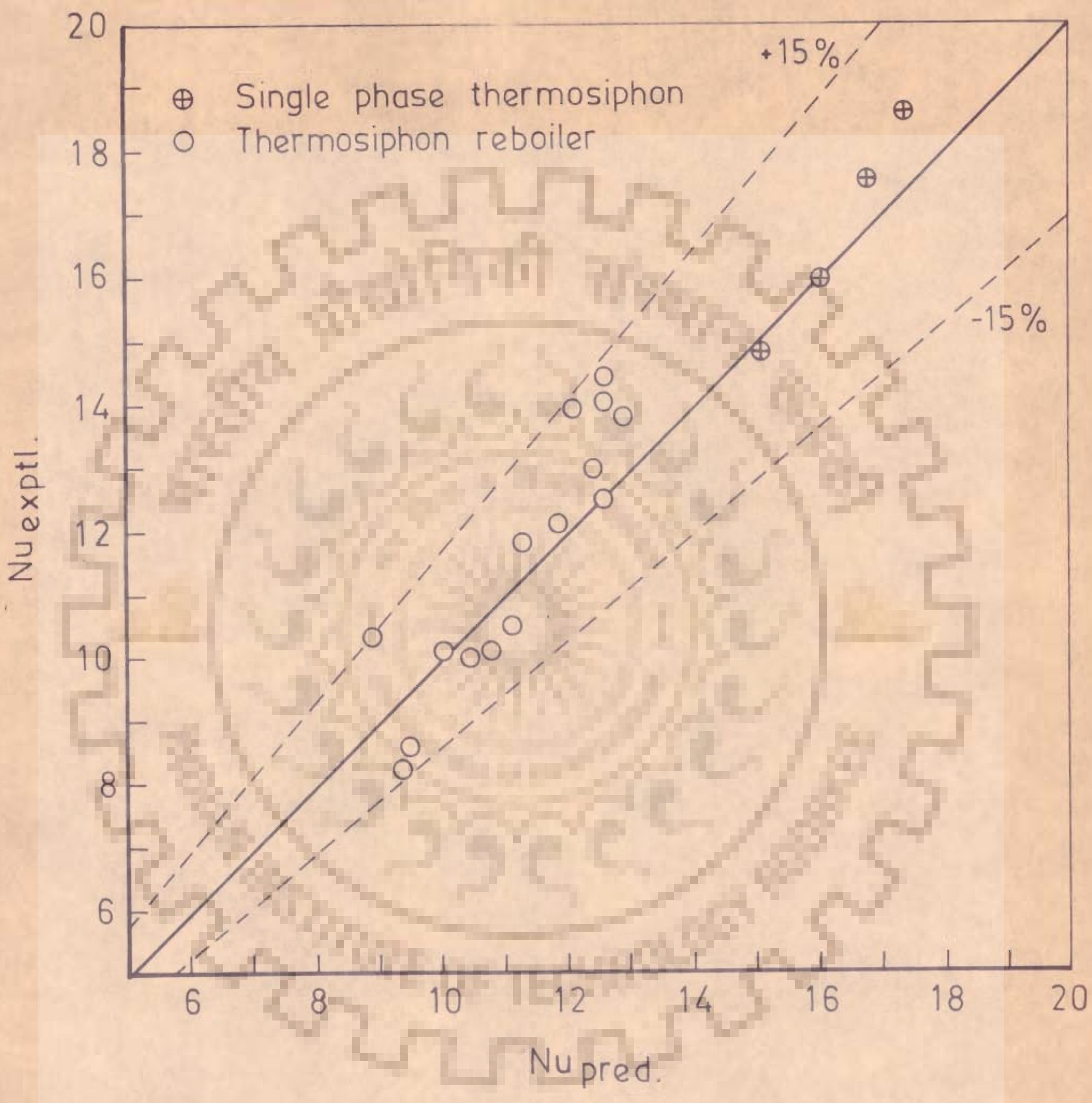



Fig.5.1 Comparison between experimental average Nusselt numbers and those predicted by eq.(5.2)

to generate experimental data with liquids having widely varying and strongly temperature dependent physical properties. The liquids chosen for experimentation were water, ethylene glycol and glycerol. Distilled water was prepared in the departmental laboratories while the laboratory reagent grade ethylene glycol and glycerol were procured from Glaxo Laboratories (India) Ltd. The experiments conducted at various levels of heat flux yielded the data with wide range of relevant parameters - dimensionless numbers as given in Table 5.1. The experimental data have been tabulated in Table C-1 of Appendix C.

Table 5-1 RANGE OF PARAMETERS IN SINGLE PHASE CLOSED LOOP THERMOSIPHON STUDY

| System | q, W/m$^2$ | z/d | Gr | Pr | Re |
|---|---|---|---|---|---|
| Water | $1.77\times10^3$ - $1.066\times10^4$ | 10.50-42.00 | $3.75\times10^5$ to $9.28\times10^6$ | 5.2 to 1.8 | 120-445 |
| Ethylene glycol | $1.77\times10^3$ - $1.066\times10^4$ | 10.50-42.00 | $5.5\times10^3$ to $1.52\times10^6$ | 127.5 to 13.8 | 9-200 |
| Glycerol | $1.77\times10^3$ - $8.88\times10^3$ | 10.50-42.00 | 76 to $9.7\times10^6$ | 1173 to 17.3 | 0.4-95.5 |

5.2.2 Thermosiphon Reboiler

The liquids used for heat transfer studies on the thermosiphon reboiler were selected keeping in view the variation of important properties like boiling point, latent heat of vaporization and surface tension which have a strong influence on boiling process. The experimental data were collected on distilled water and four organic liquids-acetone, ethyl acetate, propan-2-ol and toluene enabling a wide variation in the above properties. The test liquids were laboratory reagent grade chemicals obtained from B.D.H.(India) Ltd. The operating parameters investigated with each liquid were heat flux, inlet liquid subcooling and submergence on a fixed geometry and heating surface characteristics. All the runs were taken at atmospheric pressure. The ranges of experimental parameters covered in the present investigation are presented in Table 5.2 and experimental data are tabulated in Table C-2 of Appendix C.

Table 5.2 RANGE OF EXPERIMENTAL PARAMETERS FOR THERMOSIPHON REBOILER

| System | q, $W/m^2$ | $\Delta T_{sub}$ | S | x |
|---|---|---|---|---|
| Acetone | 3548-14500 | 0.9-26.7 | 44-100 | 0.005-0.70 |
| Ethyl Acetate | 3775-18800 | 2.5-44.5 | 28-97 | 0.025-0.62 |
| Propan-2-ol | 3342-21765 | 1.2-54.2 | 39-97 | 0.004-0.59 |
| Water | 3486-24086 | 1.0-73.00 | 36-100 | 0.002-0.50 |
| Toluene | 2042-14900 | 5.5-68.3 | 35-97 | 0.030-0.63 |

## 5.3 DATA REPRODUCIBILITY

A few runs were made under the same operating conditions but on different dates in order to check the reproducibility of the experimental data, while working with the same test liquid.

The reproducibility of heat transfer surface characteristics of thermosiphon reboiler were checked by conducting check runs with water at various heat fluxes after completing the experiments with every test liquid. Some of the data, so obtained,have been presented in Fig.5.2. A good agreement between these data shows that they are reproducible within experimental error.

The experimental data on single phase thermosiphon showed a linear variation of wall and liquid temperatures along the tube length which is quite expected trend under uniform heat flux conditions. Similar variations were obtained over the lower sensible heating regions of thermosiphon reboiler test section.The variation of q with $\Delta T$ on log-log plot was also linear for the upper section of the tube where fully developed nucleate boiling took place. All the above mentioned observations indicated that the data generated on the experimental facility are by and large consistent.

The excursions in the adjusted values of experimental parameters were negligible except in liquid submergence which fluctuated significantly during a run at full submergence.The oscillations almost subsided and stable operation was observed, when the runs were made at low submergence values. The mode of varying the heat flux values was also obtained to have an important effect on the reproducibility and consistency of the boiling heat transfer data. All the runs on thermosiphon reboiler, therefore, were conducted successively with an increasing order of heat flux.

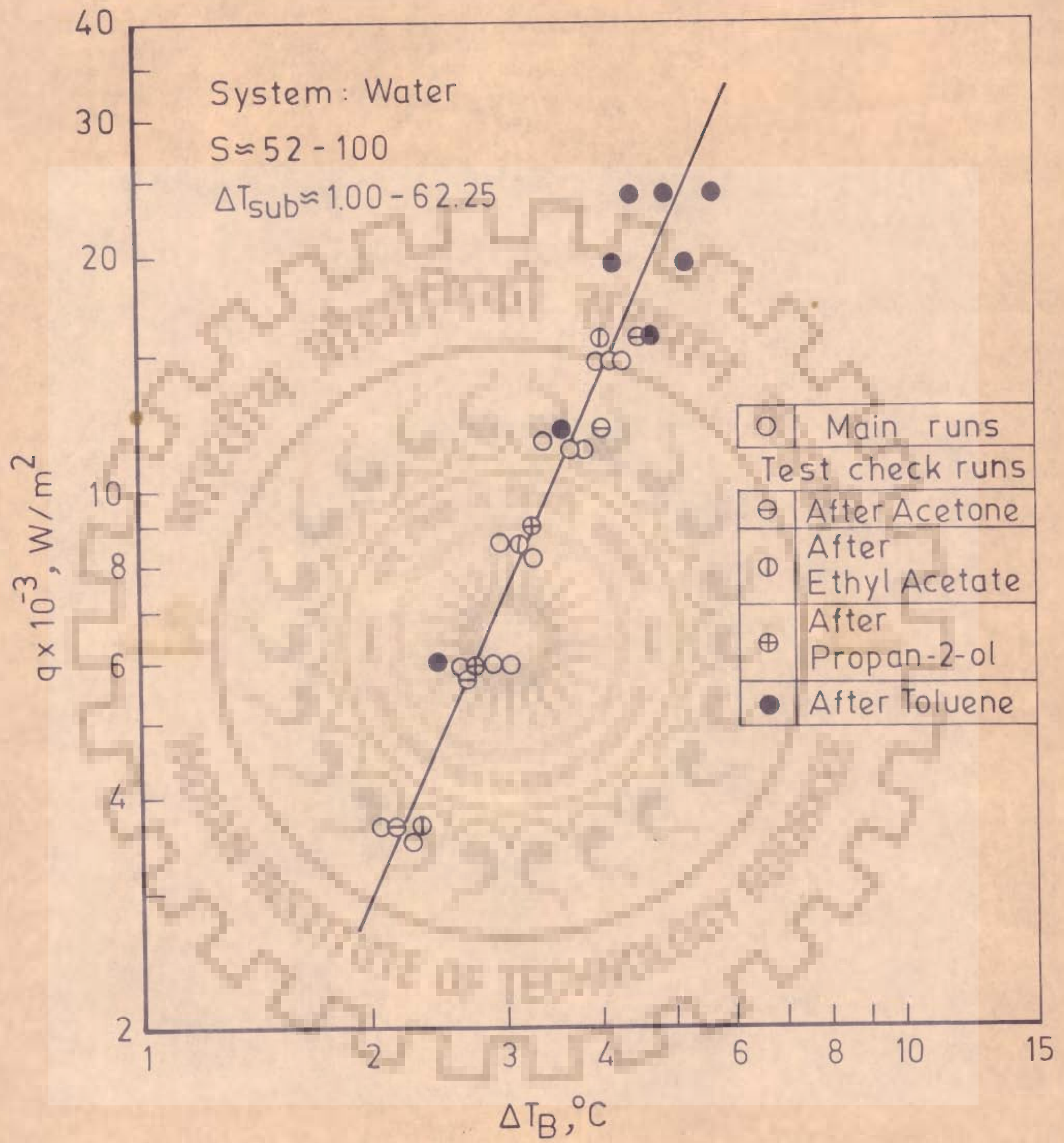



Fig. 5.2 Reproducibility of Experimental data

## 5.4 CALCULATION OF CIRCULATION RATE, LIQUID TEMPERATURE AND HEAT TRANSFER COEFFICIENT

### 5.4.1 Single Phase Closed Loop Thermosiphon

The rate of liquid circulation caused by buoyancy induced flow through the test section was evaluated by making a heat balance around the test section from the knowledge of total heat input and liquid temperatures at inlet and exit positions, as given below:

$$Q = \pi\, d\, L\, q = m\, C_L\, (T_{out} - T_{in}) \qquad \ldots (5.3)$$

or

$$m = \frac{\pi\, d\, L\, q}{C_L (T_{out} - T_{in})} \qquad \ldots (5.4)$$

where $C_L$ is at arithmetic average of $T_{in}$ and $T_{out}$.

Having known the mass flow rate of liquid, through the tube, the bulk liquid temperatures at locations corresponding to those of wall thermocouples were computed by striking heat balance around each section of the tube between two successive thermocouple positions allowing the variation in the value of liquid specific heat with temperature. The liquid temperatures so obtained have been tabulated along with measured wall temperatures in Appendix C.

The local heat transfer coefficient have been calculated by dividing wall heat flux with local values of temperature difference between the wall and liquid as expressed by equation

$$h = \frac{q}{T_W - T_L} \qquad \ldots (5.5)$$

The wall temperatures were taken directly from wall thermocouple readings because the temperature drop between the location of thermocouple beads and the heat transfer surface was found to be negligibly small.

The average values of heat transfer coefficient were obtained using the Equation (5.1).

5.4.2 Thermosiphon Reboiler

In such type of studies, liquid enters the tube at a temperature below the corresponding saturation temperature. Because of uniform heat flux distribution, the liquid bulk temperature starts to increase and continues upto the saturation value if all the heat added to the system would go to raise the temperature of the liquid only. After that, the liquid bulk temperature would remain constant at the saturation value and all the heat added would go to generate vapour. This is the thermal equilibrium model[78]. Based on this model the circulation rates and liquid bulk temperature distributions in the thermosiphon reboiler have been determined by making a heat balance on the test section.

In order to compute the liquid circulation rate, it was necessary to know the length of effective non-boiling or sensible heating region over which the liquid temperature varied linearly. The effective boiling and non-boiling zones over the entire heated length were determined from the amount of net vapour generation which could be obtained as the vapour condensed in the condenser. From heat balance around condenser, we have

$$M_v = \frac{F\ C_{L_c}(T_2 - T_1)}{\lambda + C_L(T_s - T_{sc})} \qquad \ldots (5.6)$$

where $M_v$ = rate of vapour generation, kg/s

$C_{L_c}$ = heat capacity of cooling water at average bulk temperature, J/kg °C

Thus

$$z_B = \frac{M_v \lambda}{\pi\ d\ q} \qquad \ldots (5.7)$$

and

$$z_{NB} = L - z_B \qquad \ldots (5.8)$$

The total liquid circulation rate was estimated by making heat balance over the non-boiling section of the tube in a similar manner as in Section 5.4.1. The equation expressing the rate may be written as

$$m = \frac{\pi\ d\ z_{NB}\ q}{C_L(T_s - T_{in})} \qquad \ldots (5.9)$$

The circulation rates could alternately be evaluated by writing a local material and heat balance around the point at which the liquid streams from separator and condenser join together and flow through the liquid down flow pipe. Ignoring the heat losses to the surroundings and assuming a good mixing at the point of junction, the balances may be set up as follows:

Material balance

$$m = M_L + M_v \qquad \ldots (5.10)$$

Enthalpy balance

$$m\, C_L T_m = M_L C_L T_s + M_v C_L T_{sc} \qquad \ldots (5.11)$$

where

$M_L$ = liquid flow rate from separator, kg/sec

$T_m$ = temperature of total liquid after the two streams joined, $^oC$

The values of $M_L$ and m can be evaluated solving the simultaneous Equations (5.10) and (5.11) from the knowledge of $M_v$ as mentioned earlier.

The validity of above mentioned methods based on heat balance around condenser were checked by computing the circulation rates alternately based on heat balance on jacketted portion of the cold leg for a few runs with liquid submergence above 95 per cent. The agreement between the prediction made by two independent methods were found to be very good. At lower submergences, the measurements of mixed liquid temperature $T_m$ was not feasible and accordingly the applicability of methods requiring $T_m$ was limited to higher submergence levels ohly above the top of jacket. Hence, the circulation rates for all the runs on thermosiphon reboiler were computed using Equations (5.6) to (5.9) based on heat balance on condenser. The fraction of vapour in two-phase mixture coming out of test section was taken as

$$x = \frac{M_v}{m} \qquad \ldots (5.12)$$

The test liquid temperature distributions along the tube length in the non-boiling section was represented by a linear relationship as given below:

$$T_L = \frac{T_s - T_{in}}{z_{NB}} z + T_{in} \qquad \dots (5.13)$$

where

$z \leqslant z_{NB}$

The temperature of liquid in the boiling section of the tube was taken as constant at its saturation value ignoring the effect of hydrostatic head on boiling point. This assumption did not introduce appreciable error because the test section length was not large.

The calculation of heat transfer coefficients in boiling as well as non-boiling sections was done following the same procedure as discussed in the earlier sections of this chapter using Equations (5.1) and (5.5). The average values were evaluated over two sections referred above separately.

## 5.5 ESTIMATION OF PHYSICAL PROPERTIES OF TEST LIQUIDS

The physical properties of various test liquids used were available in the literature [54,75,83,85,89] over different ranges of temperature. For the range of temperatures involved, in the present study, extrapolation was desired for some test liquids. Therefore, using the discrete values obtained from the literature, third and fourth degree polynomials were fitted with minimum error. The available properties were either in CGS or MKS units. These were first converted into internationally accepted SI units before polynomial equations were developed. The general form of the equations was:

$$P = A + BT + CT^2 + DT^3 + ET^4 \qquad \ldots (5.14)$$

where

P = property

T = temperature, $^oC$

and

A,B,C,D,E = constants of the equations.

All the properties are well represented by this general equation except the viscosity of glycerol. It was observed that the viscosity of glycerol changes exponentially with temperature, hence, this property was fitted by a third degree polynomial in exponential form as below:

$$P = Exp(A+BT+CT^2+DT^3) \qquad \ldots (5.15)$$

The constants of polynomials thus obtained for different physical properties are given in Appendix B.

## 5.6 CORRELATING METHOD

After evaluating various pertinent parameters indicating flow and heat transfer characteristics, suitable dimensionless groups were estimated. Based on these groups, generalized correlations were developed.

The development of all the correlations was done through use of linear regression analysis [45]. The equations thus developed were finally used to predict the performance of the systems in terms of various parameters. The deviations were also evaluated based on predicted values so obtained,

$$\text{Percent deviation} = \left(\frac{Y - Y_{pred}}{Y_{pred}}\right) \times 100 \qquad \ldots (5.16)$$

where $Y_{pred}$ is the predicted value through correlation for the corresponding experimental value, Y.

In the present study, all the computations were performed on DEC 2050 computer with necessary modifications in the various developed programmes used for estimating and correlating different parameters.

# CHAPTER 6

# RESULTS AND DISCUSSION

The results of experimental investigation carried out on heat transfer during natural convective flow and nucleate boiling of liquids in closed loop thermosiphon system have been presented here. The effect of various important parameters on heat transfer rates and resulting liquid circulation and their interaction are discussed in the light of underlying principles of heat transfer involved in such system. The important results are finally correlated to lend themselves more useful and are compared with the previous work reported in literature.

## 6.1 HEAT TRANSFER IN NATURAL CONVECTIVE FLOW OF LIQUIDS THROUGH THE VERTICAL TUBE OF CLOSED LOOP THERMOSIPHON

### 6.1.1 Variation of Wall and Liquid Temperatures along the Heated Length of the Tube

The experimentally measured wall temperatures at various positions along the tube length and corresponding bulk liquid temperatures computed for all the three liquids-water, ethylene glycol and glycerol have been tabulated in Appendix C. The representative plots of wall and liquid temperatures versus heated tube length at some selected heat fluxes have been shown in Figures 6.1, 6.2 and 6.3 for water, ethylene glycol and glycerol respectively. From these figures the following may be noted:

a. The bulk liquid temperature, $T_L$ varies linearly with distance along the test section.

b. The wall temperature, $T_W$ shows a linear variation along the heated tube length except near the entrance of test section ($z < 200$ mm).

c. The slopes of wall and liquid temperature profiles rise with increase in the values of imposed heat flux. At higher heat fluxes the difference of wall and liquid temperature is also higher though not in the same proportion.

d. The wall and bulk liquid temperature profiles for all the three systems studied is similar. However, the change in slopes of temperature distribution lines shows a diminishing tendency from water through ethylene glycol to glycerol. The spread between wall and liquid temperature profiles at any given heat flux is also found to change significantly with the system.

The bulk liquid temperature variation can be represented very well by a linear distribution equation

$$T_L = \left(\frac{dT_L}{dz}\right) z + T_{in} \qquad \ldots (6.1)$$

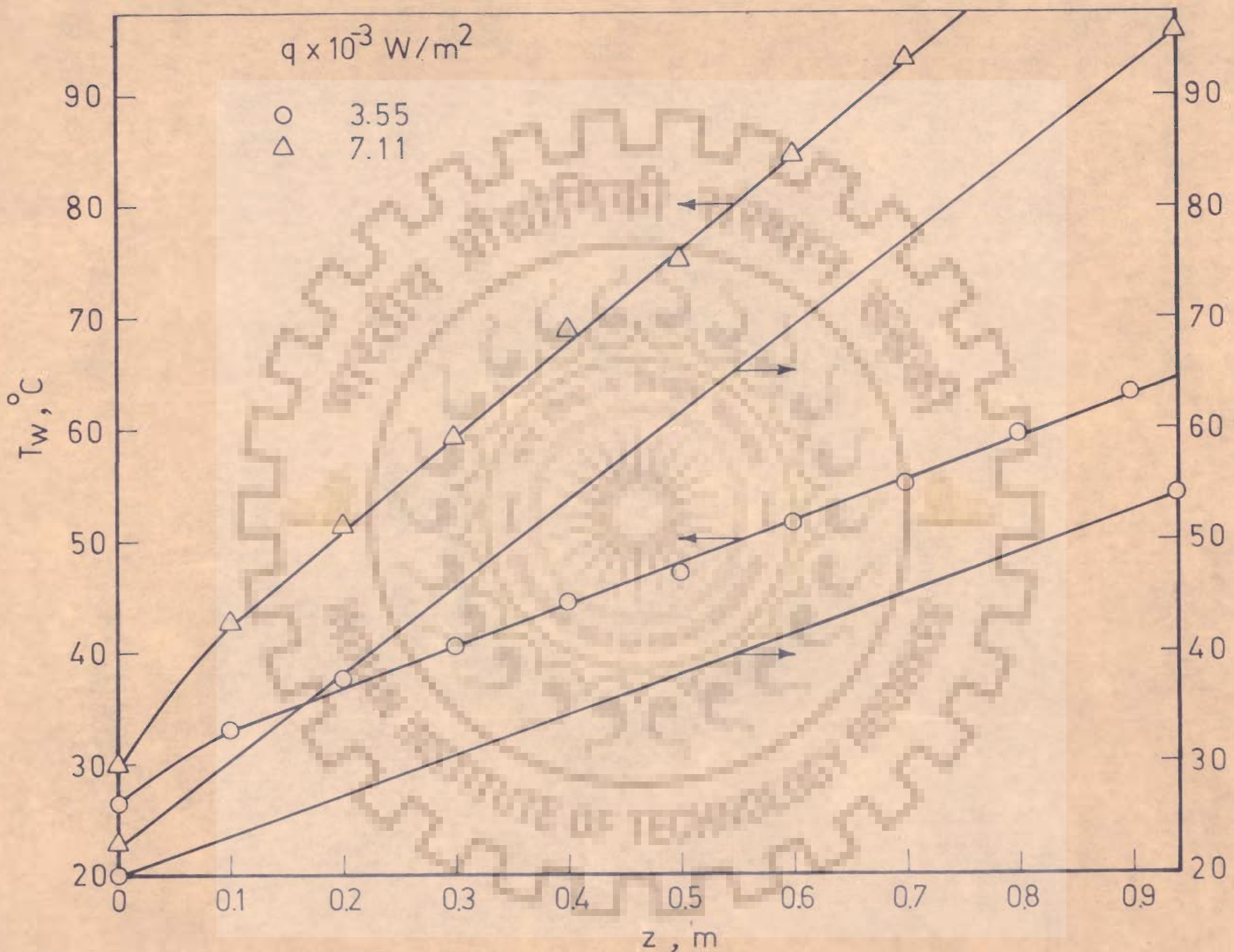



Fig.6.1 Variation of wall and liquid temperatures along the tube length for water

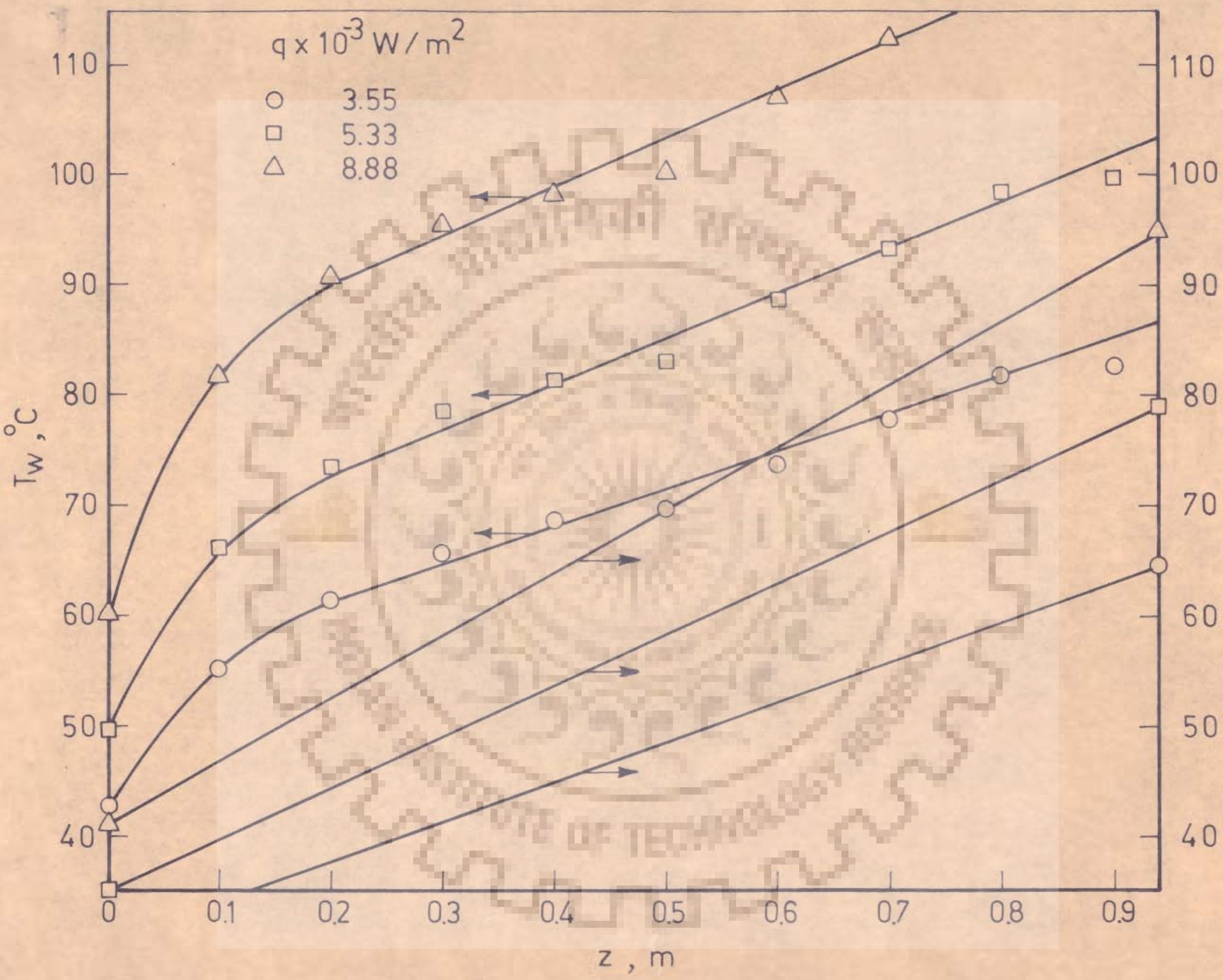



Fig. 6.2 Variation of wall and liquid temperatures along the tube length for ethylene glycol

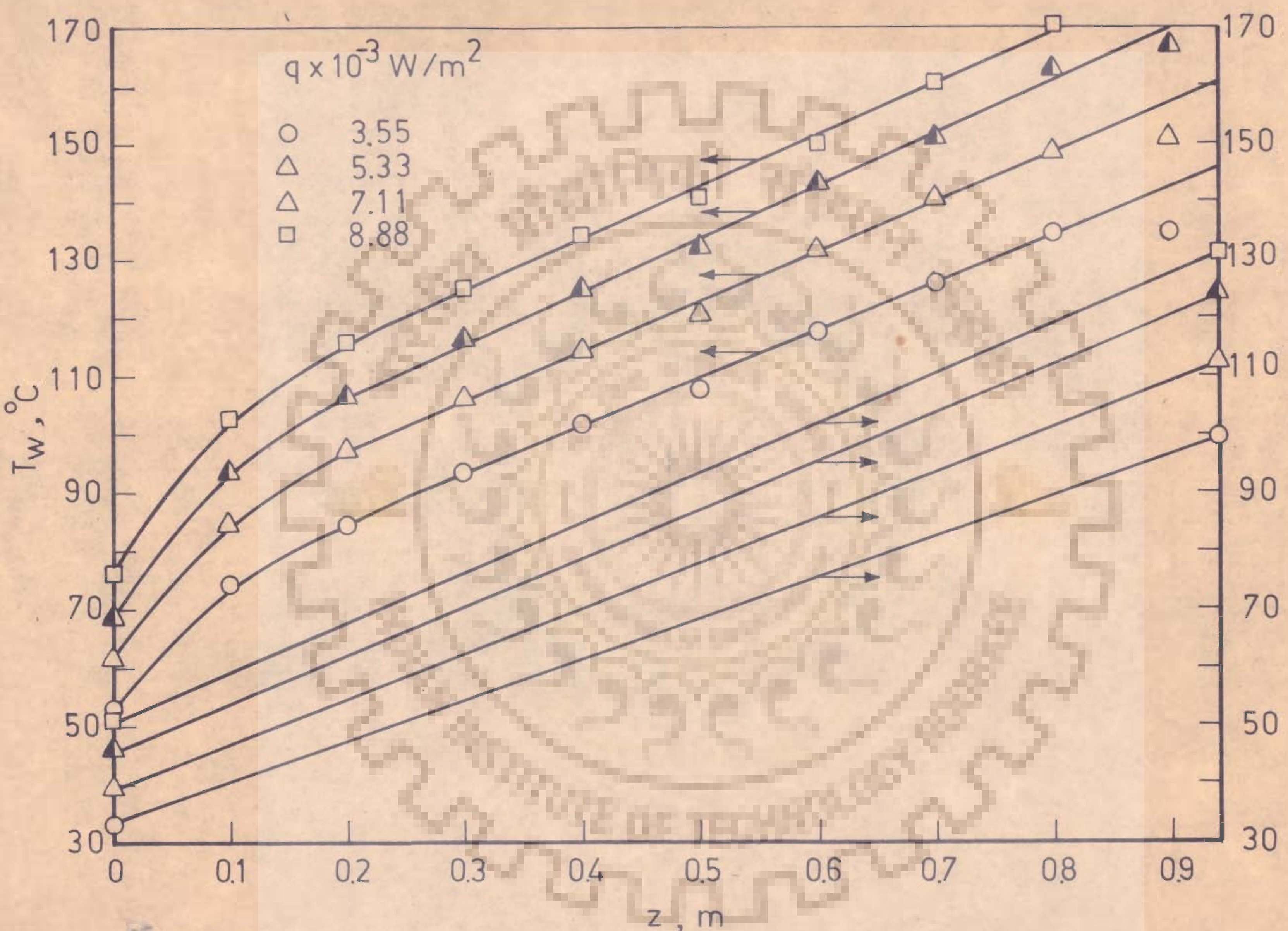



Fig. 6.3 Variation of wall and liquid temperatures along the tube length for glycerol

The slope, $(dT_L/dz)$ in Eq.(6.1) denotes the rise in liquid temperature and depends upon the heat received by the liquid according to the equation

$$q = \frac{m\ C_L}{\pi\ d}\left(\frac{dT_L}{dz}\right) \qquad \ldots (6.2)$$

At a given uniform wall heat flux, the mass flow rate attains a constant value and hence the change in slope depends only upon the variation of heat capacity of liquid with temperature. Since the heat capacities of liquids studied do not vary significantly over the temperature ranges involved, the values of slopes were found to be almost constant exhibiting linear liquid temperature profiles. As the heat flux is raised, the values of m and $(dT_L/dz)$ both increase to adjust the additional heat transfer, making the profiles steeper. In case of ethylene glycol and glycerol, the rise of temperature affect the flow properties relatively more than in case of water resulting in a higher increase in m and consequently the steepening tendency of profiles is diminished as observed in Figures 6.2 and 6.3.

The wall temperature profiles are indicative of heat dissipating characteristics of liquids. Since the variation of liquid temperatures is governed by heat balance requirements, the wall temperature distribution adjusts itself to provide the necessary temperature gradient for overcoming the thermal resistance to heat transfer. The wall to liquid heat transfer may be expressed as

$$q = h\ (T_W - T_L) \qquad \ldots (6.3)$$

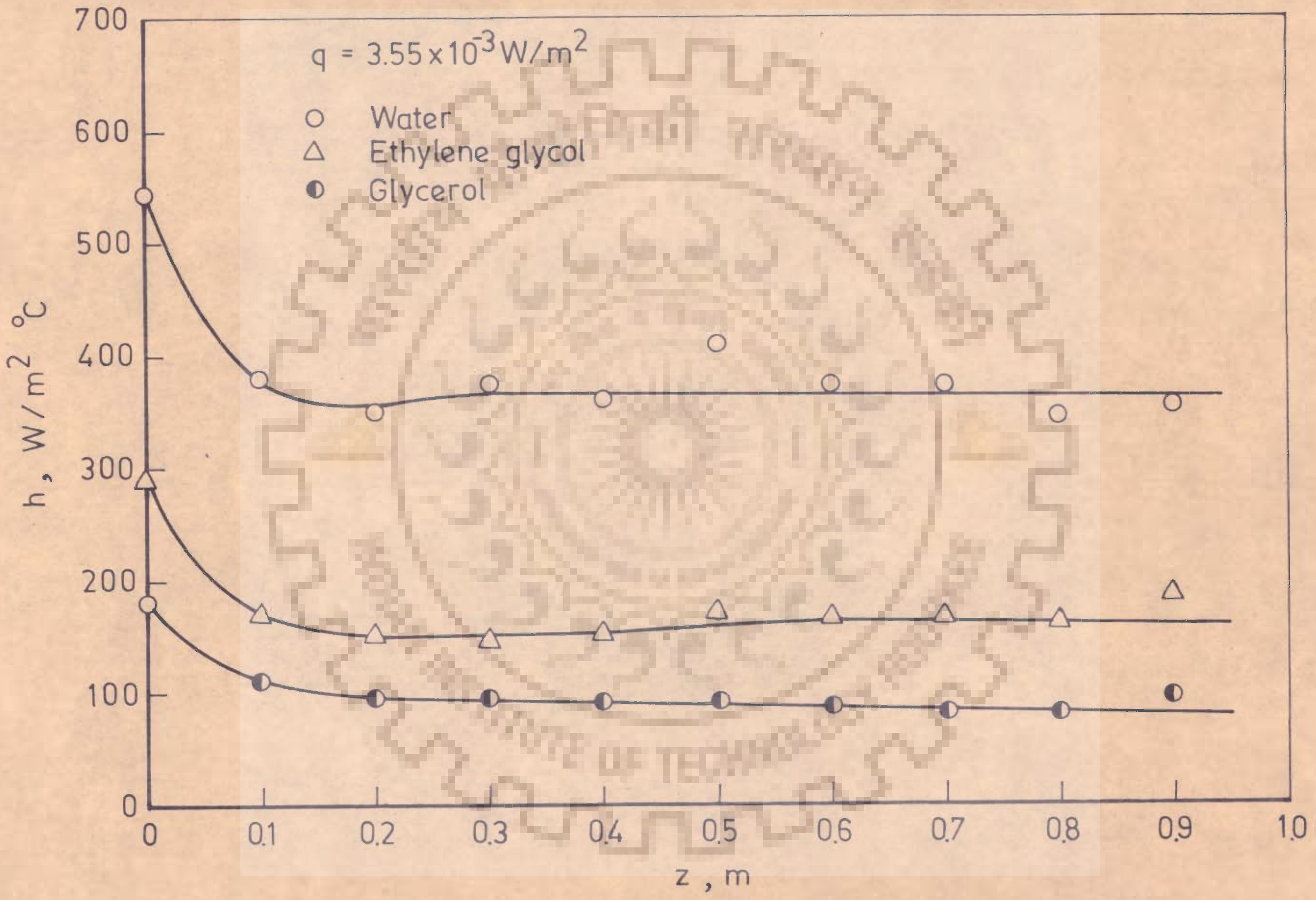



Fig. 6.4 Variation of heat transfer coefficient along the tube length

For a linear distribution of $T_L$ along the tube length at uniform heat flux, the wall temperature may also vary linearly if the variation in h is either insignificant or linear with tube length. This depends upon the extent to which the flow and thermal conditions are developed. In the present study, the flow is dependent on the change in physical properties of liquids and hence there exists a mutual adjustment of velocity and temperature profiles in the heated tube. The linear variation of wall temperature along the test section except near entrance seems to be the result of such an adjustment into either a fully developed condition or a developing condition where the change in profiles is very slow. The initial portions of wall temperature distribution are obviously due to the entrance effect with developing boundary layer.

The general characteristic features of wall temperature profiles for all the three systems at various heat fluxes investigated are observed to be similar. However, a relatively wider spread between the wall and liquid temperature distribution curves, at the same wall heat flux, for ethylene glycol and glycerol indicates poorer heat dissipating characteristics of these liquids as compared to those of water. This may be attributed mainly to the lower liquid flow rates established with these systems because of their higher viscosities than that of water. A comparison of heat transfer coefficients for water, ethylene glycol and glycerol at the same heat flux is shown in Fig.6.4. At higher values of imposed heat flux, the wall temperature profiles become not only steeper, almost parallel to liquid temperature profiles, but also they are spread wider to correspond higher values of temperature difference, $\Delta t$. An increase of about 1.7, 1.3 and 1.1 times in the values of $\Delta t$ are observed with water, ethylene glycol and glycerol respectively for about two-fold variation of heat flux. An increase in the value of wall heat flux raises the levels of wall and liquid temperatures and necessitates the establishment of higher liquid flow rates through the heat transfer section. This results in better heat transfer characteristics and consequently the rise in $\Delta t$ is not in the same proportion as that of heat flux. In case of water the enhancement of h for a two-fold increase in q seems to be only about 30 percent exhibiting an appreciable rise of about 70 percent in $\Delta t$. With glycerol, on the other hand, the increase observed in $\Delta t$ is only about 10 percent because of the significant change in physical properties and other conditions making the values of h higher to account for almost 90 percent of additional rate of heat transfer required due to the increased heat flux.

6.1.2 Correlations

A complete description of heat transfer rates from wall to the liquid under natural convective flow through a vertical tube of closed loop thermosyphon, as used in the present study, would include many independent variables. Written in dimensionless form these may be grouped as dynamic ratio (Gr), property ratio (Pr) and geometrical ratio (z/d). A functional relationship between heat transfer coefficient and the variables influencing it, in their dimensionless form, may therefore be expressed by the following equation:

$$Nu = f(Gr, Pr, z/d) \qquad \ldots (6.4)$$

In all the previous studies on natural convection, analytical as well as experimental, the dimensionless numbers Gr and Pr have generally been grouped together denoted by Rayleigh number. This proved to be very convenient particularly for systems with strongly temperature dependent physical properties.

### 6.1.2.1 Local heat transfer coefficients

In the present investigation, the wall and liquid temperatures varied significantly along the tube length resulting in the simultaneous wide spread variation of all the groups in Eq.(6.4). The local values of Nu, therefore, were plotted against Gr.Pr at various locations z/d, in Fig.6.5 for water, ethylene glycol and glycerol. The experimental data represented by only linear wall and liquid temperature profiles ($z/d > 10.5$) were considered in these plots. In this figure, it is seen that all the data points of glycerol lie on a family of parallel straight lines corresponding to various z/d ratios. It clearly indicates that at a given location in the tube the value of Nu depends exclusively upon Gr.Pr and may be expressed as

$$Nu = C_1 (Gr.Pr)^{n_1} \qquad \ldots (6.5)$$

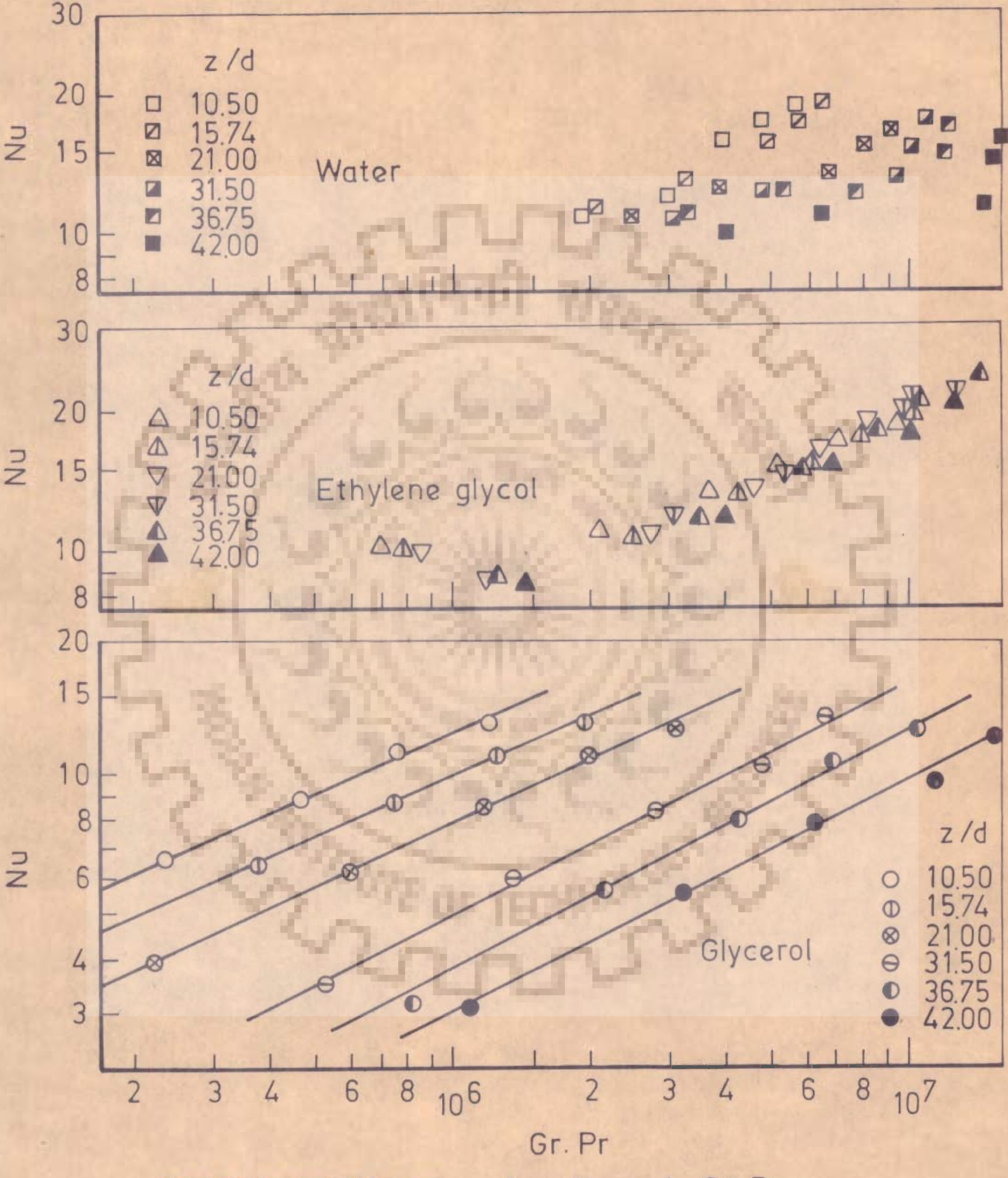



Fig.6.5 Local Nu as a function of Gr. Pr

The value of exponent $n_1$ for all z/d ratios is approximately the same. However, the coefficient $C_1$ strongly depends upon z/d. With ethylene glycol and water a similar behaviour seems to be exhibited but the lines are not distinctly separated. The slope of the lines are almost the same as that for glycerol. Thus the data points of all the three systems may be correlated by Eq.(6.5) with the same value of exponent $n_1$. The coefficient $C_1$ depends upon z/d ratio for the three systems differently. In order to obtain a unified value of $C_1$ for all the data points it was argued to choose a parameter which is strongly influenced by the local convections in the tube expressed through the following function:

$$Re = f(Gr) \qquad \ldots (6.6)$$

A plot of Re versus Gr in Fig.6.6 suggests the relationship

$$Re = C_2 \, Gr^{n_2} \qquad \ldots (6.7)$$

The average value of $n_2$ for all the systems was found to be 0.66 while the coefficient $C_2$ corresponded to z/d ratios almost in the same way as $C_1$. Thus the correlation finally assumed the following form

$$Nu = C_3(Gr.Pr)^{n_1}(Re/Gr^{0.66})^{n_3} \qquad \ldots (6.8)$$

The values of $n_1$, $n_3$ and $C_3$ in Eq.(6.8) were computed by regression analysis on a digital computer using experimental data points of water, ethylene glycol and glycerol to yield the following generalized correlation,

$$Nu = 1.14(Gr.Pr)^{0.388}(Re/Gr^{0.66})^{0.863} \qquad \ldots (6.9)$$

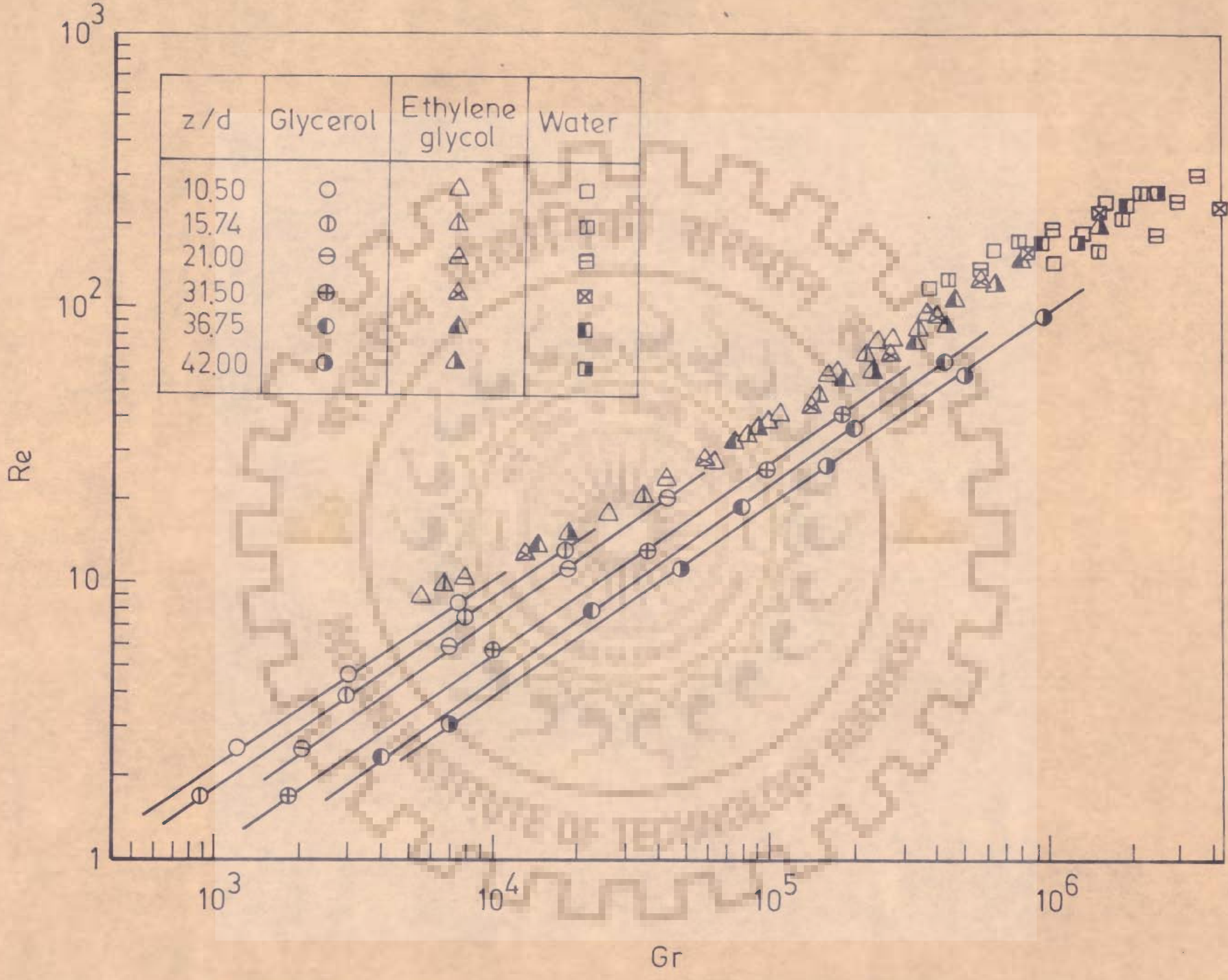



Fig.6.6 Reynolds number as a function of Grashof number

Figure 6.7 shows a comparison between the experimentally found values of Nu and those computed using Eq.(6.9). About 90 percent of 96 data points on all the systems studied are found to be within a maximum deviation of $\pm$ 20 percent. The correlation is based on the values of Gr.Pr ranging from $9.07\times10^4$ to $2.11\times10^7$ and corresponding Re from 0.39 to 445 over z/d ratios of 10.5 to 42.0. The physical properties for the local dimensionless groups in Equation (6.9) were taken at the arithmatic average of wall and liquid temperatures for any desired location along the tube length.

6.1.2.2 Average heat transfer coefficients

The average values of heat transfer coefficient were computed by dividing heat flux with average temperature difference over the tube length under consideration. Three lengths of 600, 700 and 800 mm were selected for this purpose. The heat transfer coefficient in their dimensionless form for water, ethylene glycol and glycerol were found to be best correlated by the following equation:

$$Nu_{avg} = 0.049(Gr.Pr)_{avg}^{0.584} (Re)_{avg}^{-0.131} (\ell/d)^{-0.622} \quad \ldots (6.10)$$

A comparison of experimental average Nu with those predicted by Eq.(6.10) is shown in Fig.6.8. The maximum scatter is about $\pm10$ percent. The generalized correlation as proposed above is applicable for Gr.Pr ranging from $1.13\times10^5$ to $7.34\times10^6$ with the corresponding Re varying from 0.5 to 298. The physical

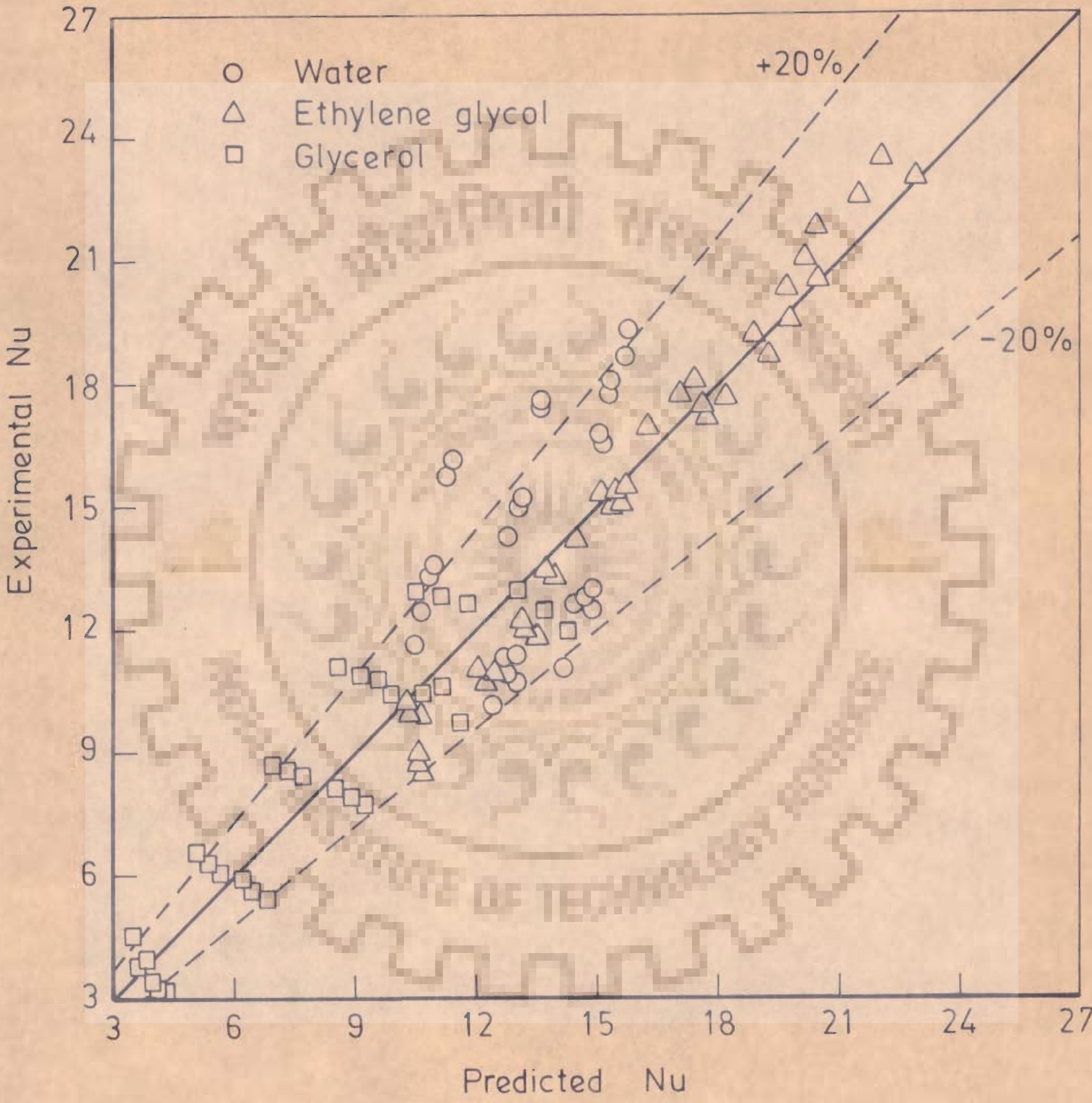



Fig. 6.7 Comparison between experimental local Nusselt numbers and those predicted by Eq.(6.9)

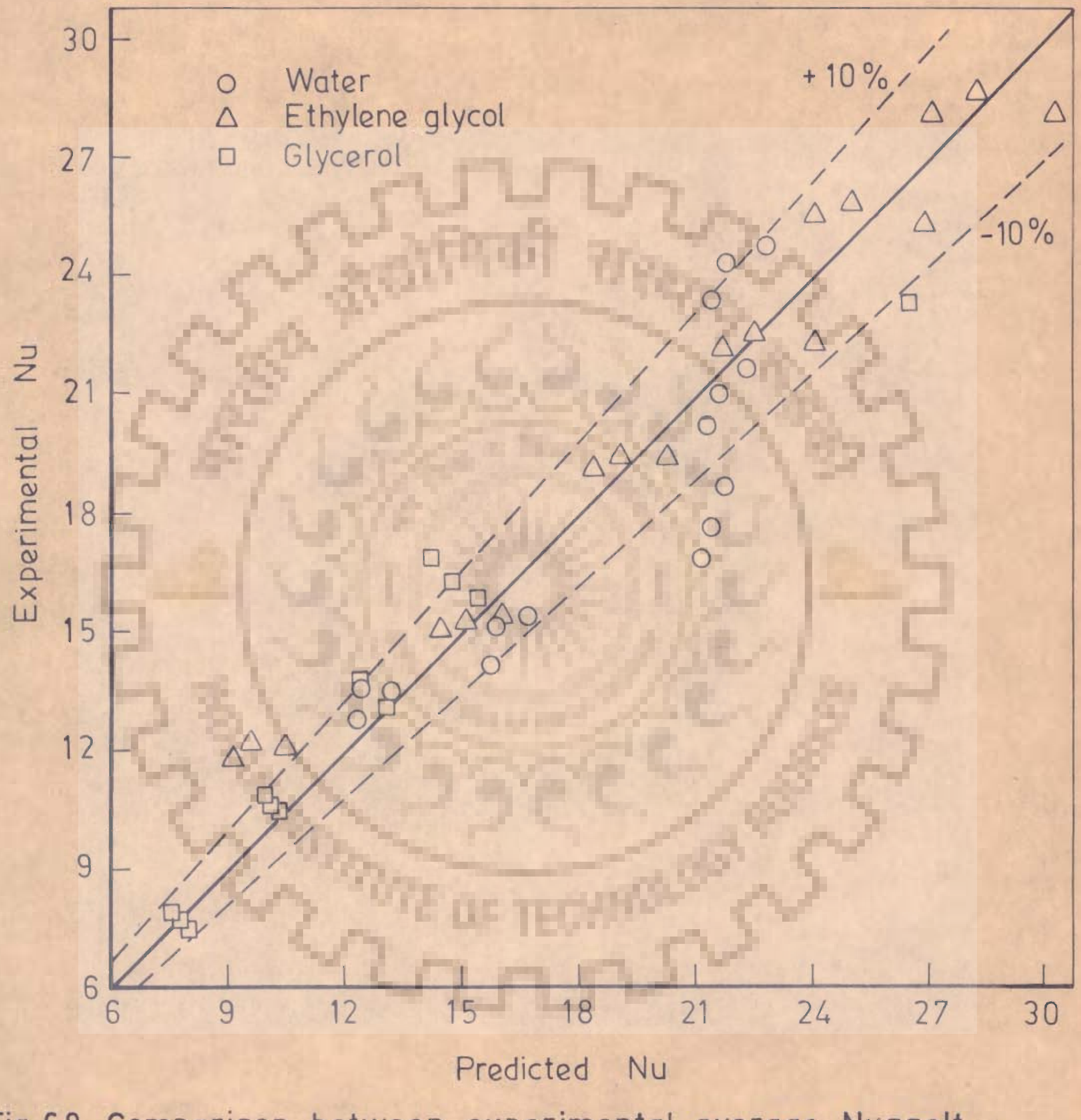



Fig. 6.8 Comparison between experimental average Nusselt numbers with those predicted by Eq.( 6.10 )

properties of liquids for this correlation were taken at the arithmatic mean of average wall and liquid bulk temperatures over the tube lengths under consideration.

## 6.2 NUCLEATE BOILING OF LIQUIDS IN VERTICAL TUBE OF CLOSED LOOP THERMOSIPHON

### 6.2.1 Wall and Liquid Temperature Distributions along the Heat Transfer Section

The wall temperature distribution along the heated length of test section were obtained from the experimentally measured values of surface temperatures at sixteen locations on it. The liquid temperatures corresponding to the above mentioned locations were computed by the method discussed in Chapter 5. The effect of heat flux, inlet liquid subcooling and submergence on these temperature distributions were studied extensively for each test liquid investigated. The data generated on thermosiphon reboiler as a result of all the 266 runs using acetone, ethyl acetate, propan-2-ol, water and toluene have been tabulated in Appendix C. Some of the runs on every system were selected to show the characteristic behaviour of wall and liquid temperature profiles graphically. The typical plots showing the variation of wall temperatures along the length of heat transfer surface with heat flux, degree of subcooling at inlet and submergence as parameters are given in Figures 6.9 to 6.11 for acetone, 6.12 to 6.14 for ethyl acetate, 6.15 to 6.17 for propan-2-ol, 6.18 to 6.22 for water and 6.23 to 6.25 for toluene. The variation of liquid temperatures have been shown corresponding to lowermost curves of wall temperatures only in Figures 6.9, 6.13,6.16, 6.18 and 6.24.

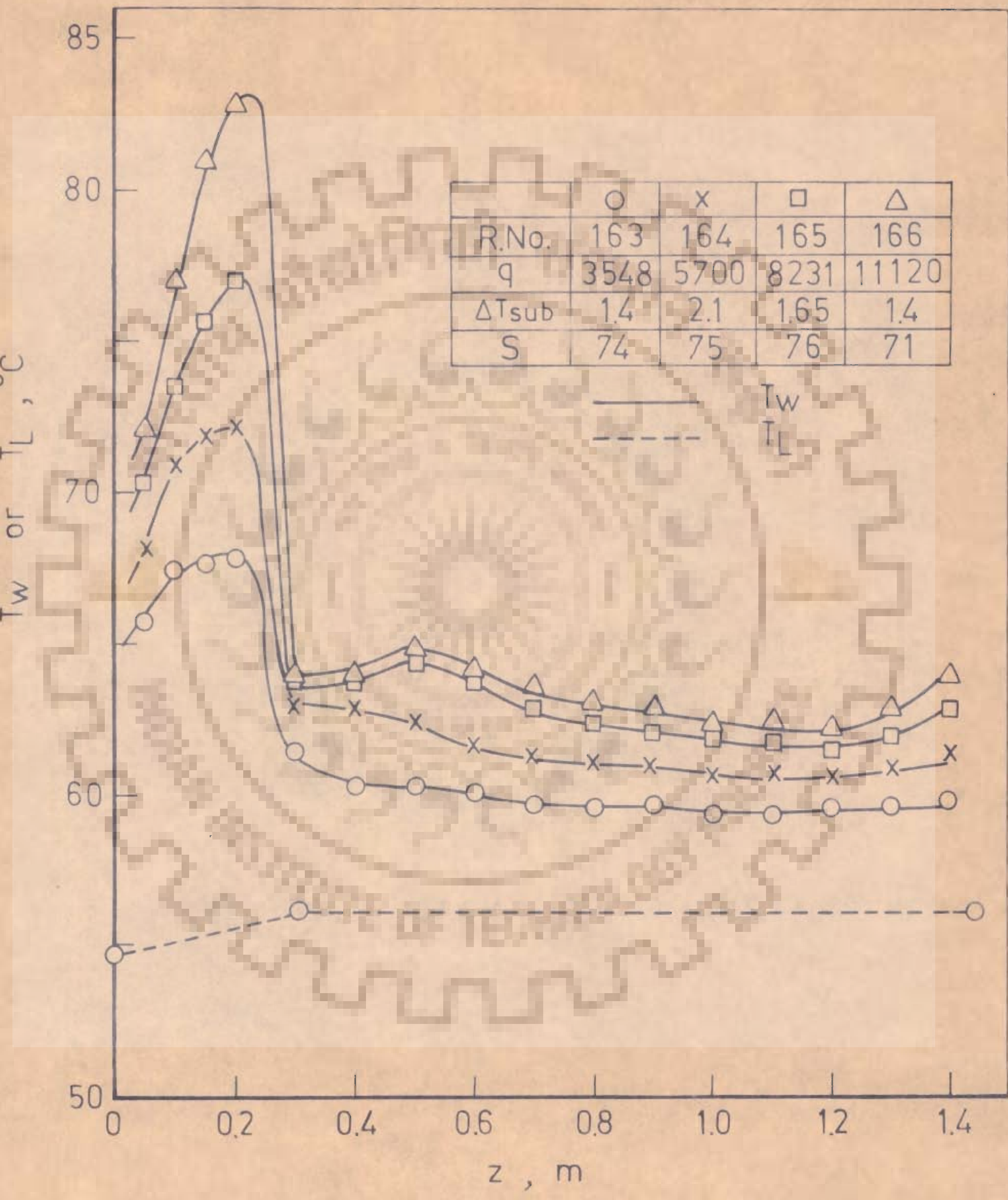



Fig.6.9 Variation of wall and liquid temperatures along the heated length for Acetone with heat flux as parameter

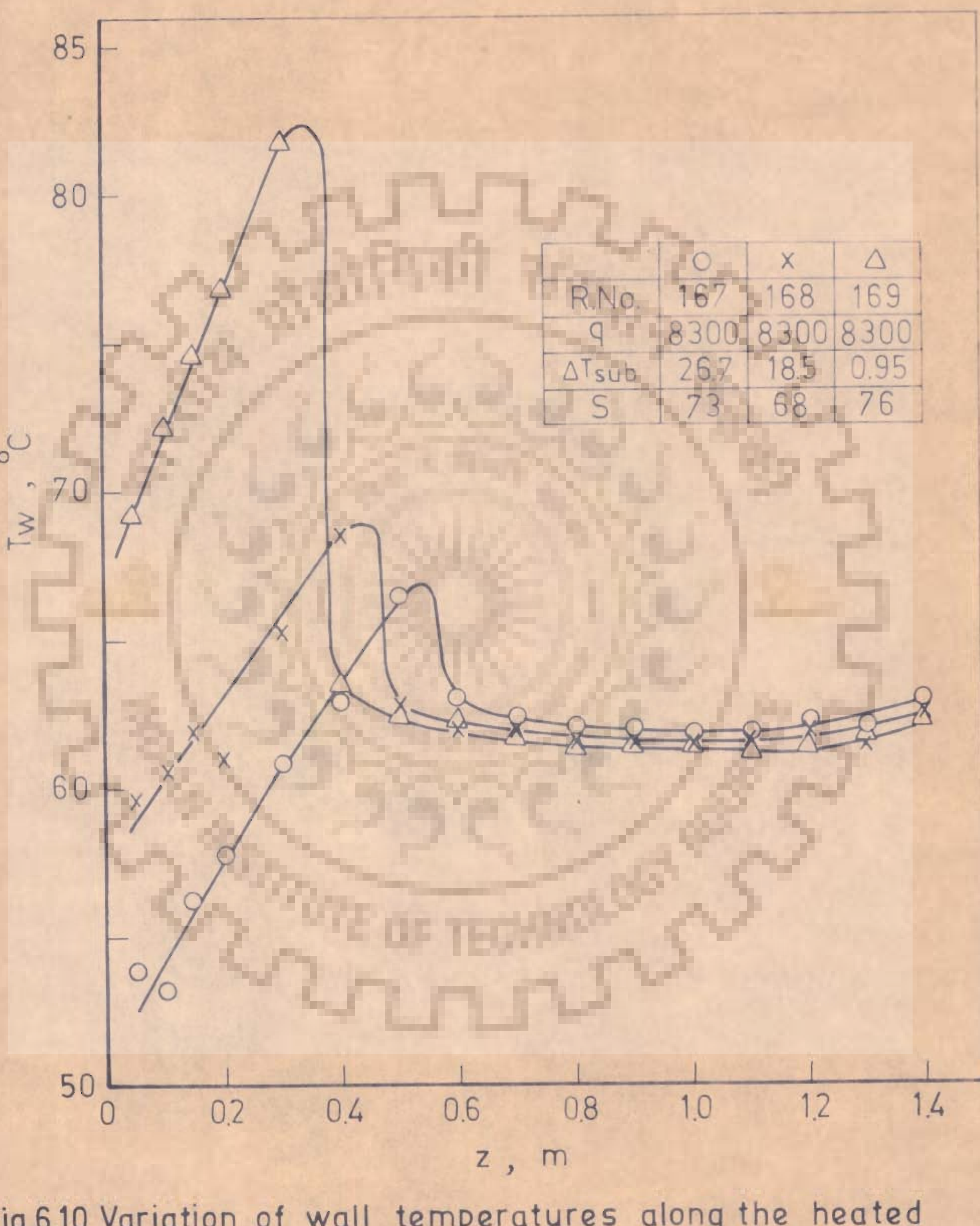



Fig.6.10 Variation of wall temperatures along the heated length for Acetone with degree of subcooling as parameter

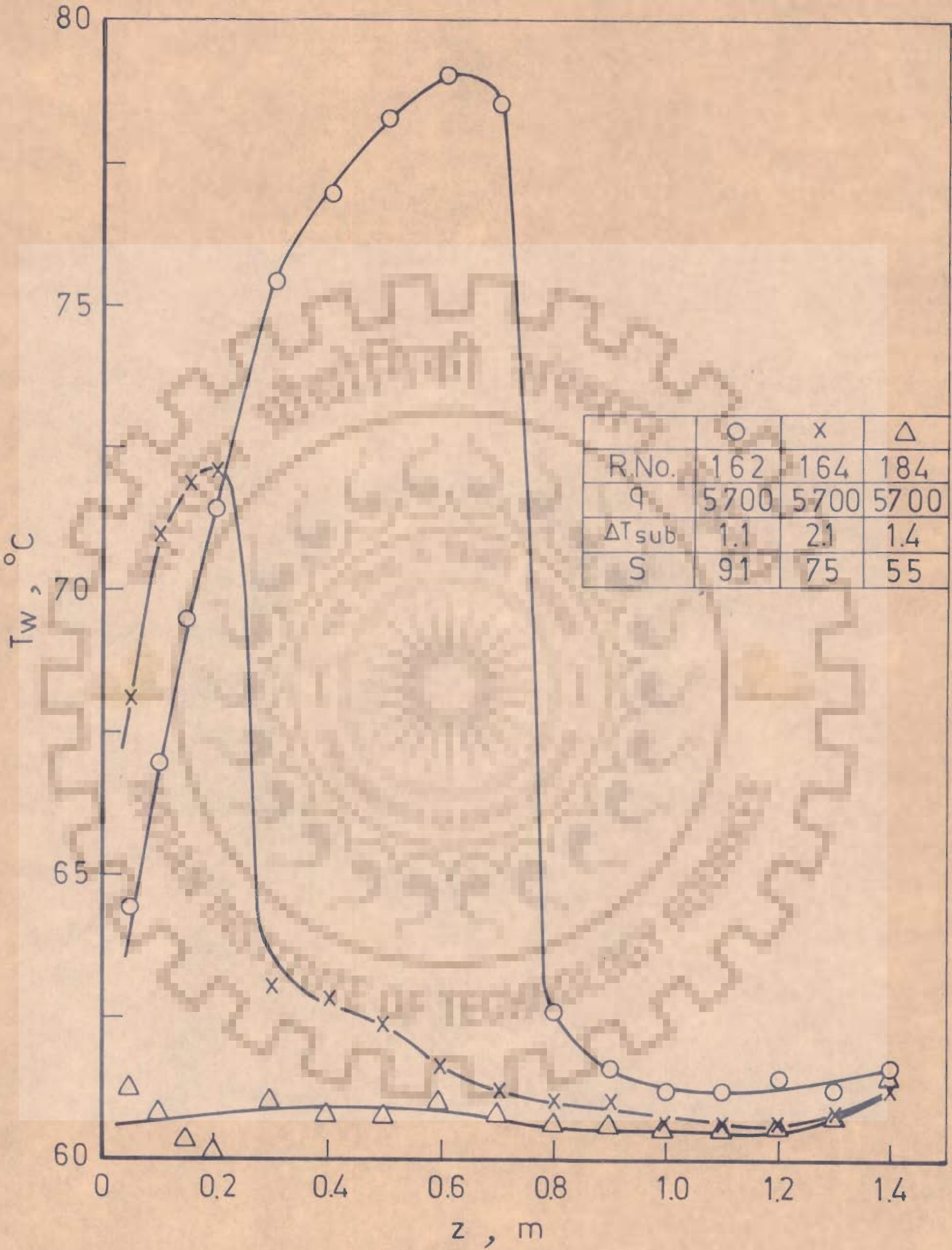



Fig.6.11 Variation of wall temperatures along the heated length for Acetone with submergence as parameter

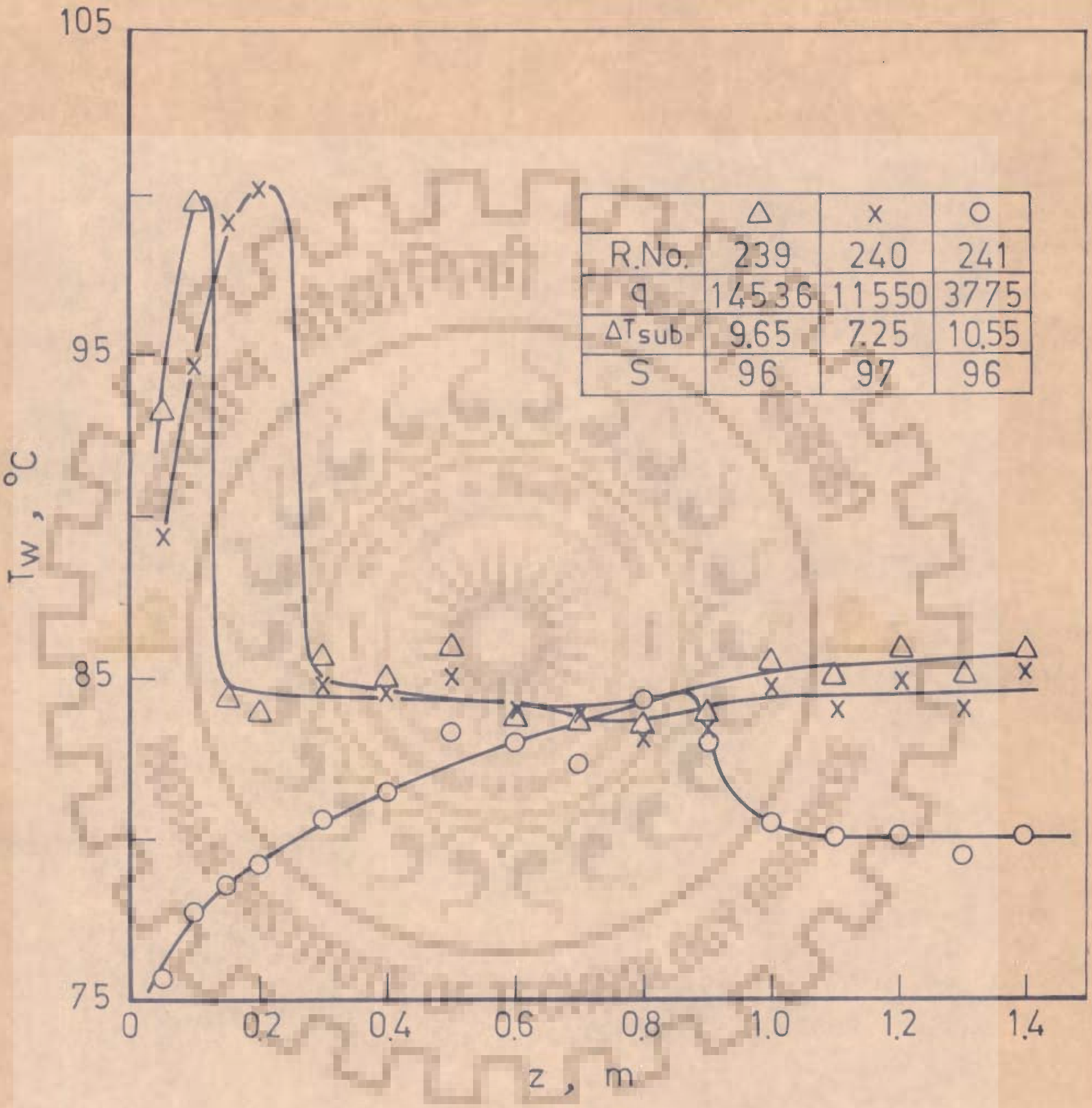



Fig.6.12 Variation of wall temperatures along the heated length for Ethyl Acetate with heat flux as parameter

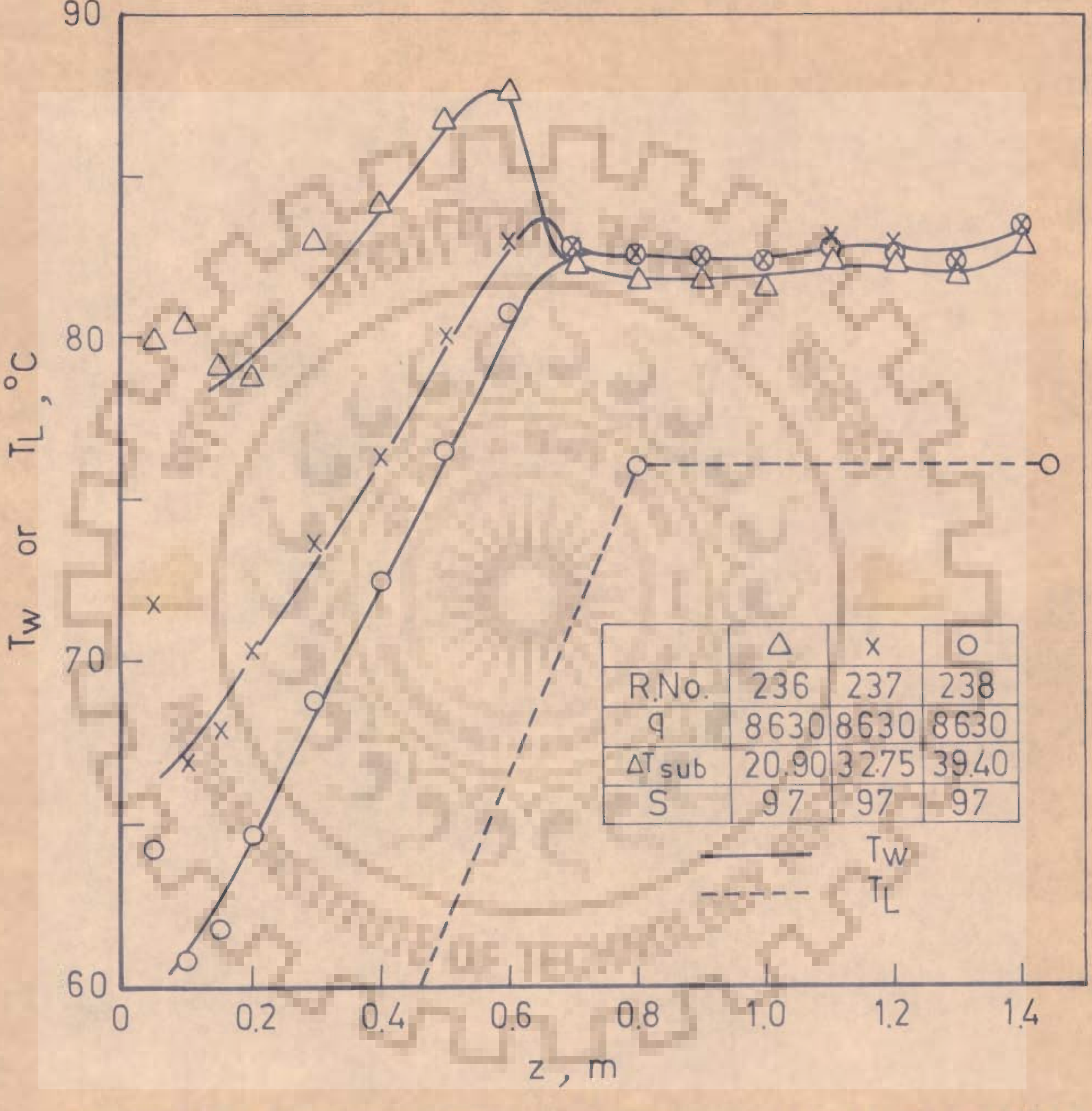



Fig.6.13 Variation of wall and liquid temperatures along the heated length for Ethyl Acetate with degree of subcooling as parameter

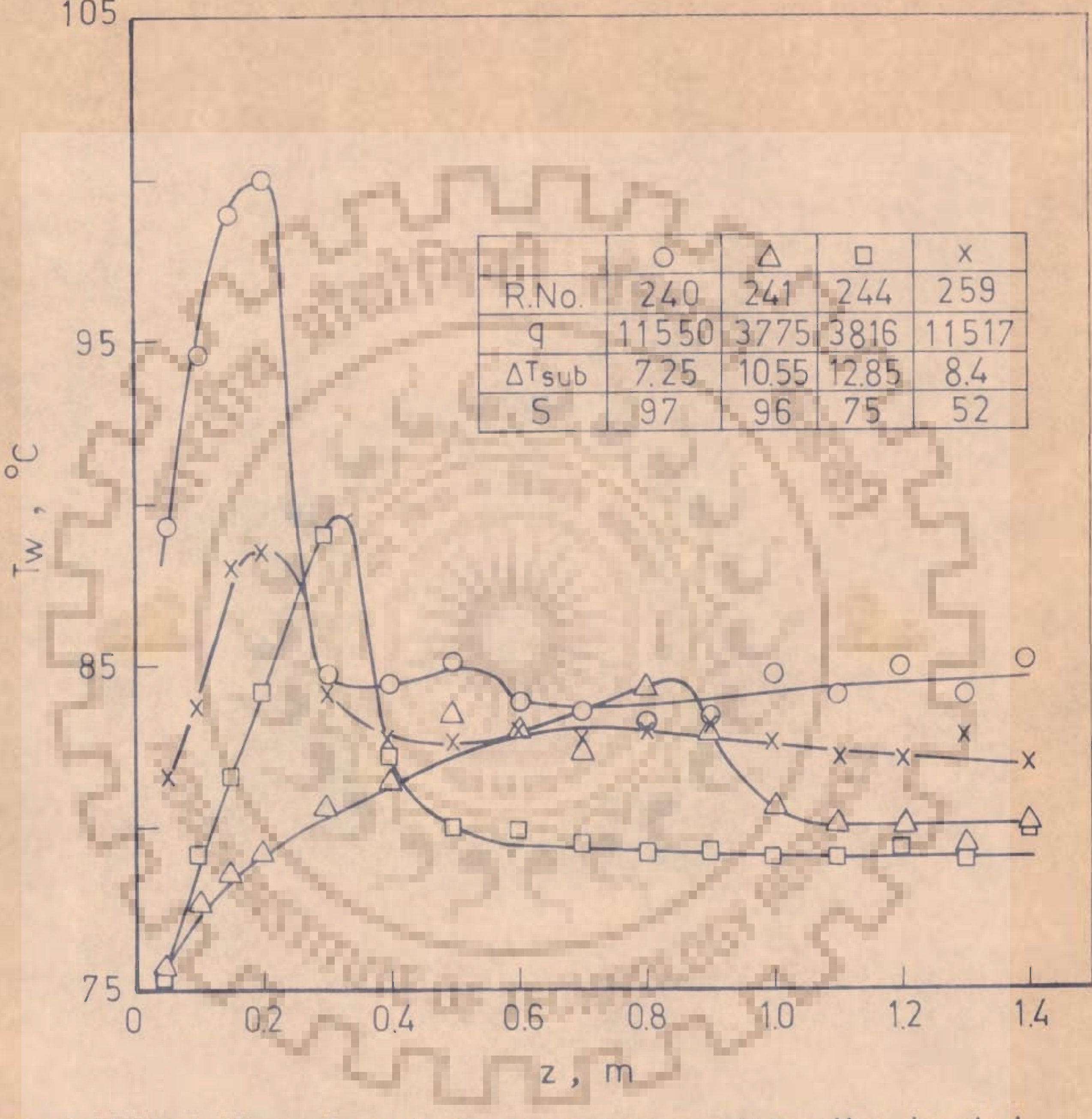



Fig.6.14 Variation of wall temperatures along the heated length for Ethyl Acetate with submergence as parameter

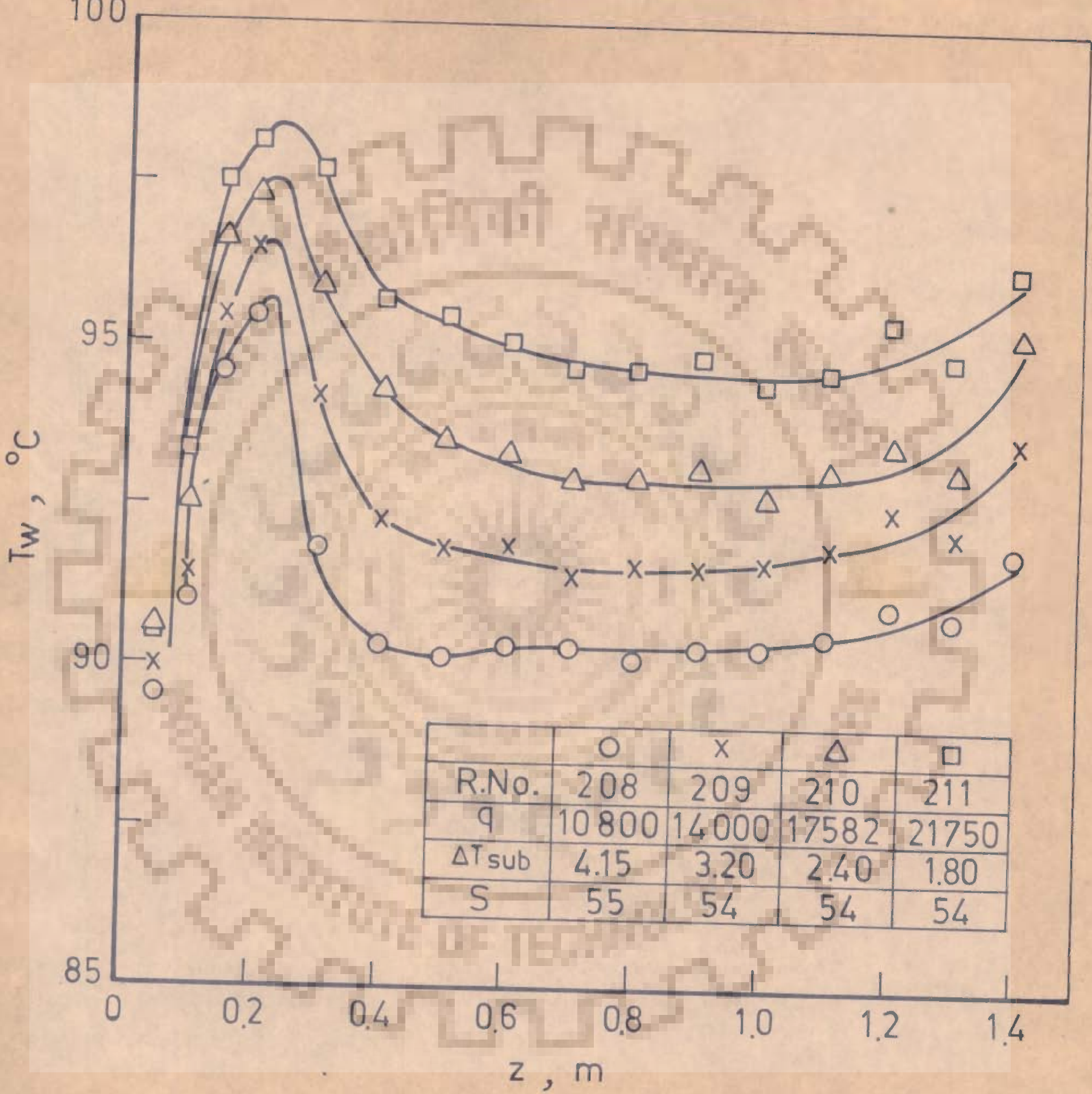



Fig.6.15 Variation of wall temperatures along the heated length for Propan-2-ol with heat flux as parameter

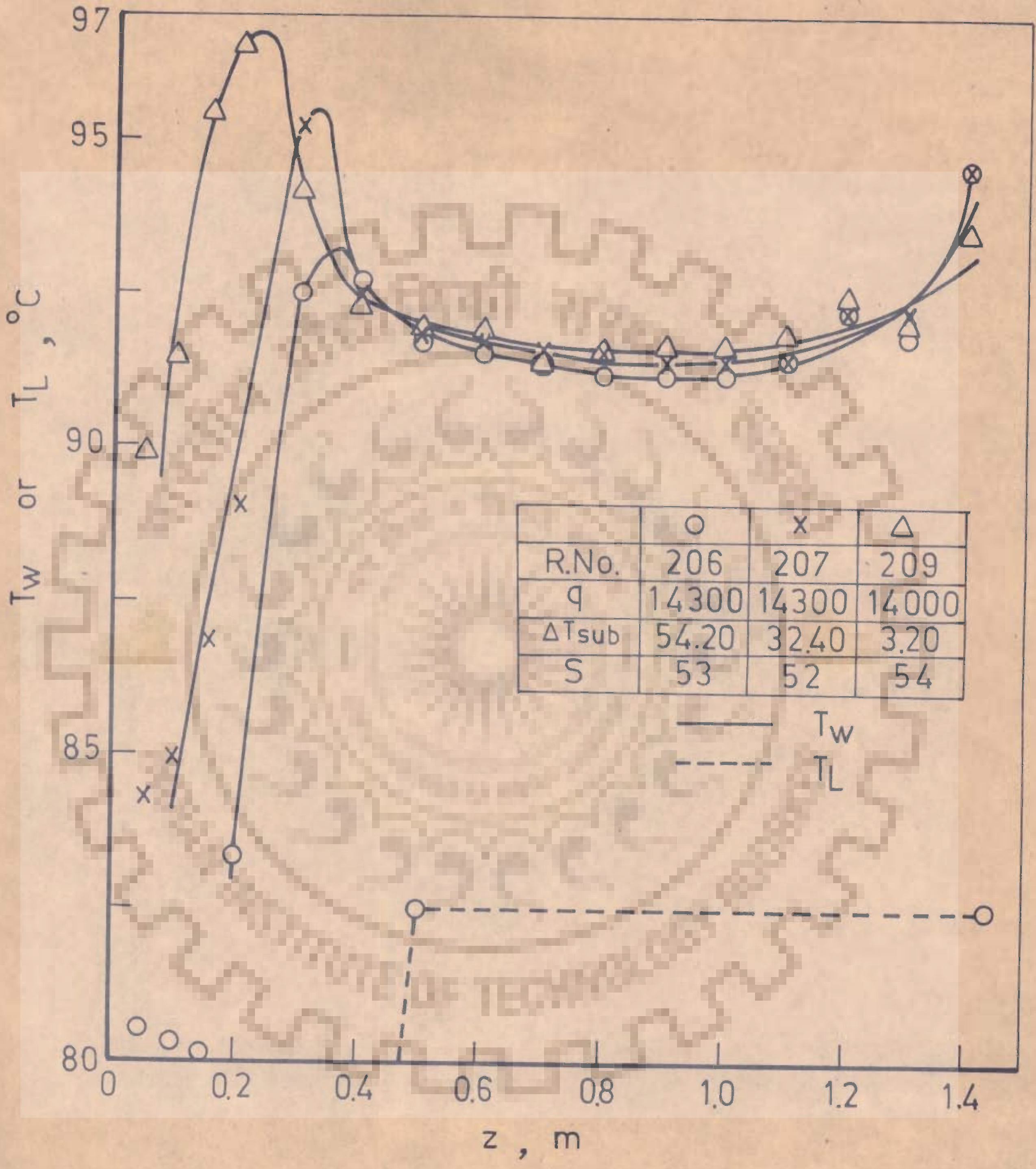



Fig. 6.16 Variation of wall and liquid temperatures along the heated length for Propan-2-ol with degree of subcooling as parameter

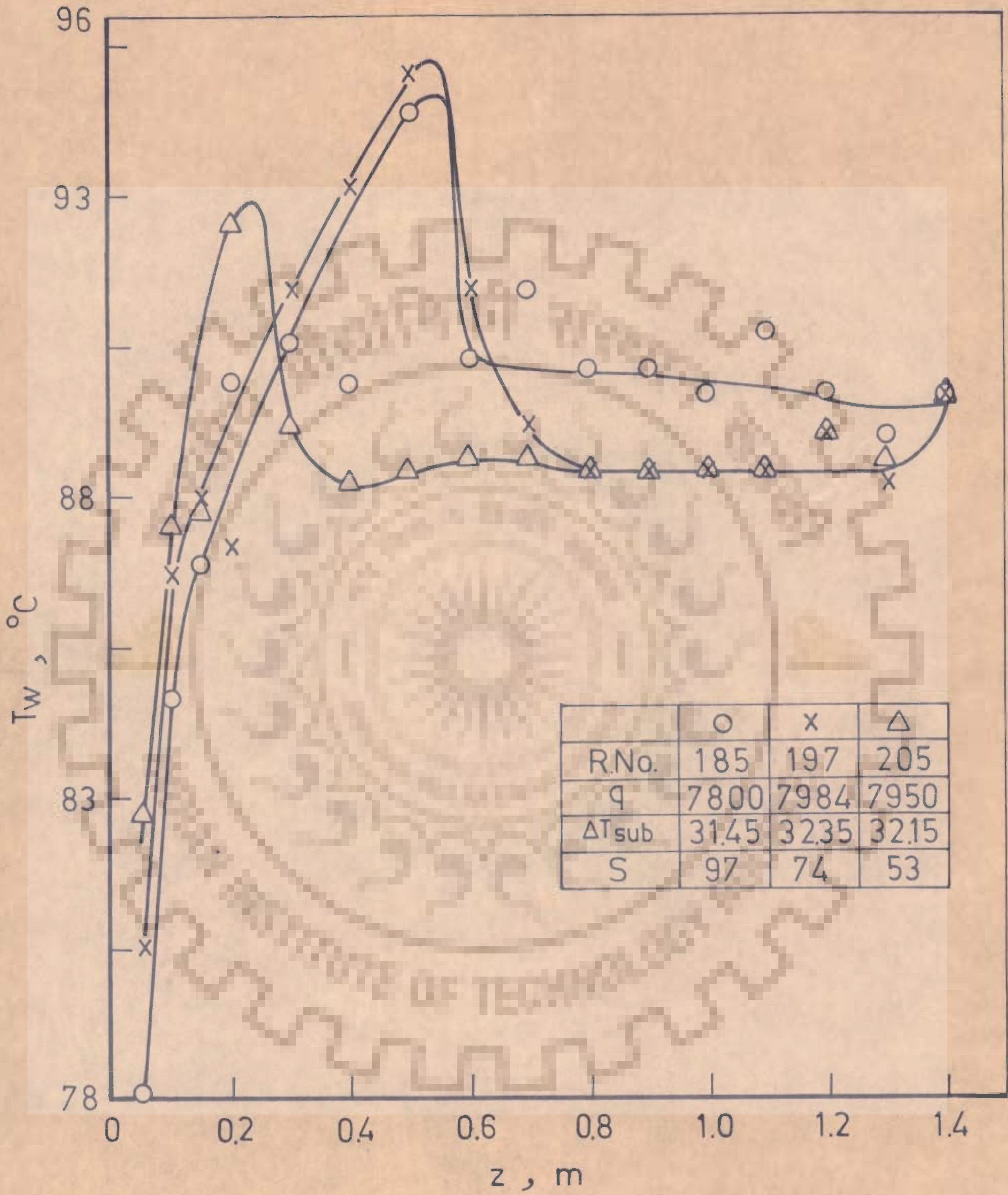



Fig.6.17 Variation of wall temperatures along the heated length for Propan-2-ol with submergence as parameter

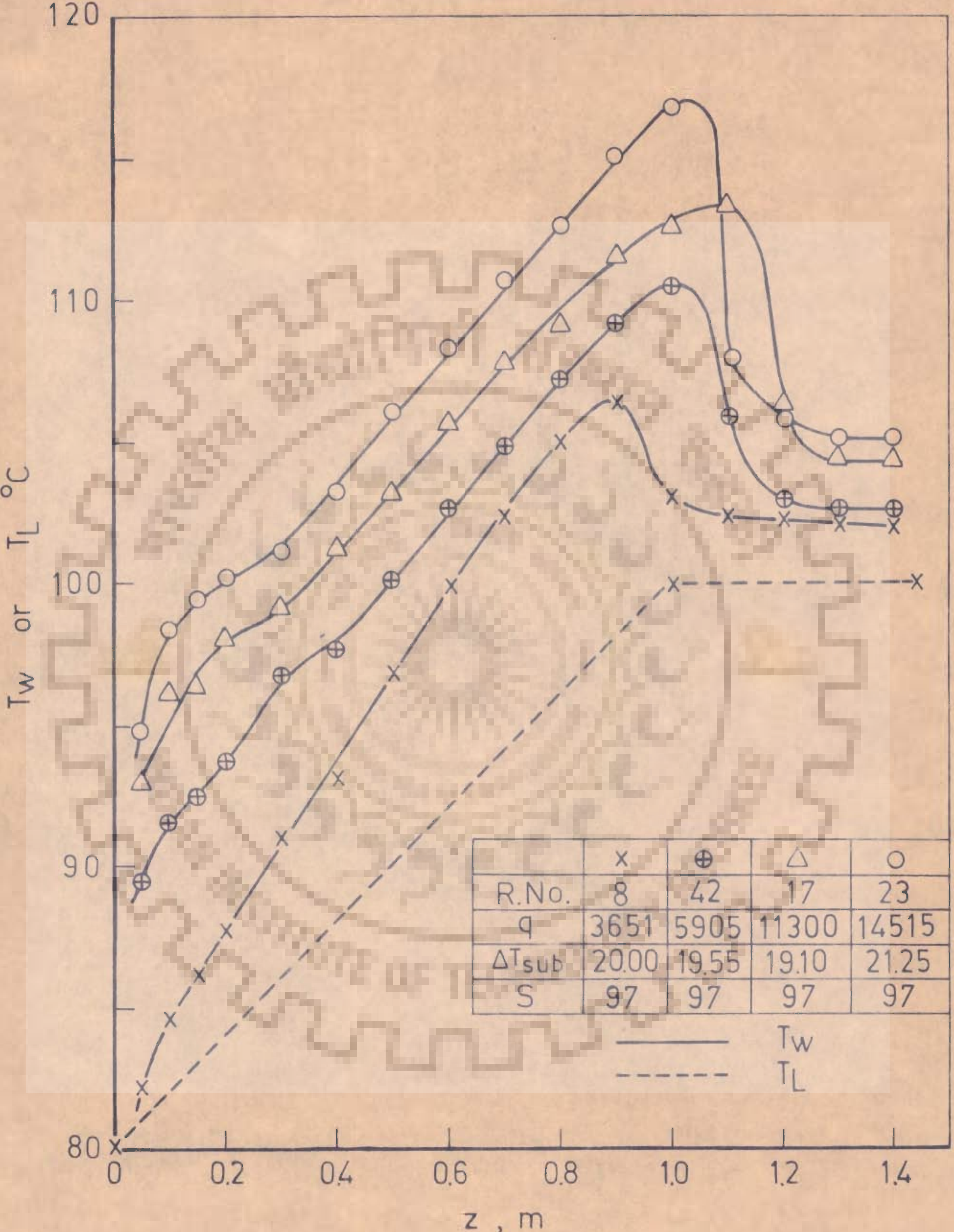



Fig.6.18 Variation of wall and liquid temperatures along the heated length for Water with heat flux as parameter

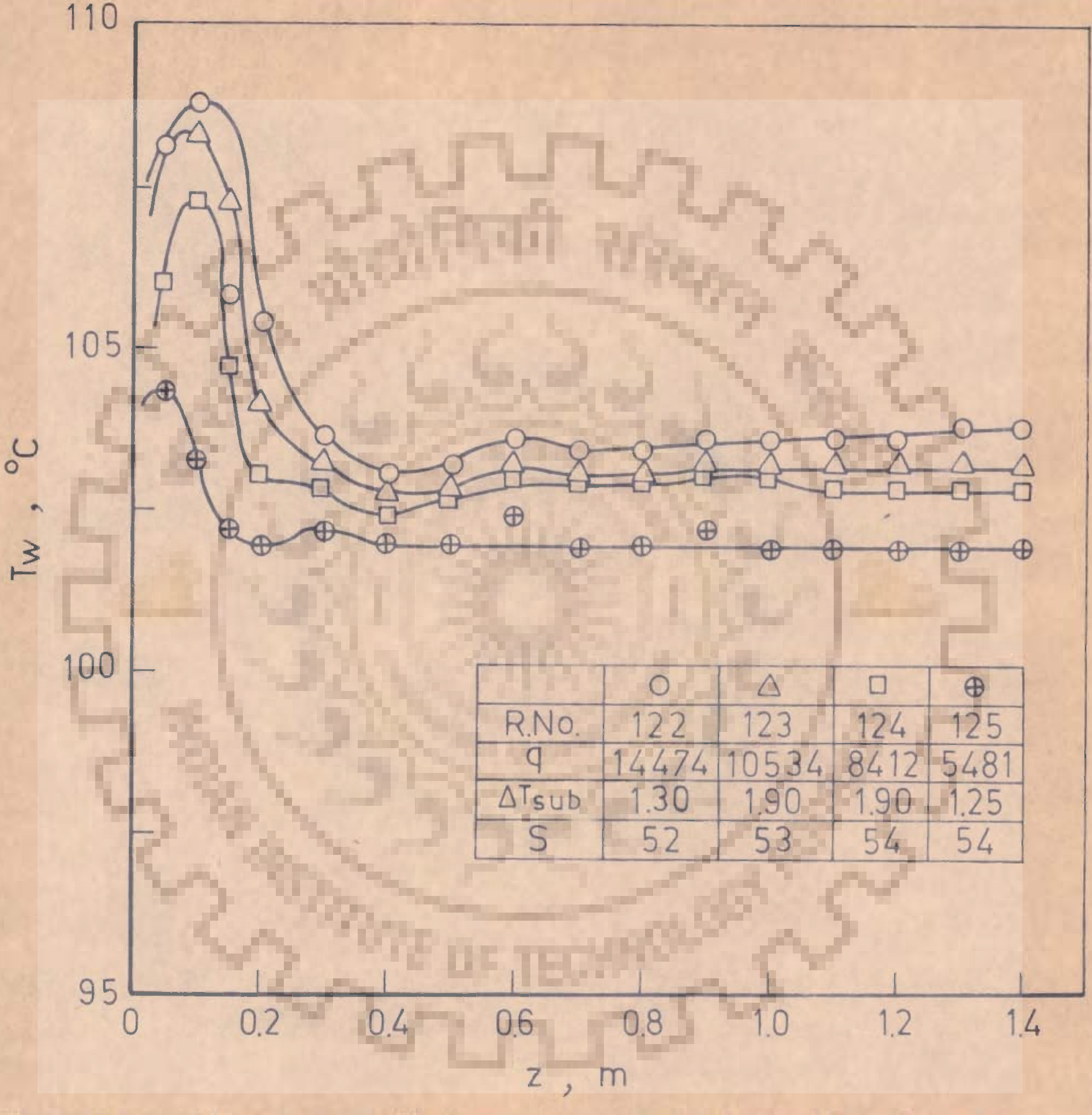



Fig.6.19 Variation of wall temperatures along the heated length for Water with heat flux as parameter

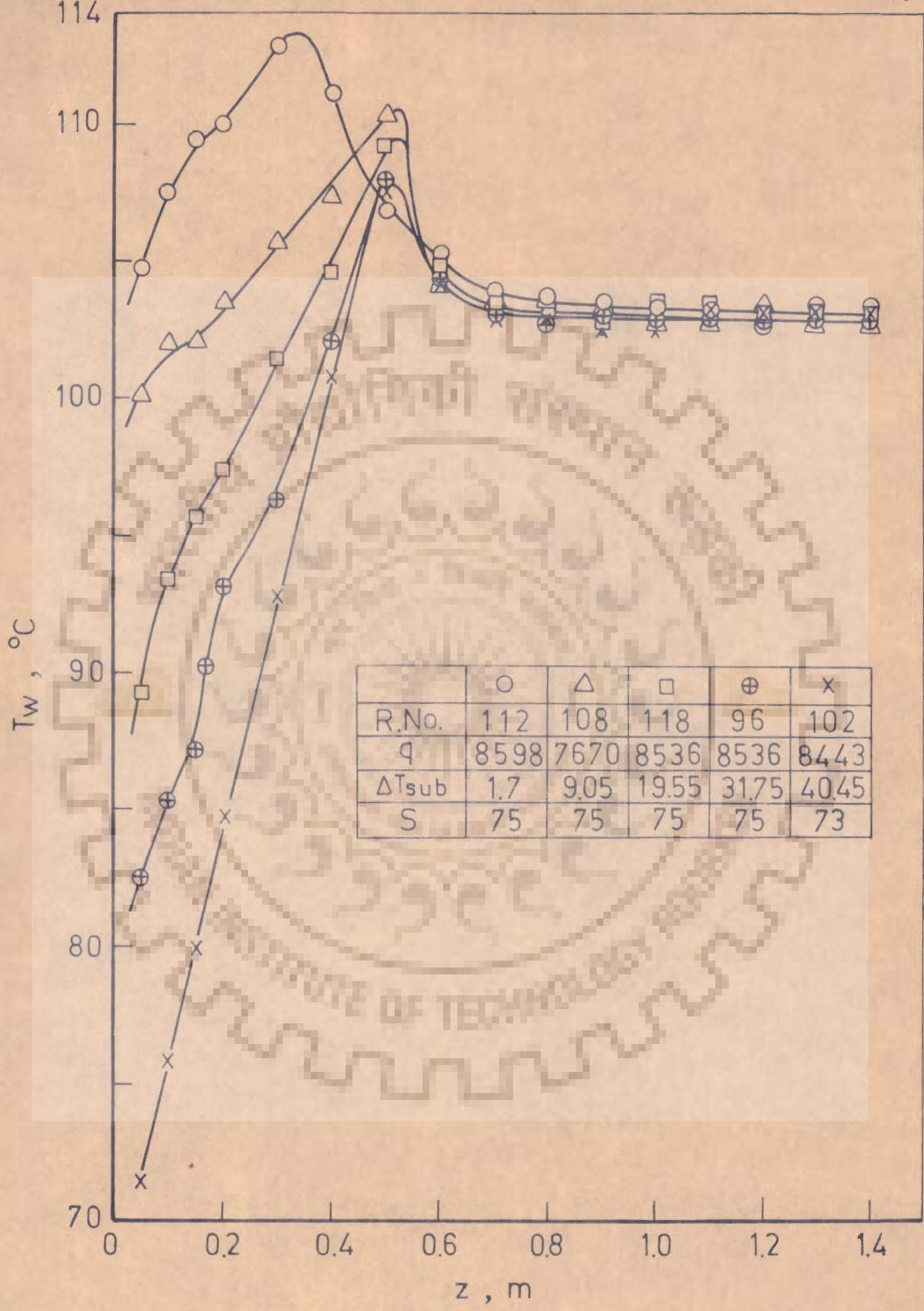
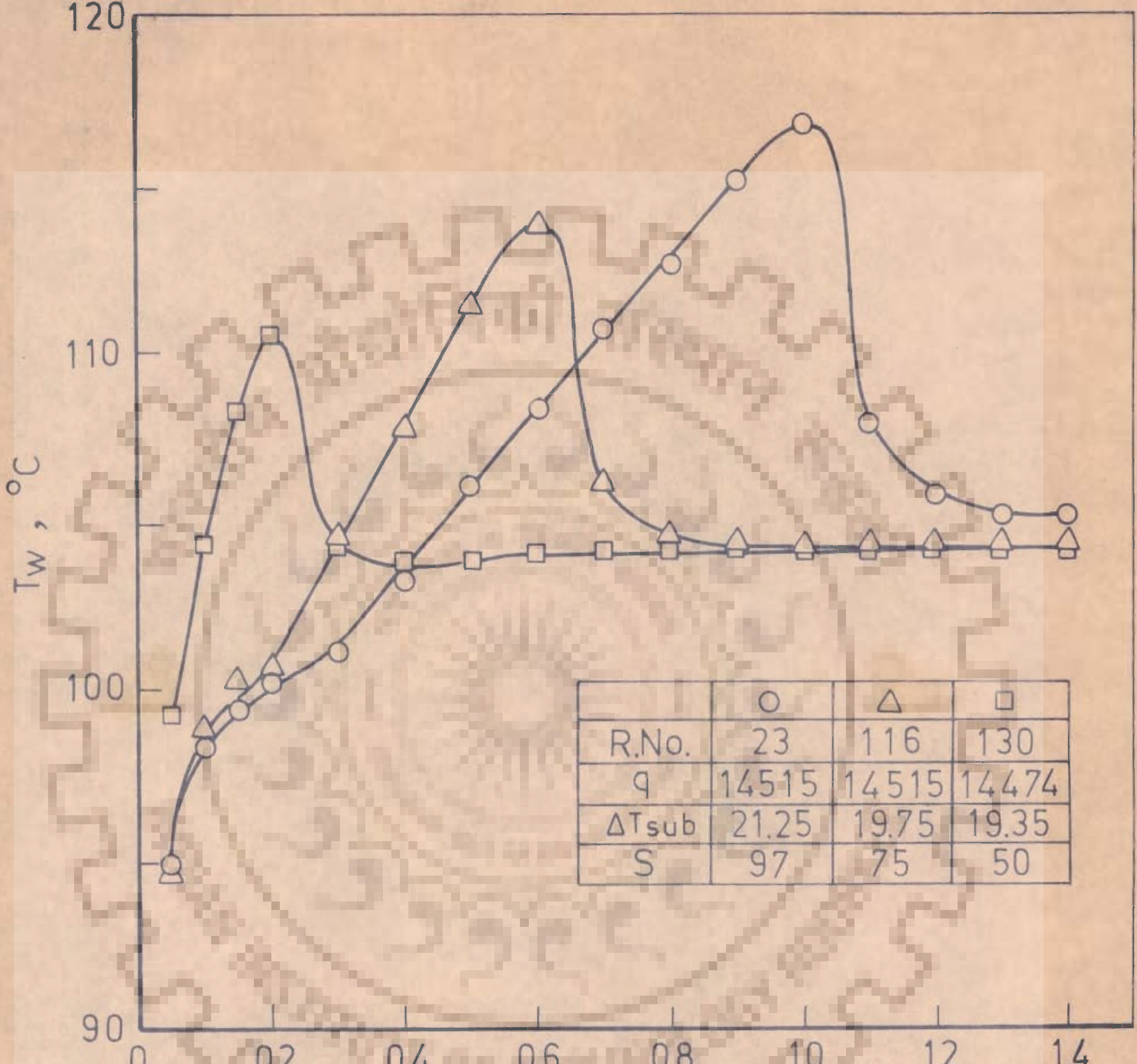



Fig.6.20 Variation of wall temperatures along the heated length for Water with degree of subcooling as parameter




| | ○ | △ | □ |
|---|---|---|---|
| R.No. | 23 | 116 | 130 |
| q | 14515 | 14515 | 14474 |
| $\Delta T_{sub}$ | 21.25 | 19.75 | 19.35 |
| S | 97 | 75 | 50 |

Fig.6.21 Variation of wall temperatures along the heated length for Water with submergence as parameter

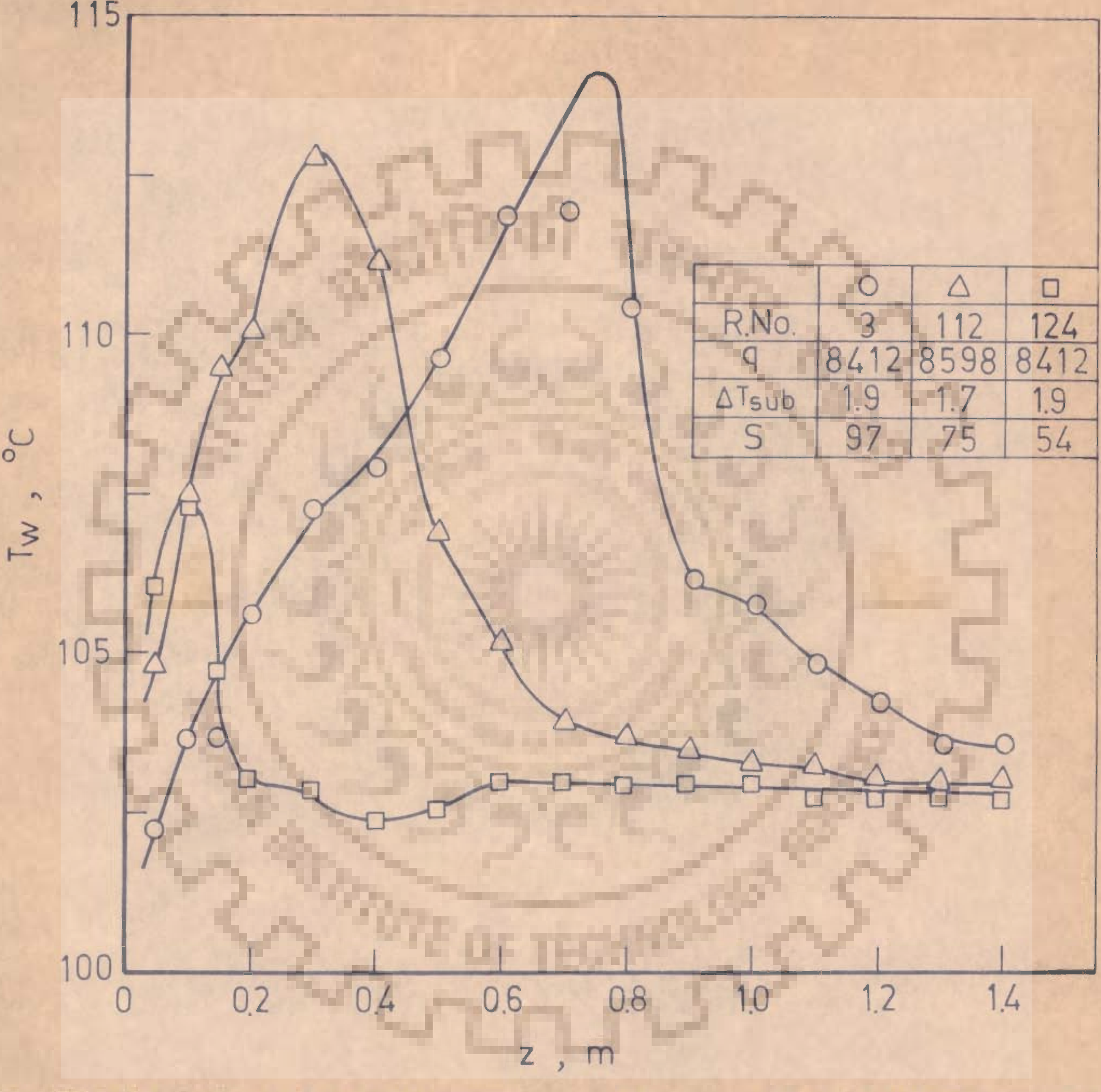



Fig.6.22 Variation of wall temperatures along the heated length for Water with submergence as parameter

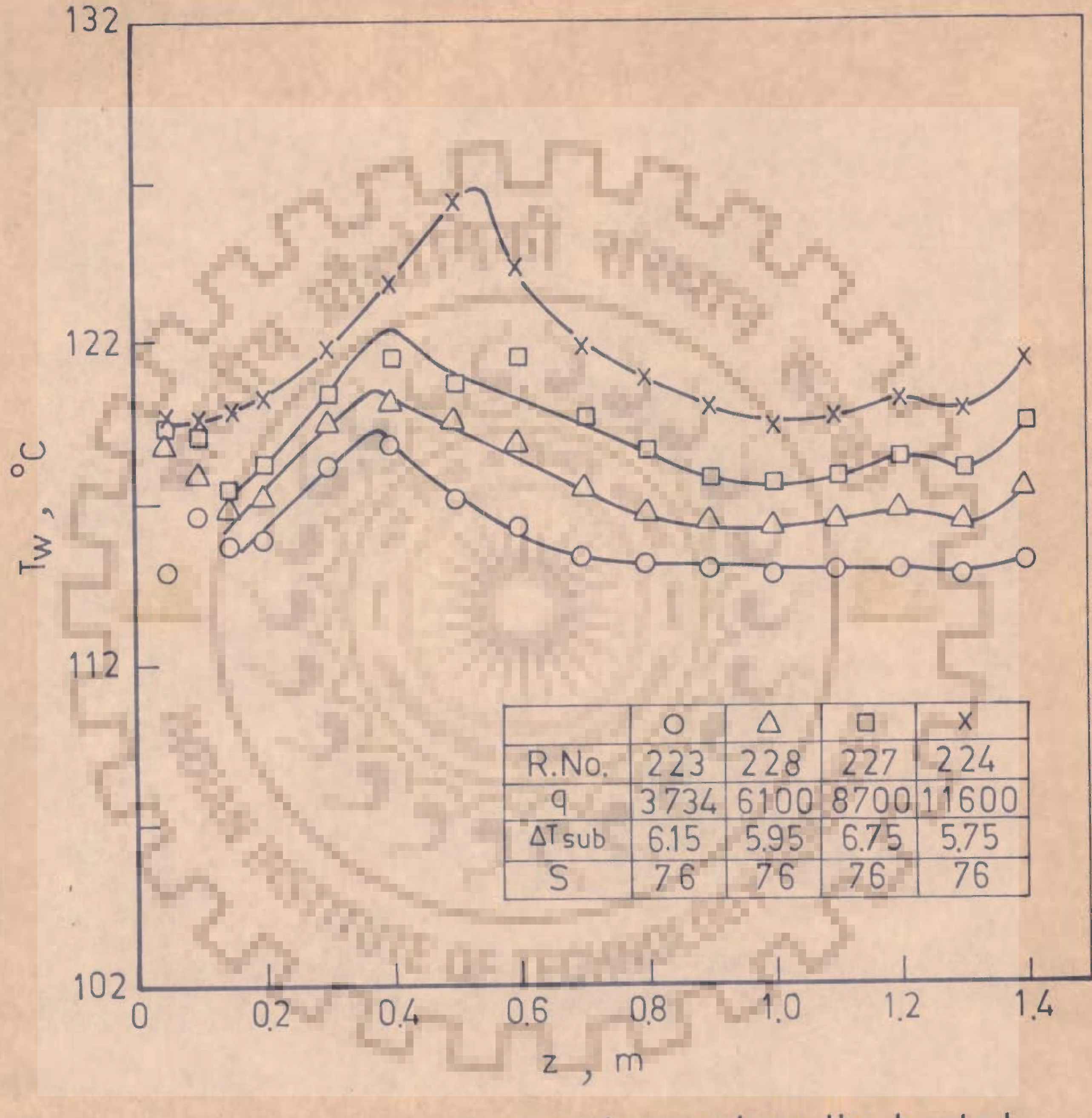



Fig.6.23 Variation of wall temperatures along the heated length for Toluene with heat flux as parameter

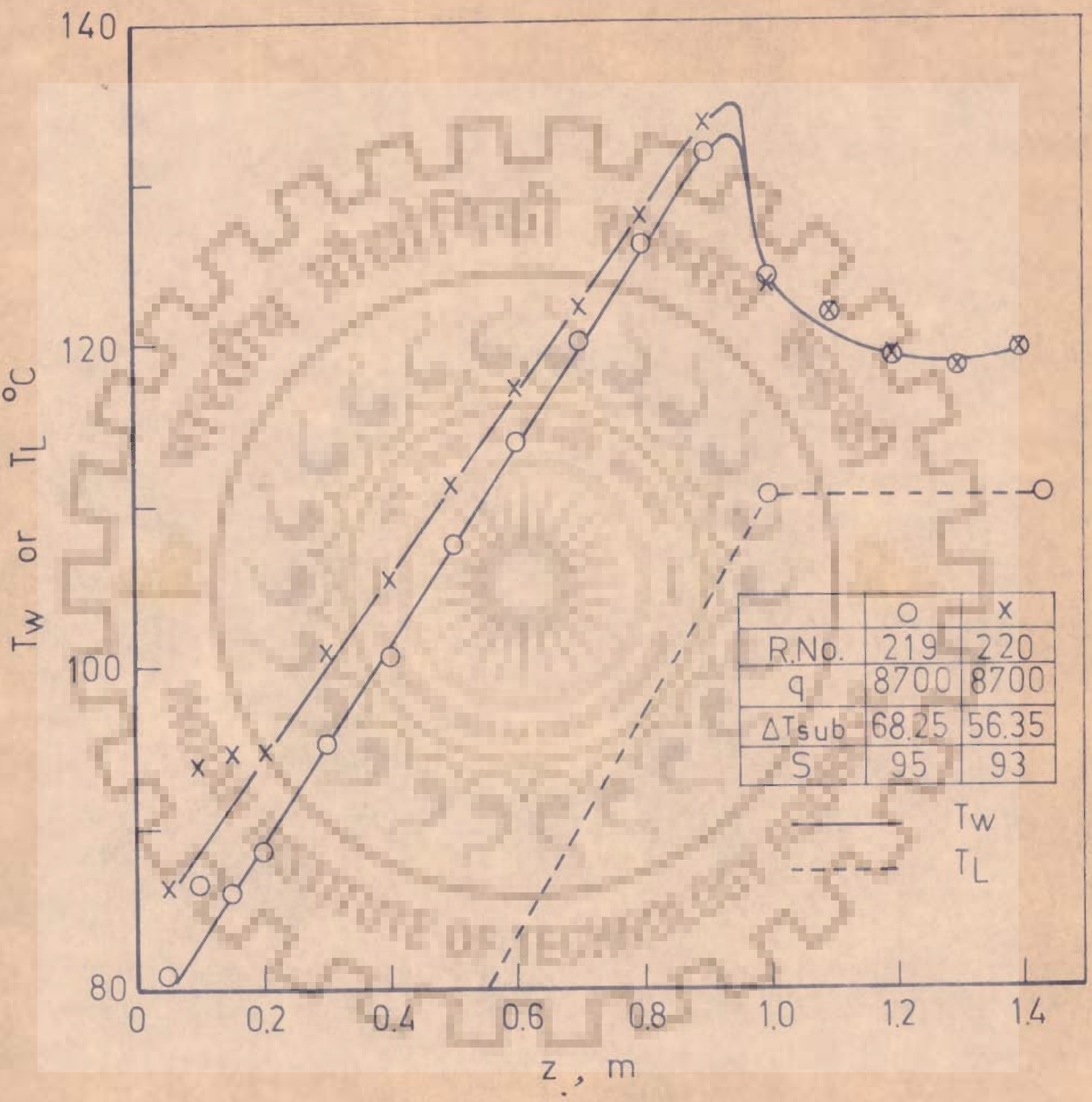



Fig.6.24 Variation of wall and liquid temperatures along the heated length for Toluene with degree of subcooling as parameter

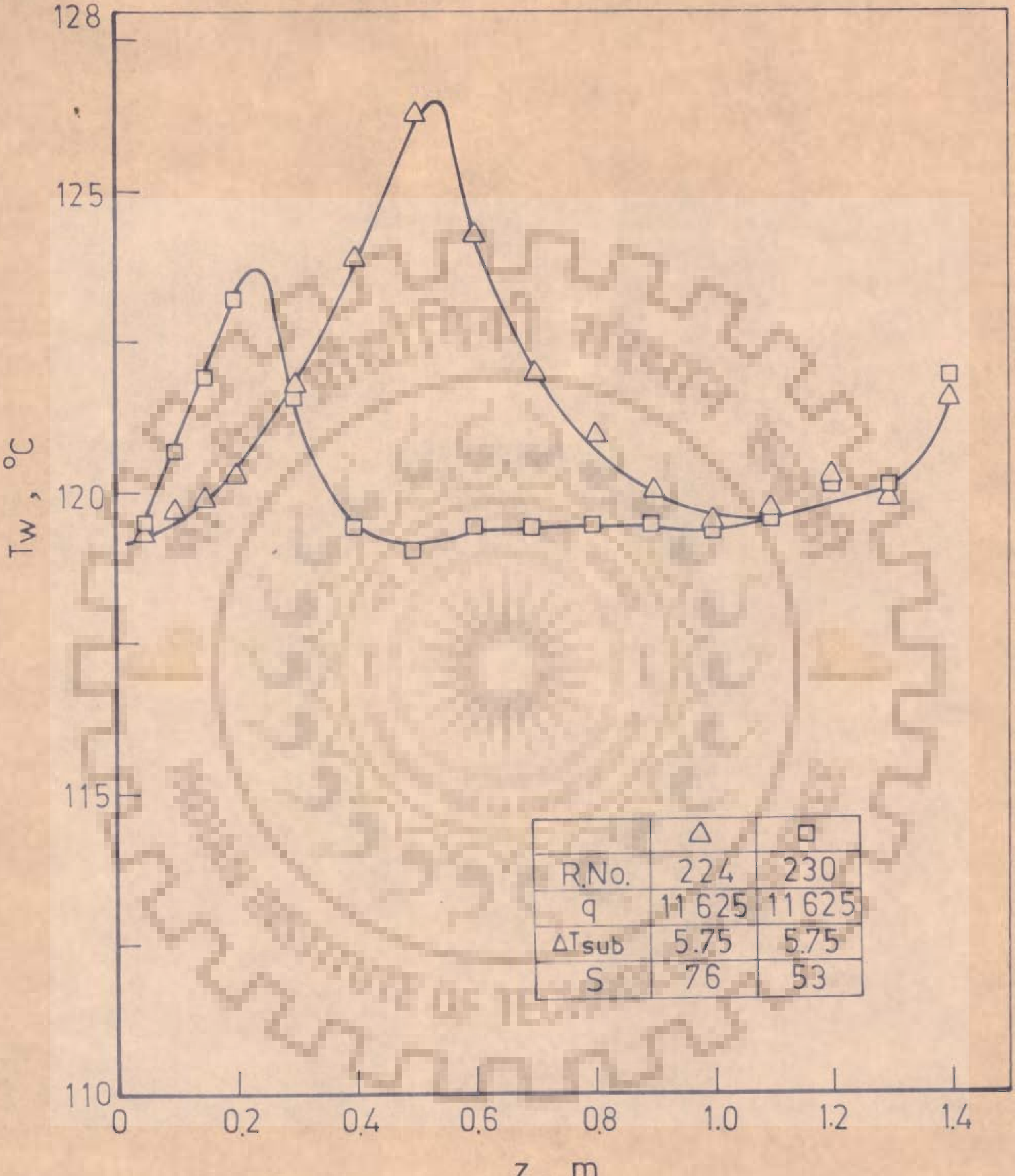



Fig.6.25 Variation of wall temperatures along the heated length for Toluene with submergence as parameter

On examining these figures, the following may be observed.

a. The liquid temperature, $T_L$, varies linearly with distance, z along the test section upto a point beyond which it becomes almost constant. The value of liquid temperature corresponding to the horizontal portion of the profile is the saturation temperature of the liquid.

b. The wall temperature, $T_w$, increases at a fast rate with distance, z, along the heated length upto a point where it attains a maximum value. Beyond this point a steep fall in the wall temperature is observed and further it changes gradually to become almost horizontal over the remaining portion of the test section. However, in case of some highly volatile organic liquids, the wall temperature tends to rise near the exit end at higher values of heat flux.

c. At approximately same values of inlet subcooling and submergence, the shape of profiles is almost similar at various heat flux values but their relative positions are altered. The curves at higher values of heat flux are shifted to higher wall temperatures than those at lower levels of heat flux.

d. The inlet liquid subcooling seems to have a strong effect on the varying wall and liquid temperature portion of the curves. The curves move towards higher wall temperatures when the degree of subcooling is reduced. The peak values of wall temperatures are also affected the same way as may be clearly seen in Figures 6.10, 6.13, 6.16, 6.20 and 6.24. At higher values of inlet subcooling, the straight line portions of the curves are longer than those at smaller degree of subcooling.

e. The maximum value of wall temperature and the position where it is attained at a fixed value of heat flux and degree of subcooling is strongly influenced by the submergence. With the decrease in its value from full submergence, the peak wall temperature diminishes and the distance required to attain this value also decreases resulting in relatively longer horizontal portions of the curves at lower submergence values. The above mentioned effect is exhibited by Figures 6.11, 6.14, 6.17, 6.21, 6.22 and 6.25.

f. The effect of heat flux, degree of subcooling and submergence on the general nature of wall and liquid temperature distributions are similar for all the five test liquids investigated. However, the maximum values of wall temperatures and relative lengths of varying and almost constant temperature portions of curves are different for different systems.

The above mentioned characteristic features of wall and liquid temperature distributions indicate the basic modes of heat transfer in the vertical tube of thermosiphon reboiler.

The linear rise of liquid temperature as it moves upward through the tube is due to the sensible heating under uniform wall heat flux conditions till the saturation temperature is attained. The linear variation of wall temperatures in this region almost parallel to liquid temperature line may be attributed to the heat transfer by natural convection with surface boiling taking place in the vicinity of maximum wall temperature conditions. At high degree of subcooling the longer straight line portions of the curves are quite similar to those of single phase thermosiphon and hence the same explanation may be given as discussed in Section 6.1. The linear portions of wall temperature curves extend even beyond the saturation temperature of liquids due to the requirement of a minimum degree of superheat for bubble nucleation as observed in pool boiling investigations. The values of wall superheat which are attained before the wall temperatures start decreasing have been found to be much higher compared to those in pool boiling as observed experimentally for acetone and water in the earlier studies [1]. This is presumably because the process of bubble nucleation and subsequent growth is suppressed by the induced flow of liquid through the tube. The points at which the curves deviate from the straight lines, mark the onset of effective subcooled boiling. The bubbles nucleate at the surface and create additional turbulence resulting in slow change of wall temperature. As the liquid moves up further, its temperature also increases facilitating the nucleation and growth of bubbles to bigger sizes and thus making the boiling process increasingly effective which is responsible for the fall in wall temperature. Once the liquid attains the saturation temperature, fully developed nucleate boiling sets in. All the heat supplied goes to evaporate the liquid and vapour exists as a second phase whose quantity increases along the tube length. The rate of heat transfer in this region is governed by the interaction between nucleate boiling and convection. As the vapour quantity increases along the tube length and hence the fluid velocity, the convective heat transfer mechanism becomes significant but the nucleation is gradually suppressed [22]. The two mechanisms, forced convective and nucleate boiling, seem to counteract each other in the region of saturated nucleate boiling and thus contribute to almost horizontal portions of wall temperature distribution curves. Since the bulk temperature is constant in this region, the heat transfer coefficient also does not change. However, in some cases the suppression of the nucleation as the quality is increased along the boiling channel leads to a temporary reduction of heat transfer coefficient and accordingly wall temperature tends to rise.

With increase in heat flux, the shifting of curves to higher wall temperatures over nonboiling natural convective heat transfer region may be explained the same way as it was done for single phase thermosiphon in Section 6.1. In nucleate boiling regions, the increase in wall temperatures with heat flux is relatively small due to the larger number of nuclei for bubble formation becoming active at higher heat flux and thus enhancing the heat transfer coefficient.

The displacement of straight line portions of curves in Figures 6.10, 6.13, 6.16, 6.20 and 6.24 with changes in degree of subcooling indicate that at a given heat flux and submergence the temperature drop between wall and liquid is not significantly influenced by the liquid temperature. Therefore, any decrease in inlet subcooling and corresponding rise of liquid inlet temperature results in the elevated wall temperatures. The locations of maximum wall temperatures are also accordingly adjusted. Once the liquid attains saturation temperature, the wall temperature is governed by nucleate boiling and becomes independent of liquid subcooling. This explains the closeness of horizontal lines in the above mentioned figures.

Under the conditions of nearly full submergence, the non-boiling regions are longer than those at smaller values of submergence mainly because of relatively higher circulation rates established. At lower submergence, the liquid level in the downflow pipe becomes small and the amount of liquid rising upward in two phase mixture is reduced with most of the liquid falling back in the tube. The nucleate boiling mechanism plays a dominant role similar to pool boiling conditions and thus the horizontal portions of the temperature distribution curves are stretched longer and peak values become smaller as the submergence is reduced. A typical variation of circulation rates with submergence may be seen for the curves of

Figures 6.21 and 6.22 as reproduced in Table 6.1.

Table 6.1 CIRCULATION RATES FOR THE CURVES OF FIGURES 6.21 AND 6.22

| Run No. | q | $\Delta t_{sub}$ | S | m |
|---|---|---|---|---|
| 23 | 14515 | 21.25 | 97 | $1.209 \times 10^{-2}$ |
| 116 | 14515 | 19.75 | 75 | $8.3 \times 10^{-3}$ |
| 130 | 14474 | 19.35 | 50 | $3.61 \times 10^{-3}$ |
| 3 | 8412 | 1.9 | 97 | $5.7 \times 10^{-2}$ |
| 112 | 8598 | 1.7 | 75 | $3.25 \times 10^{-2}$ |
| 124 | 8412 | 1.9 | 54 | $1.07 \times 10^{-2}$ |

### 6.2.2 Variation of Heat Transfer Coefficient with Distance along the Tube Length

The heat transfer coefficient at various thermocouple locations have been computed and plotted as a function of distance for some representative runs. Figure 6.26 shows the effect of heat flux on the variation of h with z for water. At a constant heat flux, heat transfer coefficient remains almost constant over a certain length of the tube from inlet and then undergoes a steep rise to much higher values. The initial portions of the curves exhibiting nearly constant values of h, may be attributed to the non-boiling natural convective mechanism of heat transfer similar to those observed in Fig.6.4. The remaining portion of curves represent the subcooled and saturated nucleate

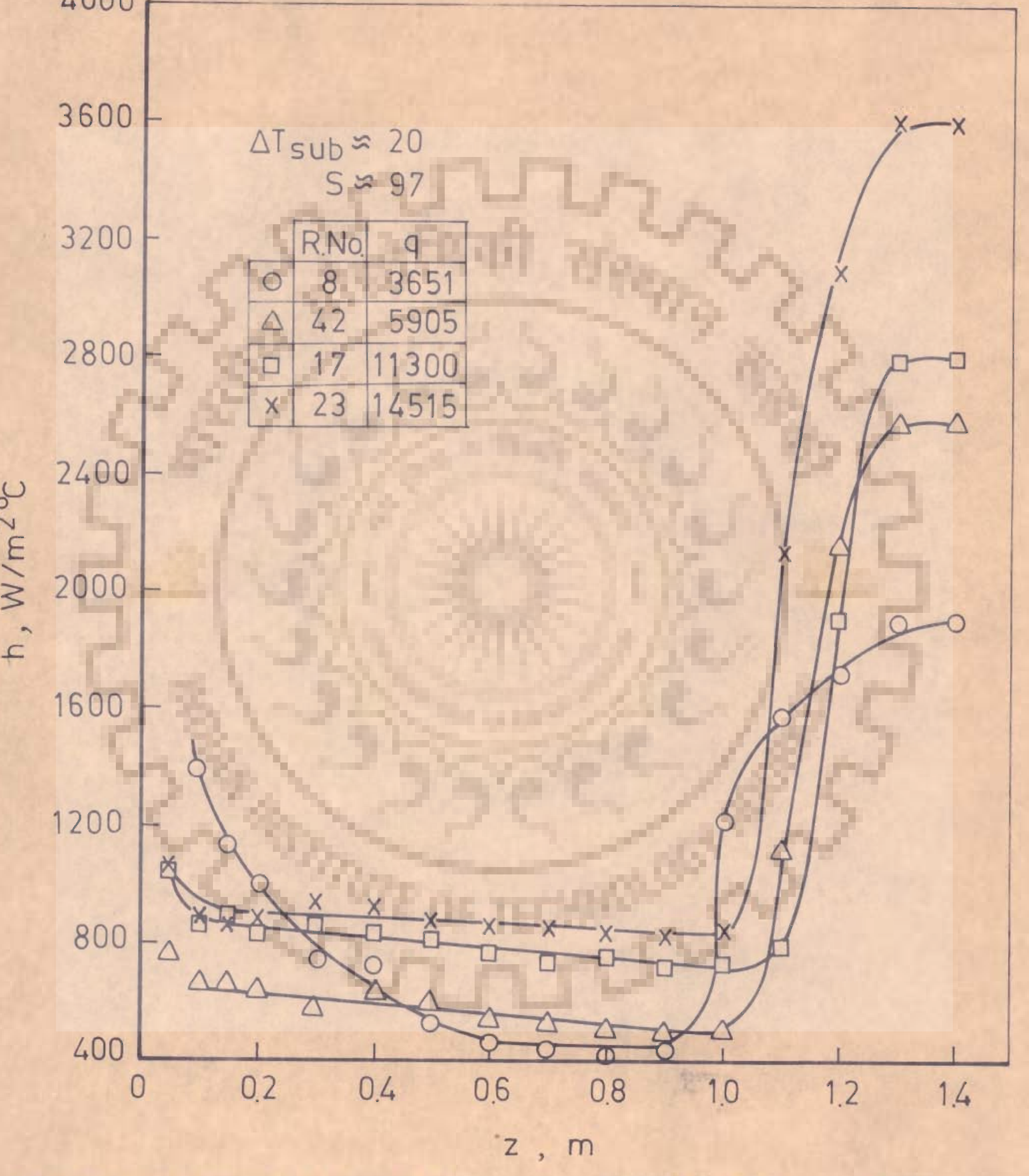



Fig.6.26 Variation of heat transfer coefficient along the heated length for Water with heat flux as parameter

boiling of liquid resulting in high heat transfer coefficient. As the heat flux is changed to a higher value, the curves also shift to higher values of heat transfer coefficient. The increase in h with q over nonboiling section seems to be due to the enhancement of circulation rates through the tube. The boiling heat transfer coefficient attains higher values as q is raised because increasingly larger number of nuclei for bubble generation become active at higher heat flux.

The effect of inlet liquid subcooling and submergence on heat transfer coefficient has been shown in Fig.6.27. In Fig.6.27(a) it is seen that the heat transfer coefficient is almost independent of inlet liquid temperature. However, the boiling heat transfer coefficient becomes slightly higher at low degree of subcooling. Figure 6.27(b) shows that the position at which the mode of heat transfer changes from non-boiling to nucleate boiling is shifted downward along the tube as the submergence is reduced. Thus the region of nucleate boiling with high heat transfer coefficient occupies a longer tube length at lower submergence. The magnitude of h in the natural convective region seems to be unaffected while that in nucleate boiling region increases slightly with decrease in submergence. Apart from much higher values of length-mean heat transfer coefficient at lower submergence as inferred from the above, the performance of the thermosiphon reboiler was also found to be more stable compared to the near full submergence conditions.

A comparison of h as a function of z under certain

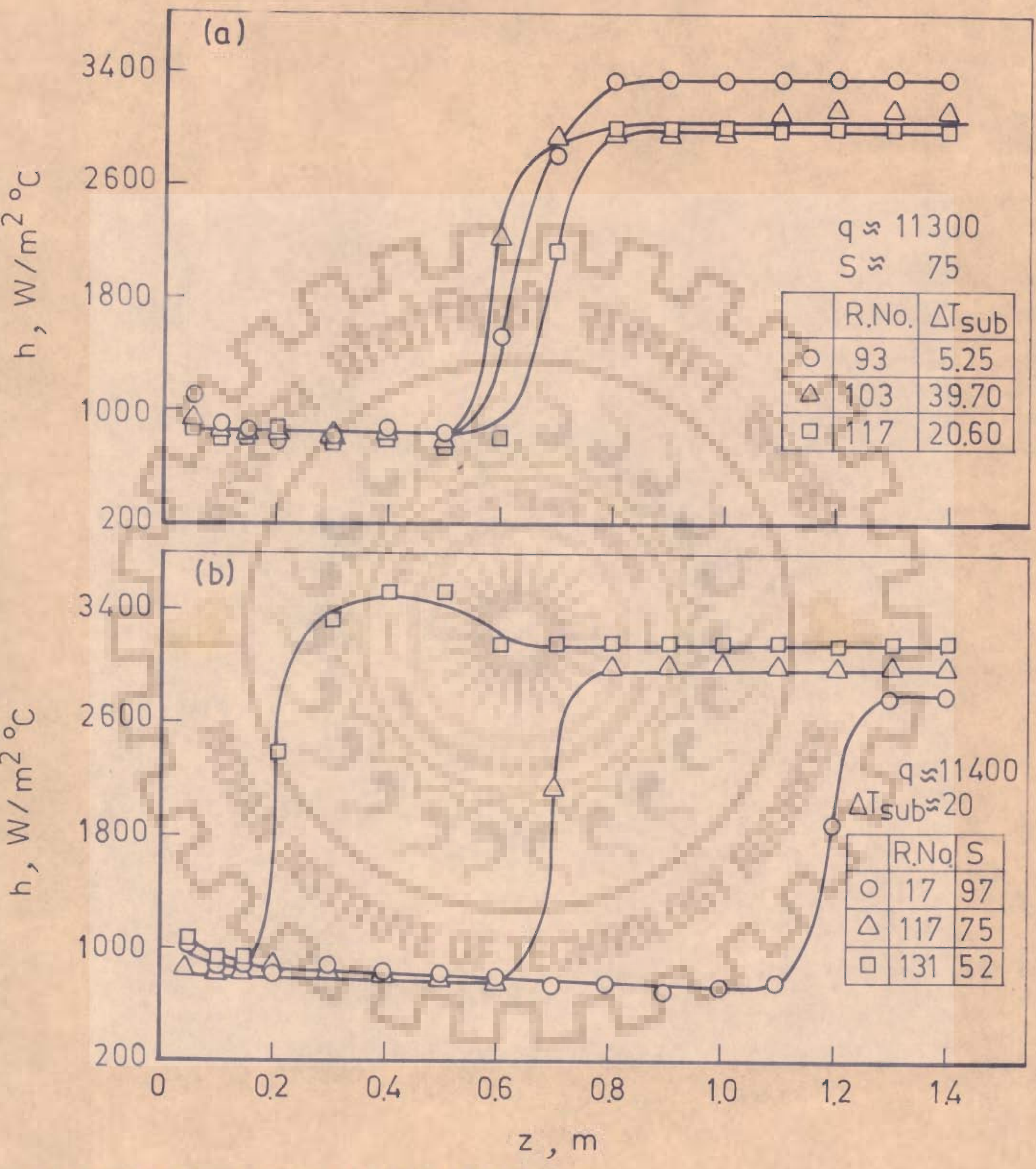



Fig.6.27 Variation of heat transfer coefficient along the heated length for Water with (a) degree of subcooling (b) submergence, as parameter

conditions of q, $\Delta T_{sub}$ and S has been made in Fig.6.28 for water, ethyl acetate and propan-2-ol. Similar plots are given for toluene and acetone in Fig.6.29. From these figures it is obvious that the variation of h with z for all the test liquids is essentially similar. However, the values of heat transfer coefficient in the two regions are quite different for different liquids at the same location in the tube and with approximately the same values of q, $\Delta T_{sub}$ and S. The lengths of non-boiling and nucleate boiling regions are also somewhat changed. The above mentioned behaviour may be attributed to the widely varying physical properties of various liquids.

### 6.2.3 Onset of Boiling

From the discussion of wall temperature distributions in Section 6.2.1, it is clear that boiling process becomes effective only when the heating surface temperature exceeds the saturation temperature of liquid appreciably. The onset of fully developed boiling requires a minimum degree of wall superheat for a given liquid and heat transfer surface. Efforts were made by many earlier workers to develop a criterion of incipient boiling both empirically as well as analytically. Most of the existing models have achieved reasonable success when applied to predict the boiling incipience with decreasing heat flux conditions. Yin and Abdelmessih [90] have developed a more generalized equation which permits the direct computation, from other measurable

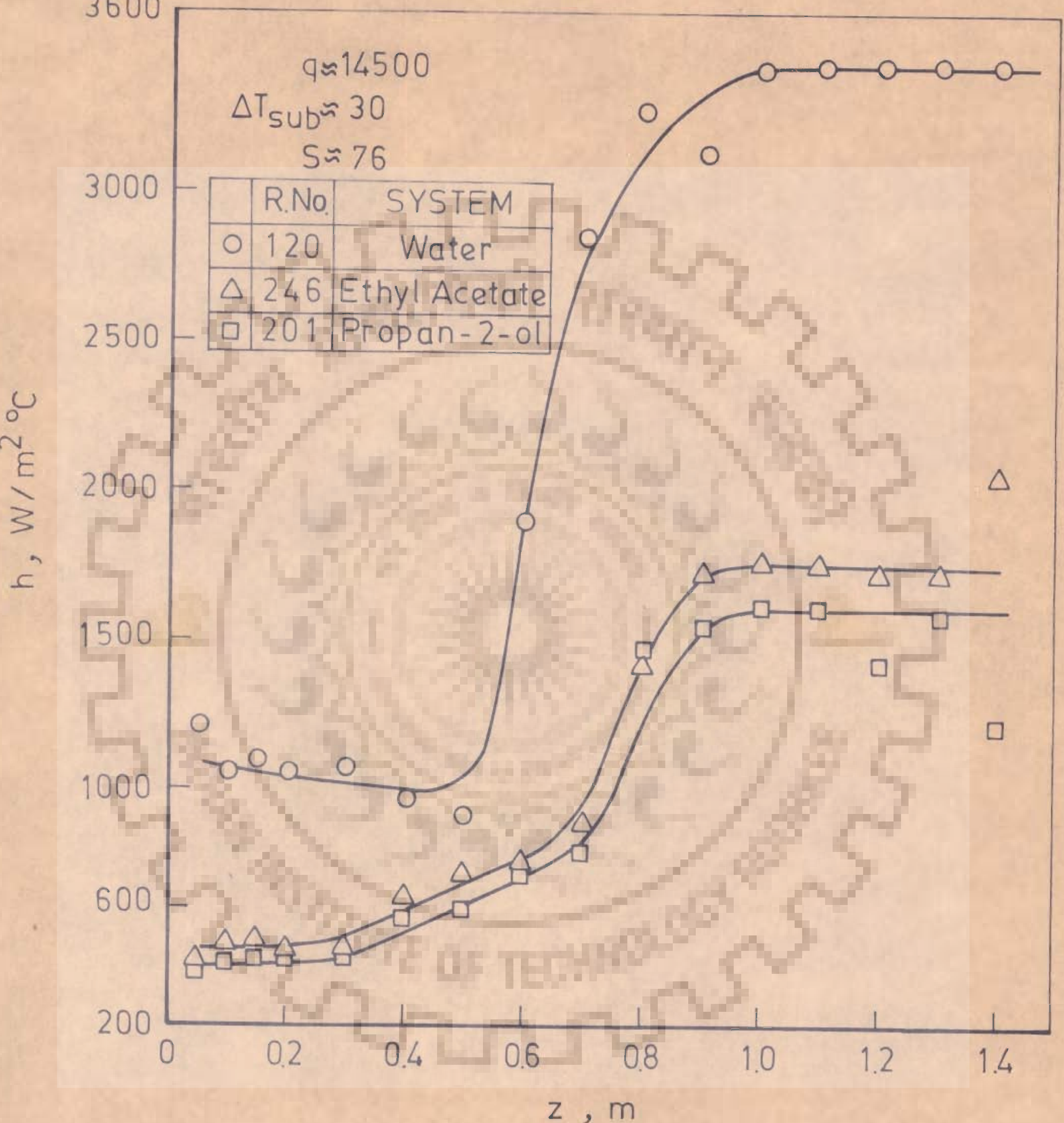



Fig. 6.28 Variation of heat transfer coefficient along the heated length for Water, Ethyl Acetate and Propan-2-ol

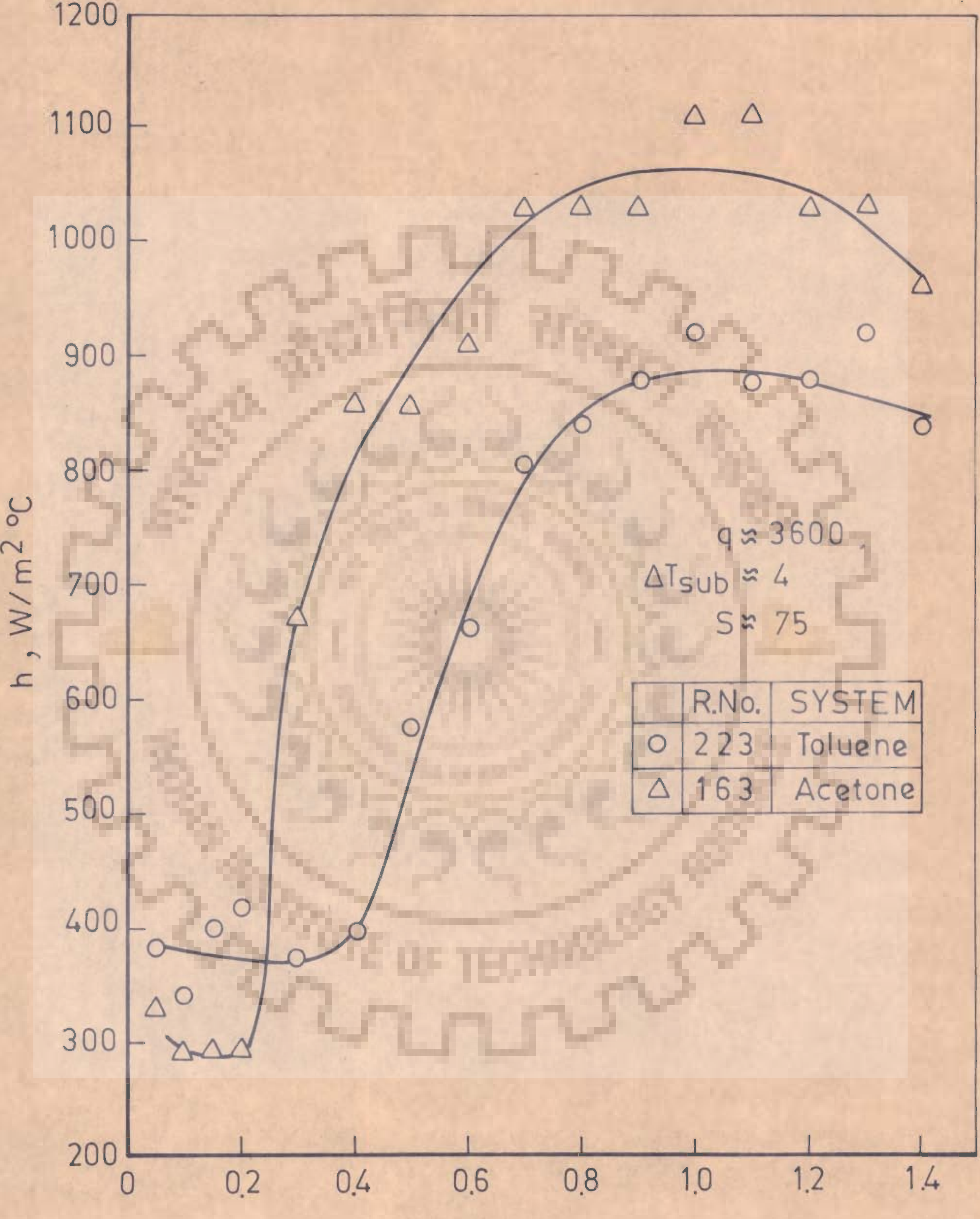



Fig.6.29 Variation of heat transfer coefficient along the heated length for Toluene and Acetone

quantities, of $\delta^*/r_c$ and was selected to correlate the experimentally obtained values of wall superheat and heat flux corresponding to incipient boiling for various test liquids used in the present study. The analytically derived expression is given below:

$$\left(\frac{\delta^*}{r_c}\right)^2 = \frac{(T_w-T_s)^2 \, k_L \, \lambda \, \rho_v}{2 \, q \, \sigma \, T_s} \qquad \ldots (6.11)$$

The computed values of $\delta^*/r_c$ from Eq.(6.11) using the experimentally measured $(T_w-T_s)$ corresponding to the maximum values of wall temperatures attained for a run are plotted as a function of q for all the five test liquids in Figures 6.30 to 6.32. The scatter of data points in these figures is mainly due to highly unstable point of maxima followed by a steep fall in wall temperature distribution curves from which the values of $(T_w-T_s)$ are taken. The data shown in the figures are fitted by the equation representing a family of straight lines in the following form for simplicity and convenience,

$$\frac{\delta^*}{r_c} = a - b\,q \qquad \ldots (6.12)$$

where a and b are constants, characteristics of liquids under consideration.

Substituting Eq.(6.12) into Eq.(6.11) gives

$$(T_w-T_s)^2 = (a - bq)^2 \, \frac{2\sigma \, T_s}{k_L \, \lambda \, \rho_v} \, q \qquad \ldots (6.13)$$

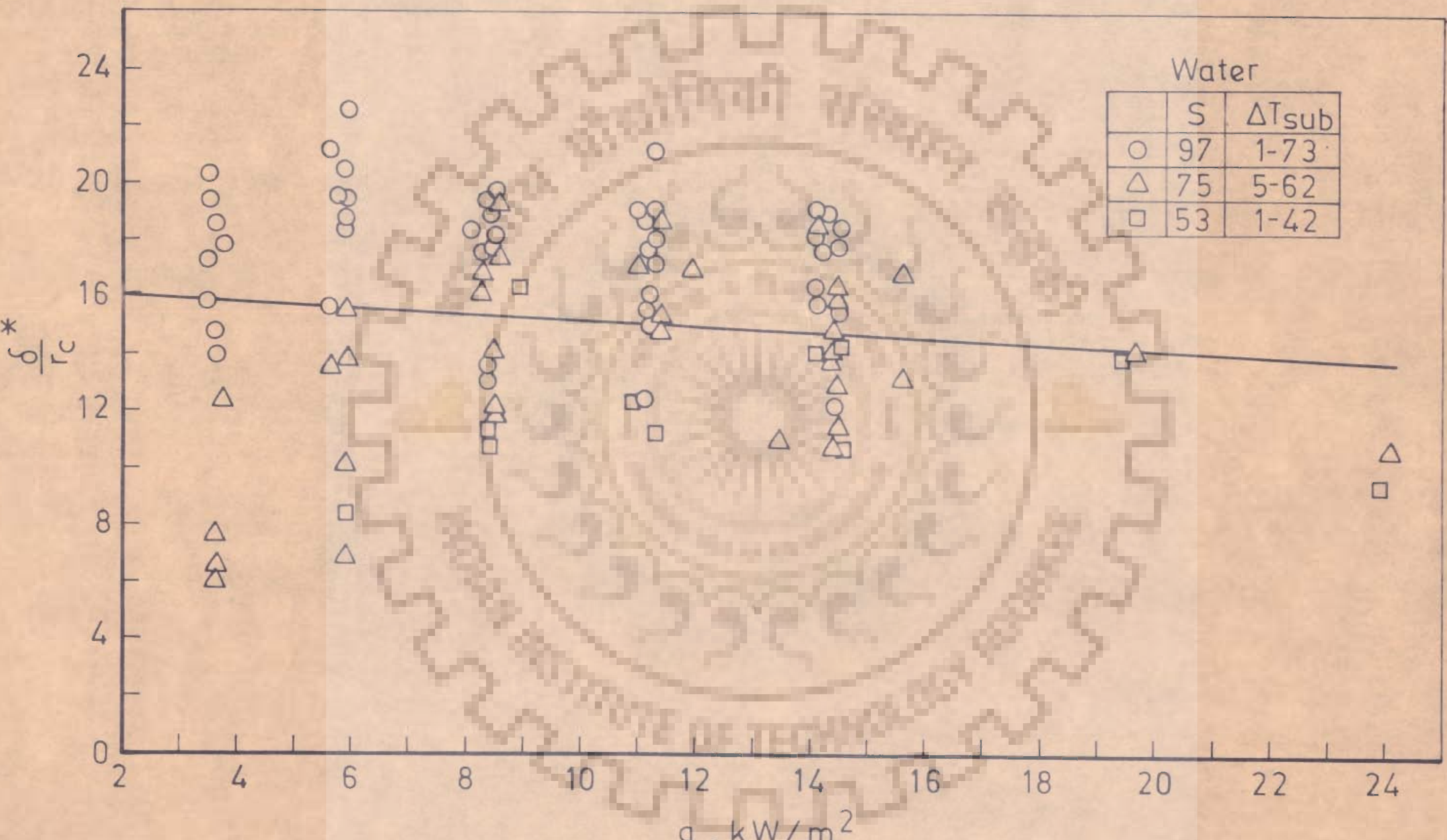



Fig.6.30 Variation of $\frac{\delta^*}{r_c}$ with q for Water

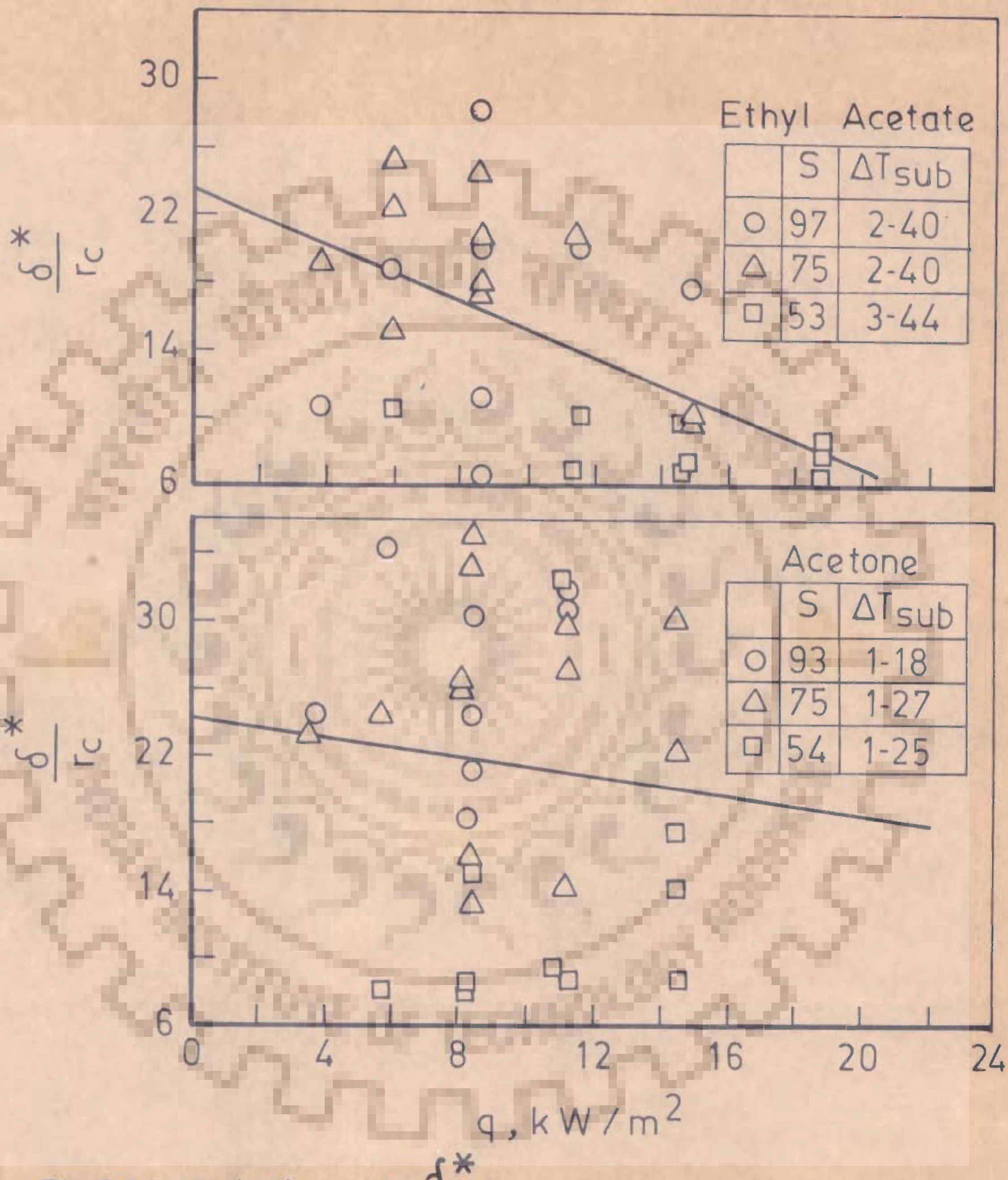



Fig.6.31 Variation of $\frac{\delta^*}{r_c}$ with q for Acetone and Ethyl Acetate

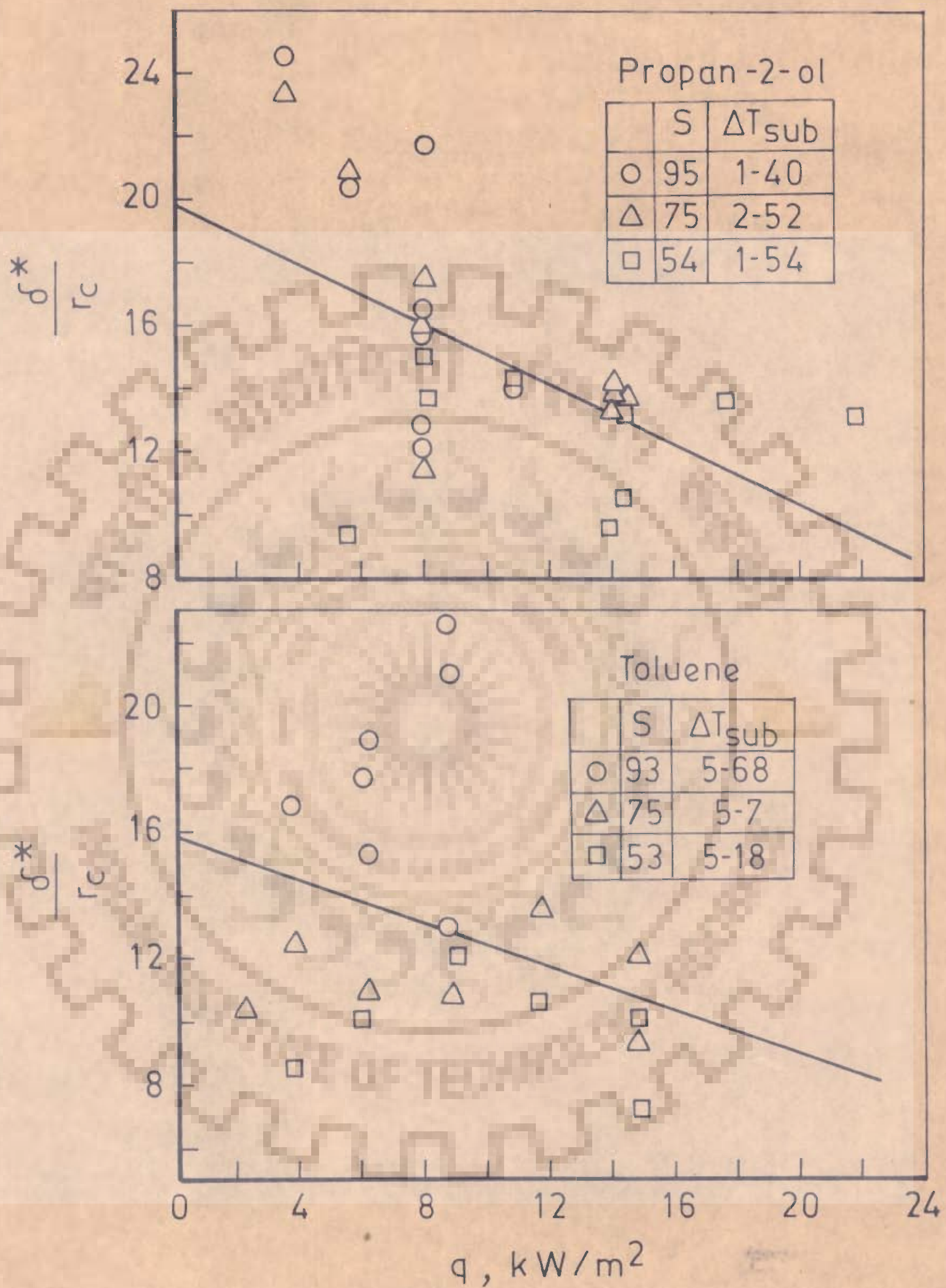



Fig.6.32 Variation of $\frac{\delta^*}{r_c}$ with q for Propan-2-ol and Toluene

Equation (6.13) may be used to predict the degree of superheat required for onset of boiling at a given heat flux using the physical properties of liquid and constants a and b. The values of a and b determined for the experimental conditions of the present study are given in Table 6.2.

Table 6.2 VALUES OF CONSTANTS IN EQ.(6.13)

| System | S | $\Delta T_{sub}$ | q | a | b |
|---|---|---|---|---|---|
| Acetone | 44-100 | 0.9-26.7 | 3548-14500 | 24.35 | $0.296\times10^{-3}$ |
| Ethyl acetate | 28-97 | 2.5-44.5 | 3775-18800 | 23.40 | $0.831\times10^{-3}$ |
| Propan-2-ol | 39-97 | 1.2-54.2 | 3342-21765 | 19.89 | $0.477\times10^{-3}$ |
| Water | 36-100 | 1.0-73.0 | 3486-24086 | 16.42 | $0.106\times10^{-3}$ |
| Toluene | 35-97 | 5.5-68.3 | 2042-14900 | 15.84 | $0.343\times10^{-3}$ |

The length of heated tube required for the onset of fully developed boiling is influenced by wall heat flux, submergence and inlet subcooling. In order to determine a functional relationship, a typical variation of $(z_{OB}/L)\times100$ with q expressed as $Pe_B$ and with S has been shown on log-log plot in Fig.6.33 for some systems. Similar plots of tube length for onset of boiling as a function of $K_{sub}$, the dimensionless degree of subcooling are given in Fig.6.34. All the data points presented in Figures 6.33 and 6.34 seem to be well represented by straight lines which suggest the correlat-

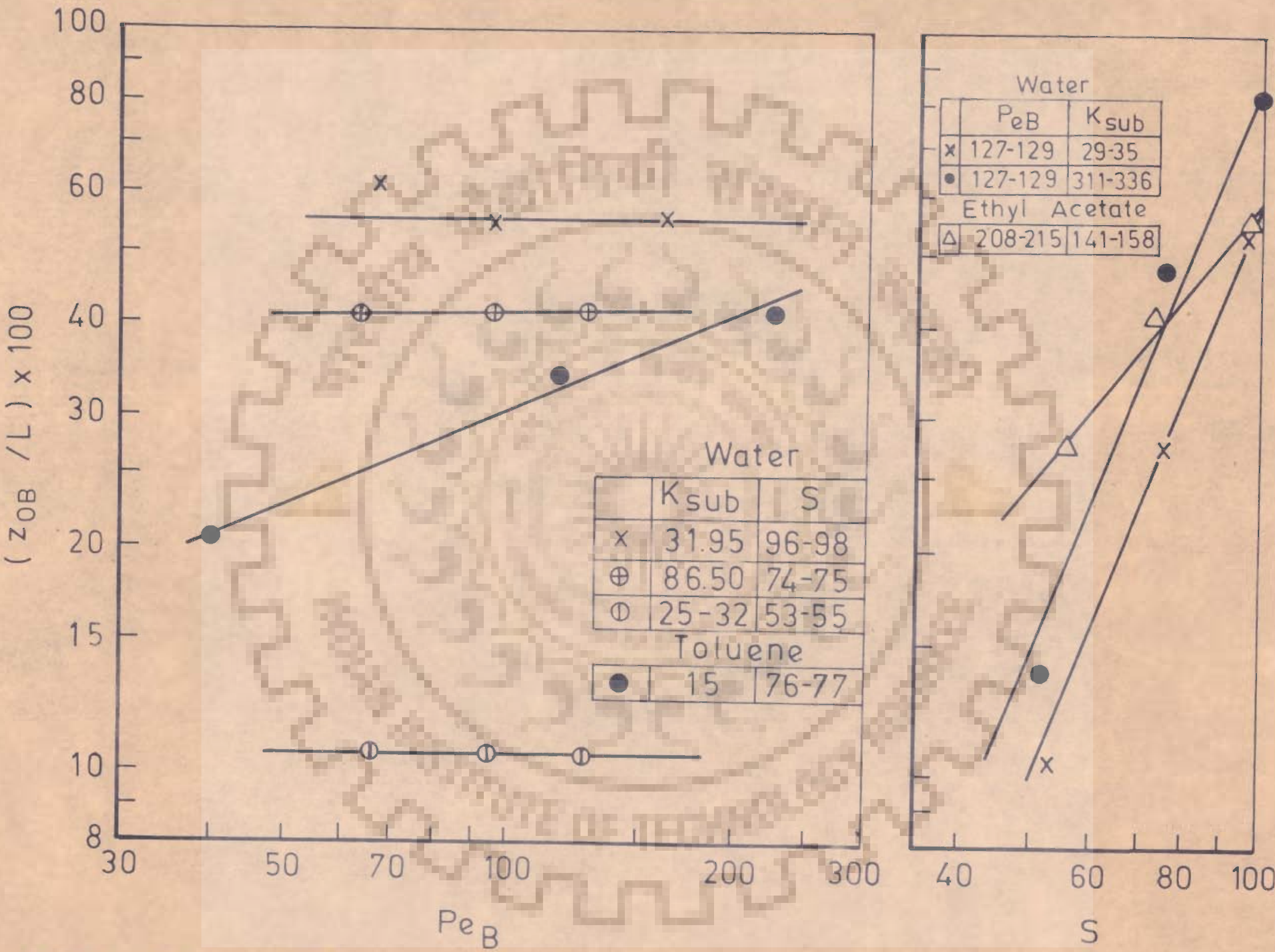



Fig.6.33 Tube length for onset of boiling as a function of $Pe_B$ and submergence

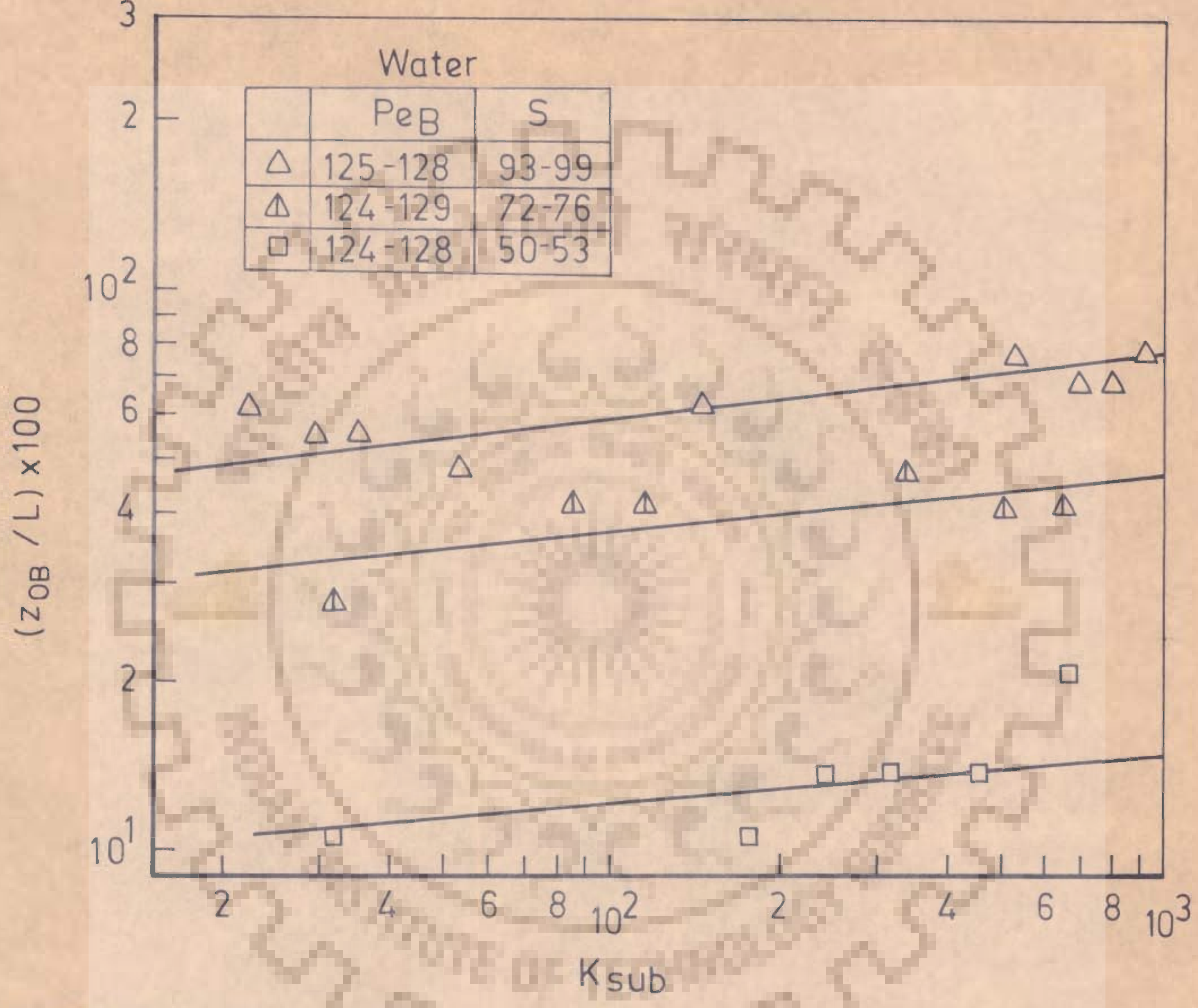



Fig.6.34 Tube length for onset of boiling as a function of $K_{sub}$

of the following form

$$\frac{z_{OB}}{L} \times 100 = C_4 (Pe_B)^{n_4} (K_{sub})^{n_5} S^{n_6} \qquad \ldots (6.14)$$

The values of indices $n_4$, $n_5$ and $n_6$ and constant $C_4$ in Eq.(6.14) were determined, system wise, by regression analysis using the data points of all the runs. They are presented in Table 6.3.

Table 6.3- VALUES OF CONSTANT AND EXPONENTS IN EQ.(6.14)

| System | $C_4$ | $n_4$ | $n_5$ | $n_6$ |
|---|---|---|---|---|
| Acetone | 0.095 | -0.2890 | 0.260 | 1.450 |
| Ethyl acetate | 0.266 | -0.1630 | 0.340 | 0.995 |
| Propan-2-ol | $0.51 \times 10^{-3}$ | 0.4430 | 0.068 | 1.993 |
| Water | $0.54 \times 10^{-3}$ | 0.0014 | 0.133 | 2.405 |
| Toluene | $1.55 \times 10^{-3}$ | 0.4370 | 0.120 | 1.740 |

A comparison between the experimental values of $z_{OB}$ and those predicted by using Eq.(6.14) has been made in Fig.6.35. Majority of data points are found to lie within $\pm$ 40 percent error lines. All the physical properties required in computing $Pe_B$ and $K_{sub}$ were taken at the saturation temperatures of test liquids.

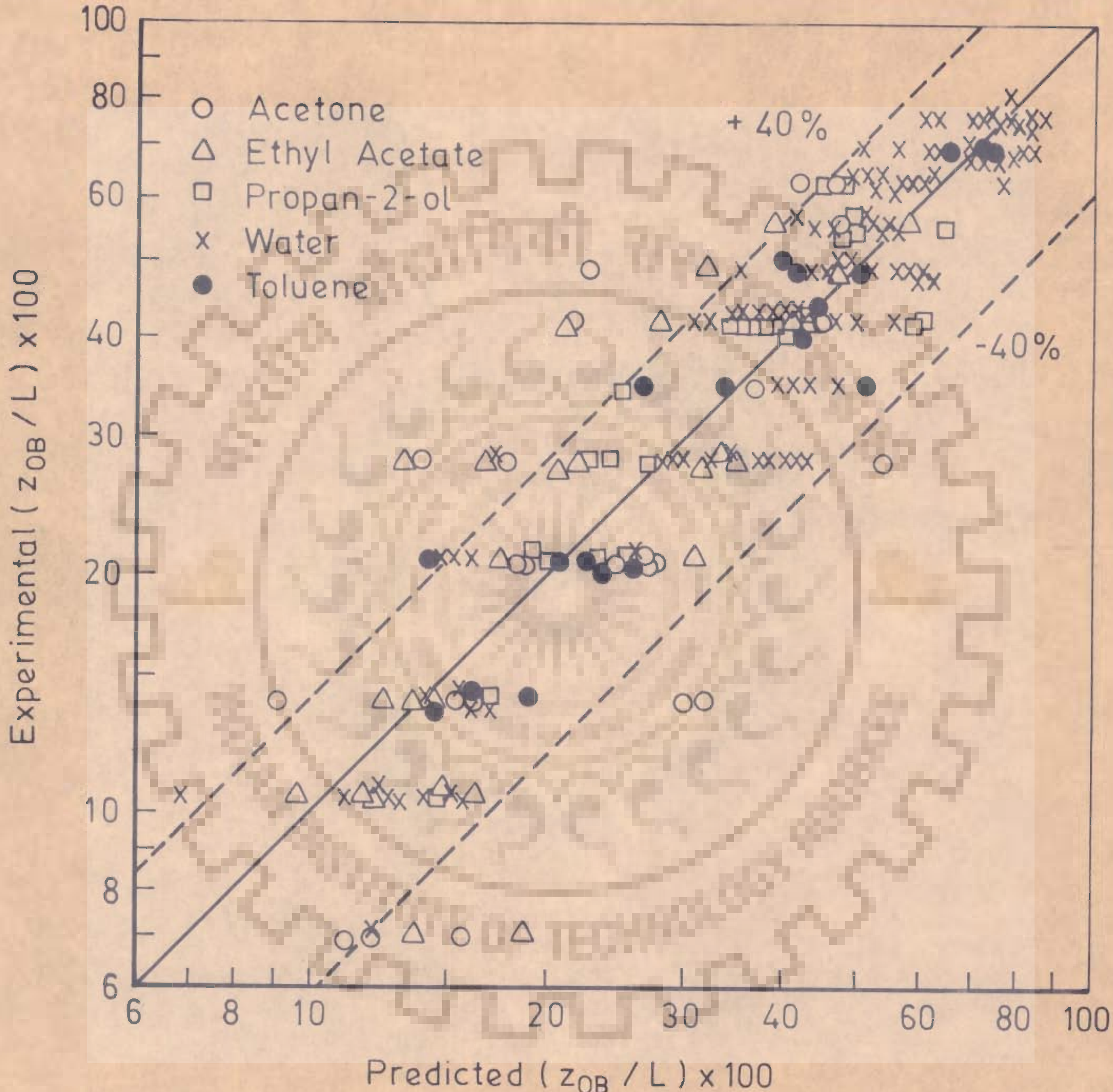



Fig.6.35 Comparison of experimental $z_{OB}$ with those predicted by Eq.(6.14)

### 6.2.4 Boiling Curves

The plots of heat flux versus wall superheat at different distances from the point of onset of boiling have been shown in Figures 6.36 to 6.38 for various test liquids. The boiling curves are straight lines similar to those of nucleate pool boiling but their slopes are smaller than those in pool boiling. The curves shift to lower values of $(T_W-T_S)$ with change in position from the onset of boiling to fully developed boiling. The shifting of curves is almost insignificant once the fully developed boiling conditions are attained.

### 6.2.5 Effect of Heat Flux on Boiling Heat Transfer Coefficient

The observations made in Sections 6.2.1 and 6.2.2 clearly indicated that the heat transfer coefficient during fully developed saturated boiling does not vary significantly with tube length at a given heat flux and approximately constant values of $\Delta T_{sub}$ and submergence. Similar inference may be made from the results of Figures 6.36 to 6.38. The average values of boiling heat transfer coefficient for that region, therefore, is taken to study the effect of heat flux. Figure 6.39 shows a log-log plot of experimentally obtained values of $h_B$ as a function of heat flux for water and propan-2-ol. The experimental data of some earlier workers [11,27,76] along with the dimensional correlation of Gel'perin etal[40] representing their experimental data have been superimposed on the same plot for comparison. A

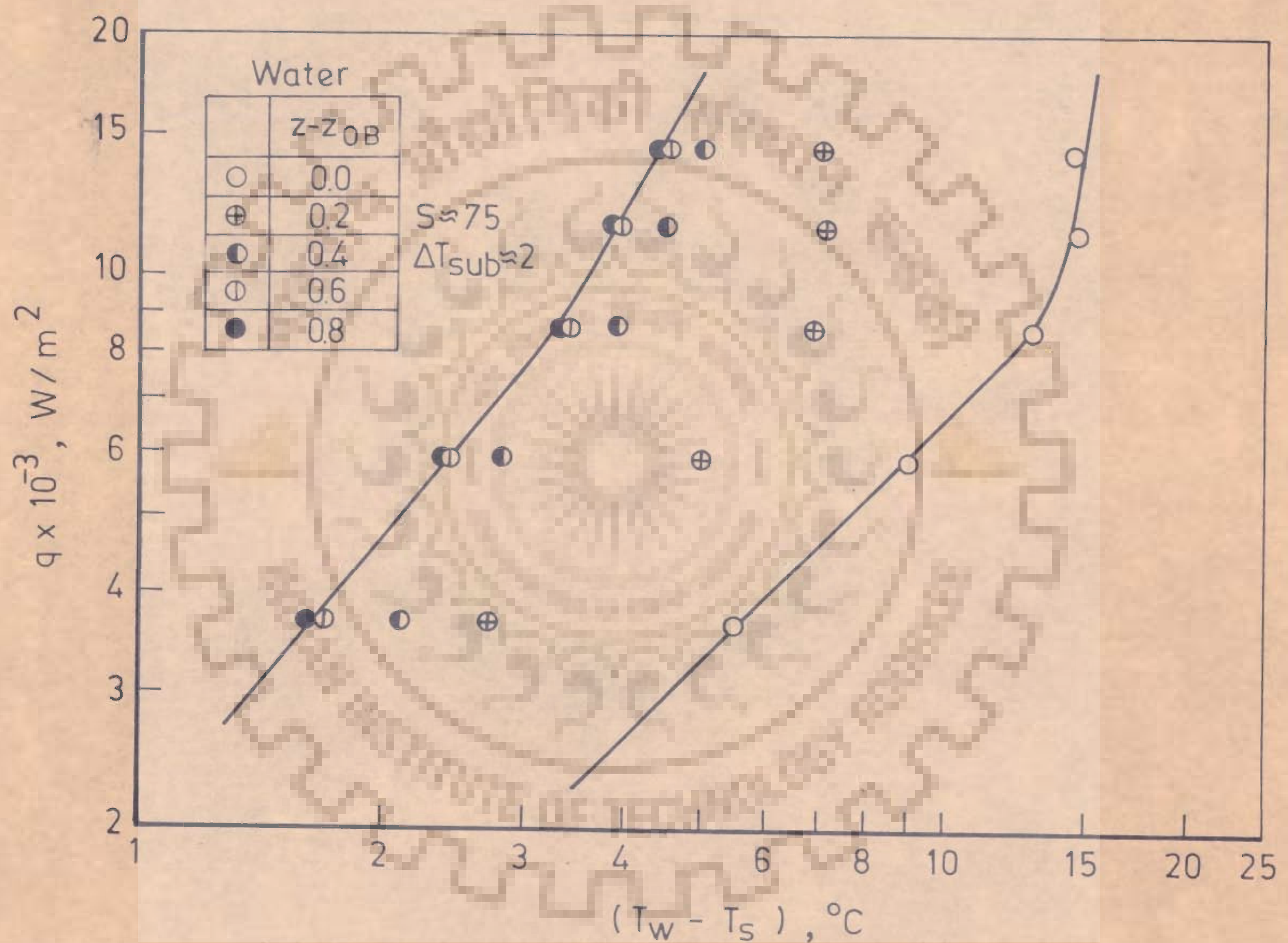



Fig.6.36 Boiling curves for Water

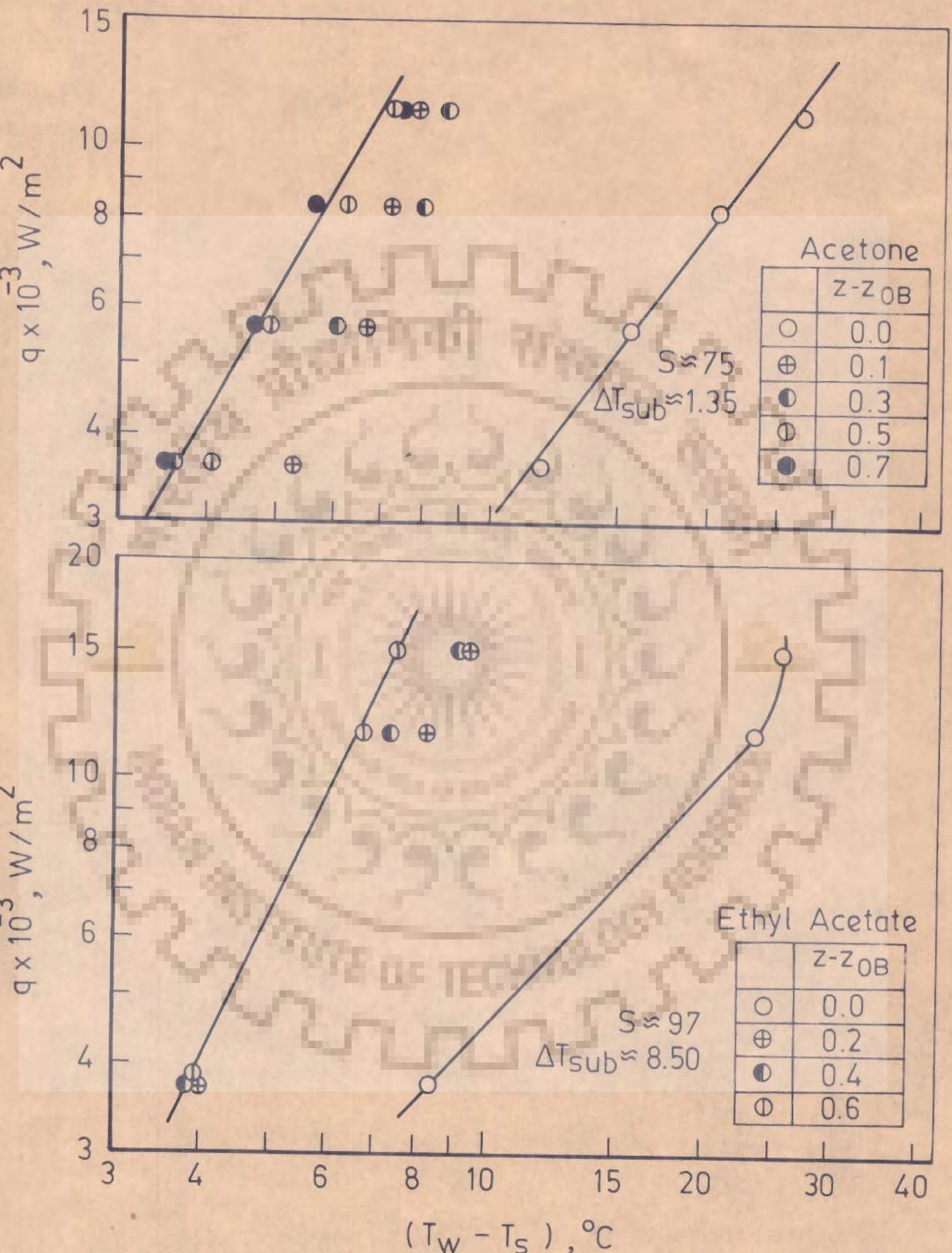



Fig.6.37 Boiling curves for Acetone and Ethyl Acetate

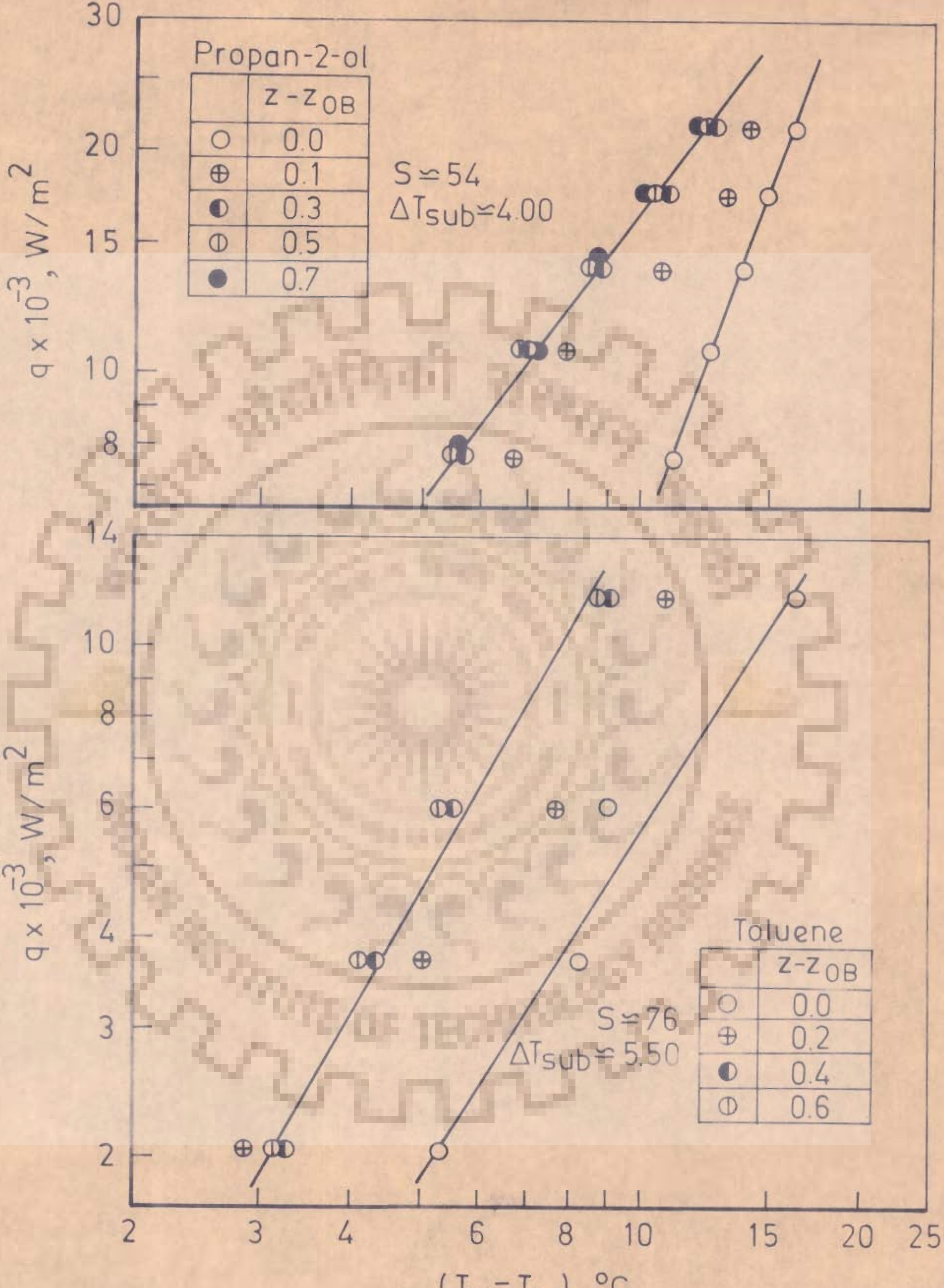



Fig.6.38 Boiling curves for Propan-2-ol and Toluene

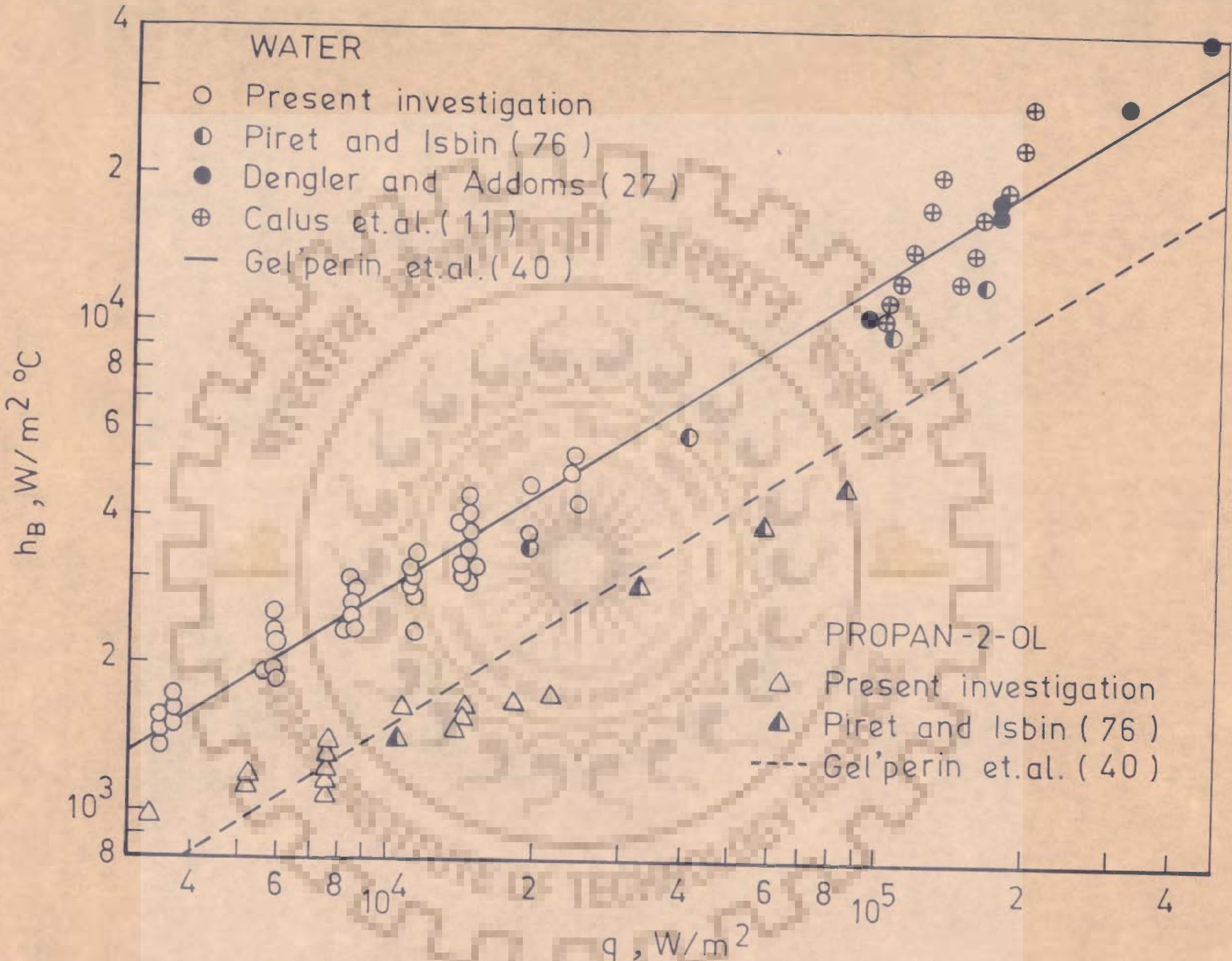



Fig.6.39 Boiling heat transfer data of present investigation and those of earlier studies compared on $h_B$ versus q plot for Water and Propan-2-ol

reasonably good agreement between the data of present study and earlier investigations is observed with some scatter expected in such studies due to different experimental conditions. The experimental data at various values of S and $\Delta T_{sub}$ have been presented on $h_B$ versus q plot for acetone, ethyl acetate and propan-2-ol in Fig.6.40 and for water and toluene in Fig.6.41. It is noted from these figures that boiling heat transfer coefficient increases with increase in heat flux. The data points covering wide ranges of $\Delta T_{sub}$ and S for a system lie close to each other forming a band which may be approximately represented by a straight line. Thus the boiling heat transfer coefficient may be conveniently correlated by simple dimensional relationship of the following form

$$h_B = c\ q^n \qquad \ldots (6.15)$$

The values of c and n in Eq.(6.15) for all the five test liquids were determined separately by the method of least square curve fitting. They are reported in Table 6.4.

Table 6.4 VALUES OF CONSTANT AND EXPONENT IN EQ.(6.15)

| System | c | n |
|---|---|---|
| Acetone | 45.31 | 0.387 |
| Ethyl acetate | 75.18 | 0.332 |
| Propan-2-ol | 54.36 | 0.351 |
| Water | 17.51 | 0.556 |
| Toluene | 37.29 | 0.381 |

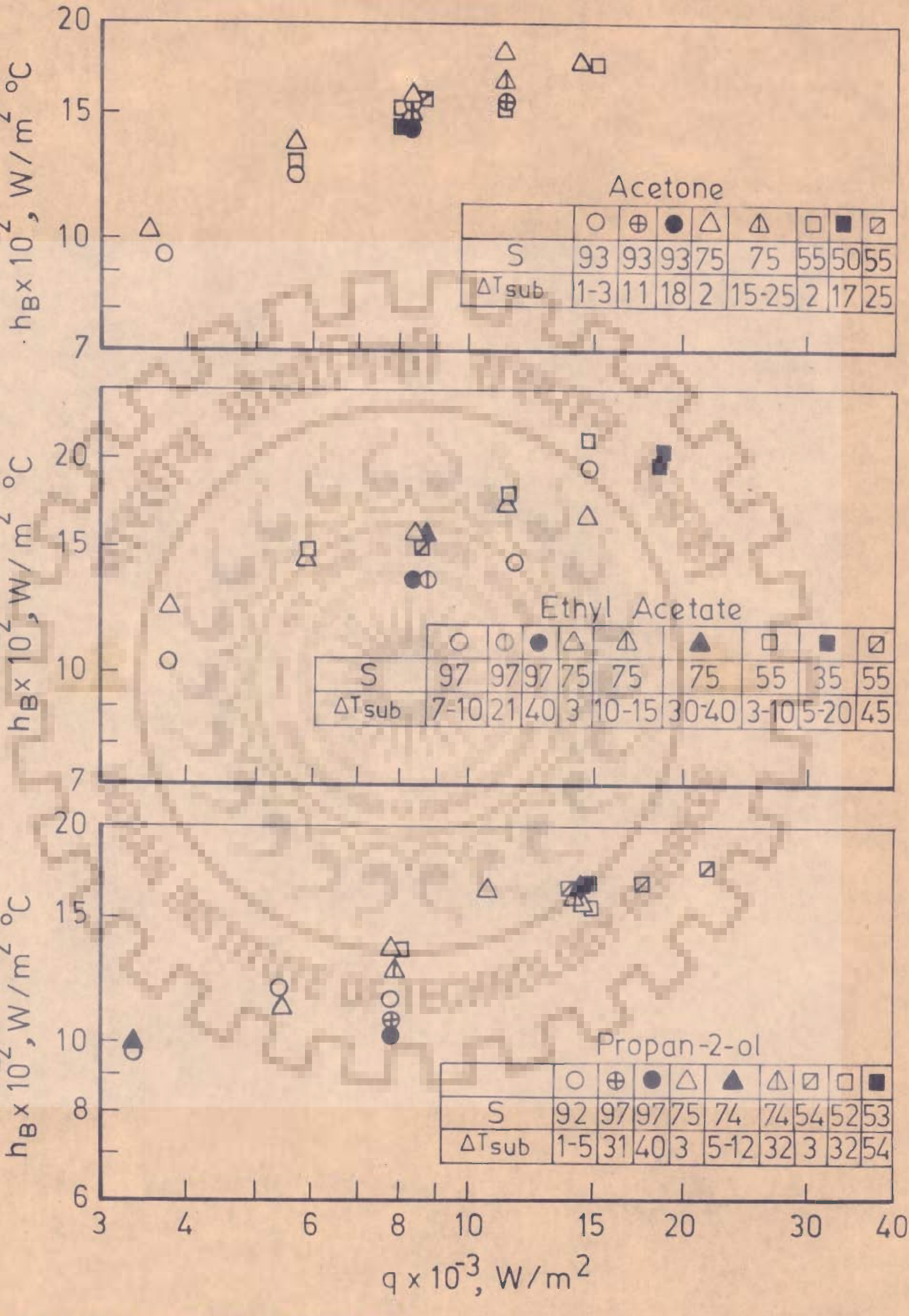



Fig.6.40 Boiling heat transfer coefficient as a function of heat flux

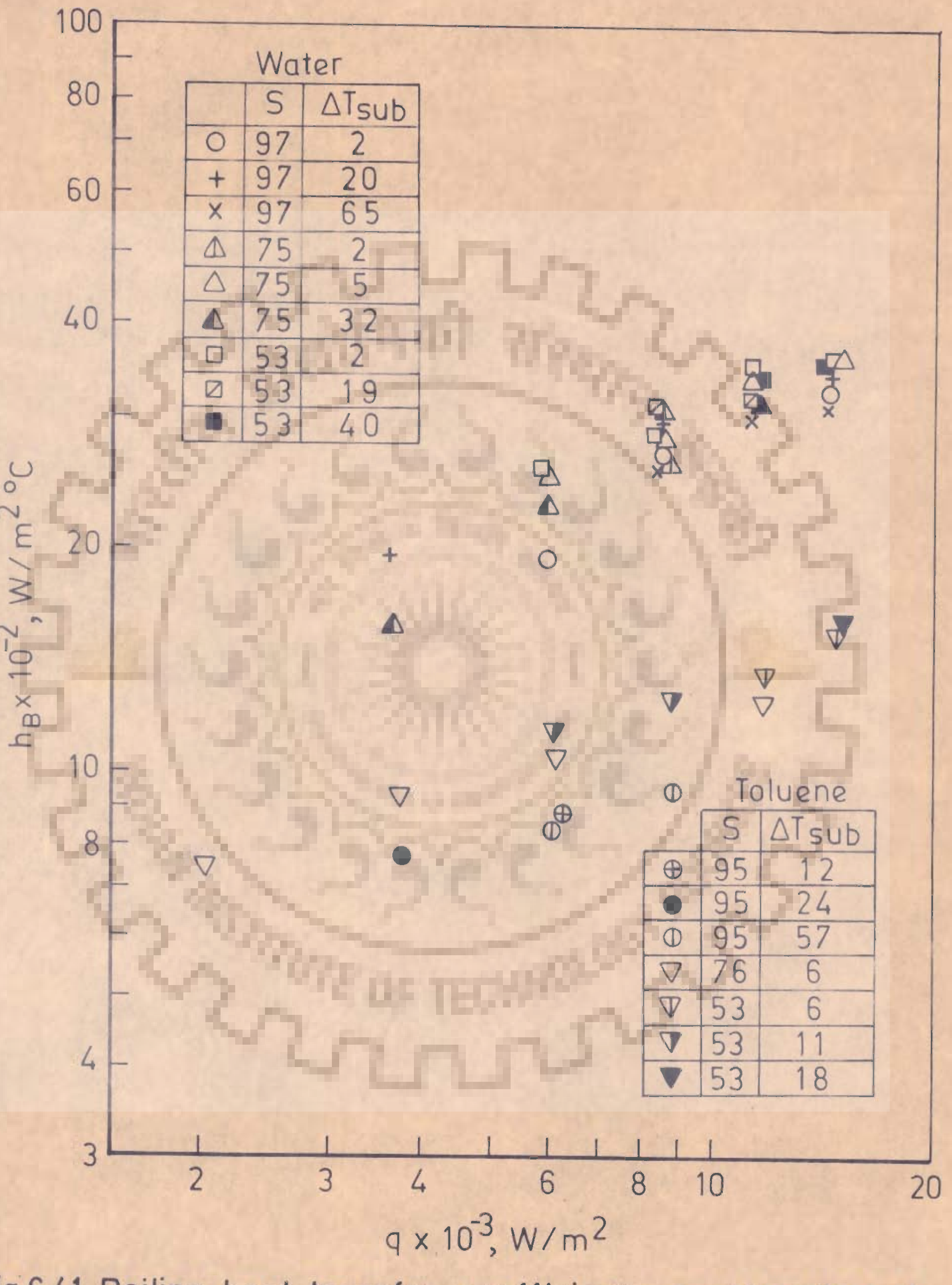



Fig.6.41 Boiling heat transfer coefficient as a function of heat flux

It is evident from Table 6.4 that the exponents n for all the liquids are much less than that of 0.7 in pool boiling conditions. This may be explained by considering the basic mechanism of bubble nucleation and growth through which q affects $h_B$. The minimum radius of curvature, $r_{min}$, for bubble nucleation is

$$r_{min} = \frac{2\sigma}{\left(\frac{dP}{dT}\right)_s (T_w - T_s)} \qquad \ldots (6.16)$$

As the heat flux is raised, the degree of superheat increases making the $r_{min}$ small. Thus the smaller nuclei also become active resulting in greater number of active sites for bubble birth on the heating surface. The increased turbulence due to the generation of larger number of bubbles accounts for the enhancement in $h_B$ with increase in q. In case of boiling of liquids in a tube, the mass velocity of fluid due to induced flow also increases with increase in quality as q is raised. This imposition of forced convection suppresses the nucleation process and hence the rate of increase in $h_B$ with q is reduced which is exhibited by smaller value of n in Eq.(6.15) than that obtained for pool boiling. Further the effect of boiling on flow velocities is more pronounced for volatile organic liquids than water. This explains relatively smaller values of n for organic liquids compared to that of water.

Figure 6.42 shows a comparison between the experimentally obtained values of $h_B$ and those computed from Eq.(6.15)

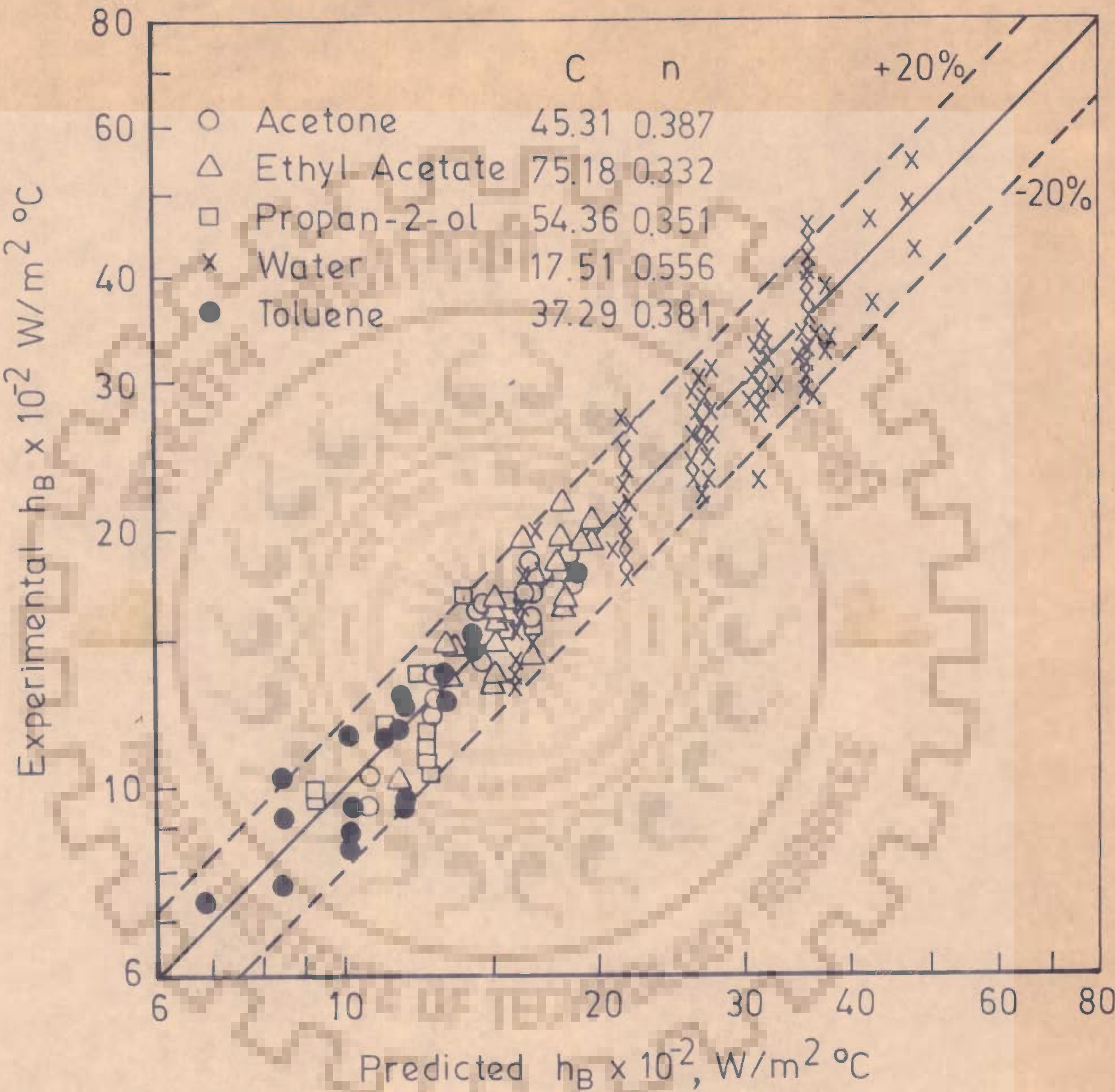



Fig.6.42 Comparison between experimental values of $h_B$ and those predicted by Eq.(6.15)

using the constants and exponents as given in Table 6.4. Almost all the data points are found to be within ± 20 per cent deviation.

### 6.2.6 Generalized Correlations

The results of previous sections have clearly demonstrated that there exist two distinct regions of heat transfer over the tube length of a thermosiphon reboiler:

a. Single phase natural convective nonboiling region.

b. Fully developed saturated boiling region.

The two regions over the tube length are separated by a zone of transition from non-boiling through subcooled boiling to fully developed saturated boiling. The non-boiling region is considered to extend from the inlet of heat transfer section to a point where tube wall attains the minimum degree of superheat required for effective surface boiling to occur. This point is identified by the peak value of wall temperature as seen in Section 6.2.1. A detailed discussion on boiling incipience has already been given in Section 6.2.3 with an empirical correlation, Eq.(6.14), for predicting the distance along the heated length at which the effective boiling sets in. The fully developed boiling region corresponds to that portion of the tube over which wall as well as liquid temperature distribution curves are horizontal as seen in Sec.6.2.1 or heat transfer coefficient remains constant as represented by Figures 6.26 to 6.29.

The heat transfer in non-boiling region of the reboiler tube in the present study is mainly governed by natural convective flow of liquid. The values of heat transfer coefficient, therefore, depend on the same parameters as encountered in Section 6.1, and a generalized correlation for average values of heat transfer coefficient may be sought in the same form as Eq.6.10. The determination of various exponents and constant yields the following correlation:

$$(Nu_{NB})_{avg} = 0.0126(Gr.Pr)_{avg}^{0.481} (Re)_{avg}^{0.064} \left(\frac{z_{OB}}{d}\right)^{-0.23} \quad \ldots (6.17)$$

A comparison between the experimental Nusselt numbers and those predicted by Eq.(6.17) as shown in Fig.6.43 indicates that the majority of data points for all the five test liquids are well represented by the equation with a maximum deviation of about ± 30 per cent. The physical properties used in computing the dimensionless groups have been taken at arithmatic mean of inlet and saturation temperatures of the liquids. The nonboiling tube length in the last group of the equation has been taken as $z_{OB}$ for convenience although the actual length would be slightly smaller than this owing to the presence of surface boiling over some length near onset of boiling. The above correlation is applicable for Gr.Pr ranging from $6.58 \times 10^6$ to $1.72 \times 10^8$, corresponding Re from 9.0 to $4.1 \times 10^4$ and ratio $(z_{OB}/d)$ from 13.99 to 46.64.

The boiling heat transfer, as discussed in Section 6.2.5, is found to depend upon the interaction between the microconvections resulting from bubble nucleation and growth on

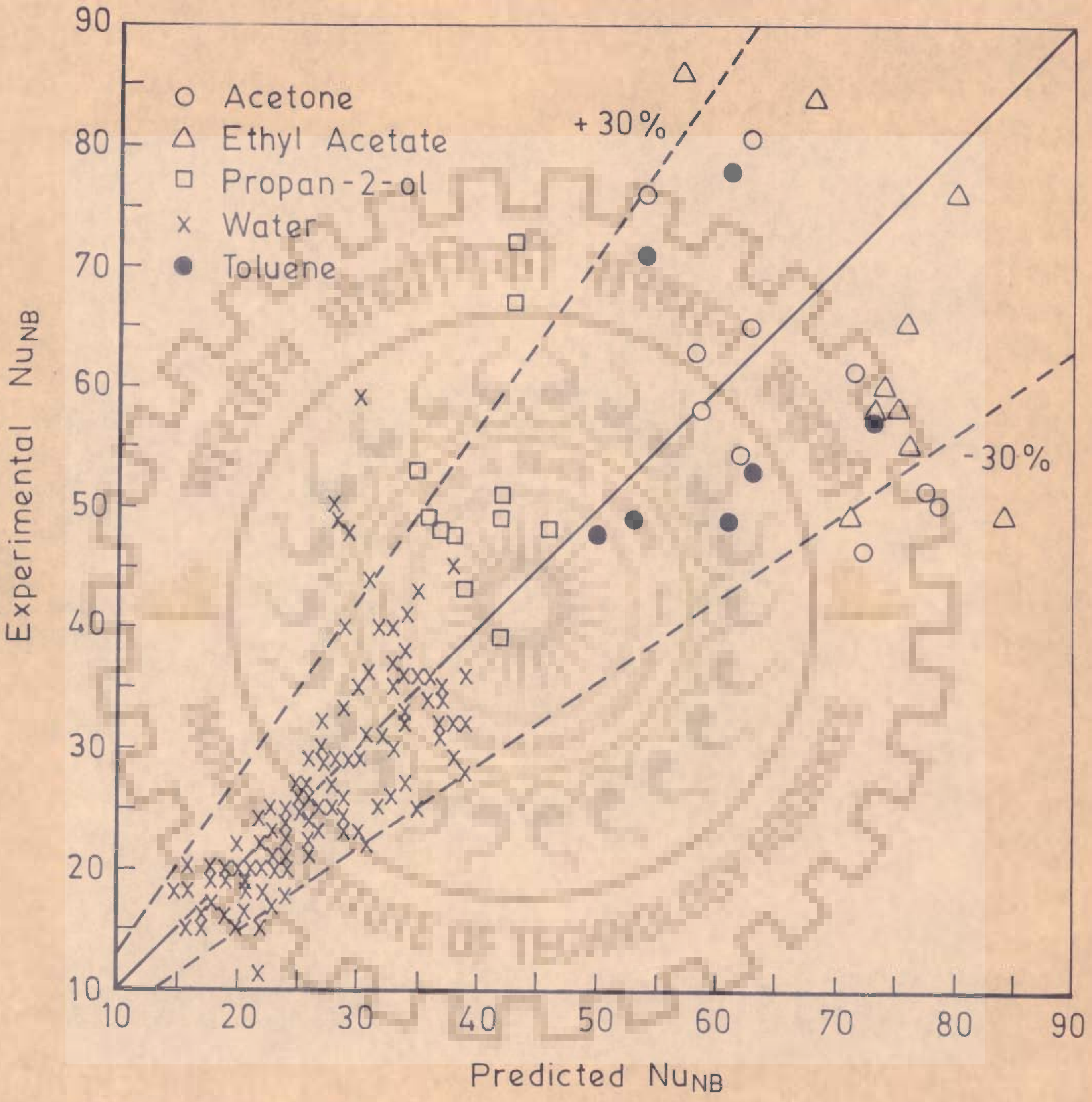



Fig.6.43 Comparison between experimental values of $Nu_{NB}$ and those predicted by Eq.(6.17)

the heating surface and macro convection due to the bulk flow of two phase fluid through the tube. The important parameter which governs the nucleate boiling is heat flux while the convective heat transfer is affected by mass velocity which in turn is influenced by the quality of fluid in addition to the physico-thermal properties of liquids and heat transfer surface characteristics. In natural circulation boiling of a liquid at high heat flux conditions, the forced convective mechanism of heat transfer dominates and vapour fraction expressed as Lokhart Martinelli parameter $X_{tt}$ is the main correlating factor. However, in the present study, low heat flux values were used at which the nucleate boiling mechanism dominates similar to pool boiling conditions owing to very small vapour fraction. It was, therefore, thought desirable to use heat flux in its dimensionless form as Peclet number and vapour fraction as $X_{tt}$ along with Prandtl number for correlating heat transfer coefficient expressed as Nusselt number. The general functional relationship may be expressed as

$$Nu_B = \phi(Pe_B, \frac{1}{X_{tt}}, Pr) \qquad \text{... (6.18)}$$

A plot of $Nu_B$ versus $Pe_B$, as shown in Fig.6.44, was made selecting the data points having approximately the same range of $1/X_{tt}$ values for all the five test liquids. The data points of different systems are well represented by separate but almost parallel straight lines having an average slope of 0.46 except those of toluene which show

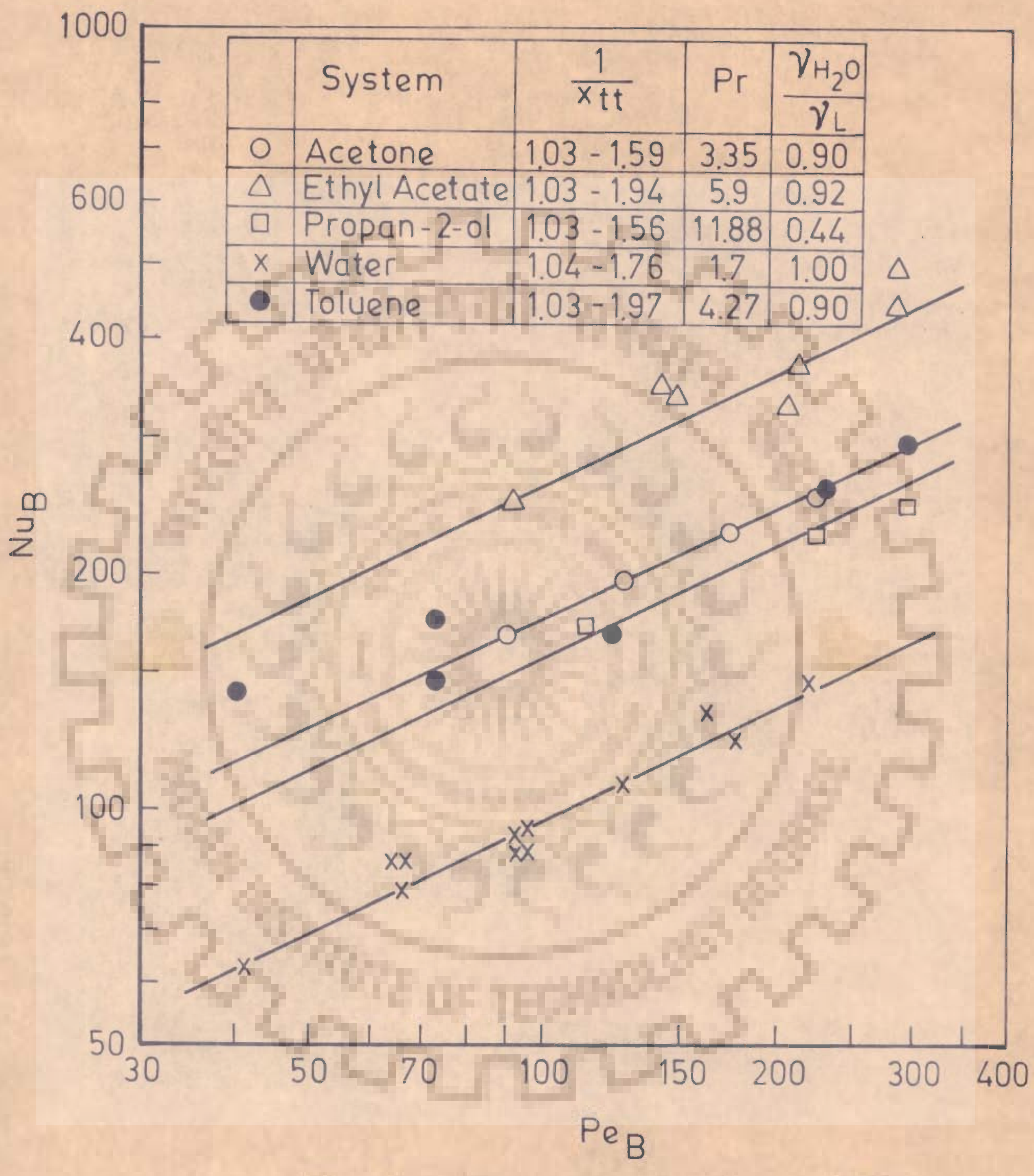



Fig.6.44 $Nu_B$ as a function of $Pe_B$

some scatter. Similar preliminary assessment indicated that all the systems except propan-2-ol could be correlated by the parameters mentioned in Eq.(6.18). An additional term, therefore, was included and the following generalized correlation resulted from the regression analysis:

$$Nu_B = 6.142(Pe_B)^{0.462}\left(\frac{1}{X_{tt}}\right)^{0.0134}(Pr)^{1.014}\left(\frac{\nu_{H_2O}}{\nu_L}\right)^{1.743} \quad \ldots (6.19)$$

A comparison between the experimental Nusselt numbers and those predicted by the Eq.(6.19) is presented in Fig.6.45. It is evident in the figure that the data points of all the five test liquids-acetone, ethyl acetate, propan-2-ol, water and toluene lie along the line describing the correlation well within a maximum deviation of ± 30 per cent. The Eq.(6.19) is applicable to $Pe_B$ ranging from 39 to 460, characteristic of low heat flux values, and correspondingly small vapor fractions yielding $1/X_{tt}$ from 0.069 to 30.4. However, the form of Eq.(6.19) is general and may correlate the data points of higher heat flux ranges also with properly selected values of exponents on various dimensionless parameters.

All the physical properties required in computing the dimensionless groups in Eq.(6.19), have been taken at the saturation temperature of the liquids.

6.2.7 Comparison of Boiling Heat Transfer Coefficients Obtained in Present Investigation with Those Predicted by the Earlier Correlations

Some of the important correlations proposed by earlier workers based on their experimental studies were selected to check

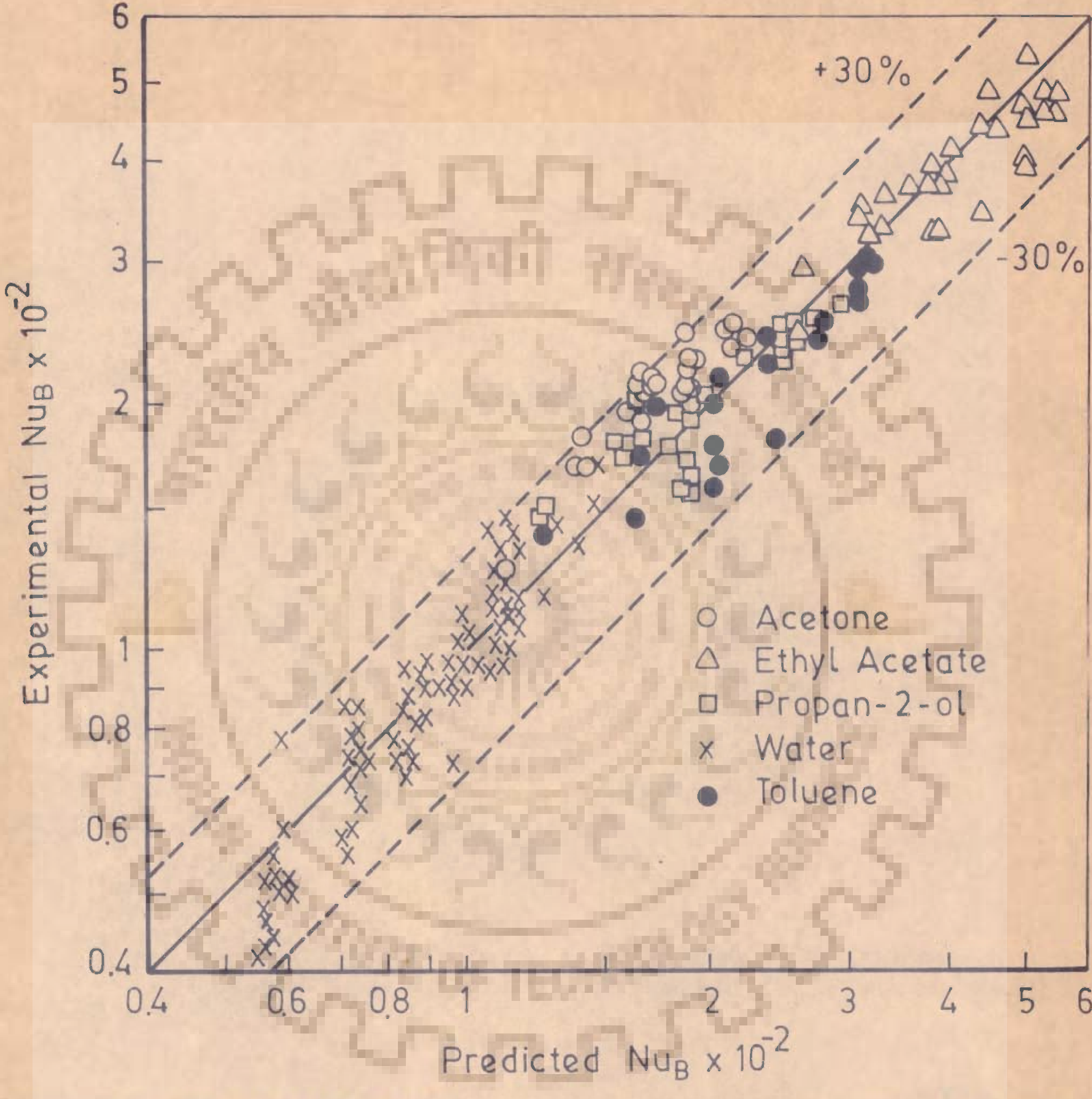



Fig.6.45 Comparison between experimental values of $Nu_B$ and those predicted by Eq.(6.19)

their validity for the experimental data of present investigation. The experimental values of $h_B$ have been plotted against those predicted by Equations (2.8), (2.9), (2.10) and (2.12) in Figures 6.46, 6.47, 6.48 and 6.49 respectively From these figures the following points may be noted:

a. A small fraction of data points for acetone and water lie close to the diagonal lines representing the correlations of Guerrieri and Talty [44] and Dengler and Addoms [27], (Figs.6.46 and 6.47). The remaining points in these figures and all the data points in Figs.6.48 and 6.49 are found to be displaced much above the diagonal lines. This indicates that the predicted values of $h_B$ are much smaller than those obtained experimentally.

b. The scatter of the data is generally very high in all the figures except Fig.6.48 in which the data points form a relatively less wider band almost parallel to the diagonal line.

The above mentioned observations may be explained by considering the role of $X_{tt}$ played in the earlier correlations. These equations are based on the forced convective mechanism of heat transfer under the conditions of high heat flux and vapour fractions. The experimental data of the present study have been generated at low heat flux values and $h_B$ depends strongly on q rather than $X_{tt}$. Therefore, the Equations (2.8) and (2.9) which have relatively smaller value of exponent on $1/X_{tt}$ agree well with some

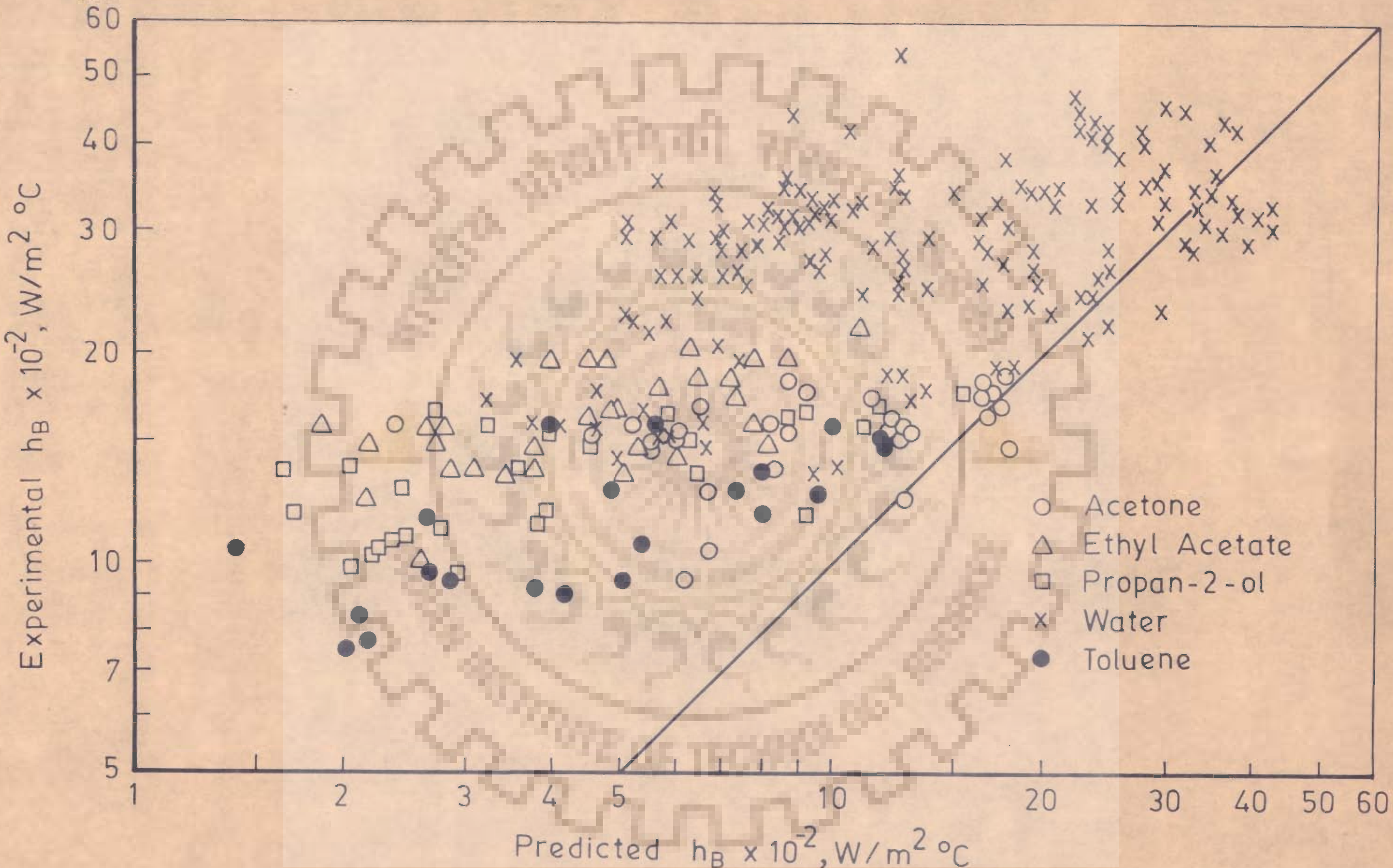



Fig.6.46 Comparison between heat transfer coefficient predicted by the correlation of Guerrieri and Talty [44] and present experimental data

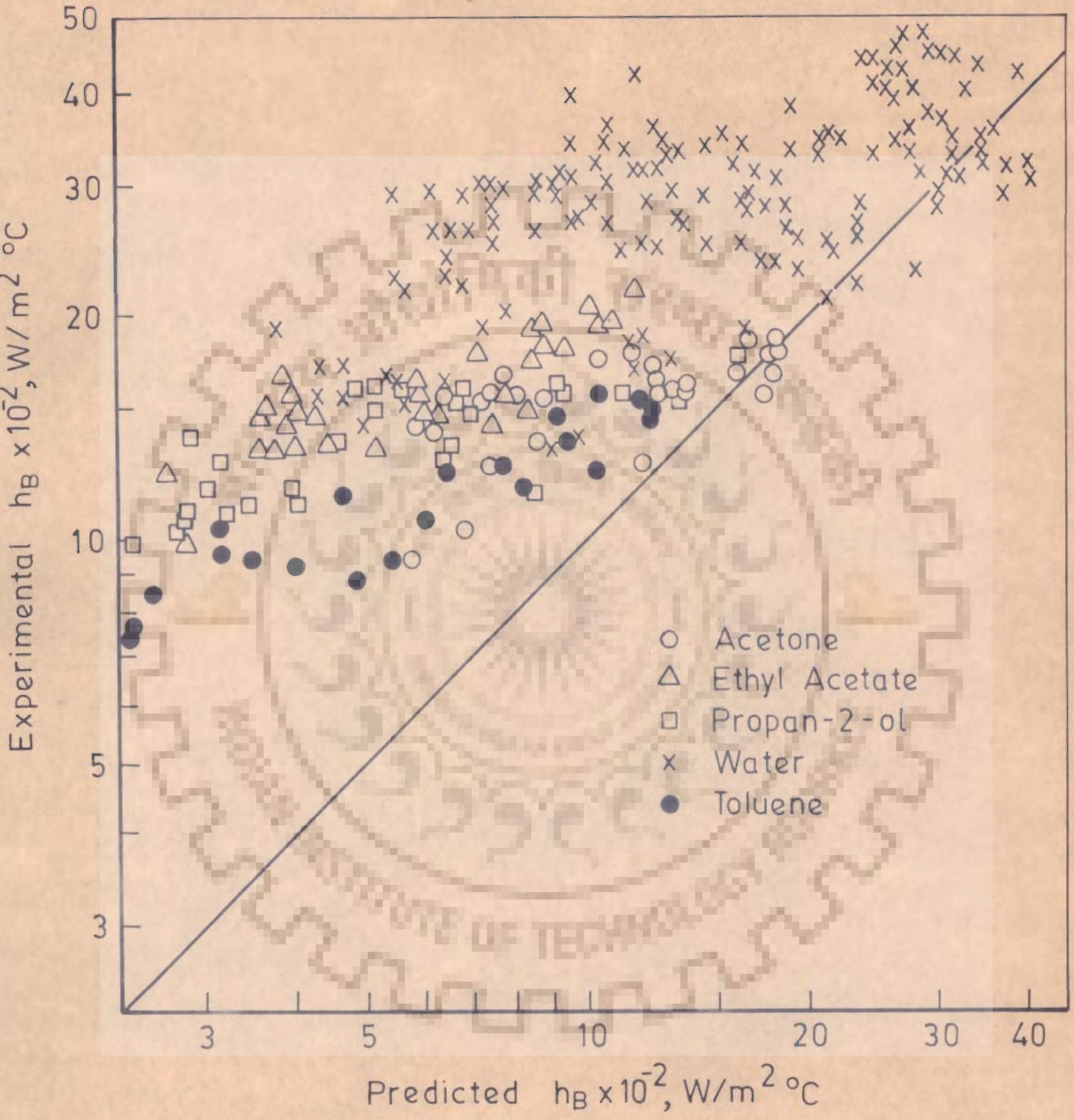



Fig.6.47 Comparison between heat transfer coefficient predicted by the correlation of Dengler and Addoms[27] and present experimental data

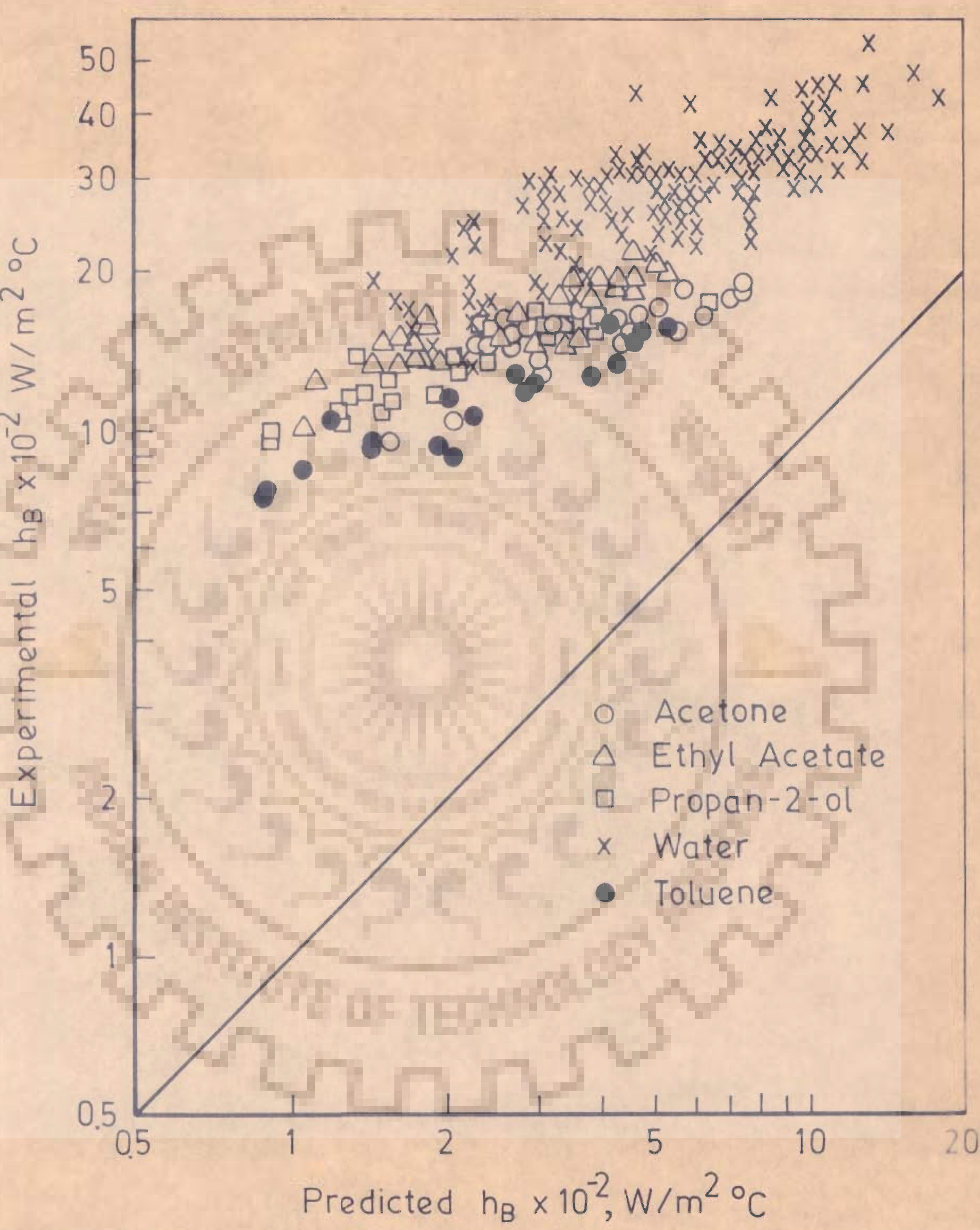



Fig.6.48 Comparison between heat transfer coefficient predicted by the correlation of Bennett et al [6] and present experimental data

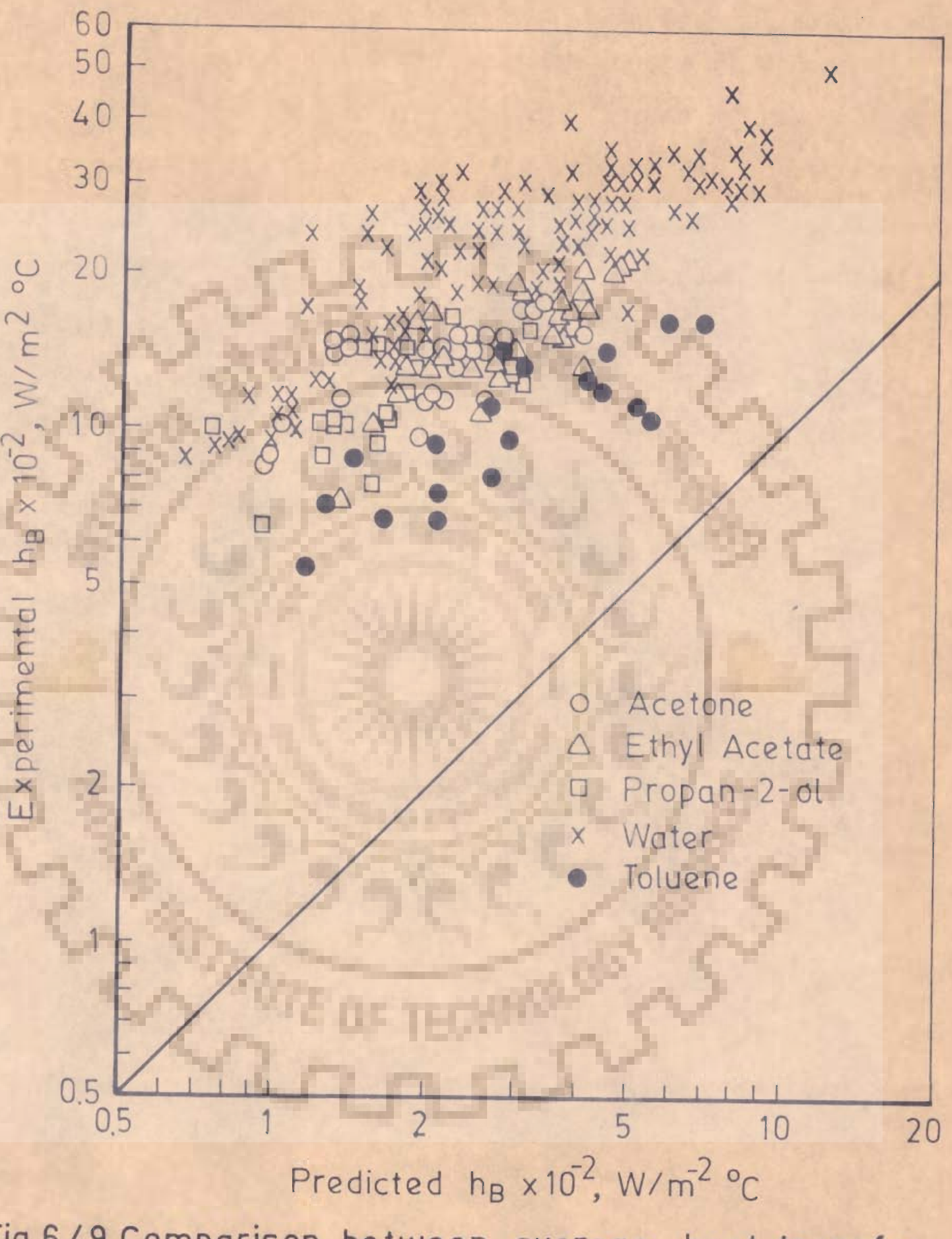



Fig.6.49 Comparison between average heat transfer coefficient predicted by the correlation of Calus et al [11] and present experimental data

data on acetone and water presumably at high values of heat flux and vapour fraction resulting in forced convective mechanism. The large scatter may be attributed to the absence of q, which could account for nucleate boiling, in these equations. The correlation of Bennett [6] contains q though with a very small value of its exponent, in addition to $X_{tt}$ and hence shows a tendency to correlate the present experimental data with changed coefficient.

CHAPTER 7

# CONCLUSIONS AND RECOMMENDATIONS

## 7.1 CONCLUSIONS

1. The heat transfer rate in natural convective flow systems depends upon the interacting effects of wall and liquid temperature differences, physical properties of liquids and the net flow of liquids through the test section. The values of heat transfer coefficient have been found to increase with heat flux due to the higher levels of temperature set up and increased induced flow rates of liquids. At the same heat flux, the transfer coefficients show a decreasing order for water, ethylene glycol and glycerol.

2. The experimentally measured local values of heat transfer coefficients for water, ethylene glycol and glycerol in single phase thermosiphon system have been correlated by the following equation with a maximum error of about $\pm 20$ percent

$$Nu = 1.14(Gr.Pr)^{0.388}(Re/Gr^{0.66})^{0.863}$$

3. A correlation, for average heat transfer coefficients, based on the arithmetic average of local $(T_W - T_L)$ over the tube length under consideration, has been proposed as given below:

$$(Nu)_{avg} = 0.049(Gr.Pr)_{avg}^{0.584}\ (Re)_{avg}^{-0.131}\ (\ell/d)_{avg}^{-0.622}$$

This equation correlated the experimental data with a maximum error of $\pm$ 10 per cent.

4. There exist two distinct regions of heat transfer over the heated length of a vertical tube of thermosiphon reboiler. The non-boiling natural convective region extends from the inlet of reboiler tube to a point where effective surface boiling sets in. The fully developed saturated boiling region starts immediately after the point of boiling incipience when the liquid has attained its saturation temperature. The non-boiling region is identified by the linearly varying liquid and wall temperatures along the tube length under the conditions of constant heat flux. The zone of transition from non-boiling through subcooled boiling to fully developed saturated boiling is marked by the attainment of maximum wall temperature followed by a sudden decrease in its value and subsequently becoming almost constant.

5. The heat transfer coefficient remains almost **invariant** with length over the nonboiling section of the tube. It jumps to much higher values at the onset of boiling conditions and becomes constant in fully developed boiling region of the tube length. The variation of h with z is found to be similar for all systems and is affected by heat flux, inlet liquid subcooling and submergence.

6. The onset of fully developed boiling requires a minimum degree of wall superheat for a given liquid and heat transfer surface. Based on the analytical study of earlier workers, the following **expression** for wall superheat has been developed,

$$(T_w - T_s)^2 = (a - b\,q)^2 \frac{2\,\sigma\,T_s}{k_L\,\lambda\,\rho_v}\,q$$

The above equation can predict the wall superheat required for onset of boiling at a given heat flux. The physical properties of liquids and constants a and b have been determined (Table 6.2) for various liquids investigated based on experimental data of the present study.

7. The distance along the heated tube required for the onset of fully developed boiling of a liquid depends upon wall heat flux, inlet liquid subcooling and submergence. An empirical correlation for predicting this length has been developed in the following form

$$\frac{z_{OB}}{L} \times 100 = C_4 (Pe_B)^{n_4} (K_{sub})^{n_5}\, S^{n_6}$$

The values of constant $C_4$ and exponents $n_4$, $n_5$ and $n_6$ for all the five liquids have been evaluated and given in Table 6.3.

8. The inlet liquid subcooling and submergence do not affect the magnitude of $h_B$ very appreciably but they

do affect the position of boiling incipience. The length of tube over which fully developed boiling occurs, increases with the decrease in the values of inlet liquid subcooling and submergence.

9. The heat transfer coefficient in fully developed boiling region has been found to be strongly dependent on heat flux due to the dominant role of nucleate boiling mechanism in the experimental conditions of present investigation. The boiling heat transfer coefficient averaged out over the fully developed boiling section of the tube can be expressed as a function of q in the following power law relationship

$$h_B = c\ q^n.$$

The values of c and n are listed in Table 6.4. The variation of $h_B$ with q also shows a good agreement with the experimental data from earlier studies of similar nature.

10. The rate of heat transfer in nonboiling region of the reboiler tube is mainly governed by natural convective flow of liquid in the similar manner as in case of single phase thermosiphon. However, the net flow of liquid through the reboiler tube is higher than that in the single phase thermosiphon due to the liquid vaporization in the upper section. The average values of heat transfer coefficient for all the five liquids are best correlated in terms of same dimensionless

groups, used in single phase thermosiphon, by the following equation

$$(Nu_{NB})_{avg} = 0.0126(Gr.Pr)_{avg}^{0.481} (Re)_{avg}^{0.064} (\frac{z_{OB}}{d})^{-0.23}$$

Majority of data points are found to lie within a maximum deviation of $\pm$ 30 per cent.

11. A correlation for boiling heat transfer coefficient has been developed in terms of dimensionless groups selected based on the probable mechanism of heat transfer. The equation as given below, correlates all the data points of acetone, ethyl acetate, propan-2-ol, water and toluene successfully with a maximum error of $\pm$ 30 percent.

$$Nu_B = 6.142(Pe_B)^{0.462} (\frac{1}{X_{tt}})^{0.0134} (Pr)^{1.014} (\frac{\nu_{H_2O}}{\nu_L})^{1.743}$$

Although, the correlation has been developed based on experimental data at very low values of heat flux and small vapour fractions, its form is fairly general and may be extended to other ranges of parameters.

None of the earlier, correlations, available in literature, has been found to agree well with the experimental data of present investigation.

## 7.2 RECOMMENDATIONS

1. The experimental study on single phase closed loop thermosiphons with different geometries and orientations

of heat transfer section may be conducted using other liquids having widely varying physical properties, to cover wider ranges of relevant parameters. The validity of proposed correlation in the present study may be checked and necessary modifications incorporated, if required.

2. Mathematical models may be derived based on momentum and energy balances incorporating the mechanism of fluid flow and heat transfer in closed loop thermosiphon. The resulting equations may be solved by numerical methods and the results compared with experimental ones. This will not only help in understanding the process thoroughly but should provide a basis for the development of generalized correlation.

3. Extensive experimentation on boiling of liquids in vertical tubes under the conditions of natural circulation at relatively higher heat fluxes with wide range of inlet liquid subcooling and submergence should bridge the gap between the present investigation and those reported in literature. A large number of industrially important liquids may be used to study and generate the design data to cover wide ranges of various important thermophysical properties.

4. The theoretical analysis of incipient boiling already available in literature may be modified to suit the experimental results more accurately. The generalized

correlations for computing wall superheats and heated lengths for onset of boiling may be developed with the help of above analysis and experimental measurements of boiling incipience.

5. The general form of the proposed correlation may be used to represent all the data points to be generated and those of earlier workers with a view to obtain a single correlation for boiling heat transfer over complete range of heat flux generally encountered in process industries. The relative effects of different mechanisms controlling heat transfer may be accounted for through the change of exponents and/or use of suitable correction factors.

# A P P E N D I X   A

## TABLES AND CHARTS OF CALIBRATIONS

# Table A-1 PERFORMANCE OF THERMOCOUPLES

(Set up – I )*

| Standard Thermo-meter °C | mv or °C | Inlet liquid thermo-couple | Wall Thermocouples z, m | | | | | | | | | | | | | | | | Outlet liquid thermo-couple |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | – | – | – | – | – | – | |
| 60.50 | mv | 2.470 | 2.468 | 2.466 | 2.471 | 2.466 | 2.468 | 2.466 | 2.470 | 2.470 | 2.469 | 2.471 | – | – | – | – | – | – | 2.466 |
| | °C | 60.50 | 60.45 | 60.40 | 60.50 | 60.40 | 60.45 | 60.40 | 60.50 | 60.50 | 60.45 | 60.50 | – | – | – | – | – | – | 60.40 |
| 76.30 | mv | 3.166 | 3.164 | 3.168 | 3.164 | 3.168 | 3.165 | 3.166 | 3.168 | 3.164 | 3.167 | 3.166 | – | – | – | – | – | – | 3.164 |
| | °C | 76.35 | 76.30 | 76.40 | 76.30 | 76.40 | 76.35 | 76.35 | 76.40 | 76.30 | 76.40 | 76.35 | – | – | – | – | – | – | 76.30 |
| 95.00 | mv | 4.012 | 4.009 | 4.007 | 4.011 | 4.010 | 4.010 | 4.010 | 4.012 | 4.011 | 4.010 | 4.014 | – | – | – | – | – | – | 4.009 |
| | °C | 95.05 | 95.00 | 94.95 | 95.05 | 95.00 | 95.00 | 95.00 | 95.05 | 95.05 | 95.00 | 95.10 | – | – | – | – | – | – | 95.00 |

(Setup – II )**

| | | | z, m | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 | |
| 26.00 | mv | 1.030 | 1.040 | 1.034 | 1.034 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 | 1.030 |
| | °C | 26.05 | 26.30 | 26.15 | 26.15 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 | 26.05 |
| 92.50 | mv | 3.931 | 3.935 | 3.933 | 3.931 | 3.931 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 | 3.930 |
| | °C | 92.50 | 92.60 | 92.55 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 |

* Used for Single Phase Closed Loop Thermosiphon

** Used for Thermosiphon Reboiler

Table A-2 CALIBRATION OF WATTMETER

| S.No. | Wattmeter readings, Watts | | % Error |
|---|---|---|---|
| | Standard | Under-test | |
| 1. | 640 | 650 | + 1.56 |
| 2. | 960 | 950 | - 1.04 |
| 3. | 1200 | 1180 | - 1.67 |
| 4. | 1340 | 1320 | - 1.49 |
| 5. | 1485 | 1470 | - 1.01 |

Table A-3 CALIBRATION OF AMMETER

| S.No. | Ammeter readings, amperes | | % error |
|---|---|---|---|
| | Standard | Under-test | |
| 1. | 1.00 | 1.00 | 0.00 |
| 2. | 1.50 | 1.50 | 0.00 |
| 3. | 2.03 | 2.00 | - 1.48 |
| 4. | 2.58 | 2.55 | - 1.16 |
| 5. | 3.05 | 3.00 | - 1.64 |
| 6. | 3.55 | 3.50 | - 1.41 |
| 7. | 4.07 | 4.00 | - 1.72 |
| 8. | 4.55 | 4.50 | - 1.09 |
| 9. | 5.08 | 5.00 | - 1.57 |

Table A-4 CALIBRATION OF VOLTMETER

| S.No. | Voltmeter readings, volts | | %. error |
|---|---|---|---|
| | Standard | Under-test | |
| 1. | 1.00 | 1.00 | 0.00 |
| 2. | 2.00 | 2.00 | 0.00 |
| 3. | 3.00 | 3.00 | 0.00 |
| 4. | 4.00 | 4.00 | 0.00 |
| 5. | 5.00 | 5.00 | 0.00 |
| 6. | 6.00 | 6.00 | 0.00 |
| 7. | 8.00 | 8.00 | 0.00 |
| 8. | 9.00 | 9.00 | 0.00 |
| 9. | 10.00 | 10.00 | 0.00 |

Table A-5 CALIBRATION OF ROTAMETERS

| S.No. | Rotameter readings, lit/mt | | |
|---|---|---|---|
| | Indicated | Measured R-1* | Measured R-2** |
| 1. | 1.00 | 0.90 | 0.90 |
| 2. | 2.00 | 1.88 | 1.88 |
| 3. | 3.00 | 2.80 | 2.84 |
| 4. | 4.00 | 3.80 | 3.82 |
| 5. | 5.00 | 4.75 | 4.82 |
| 6. | 6.00 | 5.70 | 5.80 |
| 7. | 7.00 | 6.70 | - |
| 8. | 8.00 | 7.65 | - |
| 9. | 9.00 | 8.60 | - |
| 10. | 10.00 | 9.50 | - |

* R-1 stands for Rotameter I , used for condenser flow measurements.

** R-2 stands for Rotameter II, used for jacket flow measurements.

## Table A-6 STANDARDIZATION EXPERIMENTAL DATA (Set-up I)†

| Z | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-WATER | | | | | | | | | | |
| RUN NO.= 1 | | AQ= 8.88 | | Q= 1.80 | | TIN= 23.18 | | | TOUT= | 27.17 |
| TW | 26.1 | 33.8 | 37.5 | 40.2 | 44.2 | 44.0 | 46.3 | 47.6 | 50.4 | 51.9 |
| RUN NO.= 2 | | AQ=12.44 | | Q= 1.80 | | TIN= 23.35 | | | TOUT= | 28.95 |
| TW | 27.5 | 37.3 | 42.4 | 45.6 | 50.5 | 50.6 | 53.6 | 54.8 | 58.5 | 60.1 |
| RUN NO.= 3 | | AQ=15.99 | | Q= 1.80 | | TIN= 24.20 | | | TOUT= | 31.41 |
| TW | 29.5 | 41.4 | 47.0 | 50.8 | 57.0 | 56.3 | 59.7 | 60.8 | 65.0 | 67.1 |
| RUN NO.= 4 | | AQ=19.55 | | Q= 1.80 | | TIN= 24.43 | | | TOUT= | 33.17 |
| TW | 30.7 | 44.8 | 50.9 | 55.2 | 61.7 | 61.5 | 65.4 | 66.6 | 71.7 | 73.6 |

† Used for Single Phase Closed-Loop Thermosiphon

Table A-6 continued

(Set-up II)††

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-WATER | | | | | | | | | | | | | | | | |
| RUN NO.= 1 AQ= 3.0330 Q= 1.85 TIN= 27.70 TOUT= 29.95 | | | | | | | | | | | | | | | | |
| TW | 31.45 | 32.40 | 32.90 | 33.60 | 34.90 | 35.20 | 36.20 | 36.65 | 37.20 | 37.60 | 38.10 | 38.40 | 38.80 | 39.25 | 39.75 | 40.00 |
| RUN NO.= 2 AQ= 3.0330 Q= 1.35 TIN= 28.05 TOUT= 31.10 | | | | | | | | | | | | | | | | |
| TW | 32.30 | 33.50 | 34.25 | 34.75 | 35.95 | 36.65 | 37.25 | 37.90 | 38.60 | 38.90 | 39.60 | 40.00 | 40.20 | 40.50 | 40.95 | 41.25 |
| RUN NO.= 3 AQ= 0.8046 Q= 1.35 TIN= 28.25 TOUT= 29.05 | | | | | | | | | | | | | | | | |
| TW | 29.20 | 29.50 | 29.90 | 30.10 | 30.45 | 30.90 | 31.20 | 31.35 | 31.40 | 31.65 | 31.70 | 31.90 | 32.10 | 32.35 | 32.55 | 32.70 |
| RUN NO.= 4 AQ= 0.8046 Q= 0.90 TIN= 28.35 TOUT= 29.60 | | | | | | | | | | | | | | | | |
| TW | 29.65 | 30.15 | 30.60 | 30.85 | 31.35 | 31.75 | 31.90 | 32.15 | 32.35 | 32.55 | 32.70 | 32.75 | 33.00 | 33.10 | 33.25 | 33.35 |
| RUN NO.= 5 AQ= 2.4453 Q= 1.65 TIN= 29.20 TOUT= 32.10 | | | | | | | | | | | | | | | | |
| TW | 33.55 | 34.80 | 35.95 | 36.65 | 37.40 | 38.60 | 39.35 | 40.05 | 40.50 | 41.00 | 41.45 | 41.70 | 42.40 | 42.85 | 43.10 | 43.20 |
| RUN NO.= 6 AQ= 1.8722 Q= 1.05 TIN= 28.30 TOUT= 30.75 | | | | | | | | | | | | | | | | |
| TW | 31.60 | 32.30 | 33.05 | 33.50 | 34.40 | 34.85 | 35.35 | 35.85 | 36.25 | 36.50 | 36.75 | 37.15 | 37.35 | 37.60 | 37.85 | 38.00 |
| RUN NO.= 7 AQ= 5.4670 Q= 0.90 TIN= 28.55 TOUT= 36.90 | | | | | | | | | | | | | | | | |
| TW | 38.40 | 40.45 | 42.05 | 42.95 | 44.50 | 45.70 | 46.60 | 46.40 | 45.70 | 45.70 | 46.65 | 47.60 | 48.05 | 48.75 | 49.20 | 49.75 |
| RUN NO.= 8 AQ= 3.4247 Q= 0.90 TIN= 28.50 TOUT= 33.70 | | | | | | | | | | | | | | | | |
| TW | 35.30 | 36.20 | 37.35 | 38.20 | 39.60 | 40.60 | 41.10 | 41.75 | 42.25 | 42.00 | 41.65 | 41.55 | 42.05 | 42.50 | 43.00 | 43.55 |
| RUN NO.= 9 AQ= 1.8490 Q= 0.90 TIN= 28.80 TOUT= 31.60 | | | | | | | | | | | | | | | | |
| TW | 32.30 | 33.25 | 33.75 | 34.25 | 35.00 | 35.70 | 36.20 | 36.65 | 37.00 | 37.20 | 37.45 | 37.70 | 37.95 | 38.20 | 38.20 | 37.85 |
| RUN NO.=10 AQ= 0.8046 Q= 0.83 TIN= 27.95 TOUT= 29.30 | | | | | | | | | | | | | | | | |
| TW | 29.40 | 29.60 | 30.00 | 30.55 | 31.00 | 31.45 | 31.70 | 32.05 | 32.20 | 32.40 | 32.65 | 32.70 | 32.95 | 33.10 | 33.25 | 33.35 |

†† Used for Thermosiphon Reboiler

Table A-6 continued

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RUN NO.=11 | | | AQ= 0.8046 | | | Q= 0.71 | | TIN= 28.25 | | | TOUT= 29.80 | | | |
| TW | 29.00 | 29.30 | 29.75 | 30.25 | 30.90 | 31.20 | 31.45 | 31.70 | 31.90 | 32.10 | 32.30 | 32.40 | 32.60 | 32.70 | 32.85 | 32.95 |
| | | RUN NO.=12 | | | AQ= 1.7329 | | | Q= 1.35 | | TIN= 28.95 | | | TOUT= 30.65 | | | |
| TW | 32.00 | 32.70 | 33.10 | 33.70 | 34.10 | 34.55 | 35.10 | 35.45 | 35.75 | 36.05 | 36.40 | 36.65 | 37.10 | 37.40 | 37.40 | 37.85 |
| | | RUN NO.=13 | | | AQ= 3.0739 | | | Q= 2.35 | | TIN= 26.60 | | | TOUT= 28.40 | | | |
| TW | 30.25 | 30.95 | 31.35 | 32.55 | 33.05 | 33.95 | 34.65 | 34.85 | 35.30 | 35.65 | 36.25 | 36.50 | 37.00 | 37.55 | 38.10 | 38.40 |
| | | RUN NO.=14 | | | AQ= 3.1978 | | | Q= 2.25 | | TIN= 25.00 | | | TOUT= 26.95 | | | |
| TW | 28.60 | 29.30 | 30.45 | 30.90 | 31.60 | 32.10 | 32.55 | 33.25 | 33.75 | 34.15 | 34.75 | 35.00 | 35.95 | 36.20 | 36.65 | 37.15 |
| | | RUN NO.=15 | | | AQ= 3.1978 | | | Q= 2.05 | | TIN= 26.65 | | | TOUT= 28.80 | | | |
| TW | 30.50 | 31.50 | 32.10 | 32.90 | 33.60 | 34.20 | 34.60 | 35.10 | 35.55 | 36.10 | 36.50 | 37.20 | 37.65 | 38.10 | 38.75 | 39.10 |

Notations used

Z distance along the test section, m

AQ heat flux, $kW/m^2$

TIN fluid inlet temperature to the test section, $^{o}C$

TOUT fluid outlet temperature from the test section, $^{o}C$

TW wall temperatures, $^{o}C$

Q fluid flow rate, lit/mt

# APPENDIX B

## PHYSICAL PROPERTIES OF TEST LIQUIDS

B-1 Physical Properties of Acetone

B-2 Physical Properties of Ethyl Acetate

B-3 Physical Properties of Propan-2-01

B-4 Physical Properties of Water

B-5 Physical Properties of Toluene

B-6 Physical Properties of Ethylene Glycol

B-7 Physical Properties of Glycerol

## Table B-1 PHYSICAL PROPERTIES OF ACETONE

Mol. Formula : $C_3H_6O$ Mol. Weight : 58.1 N.B.P. : 56.1 °C

$P_{crit}$ : $47.66 \times 10^5$ N / m$^2$ $T_{crit}$ : 235.0 °C $\rho_{crit}$ : 273.0 kg / m$^3$

$\lambda$ : $5.23 \times 10^5$ J / kg $\mu_v$ : $8.278 \times 10^{-6}$ Ns / m$^2$ $\rho_v$ : 2.152 kg / m$^3$

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg / m$^3$ | $\mu_L$ Ns / m$^2$ | $k_L$ W / m °C | $C_L$ J / kg °C | $\sigma_L$ N / m |
|---|---|---|---|---|---|
| Range, °C | 20 — 80 | 0 — 60 | 0 — 100 | 0 — 50 | 0 — 80 |
| A | +0.81396 E+03 | +0.38900 E-03 | +0.17744 E+00 | +0.21143 E+04 | +0.26191 E-01 |
| B | -0.12256 E+01 | -0.56934 E-05 | -0.23258 E-03 | +0.16557 E+01 | -0.11782 E-03 |
| C | +0.27652 E-02 | +0.11825 E-06 | +0.13010 E-08 | +0.49798 E-01 | -0.27690 E-06 |
| D | -0.30248 E-04 | -0.12725 E-08 | -0.21338 E-10 | -0.99114 E-03 | +0.23024 E-08 |
| E | +0.56959 E-07 | +0.21435 E-11 | +0.10671 E-12 | +0.87487 E-05 | +0.53939 E-13 |
| Max$^m$ Error, % | +0.30166 E-01 | -0.42526 E-05 | -0.55879 E-04 | -0.23116 E-01 | -0.11391 E+00 |

## Table B-2 PHYSICAL PROPERTIES OF ETHYL ACETATE

Mol. Formula : $C_4 H_8 O_2$ Mol. Weight : 88.1 N.B.P. : 77.1 °C

$P_{crit}$ : $38.44 \times 10^5$ N/m² $T_{crit}$ : 250.1 °C $\rho_{crit}$ : 308 kg/m³

$\lambda$ : $3.68 \times 10^5$ J/kg $\mu_v$ : $8.889 \times 10^{-6}$ Ns/m² $\rho_v$ : 3.0674 kg/m³

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg/m³ | $\mu_L$ Ns/m² | $k_L$ W/m °C | $C_L$ J/kg °C | $\sigma_L$ N/m |
|---|---|---|---|---|---|
| Range, °C | 0 — 90 | 20 — 80 | 16 — 60 | 10 — 93 | 0 — 80 |
| A | +0.92468E+03 | +0.62428E-03 | +0.68906 E-01 | +0.19097E+04 | +0.26951E-01 |
| B | -0.13796E+01 | -0.92212 E-05 | +0.10018 E-01 | +0.72059E+00 | -0.12591E-03 |
| C | +0.14260E-01 | +0.11083 E-06 | -0.41388 E-03 | +0.57958 E-02 | -0.62309E-06 |
| D | -0.33299E-03 | -0.97315 E-09 | +0.68419 E-05 | +0.59306 E-04 | +0.17428 E-07 |
| E | +0.22163 E-05 | +0.37200E-11 | -0.40587 E-07 | -0.75961 E-06 | -0.12286 E-09 |
| Max$^m$ Error, % | -0.16629 E+00 | -0.75159 E-04 | -0.33923 E-03 | -0.11789 E-04 | -0.21052 E+00 |

## Table B-3 PHYSICAL PROPERTIES OF PROPAN-2-OL

Mol. Formula : $C_3H_8O$ Mol. Weight : 60.1 N.B.P : 82.3 °C

$P_{crit}$ : $51.98 \times 10^5$ $N/m^2$ $T_{crit}$ : 235.6 °C $\rho_{crit}$ : 274 $kg/m^3$

$\lambda$ : $6.78 \times 10^5$ J/kg $\mu_v$ : $9.389 \times 10^{-6}$ $Ns/m^2$ $\rho_v$ : 2.062 $kg/m^3$

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ $kg/m^3$ | $\mu_L$ $Ns/m^2$ | $k_L$ W/m °C | $C_L$ J/kg °C | $\sigma_L$ N/m |
|---|---|---|---|---|---|
| Range , °C | 0 – 30 | 0 – 100 | 0 – 75 | 10 – 93 | 10 – 100 |
| A | + 0.80120 E+03 | + 0.45903 E-02 | + 0.15349 E+00 | + 0.24847 E+04 | + 0.25138 E-01 |
| B | – 0.81170 E+00 | – 0.15406 E-03 | – 0.90057 E-04 | + 0.93784 E+01 | – 0.37278 E-04 |
| C | — | + 0.25848 E-05 | – 0.24396 E-05 | + 0.10395 E+00 | – 0.17829 E-05 |
| D | — | – 0.22422 E-07 | + 0.17148 E-07 | – 0.14885 E-02 | + 0.24733 E-07 |
| E | — | + 0.77673 E-10 | + 0.51059 E-10 | + 0.75063 E-05 | – 0.11155 E-09 |
| Max^m Error, % | + 0.14862 E-02 | + 0.19718 E+01 | – 0.28878 E-05 | + 0.22416 E-04 | + 0.23441 E+00 |

## Table B-4 PHYSICAL PROPERTIES OF WATER

Mol. Formula : $H_2O$ Mol. Weight : 18 N.B.P. : 100.0 °C

$P_{crit}$ : $22.13 \times 10^6$ N/m$^2$ $T_{crit}$ : 374.15 °C $\rho_{crit}$ : 307 kg/m$^3$

$\lambda$ : $22.598 \times 10^5$ J/kg $\mu_v$ : $11.972 \times 10^{-6}$ Ns/m$^2$ $\rho_v$ : 0.588 kg/m$^3$

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg/m$^3$ | $\mu_L$ Ns/m$^2$ | $k_L$ W/m °C | $C_L$ J/kg °C | $\sigma_L$ N/m |
|---|---|---|---|---|---|
| Range, °C | 10 – 100 | 10 – 100 | 10 – 100 | 10 – 100 | 10 – 100 |
| A | +0.10000E+04 | +0.16473 E-02 | +0.54828E+00 | +0.42044E+04 | +0.70438 E-01 |
| B | +0.30844E-01 | -0.39308 E-04 | +0.28505 E-02 | -0.14695 E+01 | +0.57399E-03 |
| C | -0.67227E-02 | +0.43057E-06 | -0.19347 E-04 | +0.16179 E-01 | -0.28569 E-04 |
| D | +0.30274E-04 | -0.17472E-08 | +0.43056E-07 | +0.49681 E-04 | +0.41104 E-06 |
| E | -0.77817 E-07 | — | — | -0.48445E-06 | -0.19333 E-08 |
| Max$^m$ Error, % | -0.55437E-02 | +0.28593E+01 | +0.15622E+00 | -0.34454E-01 | +0.48690 E+01 |

## Table B-5 PHYSICAL PROPERTIES OF TOLUENE

Mol. Formula : $C_6H_5CH_3$ Mol. Weight : 92.134 N.B.P. : 110.625 °C

$P_{crit}$ : $39.23 \times 10^5$ N/m$^2$ $T_{crit}$ : 320.8 °C $\rho_{crit}$ : 290 kg/m$^3$

$\lambda$ : $3.604 \times 10^5$ J/kg $\mu_v$ : $9.158 \times 10^{-6}$ Ns/m$^2$ $\rho_v$ : 2.93 kg/m$^3$

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg/m$^3$ | $\mu_L$ Ns/m$^2$ | $k_L$ W/m °C | $C_L$ J/kg °C | $\sigma_L$ N/m |
|---|---|---|---|---|---|
| Range, °C | 25 – 110 | 10 – 120 | 0 – 120 | 0 – 100 | 10 – 100 |
| A | +0.88556 E+03 | +0.76203 E-03 | +0.13953 E+00 | +0.16304 E+04 | +0.30891 E-01 |
| B | -0.93334 E+00 | -0.10432 E-04 | -0.23256 E-03 | +0.91781 E+00 | -0.11512 E-03 |
| C | +0.24532 E-03 | +0.93828 E-07 | +0.40856 E-10 | +0.63491 E-01 | -0.24879 E-06 |
| D | -0.61391 E-05 | -0.49406 E-09 | -0.61255 E-12 | -0.20605 E-03 | +0.58546 E-08 |
| E | +0.14434 E-07 | +0.10775 E-11 | +0.26896 E-14 | -0.18619 E-05 | -0.31459 E-10 |
| Max$^m$ Error, % | +0.43267 E-02 | -0.19579 E+00 | -0.43117 E-05 | -0.74506 E-05 | +0.35591 E+00 |

## Table B-6 PHYSICAL PROPERTIES OF ETHYLENE GLYCOL

Mol. Formula : $C_2H_6O_2$ Mol. Weight : 62.07 N.B.P. : 197.3 °C

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg/m$^3$ | $\mu_L$ Ns/m$^2$ | $k_L$ W/m °C | $C_L$ J/kg °C | — |
|---|---|---|---|---|---|
| Range, °C | 25 — 115 | 25 — 115 | 25 — 115 | 25 — 115 | — |
| A | +0.11368 E+04 | +0.40303 E-01 | +0.26279 E+00 | +0.10216 E+04 | — |
| B | -0.11500 E+01 | -0.10689 E-02 | — | +0.45217 E+01 | — |
| C | — | +0.10471 E-04 | — | — | — |
| D | — | -0.36014 E-07 | — | — | — |
| Max$^m$ Error, % | — | -0.85793 E+01 | — | — | — |

# Table B-7 PHYSICAL PROPERTIES OF GLYCEROL

Mol. Formula : $C_3H_8O_3$ Mol. Weight : 92.1 N.B.P. : 290.0 °C

Constants of Polynomial for Different Physical Properties

| Properties | $\rho_L$ kg/$m^3$ | $\mu_L$ Ns/$m^2$ | $k_L$ W/m °C | $C_L$ J/kg °C | — |
|---|---|---|---|---|---|
| Range, °C | 30 — 180 | 30 — 180 | 30 — 180 | 30 — 180 | — |
| A | +0.12743 E+04 | +0.11501E-02 | +0.28372E+00 | +0.51079E+03 | — |
| B | -0.62500E+00 | -0.76956E-05 | — | +0.60289E+01 | — |
| C | — | +0.66781E-08 | — | — | — |
| D | — | +0.13519 E-10 | — | — | — |
| Max$^m$ Error, % | — | +0.64708E+01 | — | — | — |

# APPENDIX C

## EXPERIMENTAL DATA

| | |
|---|---|
| C-1 | Experimental Data for Single Phase Closed Loop Thermosiphon |
| C-2 | Experimental Data for Thermosiphon Reboiler |

NOTATIONS FOR TABLES C-1 AND C-2

| | | |
|---|---|---|
| Z | Distance along the test section, | m |
| TW | Wall temperature, | $^oC$ |
| TL | Liquid temperature, | $^oC$ |
| HT | Heat Transfer Coefficients, | $kW/m^2\ ^oC$ |
| AQ | Heat flux | $kW/m^2$ |
| TIN | Inlet liquid temperature | $^oC$ |
| TOUT | Outlet liquid temperature | $^oC$ |
| T1 | Condenser inlet temperature | $^oC$ |
| T2 | Condenser outlet temperature | $^oC$ |
| QC | Condenser flow rate | lit/mt |
| S | Submergence | percent |
| DELTSUB | Degree of subcooling | $^oC$ |
| TC | Condensate temperature | $^oC$ |

Table C-1 EXPERIMENTAL DATA FOR SINGLE PHASE CLOSED LOOP THERMOSIPHON

| Z | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-WATER | | | | | | | | | | |
| RUN NO.= 1 | | | AQ= 1.77 | | | TIN= 17.65 | | | TOUT= 47.10 | |
| TW | 21.8 | 26.5 | 30.4 | 34.0 | 37.6 | 40.7 | 45.0 | 48.9 | 53.2 | 56.6 |
| TL | 17.7 | 20.8 | 23.9 | 27.1 | 30.2 | 33.3 | 36.4 | 39.6 | 42.7 | 45.8 |
| HT | 0.432 | 0.310 | 0.272 | 0.256 | 0.239 | 0.239 | 0.206 | 0.190 | 0.168 | 0.164 |
| RUN NO.= 2 | | | AQ= 3.55 | | | TIN= 20.00 | | | TOUT= 54.50 | |
| TW | 26.5 | 33.0 | 37.5 | 40.5 | 44.5 | 47.0 | 51.5 | 55.0 | 59.6 | 63.3 |
| TL | 20.0 | 23.7 | 27.3 | 31.0 | 34.7 | 38.4 | 42.0 | 45.7 | 49.4 | 53.0 |
| HT | 0.546 | 0.381 | 0.348 | 0.373 | 0.362 | 0.412 | 0.373 | 0.381 | 0.348 | 0.344 |
| RUN NO.= 3 | | | AQ= 5.33 | | | TIN= 21.80 | | | TOUT= 63.35 | |
| TW | 30.4 | 38.5 | 43.6 | 47.3 | 52.0 | 55.2 | 60.5 | 65.1 | 70.9 | 74.9 |
| TL | 21.8 | 26.2 | 30.6 | 35.0 | 39.4 | 43.8 | 48.3 | 52.7 | 57.1 | 61.5 |
| HT | 0.619 | 0.433 | 0.410 | 0.433 | 0.423 | 0.467 | 0.436 | 0.429 | 0.386 | 0.397 |
| RUN NO.= 4 | | | AQ= 7.11 | | | TIN= 22.55 | | | TOUT= 96.10 | |
| TW | 29.9 | 42.7 | 51.3 | 59.2 | 68.9 | 75.2 | 84.5 | 93.4 | 102.2 | 102.7 |
| TL | 22.5 | 30.4 | 38.2 | 46.0 | 53.8 | 61.7 | 69.5 | 77.3 | 85.2 | 92.9 |
| HT | 0.960 | 0.578 | 0.542 | 0.538 | 0.470 | 0.526 | 0.474 | 0.441 | 0.418 | 0.725 |
| RUN NO.= 5 | | | AQ= 8.88 | | | TIN= 24.05 | | | TOUT= 96.40 | |
| TW | 32.0 | 45.9 | 54.5 | 61.9 | 71.6 | 77.4 | 86.2 | 94.5 | 103.0 | 104.4 |
| TL | 24.0 | 31.7 | 39.4 | 47.1 | 54.8 | 62.5 | 70.2 | 77.9 | 85.6 | 93.3 |
| HT | 1.110 | 0.625 | 0.588 | 0.600 | 0.528 | 0.596 | 0.555 | 0.534 | 0.510 | 0.800 |
| RUN NO.= 6 | | | AQ=10.66 | | | TIN= 25.20 | | | TOUT= 97.10 | |
| TW | 33.8 | 49.4 | 57.3 | 64.2 | 74.3 | 79.6 | 87.7 | 95.6 | 104.2 | 105.6 |
| TL | 25.2 | 32.8 | 40.5 | 48.2 | 55.8 | 63.4 | 71.1 | 78.7 | 86.4 | 94.1 |
| HT | 1.239 | 0.642 | 0.634 | 0.666 | 0.576 | 0.658 | 0.642 | 0.630 | 0.598 | 0.927 |

Table C-1 continued

| Z | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-ETHYLENE GLYCOL | | | | | | | | | | |
| RUN NO.= 7 | | | AQ= 1.77 | | | TIN= 24.65 | | | TOUT= 46.75 | |
| TW | 31.4 | 38.4 | 41.9 | 44.7 | 47.1 | 49.9 | 53.6 | 55.6 | 58.8 | 59.3 |
| TL | 24.7 | 27.0 | 29.4 | 31.8 | 34.2 | 36.6 | 38.9 | 41.2 | 43.6 | 45.9 |
| HT | 0.264 | 0.155 | 0.141 | 0.137 | 0.137 | 0.133 | 0.120 | 0.122 | 0.116 | 0.132 |
| RUN NO.= 8 | | | AQ= 3.55 | | | TIN= 30.45 | | | TOUT= 64.60 | |
| TW | 42.7 | 55.2 | 61.4 | 65.8 | 68.7 | 69.6 | 73.8 | 77.7 | 81.7 | 82.5 |
| TL | 30.5 | 34.2 | 37.9 | 41.6 | 45.3 | 48.9 | 52.6 | 56.2 | 59.7 | 63.3 |
| HT | 0.291 | 0.169 | 0.151 | 0.146 | 0.151 | 0.171 | 0.167 | 0.165 | 0.161 | 0.184 |
| RUN NO.= 9 | | | AQ= 5.33 | | | TIN= 35.00 | | | TOUT= 78.95 | |
| TW | 49.9 | 66.0 | 73.4 | 78.5 | 81.4 | 82.7 | 88.6 | 93.2 | 98.4 | 99.5 |
| TL | 35.0 | 39.9 | 44.7 | 49.5 | 54.2 | 58.9 | 63.5 | 68.2 | 72.8 | 77.3 |
| HT | 0.357 | 0.204 | 0.185 | 0.183 | 0.196 | 0.223 | 0.212 | 0.213 | 0.208 | 0.240 |
| RUN NO.=10 | | | AQ= 7.11 | | | TIN= 37.85 | | | TOUT= 88.95 | |
| TW | 55.0 | 73.9 | 82.5 | 87.9 | 90.8 | 92.9 | 100.3 | 105.1 | 111.3 | 113.0 |
| TL | 37.9 | 43.5 | 49.2 | 54.7 | 60.3 | 65.7 | 71.2 | 76.5 | 81.8 | 87.1 |
| HT | 0.415 | 0.233 | 0.213 | 0.214 | 0.233 | 0.261 | 0.244 | 0.248 | 0.241 | 0.274 |
| RUN NO.=11 | | | AQ= 8.88 | | | TIN= 41.15 | | | TOUT= 94.95 | |
| TW | 60.5 | 81.7 | 90.7 | 95.5 | 98.1 | 100.0 | 107.8 | 112.5 | 118.7 | 120.5 |
| TL | 41.2 | 47.2 | 53.1 | 59.0 | 64.8 | 70.6 | 76.2 | 81.9 | 87.5 | 93.0 |
| HT | 0.460 | 0.257 | 0.236 | 0.243 | 0.266 | 0.302 | 0.281 | 0.290 | 0.284 | 0.322 |
| RUN NO.=12 | | | AQ=10.66 | | | TIN= 44.85 | | | TOUT=103.70 | |
| TW | 66.3 | 90.0 | 99.5 | 103.9 | 106.2 | 109.5 | 117.1 | 122.3 | 129.2 | 132.2 |
| TL | 44.9 | 51.5 | 58.0 | 64.4 | 70.8 | 77.1 | 83.3 | 89.5 | 95.6 | 101.6 |
| HT | 0.498 | 0.276 | 0.256 | 0.269 | 0.301 | 0.329 | 0.315 | 0.325 | 0.317 | 0.348 |

Table C-1 continued

| Z | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-GLYCEROL | | | | | | | | | | |
| RUN NO.=13 | | | AQ= 1.77 | | | TIN= 31.00 | | | | TOUT= 82.15 |
| TW | 45.8 | 59.5 | 68.8 | 76.4 | 83.9 | 90.6 | 99.7 | 107.8 | 113.4 | 113.4 |
| TL | 31.0 | 36.8 | 42.5 | 48.2 | 53.7 | 59.2 | 64.6 | 69.9 | 75.2 | 80.4 |
| HT | 0.119 | 0.078 | 0.067 | 0.062 | 0.058 | 0.056 | 0.050 | 0.046 | 0.046 | 0.053 |
| RUN NO.=14 | | | AQ= 3.55 | | | TIN= 33.00 | | | | TOUT= 99.65 |
| TW | 52.9 | 73.2 | 84.7 | 93.4 | 101.8 | 107.9 | 117.7 | 126.6 | 134.8 | 134.8 |
| TL | 33.0 | 40.7 | 48.3 | 55.7 | 62.9 | 70.1 | 77.1 | 84.0 | 90.8 | 97.5 |
| HT | 0.173 | 0.109 | 0.097 | 0.094 | 0.091 | 0.093 | 0.087 | 0.083 | 0.080 | 0.095 |
| RUN NO.=15 | | | AQ= 5.33 | | | TIN= 39.30 | | | | TOUT=112.35 |
| TW | 61.4 | 84.5 | 97.1 | 106.0 | 114.7 | 120.9 | 131.8 | 140.7 | 143.8 | 151.1 |
| TL | 39.3 | 47.8 | 56.1 | 64.2 | 72.2 | 80.1 | 87.8 | 95.3 | 102.8 | 110.1 |
| HT | 0.241 | 0.145 | 0.120 | 0.127 | 0.125 | 0.130 | 0.121 | 0.117 | 0.115 | 0.130 |
| RUN NO.=16 | | | AQ= 7.11 | | | TIN= 45.20 | | | | TOUT=124.00 |
| TW | 68.7 | 93.6 | 106.5 | 116.1 | 124.9 | 132.2 | 143.2 | 151.1 | 162.9 | 166.7 |
| TL | 45.2 | 54.4 | 63.4 | 72.2 | 80.8 | 89.3 | 97.6 | 105.7 | 113.7 | 121.6 |
| HT | 0.302 | 0.181 | 0.165 | 0.162 | 0.161 | 0.165 | 0.155 | 0.156 | 0.144 | 0.157 |
| RUN NO.=17 | | | AQ= 8.88 | | | TIN= 51.00 | | | | TOUT=131.20 |
| TW | 76.1 | 102.6 | 115.7 | 125.1 | 134.5 | 140.5 | 150.9 | 160.6 | 170.8 | 175.9 |
| TL | 51.0 | 60.4 | 69.5 | 78.5 | 87.3 | 95.9 | 104.3 | 112.6 | 120.8 | 128.8 |
| HT | 0.353 | 0.210 | 0.102 | 0.190 | 0.188 | 0.199 | 0.194 | 0.185 | 0.177 | 0.188 |

## Table C-2 EXPERIMENTAL DATA FOR THERMOSIPHON REBOILER

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM-WATER | | | | | | | | | | | | | | | | |
| RUN NO.= 1 S= 96.88 AQ= 14.359 DELTSUB= 1.90QC= 2.5500 T1= 17.85 T2= 21.76 TC= 33.75 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 107.4 | 108.5 | 108.9 | 110.9 | 111.5 | 114.0 | 114.2 | 116.7 | 110.0 | 107.1 | 105.8 | 106.0 | 105.1 | 105.1 | 105.1 |
| TL | 98.9 | 99.0 | 99.2 | 99.3 | 99.5 | 99.7 | 100.0 | 100.2 | 100.5 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.40 | 1.71 | 1.54 | 1.48 | 1.27 | 1.22 | 1.02 | 1.03 | 0.88 | 1.54 | 2.26 | 2.82 | 2.71 | 3.23 | 3.23 | 3.23 |
| RUN NO.= 2 S= 96.88 AQ= 11.228 DELTSUB= 1.30QC= 2.3500 T1= 20.35 T2= 23.13 TC= 38.15 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 104.9 | 105.6 | 106.6 | 108.1 | 108.7 | 110.2 | 111.7 | 111.9 | 111.7 | 107.3 | 106.2 | 105.6 | 104.9 | 104.3 | 104.5 |
| TL | 99.5 | 99.5 | 99.6 | 99.7 | 99.8 | 100.0 | 100.1 | 100.3 | 100.4 | 100.6 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.82 | 2.10 | 1.88 | 1.62 | 1.36 | 1.29 | 1.11 | 0.98 | 0.98 | 1.01 | 1.71 | 2.04 | 2.29 | 2.67 | 3.12 | 2.95 |
| RUN NO.= 3 S= 97.57 AQ= 8.417 DELTSUB= 1.90QC= 1.8800 T1= 20.35 T2= 23.43 TC= 39.55 | | | | | | | | | | | | | | | | |
| TW | 102.2 | 103.6 | 103.6 | 105.6 | 107.3 | 107.9 | 109.6 | 111.9 | 111.9 | 110.4 | 106.2 | 105.8 | 104.9 | 104.3 | 103.6 | 103.6 |
| TL | 98.7 | 98.8 | 99.0 | 99.1 | 99.3 | 99.6 | 99.8 | 100.0 | 100.3 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 2.42 | 1.75 | 1.79 | 1.29 | 1.06 | 1.01 | 0.86 | 0.71 | 0.72 | 0.85 | 1.48 | 1.59 | 1.91 | 2.22 | 2.67 | 2.67 |
| RUN NO.= 4 S= 96.18 AQ= 5.880 DELTSUB= 1.90QC= 1.4000 T1= 20.80 T2= 23.29 TC= 26.80 | | | | | | | | | | | | | | | | |
| TW | 101.1 | 103.3 | 104.1 | 106.6 | 107.4 | 107.9 | 108.5 | 109.8 | 110.4 | 110.6 | 108.1 | 106.4 | 106.0 | 104.7 | 103.4 | 102.8 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.8 | 99.0 | 99.2 | 99.4 | 99.6 | 99.8 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.07 | 1.20 | 1.04 | 0.73 | 0.68 | 0.66 | 0.63 | 0.57 | 0.54 | 0.54 | 0.73 | 0.93 | 0.99 | 1.26 | 1.73 | 2.14 |
| RUN NO.= 5 S= 96.88 AQ= 5.931 DELTSUB= 1.90QC= 1.4000 T1= 20.80 T2= 23.31 TC= 26.80 | | | | | | | | | | | | | | | | |
| TW | 101.8 | 104.1 | 105.1 | 106.9 | 108.5 | 108.5 | 108.9 | 110.9 | 110.4 | 112.4 | 108.5 | 107.7 | 106.6 | 104.7 | 103.3 | 103.1 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.8 | 99.0 | 99.2 | 99.4 | 99.6 | 99.8 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.70 | 1.03 | 0.89 | 0.72 | 0.61 | 0.62 | 0.61 | 0.52 | 0.55 | 0.47 | 0.70 | 0.78 | 0.91 | 1.28 | 1.85 | 1.98 |
| RUN NO.= 6 S= 96.88 AQ= 3.672 DELTSUB= 1.45QC= 1.4000 T1= 21.60 T2= 22.86 TC= 28.80 | | | | | | | | | | | | | | | | |
| TW | 98.8 | 100.1 | 101.6 | 102.8 | 103.6 | 104.3 | 105.4 | 106.2 | 106.6 | 107.4 | 107.4 | 106.2 | 104.5 | 103.1 | 102.0 | 102.0 |
| TL | 98.5 | 98.5 | 98.6 | 98.7 | 98.8 | 99.0 | 99.1 | 99.3 | 99.4 | 99.6 | 99.7 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 11.21 | 2.44 | 1.25 | 0.89 | 0.76 | 0.69 | 0.59 | 0.53 | 0.51 | 0.47 | 0.47 | 0.58 | 0.79 | 1.15 | 1.71 | 1.71 |
| RUN NO.= 7 S= 96.18 AQ= 5.931 DELTSUB= 1.70QC= 0.9000 T1= 21.30 T2= 25.91 TC= 28.60 | | | | | | | | | | | | | | | | |
| TW | 101.8 | 103.9 | 104.7 | 105.6 | 107.5 | 108.3 | 108.9 | 110.9 | 110.3 | 108.1 | 105.1 | 103.9 | 103.3 | 103.3 | 102.8 | 102.8 |
| TL | 99.1 | 99.2 | 99.3 | 99.4 | 99.6 | 99.8 | 100.1 | 100.3 | 100.5 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.24 | 1.27 | 1.10 | 0.96 | 0.75 | 0.70 | 0.67 | 0.56 | 0.61 | 0.80 | 1.33 | 1.85 | 2.33 | 2.33 | 2.82 | 2.82 |
| RUN NO.= 8 S= 97.57 AQ= 3.652 DELTSUB= 20.02QC= 0.9000 T1= 21.80 T2= 23.76 TC= 25.55 | | | | | | | | | | | | | | | | |
| TW | 82.3 | 84.6 | 86.2 | 87.8 | 91.0 | 93.1 | 96.9 | 99.9 | 102.4 | 104.9 | 106.4 | 103.1 | 102.4 | 102.2 | 102.0 | 102.0 |
| TL | 81.1 | 82.1 | 83.1 | 84.1 | 86.1 | 88.1 | 90.1 | 92.1 | 94.1 | 96.1 | 98.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 3.04 | 1.40 | 1.16 | 0.99 | 0.74 | 0.72 | 0.53 | 0.47 | 0.44 | 0.41 | 0.44 | 1.22 | 1.57 | 1.71 | 1.89 | 1.89 |
| RUN NO.= 9 S= 95.49 AQ= 11.192 DELTSUB= 72.70QC= 1.8800 T1= 20.60 T2= 22.83 TC= 24.10 | | | | | | | | | | | | | | | | |
| TW | 48.9 | 52.4 | 55.7 | 59.4 | 65.3 | 73.2 | 79.7 | 86.9 | 93.5 | 101.6 | 107.3 | 112.1 | 105.8 | 104.3 | 103.9 | 104.1 |
| TL | 30.9 | 34.2 | 37.5 | 40.8 | 47.4 | 54.0 | 60.6 | 67.2 | 73.9 | 80.5 | 87.1 | 93.7 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.62 | 0.61 | 0.62 | 0.60 | 0.63 | 0.58 | 0.59 | 0.57 | 0.57 | 0.53 | 0.55 | 0.61 | 2.03 | 2.80 | 3.11 | 2.95 |
| RUN NO.= 10 S= 94.10 AQ= 11.192 DELTSUB= 66.80QC= 1.8800 T1= 21.35 T2= 24.23 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 53.3 | 57.1 | 59.2 | 63.3 | 69.0 | 75.9 | 81.9 | 89.7 | 95.0 | 102.0 | 109.1 | 105.8 | 103.9 | 103.7 | 103.4 | 103.4 |
| TL | 36.4 | 39.7 | 43.1 | 46.4 | 53.1 | 59.8 | 66.5 | 73.1 | 79.8 | 86.5 | 93.2 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 0.66 | 0.64 | 0.70 | 0.66 | 0.70 | 0.70 | 0.73 | 0.68 | 0.74 | 0.72 | 0.70 | 1.88 | 2.76 | 2.91 | 3.11 | 3.11 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 11 S= 94.79 AQ= 11.192 DELTSUB= 57.10QC= 1.8800 T1= 21.10 T2= 23.33 TC= 24.60 | | | | | | | | | | | | | | | | |
| TW | 61.2 | 64.2 | 66.9 | 70.3 | 76.5 | 81.6 | 87.1 | 93.5 | 97.9 | 104.8 | 110.0 | 114.6 | 106.6 | 104.7 | 104.3 | 104.3 |
| TL | 46.0 | 48.6 | 51.2 | 53.8 | 59.0 | 64.2 | 69.4 | 74.5 | 79.7 | 84.9 | 90.1 | 95.3 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 0.74 | 0.72 | 0.71 | 0.68 | 0.64 | 0.64 | 0.63 | 0.59 | 0.61 | 0.56 | 0.56 | 0.58 | 1.83 | 2.66 | 2.95 | 2.95 |
| RUN NO.= 12 S= 92.71 AQ= 11.192 DELTSUB= 48.75QC= 1.4000 T1= 21.35 T2= 25.22 TC= 24.80 | | | | | | | | | | | | | | | | |
| TW | 68.1 | 71.9 | 73.4 | 77.0 | 81.6 | 86.6 | 91.4 | 96.9 | 101.4 | 106.2 | 111.7 | 105.4 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 53.7 | 56.2 | 58.6 | 61.0 | 65.9 | 70.8 | 75.7 | 80.5 | 85.4 | 90.3 | 95.2 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.78 | 0.71 | 0.76 | 0.70 | 0.71 | 0.71 | 0.71 | 0.68 | 0.70 | 0.70 | 0.68 | 2.11 | 2.91 | 2.91 | 2.91 | 2.91 |
| RUN NO.= 13 S= 92.71 AQ= 11.192 DELTSUB= 42.90QC= 1.4000 T1= 22.80 T2= 26.66 TC= 26.80 | | | | | | | | | | | | | | | | |
| TW | 72.8 | 76.5 | 78.6 | 81.9 | 86.6 | 90.4 | 95.2 | 100.5 | 104.3 | 109.1 | 113.4 | 107.1 | 105.4 | 105.1 | 104.7 | 104.9 |
| TL | 60.6 | 62.7 | 64.9 | 67.0 | 71.3 | 75.6 | 79.9 | 84.2 | 88.5 | 92.7 | 97.0 | 101.3 | 101.4 | 101.4 | 101.4 | 101.4 |
| HT | 0.92 | 0.81 | 0.82 | 0.75 | 0.73 | 0.76 | 0.73 | 0.69 | 0.71 | 0.68 | 0.68 | 1.95 | 2.80 | 2.95 | 3.34 | 3.11 |
| RUN NO.= 14 S= 92.71 AQ= 11.264 DELTSUB= 40.40QC= 1.4000 T1= 22.10 T2= 25.99 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 75.9 | 79.3 | 80.8 | 82.5 | 87.8 | 90.8 | 96.1 | 100.7 | 104.3 | 108.9 | 112.8 | 105.8 | 104.5 | 104.3 | 104.1 | 104.1 |
| TL | 62.3 | 64.3 | 66.4 | 68.4 | 72.4 | 76.5 | 80.5 | 84.5 | 88.6 | 92.6 | 96.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 0.83 | 0.76 | 0.78 | 0.80 | 0.73 | 0.79 | 0.72 | 0.70 | 0.72 | 0.69 | 0.70 | 2.21 | 2.96 | 3.13 | 3.31 | 3.31 |
| RUN NO.= 15 S= 92.71 AQ= 11.264 DELTSUB= 8.90QC= 1.4000 T1= 21.60 T2= 26.37 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 100.9 | 104.8 | 106.0 | 107.4 | 108.8 | 107.9 | 109.8 | 112.1 | 113.1 | 113.6 | 111.7 | 105.8 | 104.8 | 104.3 | 104.3 | 104.3 |
| TL | 92.1 | 92.6 | 93.1 | 93.6 | 94.6 | 95.6 | 96.5 | 97.5 | 98.5 | 99.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 1.28 | 0.93 | 0.87 | 0.81 | 0.79 | 0.91 | 0.85 | 0.77 | 0.77 | 0.80 | 1.01 | 2.13 | 2.65 | 2.96 | 2.96 | 2.96 |
| RUN NO.= 16 S= 96.18 AQ= 11.264 DELTSUB= 32.00QC= 1.4000 T1= 21.30 T2= 24.27 TC= 32.30 | | | | | | | | | | | | | | | | |
| TW | 83.4 | 86.2 | 87.8 | 89.3 | 90.8 | 94.6 | 97.9 | 101.1 | 104.7 | 107.9 | 110.9 | 113.6 | 105.6 | 104.1 | 103.9 | 103.9 |
| TL | 69.8 | 71.2 | 72.7 | 74.1 | 77.0 | 79.9 | 82.8 | 85.7 | 88.7 | 91.6 | 94.5 | 97.4 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.83 | 0.75 | 0.75 | 0.74 | 0.82 | 0.77 | 0.75 | 0.73 | 0.70 | 0.69 | 0.69 | 0.69 | 2.12 | 2.96 | 3.13 | 3.13 |
| RUN NO.= 17 S= 100.35 AQ= 11.300 DELTSUB= 19.10QC= 1.4000 T1= 19.85 T2= 21.94 TC= 37.90 | | | | | | | | | | | | | | | | |
| TW | 92.9 | 96.1 | 96.3 | 97.9 | 99.0 | 101.1 | 103.1 | 105.6 | 107.7 | 108.9 | 111.5 | 112.6 | 113.2 | 106.2 | 104.3 | 104.3 |
| TL | 81.9 | 82.7 | 83.5 | 84.3 | 85.9 | 87.5 | 89.1 | 90.7 | 92.3 | 93.9 | 95.5 | 97.1 | 98.7 | 100.3 | 100.3 | 100.3 |
| HT | 1.03 | 0.85 | 0.89 | 0.83 | 0.86 | 0.83 | 0.81 | 0.76 | 0.73 | 0.75 | 0.71 | 0.73 | 0.78 | 1.90 | 2.79 | 2.79 |
| RUN NO.= 18 S= 99.65 AQ= 14.111 DELTSUB= 65.20QC= 1.8800 T1= 22.10 T2= 24.88 TC= 30.40 | | | | | | | | | | | | | | | | |
| TW | 58.7 | 62.6 | 65.1 | 68.8 | 73.9 | 79.7 | 85.3 | 90.8 | 95.6 | 102.2 | 108.3 | 114.0 | 107.7 | 105.6 | 105.1 | 105.1 |
| TL | 38.5 | 41.4 | 44.4 | 47.3 | 53.3 | 59.2 | 65.1 | 71.0 | 77.0 | 82.9 | 88.8 | 94.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 0.70 | 0.67 | 0.68 | 0.66 | 0.69 | 0.69 | 0.70 | 0.71 | 0.76 | 0.73 | 0.72 | 0.73 | 2.00 | 2.88 | 3.17 | 3.17 |
| RUN NO.= 19 S= 98.96 AQ= 14.111 DELTSUB= 53.45QC= 1.8800 T1= 22.30 T2= 25.10 TC= 26.55 | | | | | | | | | | | | | | | | |
| TW | 68.1 | 71.6 | 74.1 | 76.3 | 79.7 | 84.7 | 90.0 | 95.6 | 100.1 | 103.7 | 109.1 | 114.6 | 107.3 | 105.8 | 105.1 | 105.4 |
| TL | 49.9 | 52.3 | 54.7 | 57.2 | 62.0 | 66.9 | 71.7 | 76.6 | 81.4 | 86.3 | 91.2 | 96.0 | 100.9 | 100.9 | 100.9 | 100.9 |
| HT | 0.78 | 0.73 | 0.73 | 0.74 | 0.80 | 0.79 | 0.77 | 0.74 | 0.76 | 0.81 | 0.78 | 0.76 | 2.21 | 2.91 | 3.32 | 3.17 |
| RUN NO.= 20 S= 99.65 AQ= 14.111 DELTSUB= 46.10QC= 2.8000 T1= 22.80 T2= 24.68 TC= 26.55 | | | | | | | | | | | | | | | | |
| TW | 75.9 | 78.3 | 77.9 | 79.9 | 85.4 | 89.7 | 93.8 | 98.4 | 102.4 | 106.6 | 110.9 | 115.1 | 107.1 | 105.8 | 105.6 | 105.6 |
| TL | 57.1 | 59.2 | 61.3 | 63.4 | 67.6 | 71.8 | 75.9 | 80.1 | 84.3 | 88.5 | 92.7 | 96.9 | 101.1 | 101.1 | 101.1 | 101.1 |
| HT | 0.75 | 0.74 | 0.85 | 0.85 | 0.79 | 0.79 | 0.79 | 0.77 | 0.78 | 0.78 | 0.78 | 0.77 | 2.36 | 3.03 | 3.14 | 3.14 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 21 S= 99.65 AQ= 14.235 DELTSUB= 39.30QC= 2.8000 T1= 21.60 T2= 23.50 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 80.1 | 82.9 | 83.4 | 84.0 | 88.6 | 92.1 | 96.5 | 99.9 | 103.4 | 107.7 | 111.1 | 114.9 | 105.8 | 104.7 | 104.3 | 104.3 |
| TL | 62.5 | 64.3 | 66.1 | 67.9 | 71.5 | 75.0 | 78.6 | 82.2 | 85.8 | 89.3 | 92.9 | 96.5 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.81 | 0.77 | 0.83 | 0.88 | 0.83 | 0.84 | 0.80 | 0.81 | 0.80 | 0.78 | 0.78 | 0.78 | 2.50 | 3.06 | 3.35 | 3.35 |
| RUN NO.= 22 S= 99.65 AQ= 14.111 DELTSUB= 29.30QC= 2.8000 T1= 21.80 T2= 23.68 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 88.6 | 91.9 | 91.9 | 91.2 | 96.3 | 97.5 | 101.1 | 104.7 | 107.1 | 111.1 | 113.4 | 116.5 | 106.6 | 104.9 | 104.5 | 104.7 |
| TL | 72.5 | 73.9 | 75.2 | 76.5 | 79.2 | 81.9 | 84.5 | 87.2 | 89.8 | 92.5 | 95.2 | 97.8 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 0.88 | 0.78 | 0.85 | 0.96 | 0.83 | 0.90 | 0.85 | 0.81 | 0.82 | 0.76 | 0.77 | 0.76 | 2.31 | 3.17 | 3.53 | 3.36 |
| RUN NO.= 23 S= 96.88 AQ= 14.524 DELTSUB= 21.25QC= 1.4000 T1= 23.10 T2= 26.97 TC= 27.10 | | | | | | | | | | | | | | | | |
| TW | 94.8 | 98.4 | 99.4 | 100.3 | 101.1 | 103.3 | 106.0 | 108.3 | 110.6 | 112.6 | 115.1 | 116.8 | 107.9 | 105.8 | 105.1 | 105.1 |
| TL | 80.8 | 81.8 | 82.7 | 83.7 | 85.6 | 87.6 | 89.5 | 91.4 | 93.4 | 95.3 | 97.2 | 99.2 | 101.1 | 101.1 | 101.1 | 101.1 |
| HT | 1.04 | 0.88 | 0.87 | 0.88 | 0.94 | 0.93 | 0.88 | 0.86 | 0.84 | 0.84 | 0.82 | 0.83 | 2.13 | 3.09 | 3.59 | 3.59 |
| RUN NO.= 24 S= 100.35 AQ= 14.524 DELTSUB= 11.25QC= 1.4000 T1= 21.35 T2= 25.13 TC= 41.00 | | | | | | | | | | | | | | | | |
| TW | 100.9 | 103.6 | 105.6 | 107.9 | 109.4 | 108.9 | 110.0 | 111.3 | 113.4 | 114.2 | 113.6 | 114.4 | 109.6 | 106.2 | 105.1 | 104.9 |
| TL | 89.8 | 90.3 | 90.8 | 91.3 | 92.3 | 93.3 | 94.4 | 95.4 | 96.4 | 97.4 | 98.5 | 99.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 1.30 | 1.09 | 0.98 | 0.87 | 0.85 | 0.93 | 0.93 | 0.91 | 0.85 | 0.87 | 0.96 | 0.97 | 1.60 | 2.55 | 3.12 | 3.26 |
| RUN NO.= 25 S= 99.65 AQ= 8.417 DELTSUB= 3.35QC= 1.8800 T1= 21.85 T2= 25.41 TC= 40.25 | | | | | | | | | | | | | | | | |
| TW | 102.4 | 104.1 | 104.5 | 106.2 | 107.3 | 109.4 | 111.4 | 113.4 | 113.1 | 112.8 | 111.6 | 106.9 | 104.9 | 104.8 | 103.9 | 103.9 |
| TL | 98.0 | 98.2 | 98.5 | 98.7 | 99.2 | 99.7 | 100.1 | 100.6 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 |
| HT | 1.91 | 1.43 | 1.40 | 1.12 | 1.04 | 0.87 | 0.75 | 0.66 | 0.70 | 0.72 | 0.81 | 1.46 | 2.19 | 2.31 | 3.01 | 3.01 |
| RUN NO.= 26 S= 96.88 AQ= 8.417 DELTSUB= 72.75QC= 1.8800 T1= 22.60 T2= 24.27 TC= 29.40 | | | | | | | | | | | | | | | | |
| TW | 48.9 | 52.2 | 55.2 | 58.9 | 65.8 | 72.8 | 79.9 | 87.1 | 93.8 | 101.1 | 107.9 | 110.0 | 105.8 | 104.9 | 104.3 | 104.5 |
| TL | 32.1 | 35.4 | 38.7 | 42.0 | 48.7 | 55.3 | 61.9 | 68.5 | 75.1 | 81.7 | 88.4 | 95.0 | 101.6 | 101.6 | 101.6 | 101.6 |
| HT | 0.50 | 0.50 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.45 | 0.45 | 0.43 | 0.43 | 0.56 | 1.98 | 2.48 | 3.06 | 2.85 |
| RUN NO.= 27 S= 94.79 AQ= 8.417 DELTSUB= 64.15QC= 1.8800 T1= 21.80 T2= 23.97 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 52.7 | 56.4 | 59.8 | 63.3 | 69.9 | 76.8 | 83.4 | 90.1 | 96.7 | 102.4 | 108.1 | 107.1 | 104.9 | 104.8 | 104.3 | 104.3 |
| TL | 40.4 | 43.6 | 46.8 | 50.0 | 56.4 | 62.9 | 69.3 | 75.7 | 82.1 | 88.5 | 94.9 | 101.3 | 101.4 | 101.4 | 101.4 | 101.4 |
| HT | 0.68 | 0.66 | 0.65 | 0.64 | 0.63 | 0.61 | 0.60 | 0.58 | 0.58 | 0.61 | 0.64 | 1.47 | 2.34 | 2.48 | 2.85 | 2.85 |
| RUN NO.= 28 S= 94.10 AQ= 8.417 DELTSUB= 52.85QC= 1.8800 T1= 21.30 T2= 23.47 TC= 24.60 | | | | | | | | | | | | | | | | |
| TW | 61.2 | 64.6 | 67.4 | 70.5 | 75.9 | 81.6 | 87.1 | 93.6 | 99.2 | 104.9 | 108.9 | 104.8 | 103.4 | 103.3 | 103.1 | 103.1 |
| TL | 49.8 | 52.5 | 55.1 | 57.8 | 63.1 | 68.3 | 73.6 | 78.9 | 84.2 | 89.5 | 94.8 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.74 | 0.69 | 0.69 | 0.66 | 0.66 | 0.64 | 0.62 | 0.58 | 0.56 | 0.54 | 0.59 | 1.79 | 2.48 | 2.63 | 2.81 | 2.81 |
| RUN NO.= 29 S= 92.71 AQ= 8.417 DELTSUB= 44.90QC= 1.8800 T1= 20.60 T2= 22.77 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 69.4 | 72.1 | 73.6 | 76.8 | 81.4 | 86.4 | 91.6 | 96.4 | 100.3 | 105.8 | 107.9 | 103.4 | 102.6 | 102.6 | 102.6 | 102.6 |
| TL | 56.7 | 59.0 | 61.2 | 63.5 | 68.0 | 72.5 | 77.0 | 81.4 | 85.9 | 90.4 | 94.9 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 0.66 | 0.64 | 0.68 | 0.63 | 0.63 | 0.60 | 0.57 | 0.56 | 0.59 | 0.55 | 0.65 | 2.08 | 2.63 | 2.63 | 2.63 | 2.63 |
| RUN NO.= 30 S= 92.71 AQ= 8.417 DELTSUB= 38.45QC= 1.8800 T1= 20.80 T2= 22.97 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 74.5 | 77.4 | 78.3 | 81.4 | 85.6 | 89.1 | 93.8 | 99.0 | 102.2 | 106.6 | 108.5 | 103.4 | 102.6 | 102.6 | 102.2 | 102.4 |
| TL | 63.1 | 65.0 | 67.0 | 68.9 | 72.7 | 76.6 | 80.4 | 84.3 | 88.1 | 92.0 | 95.8 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 0.74 | 0.68 | 0.74 | 0.67 | 0.66 | 0.68 | 0.63 | 0.57 | 0.60 | 0.57 | 0.66 | 2.22 | 2.85 | 2.85 | 3.30 | 3.06 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 31 S= 96.88 AQ= 8.541 DELTSUB= 7.55QC= 1.4000 T1= 21.10 T2= 23.36 TC= 30.65 | | | | | | | | | | | | | | | | |
| TW | 99.2 | 102.2 | 102.8 | 104.8 | 106.2 | 106.0 | 107.4 | 109.6 | 110.6 | 111.3 | 112.4 | 112.6 | 107.4 | 105.6 | 103.6 | 103.3 |
| TL | 92.8 | 93.2 | 93.5 | 93.9 | 94.6 | 95.2 | 95.9 | 96.6 | 97.3 | 98.0 | 98.7 | 99.4 | 100.0 | 100.1 | 100.1 | 100.1 |
| HT | 1.34 | 0.95 | 0.92 | 0.79 | 0.73 | 0.79 | 0.74 | 0.66 | 0.64 | 0.64 | 0.62 | 0.65 | 1.15 | 1.55 | 2.37 | 2.67 |
| RUN NO.= 32 S= 96.88 AQ= 8.572 DELTSUB= 21.05QC= 1.4000 T1= 21.10 T2= 23.38 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 88.4 | 91.2 | 91.9 | 94.4 | 96.1 | 98.6 | 101.1 | 103.7 | 106.2 | 108.9 | 111.3 | 111.9 | 106.4 | 103.3 | 102.8 | 102.8 |
| TL | 80.0 | 80.9 | 81.9 | 82.8 | 84.7 | 86.6 | 88.6 | 90.5 | 92.4 | 94.3 | 96.2 | 98.1 | 100.0 | 100.1 | 100.1 | 100.1 |
| HT | 1.02 | 0.83 | 0.86 | 0.74 | 0.76 | 0.72 | 0.68 | 0.65 | 0.62 | 0.59 | 0.57 | 0.62 | 1.35 | 2.68 | 3.12 | 3.12 |
| RUN NO.= 33 S= 96.18 AQ= 8.417 DELTSUB= 27.75QC= 1.4000 T1= 21.60 T2= 23.84 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 83.4 | 86.0 | 87.3 | 89.1 | 92.9 | 94.4 | 98.8 | 101.8 | 105.1 | 108.5 | 111.3 | 111.5 | 104.5 | 103.6 | 103.3 | 103.3 |
| TL | 73.8 | 75.0 | 76.3 | 77.5 | 80.1 | 82.6 | 85.1 | 87.6 | 90.1 | 92.7 | 95.2 | 97.7 | 100.2 | 100.3 | 100.3 | 100.3 |
| HT | 0.88 | 0.77 | 0.76 | 0.73 | 0.66 | 0.71 | 0.61 | 0.60 | 0.56 | 0.53 | 0.52 | 0.61 | 1.97 | 2.48 | 2.81 | 2.81 |
| RUN NO.= 34 S= 98.96 AQ= 14.524 DELTSUB= 2.00QC= 1.8800 T1= 20.10 T2= 26.28 TC= 35.25 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 105.4 | 105.1 | 106.9 | 108.8 | 110.0 | 111.3 | 113.0 | 107.4 | 106.2 | 105.6 | 104.7 | 104.3 | 104.1 | 103.8 | 104.1 |
| TL | 97.9 | 98.0 | 98.2 | 98.3 | 98.6 | 98.9 | 99.2 | 99.5 | 99.7 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 |
| HT | 2.61 | 1.99 | 2.08 | 1.70 | 1.43 | 1.31 | 1.20 | 1.07 | 1.89 | 2.25 | 2.50 | 2.93 | 3.19 | 3.34 | 3.59 | 3.34 |
| RUN NO.= 35 S= 97.57 AQ= 11.300 DELTSUB= 3.20QC= 1.8800 T1= 21.70 T2= 26.46 TC= 41.70 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 105.1 | 106.2 | 106.9 | 108.1 | 110.2 | 112.1 | 114.4 | 107.1 | 106.4 | 106.4 | 106.4 | 105.1 | 104.3 | 104.3 | 104.3 |
| TL | 97.9 | 98.2 | 98.4 | 98.6 | 99.1 | 99.5 | 100.0 | 100.4 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 |
| HT | 2.05 | 1.62 | 1.45 | 1.37 | 1.25 | 1.06 | 0.93 | 0.81 | 1.84 | 2.05 | 2.05 | 2.05 | 2.66 | 3.32 | 3.32 | 3.32 |
| RUN NO.= 36 S= 98.96 AQ= 8.448 DELTSUB= 3.60QC= 1.4000 T1= 22.05 T2= 26.83 TC= 41.90 | | | | | | | | | | | | | | | | |
| TW | 102.0 | 103.6 | 104.7 | 105.4 | 107.7 | 108.8 | 110.6 | 113.1 | 109.1 | 108.3 | 107.7 | 107.1 | 106.2 | 105.1 | 103.6 | 103.6 |
| TL | 97.4 | 97.6 | 97.9 | 98.1 | 98.6 | 99.2 | 99.7 | 100.2 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 1.82 | 1.40 | 1.24 | 1.17 | 0.93 | 0.88 | 0.77 | 0.65 | 1.00 | 1.11 | 1.21 | 1.33 | 1.54 | 1.90 | 2.86 | 2.86 |
| RUN NO.= 37 S= 98.96 AQ= 5.880 DELTSUB= 12.75QC= 1.4000 T1= 21.60 T2= 23.14 TC= 37.40 | | | | | | | | | | | | | | | | |
| TW | 95.4 | 97.5 | 98.4 | 99.4 | 100.5 | 102.0 | 103.1 | 105.4 | 107.1 | 109.6 | 110.4 | 111.3 | 110.9 | 104.3 | 103.1 | 102.6 |
| TL | 88.1 | 88.7 | 89.2 | 89.8 | 91.0 | 92.1 | 93.3 | 94.5 | 95.6 | 96.8 | 97.9 | 99.1 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.80 | 0.67 | 0.65 | 0.61 | 0.62 | 0.60 | 0.60 | 0.54 | 0.51 | 0.46 | 0.47 | 0.48 | 0.55 | 1.45 | 2.10 | 2.50 |
| RUN NO.= 38 S= 99.65 AQ= 5.880 DELTSUB= 27.75QC= 1.4000 T1= 21.10 T2= 22.66 TC= 28.95 | | | | | | | | | | | | | | | | |
| TW | 79.0 | 81.4 | 82.1 | 83.8 | 87.8 | 91.0 | 94.6 | 98.4 | 101.4 | 104.5 | 107.9 | 110.6 | 104.9 | 103.1 | 102.6 | 102.6 |
| TL | 73.6 | 74.8 | 76.1 | 77.3 | 79.9 | 82.4 | 84.9 | 87.4 | 90.0 | 92.5 | 95.0 | 97.5 | 100.0 | 100.1 | 100.1 | 100.1 |
| HT | 1.08 | 0.89 | 0.99 | 0.91 | 0.75 | 0.68 | 0.61 | 0.54 | 0.52 | 0.49 | 0.46 | 0.45 | 1.20 | 1.96 | 2.31 | 2.31 |
| RUN NO.= 39 S= 99.65 AQ= 3.631 DELTSUB= 38.15QC= 0.9000 T1= 20.60 T2= 22.54 TC= 27.80 | | | | | | | | | | | | | | | | |
| TW | 69.0 | 71.4 | 72.9 | 75.4 | 79.6 | 83.6 | 88.4 | 93.1 | 97.3 | 102.2 | 106.0 | 104.7 | 103.1 | 102.2 | 101.8 | 101.8 |
| TL | 63.8 | 65.7 | 67.6 | 69.5 | 73.3 | 77.1 | 81.0 | 84.8 | 88.6 | 92.4 | 96.2 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.70 | 0.64 | 0.68 | 0.62 | 0.57 | 0.56 | 0.49 | 0.44 | 0.42 | 0.37 | 0.37 | 0.78 | 1.21 | 1.69 | 2.14 | 2.14 |
| RUN NO.= 40 S= 99.65 AQ= 3.631 DELTSUB= 12.35QC= 0.9000 T1= 20.60 T2= 22.55 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 88.8 | 91.0 | 91.4 | 93.1 | 95.0 | 96.9 | 99.0 | 101.6 | 103.3 | 105.1 | 107.4 | 104.7 | 102.6 | 102.0 | 101.8 | 101.8 |
| TL | 87.9 | 88.5 | 89.2 | 89.8 | 91.0 | 92.2 | 93.5 | 94.7 | 95.9 | 97.2 | 98.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 4.12 | 1.47 | 1.62 | 1.09 | 0.91 | 0.78 | 0.66 | 0.53 | 0.50 | 0.46 | 0.40 | 0.72 | 1.23 | 1.55 | 1.73 | 1.73 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 41 S= 96.88 AQ= 5.854 DELTSUB= 39.30QC= 0.9000 T1= 21.30 T2= 24.44 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 72.1 | 74.1 | 75.6 | 78.8 | 82.9 | 87.1 | 91.6 | 96.7 | 100.7 | 105.1 | 109.4 | 107.1 | 103.3 | 102.8 | 102.6 | 102.6 |
| TL | 62.7 | 64.7 | 66.6 | 68.6 | 72.5 | 76.5 | 80.4 | 84.3 | 88.2 | 92.2 | 96.1 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.63 | 0.62 | 0.65 | 0.57 | 0.56 | 0.55 | 0.52 | 0.47 | 0.47 | 0.45 | 0.44 | 0.83 | 1.83 | 2.13 | 2.30 | 2.30 |
| RUN NO.= 42 S= 99.65 AQ= 5.906 DELTSUB= 19.55QC= 0.9000 T1= 21.30 T2= 23.75 TC= 26.55 | | | | | | | | | | | | | | | | |
| TW | 89.5 | 91.6 | 92.5 | 93.8 | 96.7 | 97.5 | 100.1 | 102.6 | 104.8 | 107.1 | 109.1 | 110.4 | 105.8 | 103.3 | 102.8 | 102.8 |
| TL | 81.8 | 82.7 | 83.6 | 84.5 | 86.3 | 88.1 | 89.8 | 91.6 | 93.4 | 95.2 | 96.9 | 98.7 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 0.77 | 0.66 | 0.66 | 0.64 | 0.57 | 0.63 | 0.58 | 0.54 | 0.52 | 0.50 | 0.48 | 0.50 | 1.11 | 2.15 | 2.57 | 2.57 |
| RUN NO.= 43 S= 97.57 AQ= 3.652 DELTSUB= 30.85QC= 0.9000 T1= 21.80 T2= 24.21 TC= 24.55 | | | | | | | | | | | | | | | | |
| TW | 76.5 | 78.6 | 80.7 | 82.9 | 87.3 | 90.4 | 94.1 | 98.1 | 102.2 | 106.2 | 105.6 | 102.8 | 102.4 | 102.4 | 102.0 | 102.2 |
| TL | 70.9 | 72.6 | 74.3 | 76.1 | 79.5 | 82.9 | 86.3 | 89.8 | 93.2 | 96.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.65 | 0.62 | 0.57 | 0.53 | 0.47 | 0.49 | 0.47 | 0.43 | 0.40 | 0.38 | 0.66 | 1.33 | 1.55 | 1.55 | 1.87 | 1.70 |
| RUN NO.= 44 S= 93.40 AQ= 14.111 DELTSUB= 2.95QC= 4.7500 T1= 21.10 T2= 23.50 TC= 28.60 | | | | | | | | | | | | | | | | |
| TW | 103.9 | 106.0 | 106.6 | 108.3 | 110.3 | 111.9 | 114.9 | 115.3 | 106.9 | 107.3 | 107.4 | 106.4 | 104.9 | 104.7 | 104.7 | 104.5 |
| TL | 97.3 | 97.5 | 97.7 | 97.9 | 98.4 | 98.8 | 99.2 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.14 | 1.66 | 1.59 | 1.36 | 1.19 | 1.08 | 0.90 | 0.90 | 2.07 | 1.96 | 1.91 | 2.22 | 2.88 | 3.03 | 3.03 | 3.17 |
| RUN NO.= 45 S= 99.65 AQ= 11.012 DELTSUB= 3.35QC= 4.7500 T1= 21.10 T2= 22.95 TC= 35.70 | | | | | | | | | | | | | | | | |
| TW | 102.6 | 103.9 | 104.1 | 106.0 | 107.7 | 109.1 | 111.9 | 114.2 | 107.1 | 106.6 | 106.6 | 107.4 | 106.9 | 104.9 | 103.9 | 103.9 |
| TL | 96.9 | 97.2 | 97.4 | 97.7 | 98.1 | 98.6 | 99.1 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.95 | 1.64 | 1.65 | 1.32 | 1.15 | 1.04 | 0.86 | 0.75 | 1.57 | 1.68 | 1.68 | 1.49 | 1.62 | 2.25 | 2.86 | 2.86 |
| RUN NO.= 46 S= 100.35 AQ= 8.108 DELTSUB= 4.00QC= 4.7500 T1= 21.10 T2= 22.46 TC= 38.65 | | | | | | | | | | | | | | | | |
| TW | 100.9 | 102.6 | 102.2 | 104.1 | 106.0 | 107.7 | 109.6 | 111.7 | 108.3 | 109.4 | 109.1 | 107.3 | 106.6 | 104.9 | 103.6 | 103.4 |
| TL | 96.3 | 96.6 | 96.9 | 97.2 | 97.8 | 98.3 | 98.9 | 99.5 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.78 | 1.36 | 1.53 | 1.17 | 0.98 | 0.87 | 0.76 | 0.66 | 0.98 | 0.87 | 0.89 | 1.13 | 1.24 | 1.65 | 2.25 | 2.38 |
| RUN NO.= 47 S= 100.35 AQ= 5.673 DELTSUB= 12.10QC= 4.7500 T1= 20.10 T2= 20.54 TC= 36.90 | | | | | | | | | | | | | | | | |
| TW | 93.3 | 95.2 | 95.6 | 97.3 | 98.6 | 101.4 | 102.2 | 104.5 | 106.0 | 107.4 | 108.9 | 111.1 | 109.6 | 108.8 | 103.9 | 102.8 |
| TL | 88.3 | 88.9 | 89.4 | 90.0 | 91.1 | 92.2 | 93.3 | 94.4 | 95.5 | 96.6 | 97.7 | 98.8 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.13 | 0.89 | 0.91 | 0.77 | 0.76 | 0.62 | 0.63 | 0.56 | 0.54 | 0.52 | 0.50 | 0.46 | 0.58 | 0.64 | 1.40 | 1.92 |
| RUN NO.= 48 S= 96.18 AQ= 8.355 DELTSUB= 3.40QC= 5.7000 T1= 23.30 T2= 24.47 TC= 34.25 | | | | | | | | | | | | | | | | |
| TW | 102.1 | 104.9 | 106.0 | 107.6 | 109.8 | 110.6 | 111.9 | 112.4 | 111.5 | 111.5 | 108.1 | 105.1 | 103.6 | 103.3 | 102.6 | 102.6 |
| TL | 96.7 | 96.9 | 97.2 | 97.4 | 97.9 | 98.4 | 98.9 | 99.4 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.53 | 1.05 | 0.95 | 0.82 | 0.70 | 0.68 | 0.64 | 0.64 | 0.72 | 0.72 | 1.01 | 1.58 | 2.20 | 2.46 | 3.04 | 3.04 |
| RUN NO.= 49 S= 95.49 AQ= 8.355 DELTSUB= 63.45QC= 5.7000 T1= 23.30 T2= 24.00 TC= 34.25 | | | | | | | | | | | | | | | | |
| TW | 57.5 | 59.8 | 63.7 | 66.9 | 72.9 | 78.3 | 85.6 | 91.2 | 97.1 | 103.3 | 109.1 | 107.9 | 103.6 | 102.6 | 102.4 | 102.4 |
| TL | 39.4 | 42.6 | 45.7 | 48.9 | 55.3 | 61.6 | 68.0 | 74.3 | 80.7 | 87.0 | 93.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 0.46 | 0.48 | 0.46 | 0.46 | 0.47 | 0.50 | 0.47 | 0.49 | 0.51 | 0.51 | 0.53 | 1.01 | 2.09 | 2.83 | 3.04 | 3.04 |
| RUN NO.= 50 S= 97.57 AQ= 14.400 DELTSUB= 48.05QC= 5.7000 T1= 23.05 T2= 23.98 TC= 36.45 | | | | | | | | | | | | | | | | |
| TW | 73.6 | 76.8 | 79.3 | 82.5 | 87.1 | 89.9 | 95.4 | 100.3 | 104.3 | 108.8 | 113.0 | 113.4 | 105.8 | 104.7 | 104.3 | 104.3 |
| TL | 54.4 | 56.6 | 58.8 | 60.9 | 65.3 | 69.7 | 74.1 | 78.4 | 82.8 | 87.2 | 91.5 | 95.9 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.75 | 0.71 | 0.70 | 0.67 | 0.66 | 0.71 | 0.67 | 0.66 | 0.67 | 0.67 | 0.67 | 0.82 | 2.62 | 3.24 | 3.56 | 3.56 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 51 S= 98.26 AQ= 14.400 DELTSUB= 1.50QC= 5.7000 T1= 20.55 T2= 22.03 TC= 33.55 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 106.0 | 105.8 | 106.4 | 107.7 | 108.8 | 110.0 | 110.3 | 110.4 | 110.9 | 107.9 | 106.6 | 106.0 | 105.1 | 104.9 | 104.9 |
| TL | 99.1 | 99.2 | 99.2 | 99.3 | 99.5 | 99.7 | 99.8 | 100.0 | 100.2 | 100.3 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 3.30 | 2.11 | 2.20 | 2.04 | 1.76 | 1.59 | 1.42 | 1.40 | 1.40 | 1.36 | 1.95 | 2.36 | 2.62 | 3.10 | 3.24 | 3.24 |
| RUN NO.= 52 S= 96.88 AQ= 14.400 DELTSUB= 2.35QC= 5.7000 T1= 21.05 T2= 22.53 TC= 34.00 | | | | | | | | | | | | | | | | |
| TW | 104.1 | 106.0 | 105.6 | 106.9 | 107.9 | 108.1 | 108.8 | 110.3 | 110.9 | 111.1 | 108.9 | 106.9 | 106.0 | 105.8 | 104.7 | 104.9 |
| TL | 98.5 | 98.6 | 98.7 | 98.9 | 99.1 | 99.4 | 99.7 | 99.9 | 100.2 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.56 | 1.95 | 2.12 | 1.81 | 1.64 | 1.65 | 1.58 | 1.39 | 1.34 | 1.36 | 1.75 | 2.34 | 2.72 | 2.82 | 3.60 | 3.39 |
| RUN NO.= 53 S= 97.57 AQ= 3.487 DELTSUB= 2.55QC= 5.7000 T1= 21.10 T2= 21.46 TC= 38.15 | | | | | | | | | | | | | | | | |
| TW | 99.0 | 100.5 | 101.6 | 103.3 | 103.9 | 103.9 | 104.8 | 105.8 | 106.0 | 106.2 | 105.1 | 104.9 | 102.4 | 102.4 | 102.4 | 101.6 |
| TL | 97.2 | 97.4 | 97.5 | 97.7 | 98.0 | 98.2 | 98.5 | 98.8 | 99.1 | 99.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.98 | 1.12 | 0.87 | 0.62 | 0.59 | 0.62 | 0.56 | 0.50 | 0.51 | 0.51 | 0.63 | 0.66 | 1.27 | 1.27 | 1.27 | 1.84 |
| RUN NO.= 54 S= 97.57 AQ= 3.487 DELTSUB= 2.75QC= 5.7000 T1= 21.10 T2= 21.39 TC= 37.20 | | | | | | | | | | | | | | | | |
| TW | 97.9 | 100.1 | 101.1 | 101.1 | 103.1 | 103.3 | 104.1 | 105.1 | 105.8 | 106.4 | 106.6 | 104.1 | 102.8 | 102.4 | 101.6 | 101.6 |
| TL | 96.8 | 97.0 | 97.1 | 97.3 | 97.5 | 97.8 | 98.1 | 98.4 | 98.6 | 98.9 | 99.2 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 3.13 | 1.13 | 0.87 | 0.91 | 0.63 | 0.64 | 0.58 | 0.51 | 0.49 | 0.46 | 0.47 | 0.75 | 1.04 | 1.18 | 1.66 | 1.66 |
| RUN NO.= 55 S= 100.35 AQ= 3.507 DELTSUB= 14.95QC= 0.9000 T1= 20.60 T2= 22.49 TC= 23.80 | | | | | | | | | | | | | | | | |
| TW | 89.1 | 91.0 | 91.6 | 92.7 | 95.0 | 96.7 | 99.9 | 101.6 | 103.4 | 105.8 | 108.1 | 106.6 | 103.4 | 102.8 | 102.4 | 102.4 |
| TL | 85.8 | 86.6 | 87.3 | 88.1 | 89.6 | 91.1 | 92.6 | 94.1 | 95.6 | 97.1 | 98.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.10 | 0.80 | 0.81 | 0.76 | 0.65 | 0.62 | 0.48 | 0.47 | 0.44 | 0.40 | 0.37 | 0.53 | 1.03 | 1.28 | 1.49 | 1.49 |
| RUN NO.= 56 S= 100.35 AQ= 3.507 DELTSUB= 10.40QC= 1.4000 T1= 20.60 T2= 21.81 TC= 25.80 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 94.8 | 95.0 | 95.9 | 97.9 | 98.8 | 100.7 | 102.4 | 104.8 | 106.6 | 108.1 | 107.3 | 103.3 | 102.2 | 101.8 | 101.8 |
| TL | 89.8 | 90.3 | 90.8 | 91.3 | 92.4 | 93.4 | 94.4 | 95.5 | 96.5 | 97.6 | 98.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.20 | 0.78 | 0.84 | 0.78 | 0.63 | 0.65 | 0.56 | 0.51 | 0.43 | 0.39 | 0.37 | 0.46 | 0.97 | 1.38 | 1.63 | 1.63 |
| RUN NO.= 57 S= 97.57 AQ= 3.631 DELTSUB= 7.80QC= 1.4000 T1= 21.60 T2= 22.85 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 95.0 | 95.6 | 96.7 | 98.6 | 99.6 | 101.4 | 102.9 | 104.3 | 105.6 | 106.4 | 103.6 | 102.6 | 101.6 | 101.4 | 101.4 |
| TL | 91.8 | 92.2 | 92.6 | 93.0 | 93.7 | 94.5 | 95.3 | 96.1 | 96.9 | 97.6 | 98.4 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.77 | 1.29 | 1.18 | 0.97 | 0.75 | 0.71 | 0.60 | 0.54 | 0.49 | 0.46 | 0.45 | 0.81 | 1.07 | 1.55 | 1.69 | 1.69 |
| RUN NO.= 58 S= 97.57 AQ= 3.610 DELTSUB= 7.80QC= 1.4000 T1= 21.60 T2= 22.85 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 96.1 | 96.1 | 96.9 | 98.1 | 99.4 | 102.0 | 104.1 | 104.8 | 106.0 | 107.1 | 106.0 | 102.2 | 101.8 | 101.6 | 101.1 |
| TL | 91.8 | 92.2 | 92.6 | 93.0 | 93.7 | 94.5 | 95.3 | 96.1 | 96.9 | 97.6 | 98.4 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.76 | 0.93 | 1.04 | 0.92 | 0.82 | 0.74 | 0.54 | 0.45 | 0.46 | 0.43 | 0.42 | 0.53 | 1.20 | 1.42 | 1.54 | 1.90 |
| RUN NO.= 59 S= 98.96 AQ= 5.906 DELTSUB= 4.40QC= 1.4000 T1= 21.05 T2= 23.05 TC= 36.45 | | | | | | | | | | | | | | | | |
| TW | 99.4 | 102.0 | 102.2 | 103.1 | 105.1 | 105.4 | 107.1 | 108.3 | 108.8 | 109.4 | 110.4 | 109.4 | 108.5 | 105.6 | 102.6 | 102.6 |
| TL | 95.2 | 95.4 | 95.7 | 95.9 | 96.3 | 96.8 | 97.2 | 97.6 | 98.1 | 98.5 | 99.0 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.41 | 0.90 | 0.90 | 0.82 | 0.67 | 0.69 | 0.60 | 0.55 | 0.55 | 0.54 | 0.51 | 0.59 | 0.65 | 0.95 | 1.85 | 1.85 |
| RUN NO.= 60 S= 99.65 AQ= 5.906 DELTSUB= 4.25QC= 1.4000 T1= 21.30 T2= 23.30 TC= 36.90 | | | | | | | | | | | | | | | | |
| TW | 99.6 | 101.6 | 102.2 | 103.9 | 104.9 | 105.8 | 106.4 | 108.1 | 108.9 | 109.6 | 110.4 | 109.1 | 107.9 | 106.4 | 103.1 | 102.6 |
| TL | 95.6 | 95.8 | 96.0 | 96.2 | 96.7 | 97.1 | 97.5 | 97.9 | 98.4 | 98.8 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.48 | 1.03 | 0.96 | 0.77 | 0.72 | 0.68 | 0.67 | 0.58 | 0.56 | 0.55 | 0.53 | 0.62 | 0.72 | 0.87 | 1.74 | 2.00 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 51 S= 98.26 AQ= 14.400 DELTSUB= 1.50QC= 5.7000 T1= 20.55 T2= 22.03 TC= 33.55 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 106.0 | 105.8 | 106.4 | 107.7 | 108.8 | 110.0 | 110.3 | 110.4 | 110.9 | 107.9 | 106.6 | 106.0 | 105.1 | 104.9 | 104.9 |
| TL | 99.1 | 99.2 | 99.2 | 99.3 | 99.5 | 99.7 | 99.8 | 100.0 | 100.2 | 100.3 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 3.30 | 2.11 | 2.20 | 2.04 | 1.76 | 1.59 | 1.42 | 1.40 | 1.40 | 1.36 | 1.95 | 2.36 | 2.62 | 3.10 | 3.24 | 3.24 |
| RUN NO.= 52 S= 96.88 AQ= 14.400 DELTSUB= 2.35QC= 5.7000 T1= 21.05 T2= 22.53 TC= 34.00 | | | | | | | | | | | | | | | | |
| TW | 104.1 | 106.0 | 105.6 | 106.9 | 107.9 | 108.1 | 108.8 | 110.3 | 110.9 | 111.1 | 108.9 | 106.9 | 106.0 | 105.8 | 104.7 | 104.9 |
| TL | 98.5 | 98.6 | 98.7 | 98.9 | 99.1 | 99.4 | 99.7 | 99.9 | 100.2 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.56 | 1.95 | 2.12 | 1.81 | 1.64 | 1.65 | 1.58 | 1.39 | 1.34 | 1.36 | 1.75 | 2.34 | 2.72 | 2.82 | 3.60 | 3.39 |
| RUN NO.= 53 S= 97.57 AQ= 3.487 DELTSUB= 2.55QC= 5.7000 T1= 21.10 T2= 21.46 TC= 38.15 | | | | | | | | | | | | | | | | |
| TW | 99.0 | 100.5 | 101.6 | 103.3 | 103.9 | 103.9 | 104.8 | 105.8 | 106.0 | 106.2 | 105.1 | 104.9 | 102.4 | 102.4 | 102.4 | 101.6 |
| TL | 97.2 | 97.4 | 97.5 | 97.7 | 98.0 | 98.2 | 98.5 | 98.8 | 99.1 | 99.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.98 | 1.12 | 0.87 | 0.62 | 0.59 | 0.62 | 0.56 | 0.50 | 0.51 | 0.51 | 0.63 | 0.66 | 1.27 | 1.27 | 1.27 | 1.84 |
| RUN NO.= 54 S= 97.57 AQ= 3.487 DELTSUB= 2.75QC= 5.7000 T1= 21.10 T2= 21.39 TC= 37.20 | | | | | | | | | | | | | | | | |
| TW | 97.9 | 100.1 | 101.1 | 101.1 | 103.1 | 103.3 | 104.1 | 105.1 | 105.8 | 106.4 | 106.6 | 104.1 | 102.8 | 102.4 | 101.6 | 101.6 |
| TL | 96.8 | 97.0 | 97.1 | 97.3 | 97.5 | 97.8 | 98.1 | 98.4 | 98.6 | 98.9 | 99.2 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 3.13 | 1.13 | 0.87 | 0.91 | 0.63 | 0.64 | 0.58 | 0.51 | 0.49 | 0.46 | 0.47 | 0.75 | 1.04 | 1.18 | 1.66 | 1.66 |
| RUN NO.= 55 S= 100.35 AQ= 3.507 DELTSUB= 14.95QC= 0.9000 T1= 20.60 T2= 22.49 TC= 23.80 | | | | | | | | | | | | | | | | |
| TW | 89.1 | 91.0 | 91.6 | 92.7 | 95.0 | 96.7 | 99.9 | 101.6 | 103.4 | 105.8 | 108.1 | 106.6 | 103.4 | 102.8 | 102.4 | 102.4 |
| TL | 85.8 | 86.6 | 87.3 | 88.1 | 89.6 | 91.1 | 92.6 | 94.1 | 95.6 | 97.1 | 98.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.10 | 0.80 | 0.81 | 0.76 | 0.65 | 0.62 | 0.48 | 0.47 | 0.44 | 0.40 | 0.37 | 0.53 | 1.03 | 1.28 | 1.49 | 1.49 |
| RUN NO.= 56 S= 100.35 AQ= 3.507 DELTSUB= 10.40QC= 1.4000 T1= 20.60 T2= 21.81 TC= 25.80 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 94.8 | 95.0 | 95.9 | 97.9 | 98.8 | 100.7 | 102.4 | 104.8 | 106.6 | 108.1 | 107.3 | 103.3 | 102.2 | 101.8 | 101.8 |
| TL | 89.8 | 90.3 | 90.8 | 91.3 | 92.4 | 93.4 | 94.4 | 95.5 | 96.5 | 97.6 | 98.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.20 | 0.78 | 0.84 | 0.78 | 0.63 | 0.65 | 0.56 | 0.51 | 0.43 | 0.39 | 0.37 | 0.46 | 0.97 | 1.38 | 1.63 | 1.63 |
| RUN NO.= 57 S= 97.57 AQ= 3.631 DELTSUB= 7.80QC= 1.4000 T1= 21.60 T2= 22.85 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 95.0 | 95.6 | 96.7 | 98.6 | 99.6 | 101.4 | 102.9 | 104.3 | 105.6 | 106.4 | 103.6 | 102.6 | 101.6 | 101.4 | 101.4 |
| TL | 91.8 | 92.2 | 92.6 | 93.0 | 93.7 | 94.5 | 95.3 | 96.1 | 96.9 | 97.6 | 98.4 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.77 | 1.29 | 1.18 | 0.97 | 0.75 | 0.71 | 0.60 | 0.54 | 0.49 | 0.46 | 0.45 | 0.81 | 1.07 | 1.55 | 1.69 | 1.69 |
| RUN NO.= 58 S= 97.57 AQ= 3.610 DELTSUB= 7.80QC= 1.4000 T1= 21.60 T2= 22.85 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 96.1 | 96.1 | 96.9 | 98.1 | 99.4 | 102.0 | 104.1 | 104.8 | 106.0 | 107.1 | 106.0 | 102.2 | 101.8 | 101.6 | 101.1 |
| TL | 91.8 | 92.2 | 92.6 | 93.0 | 93.7 | 94.5 | 95.3 | 96.1 | 96.9 | 97.6 | 98.4 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.76 | 0.93 | 1.04 | 0.92 | 0.82 | 0.74 | 0.54 | 0.45 | 0.46 | 0.43 | 0.42 | 0.53 | 1.20 | 1.42 | 1.54 | 1.90 |
| RUN NO.= 59 S= 98.96 AQ= 5.906 DELTSUB= 4.40QC= 1.4000 T1= 21.05 T2= 23.05 TC= 36.45 | | | | | | | | | | | | | | | | |
| TW | 99.4 | 102.0 | 102.2 | 103.1 | 105.1 | 105.4 | 107.1 | 108.3 | 108.8 | 109.4 | 110.4 | 109.4 | 108.5 | 105.6 | 102.6 | 102.6 |
| TL | 95.2 | 95.4 | 95.7 | 95.9 | 96.3 | 96.8 | 97.2 | 97.6 | 98.1 | 98.5 | 99.0 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.41 | 0.90 | 0.90 | 0.82 | 0.67 | 0.69 | 0.60 | 0.55 | 0.55 | 0.54 | 0.51 | 0.59 | 0.65 | 0.95 | 1.85 | 1.85 |
| RUN NO.= 60 S= 99.65 AQ= 5.906 DELTSUB= 4.25QC= 1.4000 T1= 21.30 T2= 23.30 TC= 36.90 | | | | | | | | | | | | | | | | |
| TW | 99.6 | 101.6 | 102.2 | 103.9 | 104.9 | 105.8 | 106.4 | 108.1 | 108.9 | 109.6 | 110.4 | 109.1 | 107.9 | 106.4 | 103.1 | 102.6 |
| TL | 95.6 | 95.8 | 96.0 | 96.2 | 96.7 | 97.1 | 97.5 | 97.9 | 98.4 | 98.8 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.48 | 1.03 | 0.96 | 0.77 | 0.72 | 0.68 | 0.67 | 0.58 | 0.56 | 0.55 | 0.53 | 0.62 | 0.72 | 0.87 | 1.74 | 2.00 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=231 S= 53.13 AQ= 8.727 DELTSUB= 10.400C= 0.9000 T1= 19.85 T2= 33.51 TC= 58.90 | | | | | | | | | | | | | | | | |
| TW | 117.6 | 117.4 | 119.6 | 122.8 | 119.1 | 117.4 | 117.1 | 117.6 | 117.6 | 117.6 | 117.6 | 117.6 | 117.8 | 118.4 | 118.2 | 119.4 |
| TL | 102.0 | 103.7 | 105.5 | 107.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.56 | 0.64 | 0.61 | 0.56 | 1.04 | 1.30 | 1.34 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.23 | 1.13 | 1.16 | 0.99 |
| RUN NO.=232 S= 53.13 AQ= 5.957 DELTSUB= 12.400C= 0.9000 T1= 19.85 T2= 30.18 TC= 55.00 | | | | | | | | | | | | | | | | |
| TW | 116.3 | 116.3 | 119.4 | 117.6 | 116.1 | 115.5 | 115.9 | 116.3 | 116.1 | 116.3 | 116.3 | 116.3 | 116.3 | 116.9 | 116.7 | 117.6 |
| TL | 101.8 | 104.9 | 108.0 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 |
| HT | 0.41 | 0.52 | 0.52 | 0.92 | 1.19 | 1.35 | 1.24 | 1.15 | 1.19 | 1.15 | 1.15 | 1.15 | 1.15 | 1.03 | 1.06 | 0.92 |
| RUN NO.=233 S= 53.13 AQ= 3.734 DELTSUB= 17.100C= 0.9000 T1= 19.85 T2= 26.23 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 110.6 | 116.5 | 117.4 | 116.3 | 115.1 | 114.7 | 115.1 | 115.3 | 115.3 | 115.3 | 115.3 | 115.3 | 115.5 | 115.7 | 115.5 | 115.9 |
| TL | 98.9 | 103.2 | 107.5 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 |
| HT | 0.32 | 0.28 | 0.38 | 0.81 | 1.10 | 1.24 | 1.10 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 0.98 | 0.93 | 0.98 | 0.89 |
| RUN NO.=234 S= 35.07 AQ= 14.895 DELTSUB= 17.750C= 1.8500 T1= 20.10 T2= 31.37 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.9 | 121.3 | 121.1 | 120.3 | 119.9 | 120.3 | 120.7 | 120.9 | 121.1 | 121.3 | 121.5 | 122.6 | 124.1 | 123.9 | 127.1 |
| TL | 97.1 | 100.1 | 103.0 | 106.0 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.85 | 0.72 | 0.82 | 0.99 | 1.78 | 1.87 | 1.78 | 1.69 | 1.66 | 1.62 | 1.58 | 1.55 | 1.40 | 1.23 | 1.25 | 0.98 |
| RUN NO.=235 S= 35.07 AQ= 14.895 DELTSUB= 18.600C= 1.8500 T1= 20.10 T2= 32.36 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.3 | 121.1 | 120.9 | 120.3 | 119.9 | 120.3 | 120.9 | 120.9 | 121.1 | 121.5 | 121.5 | 122.6 | 124.3 | 124.3 | 127.1 |
| TL | 98.0 | 102.6 | 107.3 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.89 | 0.85 | 1.08 | 1.66 | 1.78 | 1.87 | 1.78 | 1.66 | 1.66 | 1.62 | 1.55 | 1.55 | 1.40 | 1.21 | 1.21 | 0.98 |
| SYSTEM-ETHYL ACETATE | | | | | | | | | | | | | | | | |
| RUN NO.=236 S= 97.57 AQ= 8.634 DELTSUB= 20.900C= 0.9000 T1= 21.80 T2= 29.11 TC= 63.70 | | | | | | | | | | | | | | | | |
| TW | 79.9 | 80.3 | 79.0 | 78.8 | 82.9 | 84.1 | 86.6 | 87.5 | 82.3 | 81.8 | 81.8 | 81.6 | 82.5 | 82.5 | 82.1 | 82.9 |
| TL | 56.7 | 58.2 | 59.7 | 61.2 | 64.2 | 67.1 | 70.1 | 73.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.37 | 0.39 | 0.45 | 0.49 | 0.46 | 0.51 | 0.52 | 0.60 | 1.39 | 1.51 | 1.51 | 1.58 | 1.35 | 1.35 | 1.45 | 1.26 |
| RUN NO.=237 S= 97.57 AQ= 8.634 DELTSUB= 32.750C= 0.9000 T1= 21.80 T2= 28.91 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 71.9 | 66.9 | 67.9 | 70.3 | 73.6 | 76.3 | 80.1 | 82.9 | 82.7 | 82.5 | 82.5 | 82.5 | 83.1 | 82.9 | 82.3 | 83.4 |
| TL | 45.7 | 48.0 | 50.4 | 52.7 | 57.4 | 62.1 | 66.7 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.33 | 0.46 | 0.49 | 0.49 | 0.53 | 0.61 | 0.65 | 0.75 | 1.30 | 1.35 | 1.35 | 1.35 | 1.22 | 1.26 | 1.39 | 1.18 |
| RUN NO.=238 S= 97.57 AQ= 8.572 DELTSUB= 39.400C= 0.9000 T1= 21.80 T2= 27.71 TC= 75.20 | | | | | | | | | | | | | | | | |
| TW | 64.2 | 60.8 | 61.7 | 64.6 | 68.8 | 72.5 | 76.5 | 80.8 | 82.7 | 82.5 | 82.5 | 82.3 | 82.9 | 82.7 | 82.5 | 83.4 |
| TL | 39.2 | 41.6 | 44.1 | 46.5 | 51.5 | 56.4 | 61.3 | 66.2 | 71.2 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.34 | 0.45 | 0.49 | 0.47 | 0.50 | 0.53 | 0.56 | 0.59 | 0.74 | 1.34 | 1.34 | 1.38 | 1.25 | 1.30 | 1.34 | 1.17 |
| RUN NO.=239 S= 96.18 AQ= 14.937 DELTSUB= 9.650C= 0.9000 T1= 21.80 T2= 43.49 TC= 66.90 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 99.6 | 84.3 | 83.8 | 85.6 | 84.7 | 85.8 | 83.8 | 83.6 | 83.4 | 83.8 | 85.4 | 84.9 | 86.0 | 85.1 | 86.0 |
| TL | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.64 | 0.56 | 1.83 | 1.94 | 1.58 | 1.74 | 1.54 | 1.94 | 1.99 | 2.06 | 1.94 | 1.61 | 1.70 | 1.51 | 1.66 | 1.51 |
| RUN NO.=240 S= 97.57 AQ= 11.553 DELTSUB= 7.250C= 0.9000 T1= 21.60 T2= 36.51 TC= 66.00 | | | | | | | | | | | | | | | | |
| TW | 89.3 | 94.6 | 99.0 | 100.1 | 84.7 | 84.4 | 85.1 | 83.8 | 83.6 | 83.1 | 83.4 | 84.7 | 84.1 | 84.9 | 84.1 | 85.1 |
| TL | 70.2 | 71.4 | 72.6 | 73.8 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.61 | 0.50 | 0.44 | 0.44 | 1.37 | 1.41 | 1.31 | 1.53 | 1.57 | 1.67 | 1.63 | 1.37 | 1.48 | 1.34 | 1.48 | 1.31 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=241 | S= | 96.18 | AQ= | 3.775 | DELTSUB= | | 10.55QC= | 0.9000 | T1= | 21.30 | | T2= | 24.90 | TC= | 65.55 |
| TW | 75.6 | 77.6 | 78.6 | 79.2 | 80.5 | 81.4 | 83.4 | 82.9 | 82.3 | 84.3 | 82.9 | 80.5 | 80.1 | 80.1 | 79.4 | 80.1 |
| TL | 66.4 | 67.3 | 68.2 | 69.1 | 70.8 | 72.6 | 74.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.41 | 0.37 | 0.36 | 0.37 | 0.39 | 0.43 | 0.42 | 0.55 | 0.61 | 0.46 | 0.55 | 0.86 | 0.96 | 0.96 | 1.13 | 0.96 |
| RUN | NO.=242 | S= | 85.07 | AQ= | 8.603 | DELTSUB= | | 2.65QC= | 0.9000 | T1= | 20.80 | | T2= | 30.90 | TC= | 66.45 |
| TW | 87.8 | 91.2 | 94.4 | 96.1 | 96.7 | 82.5 | 82.9 | 82.1 | 82.1 | 82.1 | 82.1 | 81.8 | 81.8 | 82.3 | 82.1 | 83.1 |
| TL | 73.9 | 74.3 | 74.6 | 74.9 | 75.6 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.62 | 0.51 | 0.44 | 0.41 | 0.41 | 1.38 | 1.28 | 1.48 | 1.48 | 1.48 | 1.48 | 1.55 | 1.55 | 1.42 | 1.48 | 1.25 |
| RUN | NO.=243 | S= | 89.24 | AQ= | 5.931 | DELTSUB= | | 4.90QC= | 0.9000 | T1= | 21.30 | | T2= | 27.01 | TC= | 63.50 |
| TW | 84.9 | 88.4 | 88.9 | 89.3 | 91.4 | 91.9 | 92.3 | 84.1 | 83.6 | 84.4 | 82.1 | 81.1 | 80.7 | 80.9 | 80.7 | 81.4 |
| TL | 71.8 | 72.2 | 72.6 | 73.0 | 73.8 | 74.7 | 75.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.45 | 0.37 | 0.37 | 0.36 | 0.34 | 0.35 | 0.35 | 0.76 | 0.81 | 0.73 | 1.03 | 1.22 | 1.35 | 1.28 | 1.35 | 1.16 |
| RUN | NO.=244 | S= | 75.35 | AQ= | 3.817 | DELTSUB= | | 12.85QC= | 0.9000 | T1= | 20.35 | | T2= | 24.62 | TC= | 75.40 |
| TW | 75.4 | 79.2 | 81.6 | 84.3 | 89.1 | 82.3 | 79.9 | 79.9 | 79.4 | 79.2 | 79.2 | 79.0 | 79.0 | 79.4 | 79.0 | 79.9 |
| TL | 64.9 | 66.5 | 68.1 | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.36 | 0.30 | 0.28 | 0.26 | 0.24 | 0.62 | 1.00 | 1.00 | 1.14 | 1.23 | 1.23 | 1.32 | 1.32 | 1.14 | 1.32 | 1.00 |
| RUN | NO.=245 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 32.00QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 83.8 | 81.4 | 81.1 | 84.9 | 89.3 | 83.8 | 85.6 | 87.8 | 89.3 | 86.4 | 85.6 | 84.9 | 85.1 | 85.8 | 85.6 | 83.1 |
| TL | 46.3 | 48.3 | 50.3 | 52.3 | 56.3 | 60.3 | 64.3 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.40 | 0.45 | 0.48 | 0.46 | 0.45 | 0.64 | 0.70 | 0.77 | 0.88 | 1.47 | 1.61 | 1.74 | 1.70 | 1.57 | 1.61 | 2.18 |
| RUN | NO.=246 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 31.80QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 82.9 | 80.3 | 81.1 | 85.1 | 89.1 | 83.8 | 85.4 | 88.4 | 89.5 | 86.9 | 85.6 | 85.4 | 85.4 | 85.6 | 85.6 | 83.6 |
| TL | 46.5 | 48.5 | 50.5 | 52.4 | 56.4 | 60.4 | 64.4 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.41 | 0.47 | 0.49 | 0.46 | 0.46 | 0.64 | 0.71 | 0.74 | 0.87 | 1.42 | 1.61 | 1.65 | 1.65 | 1.61 | 1.61 | 2.05 |
| RUN | NO.=247 | S= | 72.57 | AQ= | 8.603 | DELTSUB= | | 35.55QC= | 0.9000 | T1= | 21.60 | | T2= | 29.65 | TC= | 69.45 |
| TW | 70.5 | 70.5 | 74.1 | 76.8 | 83.4 | 88.6 | 95.2 | 83.8 | 82.5 | 82.3 | 82.3 | 82.1 | 82.1 | 82.9 | 82.5 | 83.8 |
| TL | 44.0 | 46.9 | 49.9 | 52.9 | 58.8 | 64.7 | 70.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.32 | 0.36 | 0.36 | 0.36 | 0.35 | 0.36 | 0.35 | 1.19 | 1.45 | 1.50 | 1.50 | 1.56 | 1.56 | 1.34 | 1.45 | 1.19 |
| RUN | NO.=248 | S= | 73.26 | AQ= | 8.603 | DELTSUB= | | 40.10QC= | 0.9000 | T1= | 21.85 | | T2= | 29.90 | TC= | 69.45 |
| TW | 65.8 | 66.4 | 70.3 | 73.4 | 80.3 | 86.9 | 94.1 | 88.8 | 82.5 | 82.1 | 81.9 | 81.6 | 81.9 | 82.5 | 82.3 | 83.6 |
| TL | 39.8 | 43.1 | 46.5 | 49.8 | 56.5 | 63.2 | 69.9 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.33 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.35 | 0.70 | 1.45 | 1.56 | 1.62 | 1.70 | 1.62 | 1.45 | 1.50 | 1.22 |
| RUN | NO.=249 | S= | 77.43 | AQ= | 5.931 | DELTSUB= | | 11.00QC= | 0.9000 | T1= | 20.60 | | T2= | 25.58 | TC= | 65.10 |
| TW | 82.3 | 83.8 | 84.3 | 85.4 | 87.9 | 89.5 | 92.7 | 94.6 | 80.9 | 80.1 | 80.1 | 79.9 | 79.9 | 80.5 | 79.9 | 80.7 |
| TL | 65.6 | 66.4 | 67.2 | 68.0 | 69.6 | 71.1 | 72.7 | 74.3 | 75.8 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 0.36 | 0.34 | 0.35 | 0.34 | 0.32 | 0.32 | 0.30 | 0.29 | 1.16 | 1.40 | 1.40 | 1.46 | 1.46 | 1.28 | 1.46 | 1.22 |
| RUN | NO.=250 | S= | 69.10 | AQ= | 5.931 | DELTSUB= | | 15.50QC= | 0.9000 | T1= | 21.10 | | T2= | 28.05 | TC= | 67.15 |
| TW | 79.6 | 81.4 | 82.5 | 84.9 | 89.5 | 85.4 | 81.4 | 80.9 | 80.7 | 80.7 | 80.7 | 80.5 | 80.5 | 81.1 | 80.7 | 81.6 |
| TL | 62.9 | 64.9 | 66.8 | 68.8 | 72.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.35 | 0.36 | 0.38 | 0.37 | 0.35 | 0.67 | 1.21 | 1.33 | 1.41 | 1.41 | 1.41 | 1.48 | 1.48 | 1.28 | 1.41 | 1.16 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=251 S= 75.35 AQ= 5.931 DELTSUB= 12.80QC= 0.9000 T1= 20.10 T2= 25.14 TC= 63.50 | | | | | | | | | | | | | | | | |
| TW | 82.5 | 83.6 | 84.1 | 85.8 | 89.1 | 91.4 | 95.2 | 98.1 | 86.2 | 80.9 | 80.7 | 80.5 | 80.7 | 80.9 | 80.9 | 81.4 |
| TL | 64.6 | 65.5 | 66.4 | 67.4 | 69.2 | 71.0 | 72.8 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.33 | 0.33 | 0.34 | 0.32 | 0.30 | 0.29 | 0.27 | 0.25 | 0.61 | 1.33 | 1.41 | 1.48 | 1.41 | 1.33 | 1.33 | 1.21 |
| RUN NO.=252 S= 78.13 AQ= 8.448 DELTSUB= 3.30QC= 0.9000 T1= 20.85 T2= 28.82 TC= 67.85 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 93.8 | 95.6 | 97.3 | 100.1 | 101.1 | 101.6 | 83.6 | 83.6 | 82.9 | 82.1 | 81.8 | 81.8 | 82.1 | 81.8 | 82.9 |
| TL | 73.5 | 73.8 | 74.0 | 74.3 | 74.9 | 75.4 | 76.0 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.49 | 0.42 | 0.39 | 0.37 | 0.34 | 0.33 | 0.33 | 1.19 | 1.19 | 1.31 | 1.52 | 1.59 | 1.59 | 1.52 | 1.59 | 1.31 |
| RUN NO.=253 S= 71.88 AQ= 11.373 DELTSUB= 2.45QC= 0.9000 T1= 21.10 T2= 37.49 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 96.5 | 101.6 | 82.3 | 82.5 | 83.4 | 82.7 | 83.8 | 85.1 | 84.3 | 83.8 | 83.6 | 83.4 | 83.4 | 84.3 | 83.6 | 84.9 |
| TL | 75.1 | 75.9 | 76.7 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| HT | 0.53 | 0.44 | 2.07 | 1.98 | 1.72 | 1.91 | 1.61 | 1.36 | 1.52 | 1.61 | 1.66 | 1.72 | 1.72 | 1.52 | 1.66 | 1.40 |
| RUN NO.=254 S= 61.46 AQ= 14.689 DELTSUB= 2.80QC= 1.8500 T1= 21.10 T2= 31.82 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 83.1 | 82.5 | 82.5 | 82.9 | 84.0 | 83.6 | 84.9 | 85.6 | 85.1 | 85.1 | 84.9 | 84.6 | 84.6 | 85.8 | 84.9 | 86.6 |
| TL | 75.1 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.82 | 2.44 | 2.45 | 2.28 | 1.96 | 2.07 | 1.75 | 1.62 | 1.71 | 1.71 | 1.75 | 1.80 | 1.80 | 1.59 | 1.75 | 1.45 |
| RUN NO.=255 S= 66.32 AQ= 8.572 DELTSUB= 7.05QC= 0.9000 T1= 22.35 T2= 32.33 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 95.0 | 94.6 | 93.6 | 97.8 | 83.8 | 83.4 | 82.7 | 82.3 | 82.3 | 82.1 | 82.3 | 82.3 | 82.7 | 82.3 | 83.4 |
| TL | 70.3 | 71.2 | 72.1 | 73.0 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.38 | 0.36 | 0.38 | 0.42 | 0.37 | 1.17 | 1.25 | 1.38 | 1.49 | 1.49 | 1.54 | 1.49 | 1.49 | 1.38 | 1.49 | 1.25 |
| RUN NO.=256 S= 60.07 AQ= 11.445 DELTSUB= 4.90QC= 0.9000 T1= 21.80 T2= 35.05 TC= 69.45 | | | | | | | | | | | | | | | | |
| TW | 82.3 | 82.5 | 82.9 | 83.1 | 84.7 | 84.1 | 82.9 | 82.7 | 82.3 | 82.1 | 82.1 | 82.5 | 82.3 | 82.3 | 83.4 | 84.9 |
| TL | 72.2 | 72.8 | 73.4 | 74.0 | 75.3 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.13 | 1.18 | 1.20 | 1.26 | 1.21 | 1.52 | 1.77 | 1.85 | 1.97 | 2.06 | 2.06 | 1.91 | 1.97 | 1.97 | 1.67 | 1.36 |
| RUN NO.=257 S= 55.21 AQ= 14.854 DELTSUB= 3.55QC= 0.9000 T1= 21.80 T2= 39.02 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 83.6 | 84.1 | 84.3 | 84.4 | 86.4 | 85.8 | 83.8 | 84.1 | 83.4 | 83.4 | 83.4 | 83.6 | 83.8 | 83.6 | 85.1 | 86.6 |
| TL | 73.4 | 73.8 | 74.3 | 74.7 | 75.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.46 | 1.45 | 1.49 | 1.53 | 1.37 | 1.60 | 2.03 | 1.97 | 2.17 | 2.17 | 2.17 | 2.09 | 2.03 | 2.09 | 1.73 | 1.46 |
| RUN NO.=258 S= 53.82 AQ= 5.957 DELTSUB= 6.65QC= 0.9000 T1= 21.60 T2= 30.31 TC= 72.05 | | | | | | | | | | | | | | | | |
| TW | 84.1 | 81.1 | 80.5 | 79.9 | 80.1 | 79.9 | 79.9 | 80.1 | 79.7 | 79.7 | 79.4 | 79.4 | 79.2 | 79.4 | 79.4 | 80.5 |
| TL | 72.1 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.50 | 1.03 | 1.17 | 1.32 | 1.27 | 1.32 | 1.32 | 1.27 | 1.39 | 1.39 | 1.47 | 1.47 | 1.57 | 1.47 | 1.47 | 1.17 |
| RUN NO.=259 S= 52.43 AQ= 11.517 DELTSUB= 8.40QC= 0.9000 T1= 21.80 T2= 36.42 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 81.6 | 83.6 | 87.9 | 88.4 | 84.1 | 82.7 | 82.5 | 82.9 | 82.7 | 82.9 | 82.7 | 82.7 | 82.1 | 82.1 | 82.7 | 81.8 |
| TL | 69.3 | 70.7 | 72.1 | 73.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.94 | 0.89 | 0.72 | 0.77 | 1.48 | 1.79 | 1.84 | 1.72 | 1.79 | 1.72 | 1.79 | 1.79 | 1.99 | 1.99 | 1.79 | 2.08 |
| RUN NO.=260 S= 55.21 AQ= 8.634 DELTSUB= 44.45QC= 0.9000 T1= 21.35 T2= 31.31 TC= 69.90 | | | | | | | | | | | | | | | | |
| TW | 63.5 | 71.2 | 77.4 | 84.3 | 90.8 | 81.6 | 82.1 | 82.1 | 81.9 | 81.6 | 81.9 | 81.9 | 81.9 | 82.5 | 82.5 | 82.3 |
| TL | 37.4 | 43.0 | 48.5 | 54.1 | 65.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.33 | 0.31 | 0.30 | 0.29 | 0.34 | 1.62 | 1.50 | 1.50 | 1.56 | 1.63 | 1.56 | 1.56 | 1.56 | 1.39 | 1.39 | 1.44 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=261 | S= | 50.35 | AQ= | 8.479 | DELTSUB= | | 4.65QC= | 0.9000 | T1= | 20.60 | | T2= | 32.81 | TC= | 67.85 |
| TW | 82.3 | 84.9 | 81.8 | 80.9 | 81.4 | 80.9 | 80.9 | 81.1 | 80.9 | 80.7 | 80.7 | 80.7 | 80.2 | 80.2 | 80.7 | 82.1 |
| TL | 72.3 | 73.9 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.85 | 0.77 | 1.32 | 1.53 | 1.41 | 1.53 | 1.53 | 1.47 | 1.53 | 1.60 | 1.60 | 1.60 | 1.77 | 1.77 | 1.60 | 1.28 |
| RUN | NO.=262 | S= | 48.26 | AQ= | 14.854 | DELTSUB= | | 6.85QC= | 0.9000 | T1= | 21.35 | | T2= | 41.86 | TC= | 69.20 |
| TW | 83.1 | 85.4 | 89.1 | 87.5 | 84.9 | 84.1 | 84.1 | 84.3 | 84.4 | 84.3 | 84.4 | 84.3 | 83.6 | 83.1 | 84.1 | 82.3 |
| TL | 71.1 | 72.8 | 74.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.23 | 1.19 | 1.02 | 1.32 | 1.72 | 1.90 | 1.90 | 1.86 | 1.81 | 1.86 | 1.81 | 1.86 | 2.02 | 2.15 | 1.90 | 2.46 |
| RUN | NO.=263 | S= | 44.79 | AQ= | 18.800 | DELTSUB= | | 6.00QC= | 1.8500 | T1= | 21.35 | | T2= | 34.05 | TC= | 68.05 |
| TW | 84.3 | 86.4 | 89.3 | 87.9 | 86.4 | 85.6 | 85.8 | 85.8 | 85.8 | 85.6 | 85.8 | 85.6 | 84.7 | 84.7 | 85.1 | 82.9 |
| TL | 71.7 | 73.2 | 74.7 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.50 | 1.42 | 1.29 | 1.61 | 1.84 | 2.02 | 1.97 | 1.97 | 1.97 | 2.02 | 1.97 | 2.02 | 2.22 | 2.22 | 2.12 | 2.83 |
| RUN | NO.=264 | S= | 38.54 | AQ= | 18.800 | DELTSUB= | | 8.00QC= | 1.8500 | T1= | 20.35 | | T2= | 33.56 | TC= | 67.40 |
| TW | 84.3 | 86.9 | 86.4 | 85.4 | 85.4 | 84.4 | 85.1 | 85.1 | 84.9 | 84.9 | 84.9 | 84.7 | 84.3 | 83.8 | 84.4 | 82.3 |
| TL | 70.3 | 72.9 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 |
| HT | 1.34 | 1.35 | 1.73 | 1.93 | 1.93 | 2.12 | 1.98 | 1.98 | 2.02 | 2.02 | 2.02 | 2.07 | 2.17 | 2.29 | 2.12 | 2.81 |
| RUN | NO.=265 | S= | 33.68 | AQ= | 18.800 | DELTSUB= | | 18.55QC= | 1.9500 | T1= | 20.60 | | T2= | 32.58 | TC= | 69.00 |
| TW | 82.3 | 85.6 | 85.8 | 85.1 | 85.1 | 84.7 | 85.4 | 85.8 | 85.8 | 85.8 | 86.0 | 85.6 | 85.1 | 84.7 | 85.6 | 83.1 |
| TL | 62.1 | 66.8 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.93 | 1.00 | 1.31 | 2.08 | 2.08 | 2.17 | 2.02 | 1.93 | 1.93 | 1.93 | 1.89 | 1.98 | 2.08 | 2.17 | 1.98 | 2.65 |
| RUN | NO.=266 | S= | 28.13 | AQ= | 18.800 | DELTSUB= | | 11.45QC= | 1.8500 | T1= | 20.35 | | T2= | 33.46 | TC= | 69.20 |
| TW | 83.6 | 84.9 | 84.7 | 84.4 | 84.9 | 84.7 | 84.9 | 85.4 | 85.4 | 85.4 | 85.4 | 85.1 | 83.4 | 83.8 | 84.9 | 129.8 |
| TL | 68.2 | 72.1 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 1.22 | 1.46 | 2.12 | 2.19 | 2.08 | 2.12 | 2.08 | 1.98 | 1.98 | 1.98 | 1.98 | 2.03 | 2.51 | 2.36 | 2.08 | 0.35 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

RUN NO.= 61 S= 97.57 AQ= 8.572 DELTSUB= 2.95QC= 1.4000 T1= 21.80 T2= 25.38 TC= 33.50

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 103.1 | 106.0 | 106.8 | 108.3 | 109.3 | 110.7 | 111.3 | 112.3 | 111.7 | 113.1 | 110.7 | 109.9 | 109.3 | 106.4 | 103.9 | 103.3 |
| TL | 97.1 | 97.2 | 97.4 | 97.6 | 97.9 | 98.2 | 98.5 | 98.9 | 99.2 | 99.5 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.43 | 0.98 | 0.91 | 0.80 | 0.75 | 0.69 | 0.67 | 0.64 | 0.69 | 0.63 | 0.79 | 0.85 | 0.91 | 1.31 | 2.14 | 2.52 |

RUN NO.= 62 S= 96.88 AQ= 8.572 DELTSUB= 2.30QC= 1.4000 T1= 21.80 T2= 26.05 TC= 33.05

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 102.6 | 104.2 | 105.2 | 105.8 | 107.8 | 109.2 | 110.0 | 109.4 | 111.2 | 110.6 | 109.4 | 106.2 | 104.2 | 103.6 | 103.2 | 103.2 |
| TL | 97.9 | 98.0 | 98.2 | 98.3 | 98.6 | 98.9 | 99.2 | 99.5 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.82 | 1.39 | 1.22 | 1.15 | 0.93 | 0.83 | 0.79 | 0.86 | 0.75 | 0.81 | 0.92 | 1.39 | 2.07 | 2.41 | 2.72 | 2.72 |

RUN NO.= 63 S= 96.18 AQ= 11.300 DELTSUB= 1.70QC= 1.8800 T1= 21.60 T2= 25.73 TC= 39.30

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 103.6 | 106.2 | 106.6 | 107.4 | 108.4 | 110.2 | 112.0 | 114.9 | 115.9 | 107.8 | 105.8 | 104.8 | 104.6 | 104.0 | 104.0 | 104.0 |
| TL | 98.5 | 98.6 | 98.7 | 98.8 | 99.0 | 99.2 | 99.4 | 99.6 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.18 | 1.48 | 1.42 | 1.31 | 1.20 | 1.03 | 0.90 | 0.74 | 0.70 | 1.46 | 1.97 | 2.38 | 2.48 | 2.86 | 2.86 | 2.86 |

RUN NO.= 64 S= 97.57 AQ= 14.524 DELTSUB= 1.70QC= 1.8800 T1= 21.60 T2= 27.73 TC= 39.80

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 103.8 | 105.4 | 106.4 | 108.4 | 109.8 | 111.2 | 113.2 | 115.0 | 113.8 | 110.8 | 109.6 | 107.6 | 107.2 | 106.8 | 104.8 | 104.8 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.9 | 99.1 | 99.4 | 99.6 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 2.63 | 2.07 | 1.84 | 1.49 | 1.33 | 1.20 | 1.05 | 0.94 | 1.04 | 1.33 | 1.49 | 1.87 | 1.98 | 2.09 | 2.93 | 2.93 |

RUN NO.= 65 S= 98.96 AQ= 11.300 DELTSUB= 2.10QC= 1.8800 T1= 21.60 T2= 25.73 TC= 39.30

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 103.4 | 105.8 | 105.8 | 106.8 | 109.8 | 110.8 | 111.8 | 114.4 | 114.6 | 112.0 | 110.0 | 109.8 | 108.0 | 107.0 | 105.4 | 104.8 |
| TL | 98.3 | 98.4 | 98.5 | 98.7 | 98.9 | 99.2 | 99.5 | 99.7 | 100.0 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 2.19 | 1.53 | 1.56 | 1.39 | 1.04 | 0.97 | 0.92 | 0.77 | 0.77 | 0.96 | 1.16 | 1.18 | 1.46 | 1.67 | 2.19 | 2.48 |

RUN NO.= 66 S= 98.26 AQ= 8.510 DELTSUB= 1.90QC= 1.8800 T1= 21.40 T2= 24.50 TC= 41.00

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 102.2 | 104.1 | 104.1 | 106.0 | 107.5 | 108.8 | 109.8 | 112.9 | 112.9 | 108.9 | 107.1 | 106.8 | 105.3 | 104.9 | 103.9 | 103.9 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.9 | 99.1 | 99.3 | 99.6 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.16 | 1.49 | 1.52 | 1.15 | 0.99 | 0.88 | 0.81 | 0.64 | 0.65 | 0.96 | 1.22 | 1.26 | 1.62 | 1.75 | 2.21 | 2.21 |

RUN NO.= 67 S= 98.96 AQ= 5.880 DELTSUB= 3.80QC= 1.4000 T1= 21.40 T2= 23.83 TC= 40.75

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 100.3 | 103.1 | 102.9 | 104.5 | 105.0 | 106.6 | 107.9 | 109.1 | 109.1 | 109.1 | 108.9 | 108.8 | 107.1 | 105.1 | 103.6 | 103.1 |
| TL | 96.5 | 96.7 | 96.9 | 97.1 | 97.5 | 97.9 | 98.4 | 98.8 | 99.2 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.55 | 0.92 | 0.99 | 0.79 | 0.79 | 0.67 | 0.62 | 0.57 | 0.59 | 0.62 | 0.66 | 0.68 | 0.83 | 1.15 | 1.63 | 1.96 |

RUN NO.= 68 S= 92.71 AQ= 14.111 DELTSUB= 2.55QC= 2.8000 T1= 20.10 T2= 23.62 TC= 29.70

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 104.9 | 107.7 | 107.4 | 109.6 | 110.4 | 113.1 | 115.3 | 116.9 | 119.2 | 105.8 | 106.0 | 106.0 | 105.1 | 104.9 | 104.7 | 104.9 |
| TL | 98.3 | 98.5 | 98.6 | 98.8 | 99.1 | 99.4 | 99.7 | 100.1 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.12 | 1.53 | 1.60 | 1.31 | 1.24 | 1.03 | 0.91 | 0.84 | 0.75 | 2.79 | 2.66 | 2.66 | 3.17 | 3.32 | 3.53 | 3.32 |

RUN NO.= 69 S= 92.71 AQ= 14.111 DELTSUB= 2.55QC= 2.8000 T1= 21.10 T2= 24.62 TC= 29.70

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 104.9 | 107.3 | 107.9 | 109.4 | 111.7 | 112.8 | 113.6 | 117.1 | 118.6 | 106.6 | 106.2 | 105.8 | 105.4 | 105.1 | 104.9 | 104.9 |
| TL | 98.3 | 98.5 | 98.6 | 98.8 | 99.1 | 99.4 | 99.7 | 100.1 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.12 | 1.61 | 1.52 | 1.34 | 1.12 | 1.06 | 1.02 | 0.83 | 0.77 | 2.39 | 2.57 | 2.79 | 3.03 | 3.17 | 3.32 | 3.32 |

RUN NO.= 70 S= 96.18 AQ= 14.400 DELTSUB= 3.40QC= 5.7000 T1= 23.00 T2= 25.29 TC= 35.65

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 105.6 | 107.6 | 108.0 | 108.6 | 111.4 | 113.6 | 114.6 | 112.1 | 108.4 | 108.3 | 107.4 | 106.1 | 104.6 | 104.4 | 104.0 | 104.0 |
| TL | 97.3 | 97.6 | 97.9 | 98.2 | 98.7 | 99.3 | 99.9 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 |
| HT | 1.75 | 1.44 | 1.43 | 1.38 | 1.13 | 1.01 | 0.98 | 1.23 | 1.80 | 1.85 | 2.07 | 2.53 | 3.43 | 3.60 | 4.06 | 4.06 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 71 S= 89.24 AQ= 14.400 DELTSUB= 3.80QC= 5.7000 T1= 23.75 T2= 26.33 TC= 32.75 | | | | | | | | | | | | | | | | |
| TW | 105.7 | 106.6 | 109.1 | 110.9 | 113.0 | 115.1 | 109.1 | 108.1 | 107.6 | 107.6 | 105.6 | 104.7 | 104.5 | 104.3 | 104.3 | 104.3 |
| TL | 97.4 | 97.8 | 98.2 | 98.6 | 99.3 | 100.1 | 100.8 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 | 100.9 |
| HT | 1.74 | 1.65 | 1.31 | 1.17 | 1.05 | 0.96 | 1.73 | 1.99 | 2.13 | 2.13 | 3.06 | 3.74 | 3.95 | 4.17 | 4.17 | 4.17 |
| RUN NO.= 72 S= 89.24 AQ= 14.400 DELTSUB= 3.80QC= 5.7000 T1= 23.75 T2= 26.33 TC= 33.25 | | | | | | | | | | | | | | | | |
| TW | 105.8 | 108.3 | 109.4 | 111.8 | 113.4 | 113.4 | 109.1 | 108.9 | 109.1 | 107.4 | 105.8 | 104.7 | 104.7 | 104.7 | 104.3 | 104.3 |
| TL | 97.7 | 98.1 | 98.5 | 98.9 | 99.6 | 100.4 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 |
| HT | 1.80 | 1.41 | 1.33 | 1.12 | 1.05 | 1.11 | 1.80 | 1.85 | 1.80 | 2.29 | 3.13 | 4.06 | 4.06 | 4.06 | 4.57 | 4,57 |
| RUN NO.= 73 S= 81.60 AQ= 14.400 DELTSUB= 4.25QC= 5.7000 T1= 24.30 T2= 27.15 TC= 34.50 | | | | | | | | | | | | | | | | |
| TW | 106.2 | 108.5 | 110.4 | 111.8 | 114.3 | 111.3 | 110.0 | 109.4 | 109.4 | 106.4 | 105.1 | 105.1 | 104.7 | 104.7 | 104.5 | 104.5 |
| TL | 97.4 | 98.0 | 98.5 | 99.0 | 100.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 | 101.1 |
| HT | 1.64 | 1.37 | 1.20 | 1.13 | 1.02 | 1.42 | 1.63 | 1.76 | 1.76 | 2.74 | 3.65 | 3.65 | 4.06 | 4.06 | 4.30 | 4.30 |
| RUN NO.= 74 S= 89.93 AQ= 14.400 DELTSUB= 62.75QC= 5.7000 T1= 23.80 T2= 25.00 TC= 34.50 | | | | | | | | | | | | | | | | |
| TW | 64.1 | 67.4 | 70.5 | 73.4 | 77.4 | 84.3 | 91.3 | 98.2 | 103.4 | 110.0 | 112.6 | 105.4 | 104.8 | 104.3 | 104.1 | 104.3 |
| TL | 41.3 | 44.5 | 47.6 | 50.7 | 57.0 | 63.2 | 69.5 | 75.8 | 82.0 | 88.3 | 94.6 | 100.8 | 100.9 | 100.9 | 100.9 | 100.9 |
| HT | 0.63 | 0.63 | 0.63 | 0.64 | 0.71 | 0.69 | 0.66 | 0.64 | 0.67 | 0.66 | 0.80 | 3.18 | 3.79 | 4.30 | 4.65 | 4.30 |
| RUN NO.= 75 S= 89.24 AQ= 8.170 DELTSUB= 2.15QC= 5.7000 T1= 20.10 T2= 21.10 TC= 30.45 | | | | | | | | | | | | | | | | |
| TW | 102.8 | 105.4 | 106.2 | 107.1 | 109.8 | 110.6 | 112.6 | 113.8 | 113.8 | 108.9 | 104.8 | 103.4 | 103.1 | 103.1 | 102.6 | 102.8 |
| TL | 97.6 | 97.8 | 97.9 | 98.0 | 98.3 | 98.6 | 98.8 | 99.1 | 99.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.58 | 1.08 | 0.98 | 0.91 | 0.71 | 0.68 | 0.60 | 0.56 | 0.57 | 0.88 | 1.60 | 2.15 | 2.40 | 2.40 | 2.77 | 2.59 |
| RUN NO.= 76 S= 89.24 AQ= 14.400 DELTSUB= 3.10QC= 5.7000 T1= 22.80 T2= 24.83 TC= 35.00 | | | | | | | | | | | | | | | | |
| TW | 103.6 | 106.6 | 107.1 | 108.9 | 111.1 | 111.7 | 114.9 | 115.9 | 110.6 | 109.1 | 107.7 | 106.2 | 105.1 | 104.9 | 104.5 | 104.8 |
| TL | 98.8 | 99.0 | 99.2 | 99.4 | 99.9 | 100.3 | 100.8 | 101.2 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| HT | 2.95 | 1.89 | 1.84 | 1.51 | 1.28 | 1.27 | 1.02 | 0.98 | 1.60 | 1.92 | 2.38 | 3.16 | 4.11 | 4.43 | 5.05 | 4.65 |
| RUN NO.= 77 S= 88.54 AQ= 14.400 DELTSUB= 4.00QC= 4.7500 T1= 22.80 T2= 25.55 TC= 35.70 | | | | | | | | | | | | | | | | |
| TW | 104.5 | 107.1 | 108.9 | 110.5 | 113.2 | 114.4 | 114.3 | 109.1 | 108.6 | 108.9 | 105.8 | 104.1 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 95.5 | 95.9 | 96.2 | 96.5 | 97.2 | 97.9 | 98.5 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 1.61 | 1.29 | 1.13 | 1.03 | 0.90 | 0.87 | 0.92 | 1.45 | 1.54 | 1.48 | 2.18 | 2.94 | 3.56 | 3.56 | 3.56 | 3.56 |
| RUN NO.= 78 S= 76.04 AQ= 14.400 DELTSUB= 70.70QC= 4.7500 T1= 22.80 T2= 25.24 TC= 31.10 | | | | | | | | | | | | | | | | |
| TW | 56.2 | 61.0 | 65.1 | 69.9 | 78.8 | 88.8 | 97.9 | 108.8 | 106.0 | 103.9 | 103.9 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 34.0 | 39.0 | 44.1 | 49.1 | 59.2 | 69.3 | 79.4 | 89.5 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 0.65 | 0.66 | 0.69 | 0.69 | 0.74 | 0.74 | 0.78 | 0.75 | 2.25 | 3.39 | 3.39 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 |
| RUN NO.= 79 S= 87.85 AQ= 14.400 DELTSUB= 2.55QC= 5.7000 T1= 24.50 T2= 26.53 TC= 36.20 | | | | | | | | | | | | | | | | |
| TW | 106.0 | 107.7 | 108.3 | 110.6 | 113.2 | 115.1 | 115.9 | 116.1 | 108.8 | 107.7 | 107.9 | 106.9 | 106.2 | 106.0 | 105.8 | 105.8 |
| TL | 100.0 | 100.2 | 100.4 | 100.6 | 100.9 | 101.3 | 101.7 | 102.0 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 |
| HT | 2.41 | 1.92 | 1.82 | 1.43 | 1.17 | 1.04 | 1.01 | 1.02 | 2.27 | 2.72 | 2.62 | 3.24 | 3.79 | 4.00 | 4.24 | 4.24 |
| RUN NO.= 80 S= 87.85 AQ= 14.400 DELTSUB= 44.80QC= 5.7000 T1= 25.30 T2= 26.78 TC= 34.00 | | | | | | | | | | | | | | | | |
| TW | 78.3 | 81.6 | 83.6 | 84.7 | 89.1 | 95.2 | 100.3 | 104.3 | 108.8 | 114.9 | 112.6 | 106.6 | 106.2 | 106.0 | 106.0 | 106.0 |
| TL | 60.5 | 63.0 | 65.4 | 67.9 | 72.9 | 77.9 | 82.8 | 87.8 | 92.8 | 97.7 | 102.7 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| HT | 0.81 | 0.77 | 0.79 | 0.86 | 0.89 | 0.83 | 0.83 | 0.87 | 0.90 | 0.84 | 1.46 | 3.79 | 4.24 | 4.50 | 4.50 | 4.50 |

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Z    0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40

RUN NO.= 81   S=   89.24   AQ= 14.111   DELTSUB=    1.30QC= 5.7000   T1=   20.35      T2=   22.63   TC= 26.10
TW 104.5 106.9 107.3 108.1 110.9 111.5 113.0 112.1 110.3 108.3 106.9 105.8 104.5 104.5 104.5 104.5
TL  98.7  98.8  98.9  99.0  99.2  99.4  99.6  99.8  99.9  99.9  99.9  99.9  99.9  99.9  99.9  99.9
HT   2.42  1.75  1.68  1.55  1.21  1.17  1.06  1.15  1.36  1.67  2.02  2.37  3.03  3.03  3.03  3.03

RUN NO.= 82   S=   91.32   AQ= 14.400   DELTSUB=    2.15QC= 5.7000   T1=   23.30      T2=   25.05   TC= 36.70
TW 104.7 106.3 105.6 108.1 108.5 110.6 111.5 111.8 111.9 111.3 106.6 105.8 105.6 105.1 104.7 104.7
TL  99.5  99.7  99.8  99.9 100.2 100.5 100.7 101.0 101.3 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   2.79  2.19  2.51  1.76  1.74  1.42  1.34  1.34  1.35  1.48  2.85  3.43  3.60  4.00  4.57  4.57

RUN NO.= 83   S=   76.74   AQ= 14.400   DELTSUB=    5.70QC= 5.7000   T1=   23.80      T2=   26.66   TC= 31.85
TW 105.6 108.5 109.8 112.1 112.4 111.1 108.5 108.8 106.0 104.9 104.1 103.9 103.9 103.9 103.9 103.9
TL  95.7  96.4  97.1  97.8  99.3 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7
HT   1.46  1.19  1.14  1.01  1.10  1.38  1.85  1.79  2.72  3.43  4.24  4.50  4.50  4.50  4.50  4.50

RUN NO.= 84   S=   76.74   AQ= 14.400   DELTSUB=    5.50QC= 5.7000   T1=   23.80      T2=   26.65   TC= 32.55
TW 105.8 109.1 110.7 111.8 112.6 109.6 108.8 108.9 105.4 104.1 103.6 103.6 103.6 103.6 103.6 103.6
TL  95.7  96.4  97.0  97.7  99.1 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5
HT   1.43  1.13  1.05  1.03  1.07  1.59  1.75  1.71  2.97  4.00  4.57  4.57  4.57  4.57  4.57  4.57

RUN NO.= 85   S=   74.65   AQ= 14.400   DELTSUB=    5.70QC= 5.7000   T1=   25.30      T2=   28.15   TC= 34.55
TW 107.1 110.5 111.8 113.2 114.3 111.5 110.1 110.3 105.8 104.9 104.9 104.9 104.9 104.9 104.9 104.9
TL  96.6  97.3  98.0  98.7 100.1 101.5 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   1.37  1.09  1.05  0.99  1.02  1.45  1.69  1.66  3.39  4.24  4.24  4.24  4.24  4.24  4.24  4.24

RUN NO.= 86   S=   74.65   AQ= 14.400   DELTSUB=    5.90QC= 5.7000   T1=   25.45      T2=   28.30   TC= 34.85
TW 106.6 110.3 112.4 113.6 114.1 109.6 109.8 108.9 106.0 105.1 105.1 105.1 105.1 105.1 105.1 105.1
TL  96.5  97.2  98.0  98.7 100.2 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   1.42  1.10  1.00  0.97  1.04  1.81  1.77  1.97  3.31  4.24  4.24  4.24  4.24  4.24  4.24  4.24

RUN NO.= 87   S=   84.38   AQ= 14.400   DELTSUB=    2.95QC= 5.7000   T1=   24.05      T2=   26.90   TC= 36.20
TW 104.5 106.4 107.3 108.5 110.0 109.4 108.8 107.9 106.6 105.6 105.6 105.1 105.1 105.1 104.9 105.1
TL  99.6  99.9 100.3 100.7 101.4 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1
HT   2.92  2.23  2.07  1.84  1.68  1.99  2.18  2.50  3.24  4.24  4.24  4.80  4.80  4.80  5.14  4.80

RUN NO.= 88   S=   80.21   AQ= 14.400   DELTSUB=    4.75QC= 5.7000   T1=   23.80      T2=   26.64   TC= 36.45
TW 105.6 108.5 110.3 111.1 113.0 111.1 108.5 109.1 108.3 105.4 104.3 104.1 103.9 103.9 103.9 103.9
TL  96.3  96.9  97.5  98.1  99.3 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5
HT   1.56  1.25  1.13  1.11  1.05  1.36  1.80  1.66  1.85  2.97  3.79  4.00  4.24  4.24  4.24  4.24

RUN NO.= 89   S=   78.82   AQ= 14.400   DELTSUB=    4.65QC= 5.7000   T1=   24.05      T2=   26.87   TC= 39.80
TW 105.8 108.1 110.1 111.9 114.9 111.3 108.9 109.4 108.9 106.4 104.9 104.7 104.5 104.5 104.3 104.3
TL  96.8  97.4  98.0  98.6  99.7 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9
HT   1.61  1.35  1.19  1.08  0.95  1.38  1.80  1.70  1.80  2.62  3.60  3.79  4.00  4.00  4.24  4.24

RUN NO.= 90   S=   80.90   AQ= 14.400   DELTSUB=    5.05QC= 5.7000   T1=   24.55      T2=   27.38   TC= 39.05
TW 106.0 108.9 110.7 112.8 114.9 110.4 108.9 109.4 107.9 105.6 104.7 104.5 104.5 104.5 104.5 104.5
TL  96.7  97.3  97.9  98.6  99.8 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1
HT   1.55  1.24  1.13  1.01  0.96  1.54  1.85  1.75  2.12  3.24  4.00  4.24  4.24  4.24  4.24  4.24
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 Z    0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40
RUN NO.= 91   S=   89.24  AQ= 11.120  DELTSUB=    1.45QC= 5.7000  T1=  20.30      T2=   21.64  TC= 38.40
TW 104.1 106.9 107.4 108.9 110.9 112.1 114.0 115.3 117.8 107.9 104.9 104.1 103.9 103.9 103.6 103.6
TL  98.9  99.0  99.1  99.2  99.3  99.5  99.7  99.9 100.1 100.2 100.3 100.3 100.3 100.3 100.3 100.3
HT   2.13  1.41  1.33  1.14  0.96  0.88  0.78  0.72  0.63  1.45  2.37  2.89  3.05  3.05  3.27  3.27
RUN NO.= 92   S=   89.24  AQ=  5.673  DELTSUB=    1.00QC= 5.7000  T1=  20.60      T2=   21.40  TC= 35.70
TW 101.6 103.6 103.6 105.1 106.6 107.1 107.3 108.1 107.3 105.8 103.6 103.6 102.9 102.9 102.2 102.0
TL  98.9  98.9  99.0  99.1  99.2  99.4  99.5  99.7  99.8  99.8  99.8  99.8  99.8  99.8  99.8  99.8
HT   2.12  1.21  1.22  0.94  0.76  0.73  0.73  0.67  0.76  0.95  1.47  1.47  1.86  1.86  2.36  2.58
RUN NO.= 93   S=   75.35  AQ= 11.337  DELTSUB=    5.25QC= 1.4000  T1=  19.85      T2=   27.30  TC= 27.55
TW 105.8 108.8 109.8 111.5 111.7 111.5 113.4 107.7 104.3 103.6 103.6 103.6 103.6 103.6 103.6 103.6
TL  95.4  95.9  96.3  96.7  97.6  98.5  99.4 100.2 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   1.09  0.88  0.84  0.77  0.81  0.87  0.81  1.52  2.80  3.33  3.33  3.33  3.33  3.33  3.33  3.33
RUN NO.= 94   S=   76.04  AQ=  8.603  DELTSUB=    5.25QC= 1.4000  T1=  20.80      T2=   26.47  TC= 25.80
TW 103.3 105.1 106.8 107.9 108.8 110.0 111.7 107.1 103.9 103.4 103.3 103.3 103.3 103.3 103.3 103.3
TL  95.4  95.9  96.3  96.7  97.6  98.5  99.4 100.2 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   1.10  0.93  0.82  0.77  0.77  0.75  0.70  1.26  2.36  2.69  2.87  2.87  2.87  2.87  2.87  2.87
RUN NO.= 95   S=   73.96  AQ=  5.906  DELTSUB=    5.25QC= 1.4000  T1=  21.55      T2=   25.45  TC= 24.05
TW  99.4 101.6 102.4 103.3 106.4 107.3 107.7 104.5 103.0 102.8 102.8 102.6 102.6 102.4 102.4 102.4
TL  95.4  95.9  96.3  96.7  97.6  98.5  99.4 100.2 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   1.49  1.04  0.97  0.91  0.67  0.67  0.71  1.39  2.15  2.32  2.32  2.51  2.51  2.75  2.75  2.75
RUN NO.= 96   S=   75.35  AQ=  8.541  DELTSUB=   31.75QC= 0.9000  T1=  21.10      T2=   29.84  TC= 26.80
TW  82.5  85.3  87.1  93.1  96.3 102.0 107.9 104.9 103.1 103.1 103.1 103.1 103.1 103.1 103.1 103.1
TL  71.1  73.8  76.4  79.1  84.4  89.6  94.9 100.2 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   0.75  0.74  0.80  0.61  0.72  0.69  0.66  1.80  3.05  3.05  3.05  3.05  3.05  3.05  3.05  3.05
RUN NO.= 97   S=   74.65  AQ=  5.906  DELTSUB=   31.95QC= 0.9000  T1=  20.80      T2=   26.85  TC= 25.55
TW  77.9  81.6  84.7  88.4  95.6 101.8 105.6 103.3 102.8 102.8 102.8 102.6 102.6 102.6 102.6 102.6
TL  70.8  73.4  76.1  78.7  84.0  89.4  94.7 100.0 100.1 100.1 100.1 100.1 100.1 100.1 100.1 100.1
HT   0.83  0.72  0.68  0.61  0.51  0.48  0.54  1.81  2.15  2.15  2.15  2.32  2.32  2.32  2.32  2.32
RUN NO.= 98   S=   75.35  AQ=  3.652  DELTSUB=   20.60QC= 0.9000  T1=  21.10      T2=   25.30  TC= 24.55
TW  80.9  85.1  88.6  93.3 102.0 103.0 102.6 102.8 102.6 102.6 102.6 102.4 102.2 102.2 102.2 102.2
TL  81.7  83.8  85.8  87.9  92.0  96.1 100.2 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT  -4.81  2.74  1.32  0.67  0.37  0.53  1.55  1.43  1.55  1.55  1.55  1.70  1.87  1.87  1.87  1.87
RUN NO.= 99   S=   75.35  AQ=  3.652  DELTSUB=   31.75QC= 0.9000  T1=  21.30      T2=   25.49  TC= 24.80
TW  78.6  82.9  86.9  91.6 101.6 103.3 103.0 103.0 102.8 102.8 102.6 102.6 102.6 102.2 102.2 102.2
TL  71.7  74.8  78.0  81.2  87.5  93.8 100.1 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   0.53  0.45  0.41  0.35  0.26  0.39  1.27  1.33  1.43  1.43  1.55  1.55  1.55  1.87  1.87  1.87
RUN NO.=100   S=   74.65  AQ=  3.652  DELTSUB=   41.35QC= 0.9000  T1=  21.30      T2=   25.94  TC= 24.30
TW  72.9  79.0  84.4  90.1 101.1 102.8 102.8 102.8 102.6 102.6 102.6 102.4 102.2 102.2 102.2 102.2
TL  64.0  69.2  74.3  79.5  89.8 100.0 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3 100.3
HT   0.41  0.37  0.36  0.34  0.32  1.32  1.43  1.43  1.55  1.55  1.55  1.70  1.87  1.87  1.87  1.87
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| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=101 S= 73.96 AQ= 5.906 DELTSUB= 42.50QC= 0.9000 T1= 21.30 T2= 27.37 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 70.5 | 74.9 | 79.2 | 84.3 | 94.4 | 102.2 | 103.9 | 103.4 | 103.2 | 103.2 | 103.0 | 103.0 | 102.8 | 102.6 | 102.4 | 102.4 |
| TL | 61.3 | 64.8 | 68.4 | 71.9 | 79.0 | 86.0 | 93.1 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.64 | 0.58 | 0.54 | 0.48 | 0.38 | 0.37 | 0.55 | 1.84 | 2.00 | 2.00 | 2.15 | 2.15 | 2.32 | 2.51 | 2.75 | 2.75 |
| RUN NO.=102 S= 72.57 AQ= 8.448 DELTSUB= 40.45QC= 0.9000 T1= 21.30 T2= 29.98 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 71.4 | 75.9 | 79.9 | 84.7 | 92.9 | 100.7 | 107.9 | 104.1 | 103.4 | 103.4 | 103.4 | 103.3 | 103.3 | 103.3 | 103.1 | 103.1 |
| TL | 63.0 | 66.3 | 69.7 | 73.1 | 79.8 | 86.5 | 93.3 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.89 | 0.83 | 0.73 | 0.64 | 0.60 | 0.58 | 2.06 | 2.48 | 2.48 | 2.48 | 2.64 | 2.64 | 2.64 | 2.82 | 2.82 |
| RUN NO.=103 S= 71.88 AQ= 11.337 DELTSUB= 39.70QC= 0.9000 T1= 21.30 T2= 32.95 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 76.5 | 80.7 | 83.8 | 87.9 | 94.4 | 100.7 | 108.5 | 105.4 | 104.1 | 104.1 | 104.1 | 104.1 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 63.9 | 67.2 | 70.5 | 73.8 | 80.4 | 87.0 | 93.6 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.90 | 0.84 | 0.85 | 0.80 | 0.81 | 0.83 | 0.76 | 2.21 | 2.94 | 2.94 | 2.94 | 2.94 | 3.11 | 3.11 | 3.11 | 3.11 |
| RUN NO.=104 S= 71.18 AQ= 14.483 DELTSUB= 39.75QC= 0.9000 T1= 21.10 T2= 35.95 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 78.3 | 83.1 | 86.2 | 89.9 | 96.7 | 102.8 | 109.8 | 106.6 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 |
| TL | 63.6 | 66.9 | 70.2 | 73.5 | 80.1 | 86.8 | 93.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.99 | 0.89 | 0.91 | 0.88 | 0.88 | 0.90 | 0.88 | 2.19 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 |
| RUN NO.=105 S= 75.35 AQ= 14.111 DELTSUB= 4.85QC= 4.7500 T1= 20.60 T2= 23.98 TC= 28.10 | | | | | | | | | | | | | | | | |
| TW | 105.8 | 110.0 | 110.6 | 113.8 | 115.3 | 115.1 | 111.9 | 108.9 | 104.7 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 | 104.1 | 104.1 |
| TL | 95.6 | 96.2 | 96.8 | 97.4 | 98.6 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.38 | 1.02 | 1.02 | 0.86 | 0.85 | 0.93 | 1.17 | 1.55 | 2.91 | 3.17 | 3.17 | 3.17 | 3.17 | 3.17 | 3.32 | 3.32 |
| RUN NO.=106 S= 75.35 AQ= 11.048 DELTSUB= 7.15QC= 4.7500 T1= 20.60 T2= 22.74 TC= 27.10 | | | | | | | | | | | | | | | | |
| TW | 103.9 | 107.3 | 108.5 | 109.8 | 109.4 | 110.9 | 112.6 | 107.5 | 104.1 | 103.6 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 |
| TL | 93.3 | 93.9 | 94.5 | 95.1 | 96.3 | 97.5 | 98.7 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.05 | 0.83 | 0.79 | 0.75 | 0.84 | 0.83 | 0.79 | 1.44 | 2.60 | 2.91 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 |
| RUN NO.=107 S= 75.35 AQ= 8.355 DELTSUB= 12.75QC= 1.8500 T1= 21.10 T2= 25.27 TC= 25.05 | | | | | | | | | | | | | | | | |
| TW | 97.1 | 99.9 | 100.7 | 102.2 | 105.6 | 108.8 | 111.5 | 108.3 | 104.9 | 103.9 | 103.4 | 103.4 | 103.4 | 103.3 | 103.3 | 103.4 |
| TL | 88.8 | 89.9 | 90.9 | 92.0 | 94.1 | 96.2 | 98.4 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 1.01 | 0.84 | 0.86 | 0.82 | 0.73 | 0.67 | 0.64 | 1.07 | 1.88 | 2.46 | 2.83 | 2.83 | 2.83 | 3.04 | 3.04 | 2.83 |
| RUN NO.=108 S= 75.35 AQ= 8.232 DELTSUB= 9.05QC= 4.7500 T1= 20.60 T2= 22.20 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 100.1 | 102.0 | 102.0 | 103.4 | 105.6 | 107.3 | 110.3 | 104.5 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 91.6 | 92.3 | 93.1 | 93.8 | 95.3 | 96.8 | 98.4 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 0.97 | 0.85 | 0.92 | 0.85 | 0.81 | 0.79 | 0.69 | 1.77 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 |
| RUN NO.=109 S= 75.35 AQ= 5.673 DELTSUB= 9.50QC= 4.7500 T1= 20.35 T2= 21.45 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 95.6 | 98.1 | 98.6 | 101.1 | 104.3 | 105.8 | 106.9 | 103.4 | 102.0 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 |
| TL | 90.9 | 91.7 | 92.5 | 93.3 | 94.9 | 96.5 | 98.0 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.20 | 0.88 | 0.93 | 0.73 | 0.60 | 0.61 | 0.64 | 1.48 | 2.41 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 |
| RUN NO.=110 S= 75.35 AQ= 14.524 DELTSUB= 1.90QC= 1.8800 T1= 21.80 T2= 30.62 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 106.6 | 109.1 | 109.8 | 112.1 | 114.2 | 108.9 | 107.1 | 106.6 | 104.9 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 |
| TL | 98.6 | 98.8 | 99.1 | 99.3 | 99.8 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.81 | 1.41 | 1.35 | 1.13 | 1.01 | 1.67 | 2.14 | 2.29 | 3.09 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=111 | S= 75.35 | AQ= 11.481 | DELTSUB= 1.90 | QC= 1.8800 | T1= 20.80 | T2= 27.77 | TC= 25.80 | | | | | | | | | |
| TW | 106.2 | 108.8 | 109.4 | 111.7 | 114.4 | 110.6 | 108.1 | 105.8 | 104.8 | 104.1 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 98.6 | 98.8 | 99.1 | 99.3 | 99.8 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.51 | 1.16 | 1.11 | 0.93 | 0.78 | 1.10 | 1.46 | 2.07 | 2.55 | 2.98 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 |
| RUN NO.=112 | S= 75.35 | AQ= 8.603 | DELTSUB= 1.70 | QC= 1.4000 | T1= 20.80 | T2= 27.82 | TC= 25.80 | | | | | | | | | |
| TW | 104.8 | 107.4 | 109.4 | 110.0 | 112.8 | 111.1 | 106.9 | 105.1 | 103.9 | 103.6 | 103.4 | 103.3 | 103.3 | 103.1 | 103.1 | 103.1 |
| TL | 98.6 | 98.8 | 99.0 | 99.2 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.39 | 0.99 | 0.83 | 0.80 | 0.66 | 0.78 | 1.27 | 1.69 | 2.23 | 2.39 | 2.53 | 2.69 | 2.69 | 2.87 | 2.87 | 2.87 |
| RUN NO.=113 | S= 76.04 | AQ= 5.931 | DELTSUB= 2.15 | QC= 0.9000 | T1= 20.80 | T2= 28.33 | TC= 25.30 | | | | | | | | | |
| TW | 103.3 | 104.8 | 105.6 | 107.3 | 108.5 | 108.3 | 105.6 | 104.5 | 103.1 | 102.6 | 102.6 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 |
| TL | 98.2 | 98.4 | 98.7 | 99.0 | 99.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.17 | 0.94 | 0.87 | 0.72 | 0.66 | 0.72 | 1.08 | 1.33 | 1.98 | 2.33 | 2.33 | 2.52 | 2.52 | 2.52 | 2.52 | 2.52 |
| RUN NO.=114 | S= 75.35 | AQ= 3.693 | DELTSUB= 2.15 | QC= 0.9000 | T1= 21.30 | T2= 25.99 | TC= 25.05 | | | | | | | | | |
| TW | 100.7 | 102.4 | 102.8 | 103.9 | 105.4 | 103.2 | 102.8 | 102.6 | 102.2 | 102.0 | 101.8 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| TL | 98.2 | 98.4 | 98.7 | 99.0 | 99.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.46 | 0.93 | 0.90 | 0.75 | 0.63 | 1.17 | 1.34 | 1.45 | 1.72 | 1.89 | 2.17 | 2.46 | 2.46 | 2.46 | 2.46 | 2.46 |
| RUN NO.=115 | S= 75.35 | AQ= 14.524 | DELTSUB= 9.50 | QC= 0.9000 | T1= 20.80 | T2= 35.67 | TC= 26.30 | | | | | | | | | |
| TW | 104.3 | 107.7 | 108.5 | 108.8 | 109.1 | 112.4 | 113.8 | 109.6 | 104.9 | 104.5 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 91.3 | 92.1 | 92.9 | 93.7 | 95.3 | 96.9 | 98.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.12 | 0.93 | 0.93 | 0.97 | 1.05 | 0.94 | 0.95 | 1.52 | 2.96 | 3.26 | 3.26 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |
| RUN NO.=116 | S= 75.35 | AQ= 14.524 | DELTSUB= 19.75 | QC= 0.9000 | T1= 20.80 | T2= 33.90 | TC= 26.30 | | | | | | | | | |
| TW | 94.6 | 98.8 | 100.3 | 100.5 | 104.5 | 107.7 | 111.3 | 113.6 | 106.0 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 81.7 | 83.1 | 84.5 | 85.9 | 88.8 | 91.6 | 94.4 | 97.2 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.13 | 0.93 | 0.92 | 1.00 | 0.92 | 0.90 | 0.86 | 0.89 | 2.43 | 3.26 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |
| RUN NO.=117 | S= 75.35 | AQ= 11.445 | DELTSUB= 20.60 | QC= 0.9000 | T1= 20.80 | T2= 31.12 | TC= 26.55 | | | | | | | | | |
| TW | 94.1 | 96.3 | 97.3 | 98.6 | 102.6 | 105.4 | 110.0 | 111.5 | 105.4 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 80.9 | 82.4 | 83.9 | 85.3 | 88.3 | 91.2 | 94.2 | 97.1 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.87 | 0.83 | 0.85 | 0.87 | 0.80 | 0.81 | 0.72 | 0.79 | 2.15 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 |
| RUN NO.=118 | S= 74.65 | AQ= 8.541 | DELTSUB= 19.55 | QC= 0.9000 | T1= 20.60 | T2= 29.35 | TC= 25.55 | | | | | | | | | |
| TW | 89.3 | 93.3 | 95.6 | 97.3 | 101.4 | 104.5 | 109.1 | 104.9 | 103.4 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 82.1 | 83.8 | 85.4 | 87.0 | 90.3 | 93.5 | 96.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.20 | 0.89 | 0.83 | 0.83 | 0.77 | 0.78 | 0.69 | 1.73 | 2.51 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 |
| RUN NO.=119 | S= 73.96 | AQ= 5.931 | DELTSUB= 21.25 | QC= 0.9000 | T1= 21.30 | T2= 27.38 | TC= 26.05 | | | | | | | | | |
| TW | 89.1 | 91.9 | 94.1 | 96.6 | 101.6 | 105.4 | 106.6 | 104.3 | 103.4 | 103.3 | 103.3 | 103.3 | 103.1 | 103.1 | 103.1 | 103.1 |
| TL | 80.8 | 82.5 | 84.3 | 86.1 | 89.6 | 93.2 | 96.7 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.72 | 0.64 | 0.60 | 0.56 | 0.50 | 0.49 | 0.60 | 1.46 | 1.85 | 1.98 | 1.98 | 1.98 | 2.12 | 2.12 | 2.12 | 2.12 |
| RUN NO.=120 | S= 73.26 | AQ= 14.524 | DELTSUB= 28.00 | QC= 0.9000 | T1= 20.80 | T2= 35.67 | TC= 26.30 | | | | | | | | | |
| TW | 86.4 | 90.6 | 92.3 | 95.2 | 99.6 | 105.8 | 111.3 | 107.7 | 105.1 | 104.5 | 104.7 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 74.4 | 76.7 | 79.0 | 81.4 | 86.0 | 90.7 | 95.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.21 | 1.05 | 1.10 | 1.05 | 1.07 | 0.96 | 0.91 | 1.89 | 2.85 | 3.26 | 3.12 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=121 S= 73.26 AQ= 11.337 DELTSUB= 30.80QC= 0.9000 T1= 20.60 T2= 32.21 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 83.1 | 87.1 | 88.8 | 92.3 | 98.1 | 103.3 | 109.4 | 105.8 | 103.9 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 71.8 | 74.4 | 76.9 | 79.5 | 84.6 | 89.8 | 94.9 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.89 | 0.96 | 0.89 | 0.84 | 0.84 | 0.78 | 1.96 | 2.94 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 |
| RUN NO.=122 S= 51.74 AQ= 14.483 DELTSUB= 1.30QC= 1.4000 T1= 19.60 T2= 34.24 TC= 25.80 | | | | | | | | | | | | | | | | |
| TW | 108.1 | 108.8 | 105.8 | 105.4 | 103.6 | 103.1 | 103.3 | 103.6 | 103.4 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.9 | 103.9 |
| TL | 98.8 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.55 | 1.52 | 2.35 | 2.52 | 3.62 | 4.26 | 4.02 | 3.62 | 3.81 | 3.81 | 3.62 | 3.62 | 3.62 | 3.62 | 3.45 | 3.45 |
| RUN NO.=123 S= 53.13 AQ= 11.300 DELTSUB= 1.90QC= 1.4000 T1= 20.10 T2= 31.52 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 108.1 | 108.3 | 107.3 | 104.1 | 103.2 | 102.8 | 102.8 | 103.2 | 103.0 | 103.0 | 103.2 | 103.2 | 103.2 | 103.2 | 103.2 | 103.2 |
| TL | 98.6 | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.19 | 1.24 | 1.52 | 2.66 | 3.37 | 3.83 | 3.83 | 3.37 | 3.59 | 3.59 | 3.37 | 3.37 | 3.37 | 3.37 | 3.37 | 3.37 |
| RUN NO.=124 S= 53.82 AQ= 8.417 DELTSUB= 1.90QC= 1.4000 T1= 20.35 T2= 28.86 TC= 25.55 | | | | | | | | | | | | | | | | |
| TW | 106.0 | 107.3 | 104.7 | 103.0 | 102.8 | 102.4 | 102.6 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 98.6 | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.13 | 1.05 | 1.73 | 2.67 | 2.85 | 3.30 | 3.06 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.85 | 2.85 | 2.85 | 2.85 |
| RUN NO.=125 S= 53.82 AQ= 5.880 DELTSUB= 1.25QC= 0.9000 T1= 20.35 T2= 30.01 TC= 22.10 | | | | | | | | | | | | | | | | |
| TW | 104.3 | 103.3 | 102.2 | 101.9 | 102.2 | 101.9 | 101.9 | 102.4 | 101.9 | 101.9 | 102.2 | 101.9 | 101.9 | 101.9 | 101.9 | 101.9 |
| TL | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.16 | 1.72 | 2.50 | 2.80 | 2.50 | 2.80 | 2.80 | 2.31 | 2.80 | 2.80 | 2.50 | 2.80 | 2.80 | 2.80 | 2.80 | 2.80 |
| RUN NO.=126 S= 54.51 AQ= 5.880 DELTSUB= 1.50QC= 0.9000 T1= 20.60 T2= 29.90 TC= 22.10 | | | | | | | | | | | | | | | | |
| TW | 103.3 | 103.4 | 100.7 | 101.6 | 101.9 | 101.8 | 102.2 | 102.4 | 102.2 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.2 | 102.2 |
| TL | 98.8 | 99.3 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.33 | 1.43 | 6.78 | 3.46 | 2.80 | 3.09 | 2.50 | 2.31 | 2.50 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.50 | 2.50 |
| RUN NO.=127 S= 50.35 AQ= 14.483 DELTSUB= 4.00QC= 0.9000 T1= 20.80 T2= 43.59 TC= 25.80 | | | | | | | | | | | | | | | | |
| TW | 108.5 | 112.1 | 110.9 | 107.1 | 104.3 | 103.6 | 103.9 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 97.4 | 98.7 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.30 | 1.08 | 1.34 | 2.07 | 3.41 | 4.02 | 3.81 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.41 | 3.41 | 3.41 | 3.41 |
| RUN NO.=128 S= 51.04 AQ= 11.337 DELTSUB= 10.80QC= 0.9000 T1= 20.60 T2= 38.42 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 104.7 | 108.5 | 107.7 | 104.7 | 103.4 | 103.1 | 103.1 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 |
| TL | 92.8 | 96.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.95 | 0.94 | 1.46 | 2.44 | 3.33 | 3.78 | 3.78 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| RUN NO.=129 S= 51.74 AQ= 8.448 DELTSUB= 11.85QC= 0.9000 T1= 20.60 T2= 33.88 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 102.0 | 106.8 | 104.1 | 102.6 | 102.4 | 102.4 | 102.6 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 91.9 | 95.8 | 99.7 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 0.84 | 0.77 | 1.94 | 3.07 | 3.31 | 3.31 | 3.07 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 |
| RUN NO.=130 S= 50.35 AQ= 14.483 DELTSUB= 19.35QC= 0.9000 T1= 20.60 T2= 40.72 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 99.2 | 104.3 | 108.3 | 110.4 | 104.3 | 103.6 | 103.9 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 |
| TL | 83.9 | 87.1 | 90.3 | 93.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.95 | 0.84 | 0.81 | 0.86 | 3.35 | 4.02 | 3.81 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=131 | S= 51.74 | AQ= 11.300 | DELTSUB= 19.75 | QC= 0.9000 | T1= 20.60 | T2= 37.67 | TC= 26.55 | | | | | | | | | |
| TW | 96.3 | 102.6 | 107.7 | 104.7 | 103.4 | 103.3 | 103.3 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 85.2 | 90.1 | 95.0 | 99.9 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.02 | 0.91 | 0.89 | 2.37 | 3.32 | 3.53 | 3.53 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 |
| RUN NO.=132 | S= 51.74 | AQ= 8.541 | DELTSUB= 19.30 | QC= 0.9000 | T1= 20.60 | T2= 34.03 | TC= 26.30 | | | | | | | | | |
| TW | 95.6 | 104.3 | 103.4 | 103.1 | 102.8 | 102.8 | 102.8 | 103.1 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 103.1 |
| TL | 87.1 | 93.5 | 99.9 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.79 | 2.43 | 2.85 | 3.11 | 3.11 | 3.11 | 2.85 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 2.85 |
| RUN NO.=133 | S= 51.04 | AQ= 11.300 | DELTSUB= 28.65 | QC= 0.9000 | T1= 20.80 | T2= 37.89 | TC= 26.05 | | | | | | | | | |
| TW | 92.3 | 100.9 | 106.4 | 104.1 | 103.6 | 103.3 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 78.7 | 85.8 | 93.0 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.84 | 0.75 | 0.84 | 2.82 | 3.32 | 3.77 | 3.53 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 |
| RUN NO.=134 | S= 51.74 | AQ= 8.448 | DELTSUB= 32.00 | QC= 0.9000 | T1= 20.60 | T2= 33.37 | TC= 26.05 | | | | | | | | | |
| TW | 91.2 | 102.2 | 103.6 | 103.1 | 102.8 | 102.8 | 102.8 | 103.1 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 76.0 | 83.9 | 91.9 | 99.8 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.56 | 0.46 | 0.72 | 2.63 | 3.07 | 3.07 | 3.07 | 2.82 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 |
| RUN NO.=135 | S= 50.35 | AQ= 14.483 | DELTSUB= 40.65 | QC= 0.9000 | T1= 20.60 | T2= 40.74 | TC= 26.05 | | | | | | | | | |
| TW | 83.6 | 93.1 | 100.3 | 107.9 | 103.9 | 103.6 | 103.6 | 104.1 | 103.9 | 103.9 | 104.1 | 104.1 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 66.4 | 73.1 | 79.9 | 86.6 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.84 | 0.72 | 0.71 | 0.68 | 3.90 | 4.26 | 4.26 | 3.76 | 4.02 | 4.02 | 3.76 | 3.76 | 3.58 | 3.58 | 3.58 | 3.58 |
| RUN NO.=136 | S= 50.35 | AQ= 11.300 | DELTSUB= 41.55 | QC= 0.9000 | T1= 20.80 | T2= 36.51 | TC= 26.05 | | | | | | | | | |
| TW | 84.7 | 94.4 | 102.6 | 105.6 | 103.4 | 103.4 | 103.4 | 103.6 | 103.6 | 103.6 | 103.9 | 103.9 | 103.6 | 103.9 | 103.9 | 103.9 |
| TL | 65.6 | 72.5 | 79.4 | 86.3 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.59 | 0.52 | 0.49 | 0.59 | 3.36 | 3.53 | 3.53 | 3.32 | 3.32 | 3.32 | 3.14 | 3.14 | 3.32 | 3.14 | 3.14 | 3.14 |
| RUN NO.=137 | S= 52.43 | AQ= 14.111 | DELTSUB= 8.45 | QC= 4.7500 | T1= 21.10 | T2= 24.80 | TC= 28.35 | | | | | | | | | |
| TW | 104.9 | 108.9 | 111.5 | 111.5 | 105.6 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 92.6 | 94.0 | 95.4 | 96.8 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.15 | 0.94 | 0.88 | 0.96 | 2.36 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 |
| RUN NO.=138 | S= 52.43 | AQ= 11.012 | DELTSUB= 14.90 | QC= 4.7500 | T1= 21.10 | T2= 24.25 | TC= 27.10 | | | | | | | | | |
| TW | 100.3 | 106.0 | 108.9 | 105.6 | 103.4 | 102.8 | 103.1 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 88.6 | 92.3 | 96.1 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 |
| HT | 0.94 | 0.81 | 0.85 | 1.90 | 3.02 | 3.67 | 3.39 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 |
| RUN NO.=139 | S= 48.26 | AQ= 14.400 | DELTSUB= 28.70 | QC= 4.7500 | T1= 21.60 | T2= 25.68 | TC= 31.85 | | | | | | | | | |
| TW | 95.6 | 102.1 | 108.9 | 106.6 | 103.6 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 |
| TL | 77.1 | 84.3 | 91.4 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 |
| HT | 0.78 | 0.81 | 0.82 | 1.80 | 2.85 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 |
| RUN NO.=140 | S= 48.26 | AQ= 14.400 | DELTSUB= 72.85 | QC= 4.7500 | T1= 23.05 | T2= 26.78 | TC= 35.25 | | | | | | | | | |
| TW | 67.6 | 84.3 | 99.0 | 105.8 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 38.9 | 50.9 | 63.0 | 75.1 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 0.50 | 0.43 | 0.40 | 0.47 | 3.40 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=141 S= 99.65 AQ= 8.974 DELTSUB= 3.45QC= 0.9000 T1= 24.05 T2= 27.48 TC= 73.20 | | | | | | | | | | | | | | | | |
| TW | 101.4 | 103.4 | 104.5 | 106.0 | 108.3 | 108.5 | 108.9 | 109.1 | 109.4 | 110.4 | 110.9 | 110.9 | 104.1 | 103.6 | 102.8 | 103.3 |
| TL | 96.7 | 96.8 | 97.0 | 97.1 | 97.4 | 97.8 | 98.1 | 98.4 | 98.7 | 99.0 | 99.3 | 99.6 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.91 | 1.35 | 1.19 | 1.01 | 0.83 | 0.84 | 0.82 | 0.83 | 0.84 | 0.78 | 0.78 | 0.80 | 2.16 | 2.43 | 3.15 | 2.72 |
| RUN NO.=142 S= 93.40 AQ= 11.950 DELTSUB= 2.35QC= 0.9000 T1= 24.05 T2= 35.85 TC= 47.45 | | | | | | | | | | | | | | | | |
| TW | 103.1 | 104.7 | 105.8 | 106.9 | 108.8 | 110.9 | 112.6 | 112.1 | 108.5 | 107.3 | 106.0 | 103.9 | 103.1 | 103.1 | 102.2 | 103.1 |
| TL | 97.3 | 97.5 | 97.7 | 97.9 | 98.3 | 98.7 | 99.1 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 2.08 | 1.66 | 1.47 | 1.33 | 1.14 | 0.98 | 0.89 | 0.94 | 1.32 | 1.53 | 1.82 | 2.69 | 3.32 | 3.32 | 4.35 | 3.32 |
| RUN NO.=143 S= 90.63 AQ= 15.638 DELTSUB= 1.50QC= 1.4000 T1= 22.10 T2= 33.01 TC= 58.00 | | | | | | | | | | | | | | | | |
| TW | 104.7 | 106.6 | 107.9 | 108.9 | 111.9 | 113.4 | 110.9 | 110.3 | 108.1 | 106.9 | 106.0 | 104.5 | 104.3 | 104.5 | 104.5 | 104.5 |
| TL | 98.3 | 98.4 | 98.6 | 98.7 | 99.0 | 99.3 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 2.44 | 1.92 | 1.68 | 1.53 | 1.22 | 1.11 | 1.39 | 1.48 | 1.85 | 2.17 | 2.46 | 3.22 | 3.36 | 3.22 | 3.22 | 3.22 |
| RUN NO.=144 S= 73.96 AQ= 19.589 DELTSUB= 3.35QC= 1.8500 T1= 21.10 T2= 32.51 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 107.4 | 110.0 | 111.7 | 113.6 | 112.9 | 106.9 | 106.2 | 105.1 | 104.1 | 103.6 | 103.6 | 103.9 | 104.5 | 104.5 | 104.7 |
| TL | 96.1 | 96.5 | 96.9 | 97.3 | 98.2 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 |
| HT | 2.21 | 1.79 | 1.50 | 1.36 | 1.27 | 1.40 | 2.50 | 2.72 | 3.19 | 3.84 | 4.21 | 4.21 | 4.00 | 3.56 | 3.56 | 3.44 |
| RUN NO.=145 S= 70.49 AQ= 24.086 DELTSUB= 3.55QC= 1.8500 T1= 21.35 T2= 36.38 TC= 72.50 | | | | | | | | | | | | | | | | |
| TW | 107.2 | 109.6 | 110.6 | 110.9 | 109.4 | 109.9 | 109.9 | 108.3 | 106.2 | 104.7 | 104.5 | 104.5 | 104.5 | 105.1 | 105.1 | 105.4 |
| TL | 96.2 | 96.8 | 97.4 | 98.0 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.20 | 1.89 | 1.83 | 1.88 | 2.37 | 2.26 | 2.26 | 2.65 | 3.44 | 4.38 | 4.54 | 4.54 | 4.54 | 4.05 | 4.05 | 3.92 |
| RUN NO.=146 S= 76.04 AQ= 11.950 DELTSUB= 16.25QC= 0.9000 T1= 21.60 T2= 32.05 TC= 44.10 | | | | | | | | | | | | | | | | |
| TW | 96.3 | 98.6 | 99.4 | 100.3 | 104.1 | 105.8 | 109.4 | 112.6 | 104.5 | 103.5 | 103.5 | 103.3 | 103.3 | 103.5 | 103.5 | 103.5 |
| TL | 84.3 | 85.5 | 86.6 | 87.8 | 90.1 | 92.4 | 94.7 | 97.1 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.00 | 0.91 | 0.94 | 0.96 | 0.85 | 0.89 | 0.82 | 0.77 | 2.34 | 2.91 | 2.91 | 3.10 | 3.10 | 2.91 | 2.91 | 2.91 |
| RUN NO.=147 S= 71.88 AQ= 15.638 DELTSUB= 4.85QC= 0.9000 T1= 21.10 T2= 40.12 TC= 50.60 | | | | | | | | | | | | | | | | |
| TW | 106.4 | 110.3 | 112.1 | 113.1 | 114.3 | 112.9 | 108.1 | 106.9 | 104.3 | 103.9 | 103.9 | 103.7 | 103.7 | 104.1 | 104.1 | 104.1 |
| TL | 95.2 | 95.8 | 96.4 | 97.0 | 98.2 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.40 | 1.08 | 0.99 | 0.97 | 0.98 | 1.16 | 1.81 | 2.11 | 3.22 | 3.51 | 3.51 | 3.68 | 3.68 | 3.36 | 3.36 | 3.36 |
| RUN NO.=148 S= 55.90 AQ= 19.542 DELTSUB= 8.65QC= 1.5000 T1= 23.05 T2= 37.17 TC= 56.60 | | | | | | | | | | | | | | | | |
| TW | 108.5 | 111.5 | 110.6 | 111.7 | 113.4 | 104.1 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.9 | 104.5 | 103.6 | 104.5 |
| TL | 92.1 | 93.2 | 94.2 | 95.3 | 97.5 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.19 | 1.07 | 1.19 | 1.19 | 1.23 | 4.38 | 4.89 | 4.89 | 4.89 | 4.89 | 4.89 | 4.89 | 4.60 | 4.03 | 4.89 | 4.03 |
| RUN NO.=149 S= 52.43 AQ= 23.932 DELTSUB= 6.95QC= 1.4000 T1= 24.05 T2= 46.50 TC= 70.05 | | | | | | | | | | | | | | | | |
| TW | 110.0 | 110.0 | 109.4 | 108.9 | 109.6 | 104.8 | 104.3 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.5 | 105.4 | 105.1 | 105.8 |
| TL | 95.0 | 97.3 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.60 | 1.89 | 2.45 | 2.57 | 2.41 | 4.69 | 5.15 | 4.93 | 5.15 | 5.15 | 5.15 | 5.15 | 4.93 | 4.20 | 4.35 | 3.89 |
| RUN NO.=150 S= 36.46 AQ= 23.932 DELTSUB= 21.55QC= 1.8500 T1= 23.30 T2= 40.47 TC= 63.95 | | | | | | | | | | | | | | | | |
| TW | 106.9 | 107.9 | 103.6 | 103.4 | 103.9 | 103.6 | 103.6 | 104.3 | 104.1 | 104.3 | 104.3 | 104.3 | 104.9 | 105.6 | 105.4 | 106.4 |
| TL | 85.3 | 92.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.11 | 1.55 | 5.89 | 6.30 | 5.63 | 5.98 | 5.98 | 5.15 | 5.38 | 5.15 | 5.15 | 5.15 | 4.52 | 4.02 | 4.20 | 3.55 |

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Z     0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40

RUN NO.=141   S=   99.65   AQ=   8.974   DELTSUB=    3.45QC= 0.9000   T1=   24.05      T2=   27.48   TC= 73.20
TW 101.4 103.4 104.5 106.0 108.3 108.5 108.9 109.1 109.4 110.4 110.9 110.9 104.1 103.6 102.8 103.3
TL   96.7  96.8  97.0  97.1  97.4  97.8  98.1  98.4  98.7  99.0  99.3  99.6  99.9  99.9  99.9  99.9
HT   1.91  1.35  1.19  1.01  0.83  0.84  0.82  0.83  0.84  0.78  0.78  0.80  2.16  2.43  3.15  2.72

RUN NO.=142   S=   93.40   AQ=  11.950   DELTSUB=    2.35QC= 0.9000   T1=   24.05      T2=   35.85   TC= 47.45
TW 103.1 104.7 105.8 106.9 108.8 110.9 112.6 112.1 108.5 107.3 106.0 103.9 103.1 103.1 102.2 103.1
TL   97.3  97.5  97.7  97.9  98.3  98.7  99.1  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   2.08  1.66  1.47  1.33  1.14  0.98  0.89  0.94  1.32  1.53  1.82  2.69  3.32  3.32  4.35  3.32

RUN NO.=143   S=   90.63   AQ=  15.638   DELTSUB=    1.50QC= 1.4000   T1=   22.10      T2=   33.01   TC= 58.00
TW 104.7 106.6 107.9 108.9 111.9 113.4 110.9 110.3 108.1 106.9 106.0 104.5 104.3 104.5 104.5 104.5
TL   98.3  98.4  98.6  98.7  99.0  99.3  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   2.44  1.92  1.68  1.53  1.22  1.11  1.39  1.48  1.85  2.17  2.46  3.22  3.36  3.22  3.22  3.22

RUN NO.=144   S=   73.96   AQ=  19.589   DELTSUB=    3.35QC= 1.8500   T1=   21.10      T2=   32.51   TC= 59.15
TW 104.9 107.4 110.0 111.7 113.6 112.9 106.9 106.2 105.1 104.1 103.6 103.6 103.9 104.5 104.5 104.7
TL   96.1  96.5  96.9  97.3  98.2  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0
HT   2.21  1.79  1.50  1.36  1.27  1.40  2.50  2.72  3.19  3.84  4.21  4.21  4.00  3.56  3.56  3.44

RUN NO.=145   S=   70.49   AQ=  24.086   DELTSUB=    3.55QC= 1.8500   T1=   21.35      T2=   36.38   TC= 72.50
TW 107.2 109.6 110.6 110.9 109.4 109.9 109.9 108.3 106.2 104.7 104.5 104.5 104.5 105.1 105.1 105.4
TL   96.2  96.8  97.4  98.0  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2
HT   2.20  1.89  1.83  1.88  2.37  2.26  2.26  2.65  3.44  4.38  4.54  4.54  4.54  4.05  4.05  3.92

RUN NO.=146   S=   76.04   AQ=  11.950   DELTSUB=   16.25QC= 0.9000   T1=   21.60      T2=   32.05   TC= 44.10
TW   96.3  98.6  99.4 100.3 104.1 105.8 109.4 112.6 104.5 103.5 103.5 103.3 103.3 103.5 103.5 103.5
TL   84.3  85.5  86.6  87.8  90.1  92.4  94.7  97.1  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   1.00  0.91  0.94  0.96  0.85  0.89  0.82  0.77  2.34  2.91  2.91  3.10  3.10  2.91  2.91  2.91

RUN NO.=147   S=   71.88   AQ=  15.638   DELTSUB=    4.85QC= 0.9000   T1=   21.10      T2=   40.12   TC= 50.60
TW 106.4 110.3 112.1 113.1 114.3 112.9 108.1 106.9 104.3 103.9 103.9 103.7 103.7 104.1 104.1 104.1
TL   95.2  95.8  96.4  97.0  98.2  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   1.40  1.08  0.99  0.97  0.98  1.16  1.81  2.11  3.22  3.51  3.51  3.68  3.68  3.36  3.36  3.36

RUN NO.=148   S=   55.90   AQ=  19.542   DELTSUB=    8.65QC= 1.5000   T1=   23.05      T2=   37.17   TC= 56.60
TW 108.5 111.5 110.6 111.7 113.4 104.1 103.6 103.6 103.6 103.6 103.6 103.6 103.9 104.5 103.6 104.5
TL   92.1  93.2  94.2  95.3  97.5  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.19  1.07  1.19  1.19  1.23  4.38  4.89  4.89  4.89  4.89  4.89  4.89  4.60  4.03  4.89  4.03

RUN NO.=149   S=   52.43   AQ=  23.932   DELTSUB=    6.95QC= 1.4000   T1=   24.05      T2=   46.50   TC= 70.05
TW 110.0 110.0 109.4 108.9 109.6 104.8 104.3 104.5 104.3 104.3 104.3 104.3 104.5 105.4 105.1 105.8
TL   95.0  97.3  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.60  1.89  2.45  2.57  2.41  4.69  5.15  4.93  5.15  5.15  5.15  5.15  4.93  4.20  4.35  3.89

RUN NO.=150   S=   36.46   AQ=  23.932   DELTSUB=   21.55QC= 1.8500   T1=   23.30      T2=   40.47   TC= 63.95
TW 106.9 107.9 103.6 103.4 103.9 103.6 103.6 104.3 104.1 104.3 104.3 104.3 104.9 105.6 105.4 106.4
TL   85.3  92.4  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.11  1.55  5.89  6.30  5.63  5.98  5.98  5.15  5.38  5.15  5.15  5.15  4.52  4.02  4.20  3.55
```

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=231 S= 53.13 AQ= 8.727 DELTSUB= 10.40QC= 0.9000 T1= 19.85 T2= 33.51 TC= 58.90 | | | | | | | | | | | | | | | | |
| TW | 117.6 | 117.4 | 119.6 | 122.8 | 119.1 | 117.4 | 117.1 | 117.6 | 117.6 | 117.6 | 117.6 | 117.6 | 117.8 | 118.4 | 118.2 | 119.4 |
| TL | 102.0 | 103.7 | 105.5 | 107.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.56 | 0.64 | 0.61 | 0.56 | 1.04 | 1.30 | 1.34 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.23 | 1.13 | 1.16 | 0.99 |
| RUN NO.=232 S= 53.13 AQ= 5.957 DELTSUB= 12.40QC= 0.9000 T1= 19.85 T2= 30.18 TC= 55.00 | | | | | | | | | | | | | | | | |
| TW | 116.3 | 116.3 | 119.4 | 117.6 | 116.1 | 115.5 | 115.9 | 116.3 | 116.1 | 116.3 | 116.3 | 116.3 | 116.3 | 116.9 | 116.7 | 117.6 |
| TL | 101.8 | 104.9 | 108.0 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 |
| HT | 0.41 | 0.52 | 0.52 | 0.92 | 1.19 | 1.35 | 1.24 | 1.15 | 1.19 | 1.15 | 1.15 | 1.15 | 1.15 | 1.03 | 1.06 | 0.92 |
| RUN NO.=233 S= 53.13 AQ= 3.734 DELTSUB= 17.10QC= 0.9000 T1= 19.85 T2= 26.23 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 110.6 | 116.5 | 117.4 | 116.3 | 115.1 | 114.7 | 115.1 | 115.3 | 115.3 | 115.3 | 115.3 | 115.3 | 115.5 | 115.7 | 115.5 | 115.9 |
| TL | 98.9 | 103.2 | 107.5 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 |
| HT | 0.32 | 0.28 | 0.38 | 0.81 | 1.10 | 1.24 | 1.10 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 0.98 | 0.93 | 0.98 | 0.89 |
| RUN NO.=234 S= 35.07 AQ= 14.895 DELTSUB= 17.75QC= 1.8500 T1= 20.10 T2= 31.37 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.9 | 121.3 | 121.1 | 120.3 | 119.9 | 120.3 | 120.7 | 120.9 | 121.1 | 121.3 | 121.5 | 122.6 | 124.1 | 123.9 | 127.1 |
| TL | 97.1 | 100.1 | 103.0 | 106.0 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.85 | 0.72 | 0.82 | 0.99 | 1.78 | 1.87 | 1.78 | 1.69 | 1.66 | 1.62 | 1.58 | 1.55 | 1.40 | 1.23 | 1.25 | 0.98 |
| RUN NO.=235 S= 35.07 AQ= 14.895 DELTSUB= 18.60QC= 1.8500 T1= 20.10 T2= 32.36 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.3 | 121.1 | 120.9 | 120.3 | 119.9 | 120.3 | 120.9 | 120.9 | 121.1 | 121.5 | 121.5 | 122.6 | 124.3 | 124.3 | 127.1 |
| TL | 98.0 | 102.6 | 107.3 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.89 | 0.85 | 1.08 | 1.66 | 1.78 | 1.87 | 1.78 | 1.66 | 1.66 | 1.62 | 1.55 | 1.55 | 1.40 | 1.21 | 1.21 | 0.98 |

SYSTEM-ETHYL ACETATE

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=236 S= 97.57 AQ= 8.634 DELTSUB= 20.90QC= 0.9000 T1= 21.80 T2= 29.11 TC= 63.70 | | | | | | | | | | | | | | | | |
| TW | 79.9 | 80.3 | 79.0 | 78.8 | 82.9 | 84.1 | 86.6 | 87.5 | 82.3 | 81.8 | 81.8 | 81.6 | 82.5 | 82.5 | 82.1 | 82.9 |
| TL | 56.7 | 58.2 | 59.7 | 61.2 | 64.2 | 67.1 | 70.1 | 73.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.37 | 0.39 | 0.45 | 0.49 | 0.46 | 0.51 | 0.52 | 0.60 | 1.39 | 1.51 | 1.51 | 1.58 | 1.35 | 1.35 | 1.45 | 1.26 |
| RUN NO.=237 S= 97.57 AQ= 8.634 DELTSUB= 32.75QC= 0.9000 T1= 21.80 T2= 28.91 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 71.9 | 66.9 | 67.9 | 70.3 | 73.6 | 76.3 | 80.1 | 82.9 | 82.7 | 82.5 | 82.5 | 82.5 | 83.1 | 82.9 | 82.3 | 83.4 |
| TL | 45.7 | 48.0 | 50.4 | 52.7 | 57.4 | 62.1 | 66.7 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.33 | 0.46 | 0.49 | 0.49 | 0.53 | 0.61 | 0.65 | 0.75 | 1.30 | 1.35 | 1.35 | 1.35 | 1.22 | 1.26 | 1.39 | 1.18 |
| RUN NO.=238 S= 97.57 AQ= 8.572 DELTSUB= 39.40QC= 0.9000 T1= 21.80 T2= 27.71 TC= 75.20 | | | | | | | | | | | | | | | | |
| TW | 64.2 | 60.8 | 61.7 | 64.6 | 68.8 | 72.5 | 76.5 | 80.8 | 82.7 | 82.5 | 82.5 | 82.3 | 82.9 | 82.7 | 82.5 | 83.4 |
| TL | 39.2 | 41.6 | 44.1 | 46.5 | 51.5 | 56.4 | 61.3 | 66.2 | 71.2 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.34 | 0.45 | 0.49 | 0.47 | 0.50 | 0.53 | 0.56 | 0.59 | 0.74 | 1.34 | 1.34 | 1.38 | 1.25 | 1.30 | 1.34 | 1.17 |
| RUN NO.=239 S= 96.18 AQ= 14.937 DELTSUB= 9.65QC= 0.9000 T1= 21.80 T2= 43.49 TC= 66.90 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 99.6 | 84.3 | 83.8 | 85.6 | 84.7 | 85.8 | 83.8 | 83.6 | 83.4 | 83.8 | 85.4 | 84.9 | 86.0 | 85.1 | 86.0 |
| TL | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.64 | 0.56 | 1.83 | 1.94 | 1.58 | 1.74 | 1.54 | 1.94 | 1.99 | 2.06 | 1.94 | 1.61 | 1.70 | 1.51 | 1.66 | 1.51 |
| RUN NO.=240 S= 97.57 AQ= 11.553 DELTSUB= 7.25QC= 0.9000 T1= 21.60 T2= 36.51 TC= 66.00 | | | | | | | | | | | | | | | | |
| TW | 89.3 | 94.6 | 99.0 | 100.1 | 84.7 | 84.4 | 85.1 | 83.8 | 83.6 | 83.1 | 83.4 | 84.7 | 84.1 | 84.9 | 84.1 | 85.1 |
| TL | 70.2 | 71.4 | 72.6 | 73.8 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.61 | 0.50 | 0.44 | 0.44 | 1.37 | 1.41 | 1.31 | 1.53 | 1.57 | 1.67 | 1.63 | 1.37 | 1.48 | 1.34 | 1.48 | 1.31 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=241 | S= | 96.18 | AQ= | 3.775 | DELTSUB= | | 10.55QC= | 0.9000 | T1= | 21.30 | | T2= | 24.90 | TC= | 65.55 |
| TW | 75.6 | 77.6 | 78.6 | 79.2 | 80.5 | 81.4 | 83.4 | 82.9 | 82.3 | 84.3 | 82.9 | 80.5 | 80.1 | 80.1 | 79.4 | 80.1 |
| TL | 66.4 | 67.3 | 68.2 | 69.1 | 70.8 | 72.6 | 74.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.41 | 0.37 | 0.36 | 0.37 | 0.39 | 0.43 | 0.42 | 0.55 | 0.61 | 0.46 | 0.55 | 0.86 | 0.96 | 0.96 | 1.13 | 0.96 |
| RUN | NO.=242 | S= | 85.07 | AQ= | 8.603 | DELTSUB= | | 2.65QC= | 0.9000 | T1= | 20.80 | | T2= | 30.90 | TC= | 66.45 |
| TW | 87.8 | 91.2 | 94.4 | 96.1 | 96.7 | 82.5 | 82.9 | 82.1 | 82.1 | 82.1 | 82.1 | 81.8 | 81.8 | 82.3 | 82.1 | 83.1 |
| TL | 73.9 | 74.3 | 74.6 | 74.9 | 75.6 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.62 | 0.51 | 0.44 | 0.41 | 0.41 | 1.38 | 1.28 | 1.48 | 1.48 | 1.48 | 1.48 | 1.55 | 1.55 | 1.42 | 1.48 | 1.25 |
| RUN | NO.=243 | S= | 89.24 | AQ= | 5.931 | DELTSUB= | | 4.90QC= | 0.9000 | T1= | 21.30 | | T2= | 27.01 | TC= | 63.50 |
| TW | 84.9 | 88.4 | 88.9 | 89.3 | 91.4 | 91.9 | 92.3 | 84.1 | 83.6 | 84.4 | 82.1 | 81.1 | 80.7 | 80.9 | 80.7 | 81.4 |
| TL | 71.8 | 72.2 | 72.6 | 73.0 | 73.8 | 74.7 | 75.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.45 | 0.37 | 0.37 | 0.36 | 0.34 | 0.35 | 0.35 | 0.76 | 0.81 | 0.73 | 1.03 | 1.22 | 1.35 | 1.28 | 1.35 | 1.16 |
| RUN | NO.=244 | S= | 75.35 | AQ= | 3.817 | DELTSUB= | | 12.85QC= | 0.9000 | T1= | 20.35 | | T2= | 24.62 | TC= | 75.40 |
| TW | 75.4 | 79.2 | 81.6 | 84.3 | 89.1 | 82.3 | 79.9 | 79.9 | 79.4 | 79.2 | 79.2 | 79.0 | 79.0 | 79.4 | 79.0 | 79.9 |
| TL | 64.9 | 66.5 | 68.1 | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.36 | 0.30 | 0.28 | 0.26 | 0.24 | 0.62 | 1.00 | 1.00 | 1.14 | 1.23 | 1.23 | 1.32 | 1.32 | 1.14 | 1.32 | 1.00 |
| RUN | NO.=245 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 32.00QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 83.8 | 81.4 | 81.1 | 84.9 | 89.3 | 83.8 | 85.6 | 87.8 | 89.3 | 86.4 | 85.6 | 84.9 | 85.1 | 85.8 | 85.6 | 83.1 |
| TL | 46.3 | 48.3 | 50.3 | 52.3 | 56.3 | 60.3 | 64.3 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.40 | 0.45 | 0.48 | 0.46 | 0.45 | 0.64 | 0.70 | 0.77 | 0.88 | 1.47 | 1.61 | 1.74 | 1.70 | 1.57 | 1.61 | 2.18 |
| RUN | NO.=246 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 31.80QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 82.9 | 80.3 | 81.1 | 85.1 | 89.1 | 83.8 | 85.4 | 88.4 | 89.5 | 86.9 | 85.6 | 85.4 | 85.4 | 85.6 | 85.6 | 83.6 |
| TL | 46.5 | 48.5 | 50.5 | 52.4 | 56.4 | 60.4 | 64.4 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.41 | 0.47 | 0.49 | 0.46 | 0.46 | 0.64 | 0.71 | 0.74 | 0.87 | 1.42 | 1.61 | 1.65 | 1.65 | 1.61 | 1.61 | 2.05 |
| RUN | NO.=247 | S= | 72.57 | AQ= | 8.603 | DELTSUB= | | 35.55QC= | 0.9000 | T1= | 21.60 | | T2= | 29.65 | TC= | 69.45 |
| TW | 70.5 | 70.5 | 74.1 | 76.8 | 83.4 | 88.6 | 95.2 | 83.8 | 82.5 | 82.3 | 82.3 | 82.1 | 82.1 | 82.9 | 82.5 | 83.8 |
| TL | 44.0 | 46.9 | 49.9 | 52.9 | 58.8 | 64.7 | 70.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.32 | 0.36 | 0.36 | 0.36 | 0.35 | 0.36 | 0.35 | 1.19 | 1.45 | 1.50 | 1.50 | 1.56 | 1.56 | 1.34 | 1.45 | 1.19 |
| RUN | NO.=248 | S= | 73.26 | AQ= | 8.603 | DELTSUB= | | 40.10QC= | 0.9000 | T1= | 21.85 | | T2= | 29.90 | TC= | 69.45 |
| TW | 65.8 | 66.4 | 70.3 | 73.4 | 80.3 | 86.9 | 94.1 | 88.8 | 82.5 | 82.1 | 81.9 | 81.6 | 81.9 | 82.5 | 82.3 | 83.6 |
| TL | 39.8 | 43.1 | 46.5 | 49.8 | 56.5 | 63.2 | 69.9 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.33 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.35 | 0.70 | 1.45 | 1.56 | 1.62 | 1.70 | 1.62 | 1.45 | 1.50 | 1.22 |
| RUN | NO.=249 | S= | 77.43 | AQ= | 5.931 | DELTSUB= | | 11.00QC= | 0.9000 | T1= | 20.60 | | T2= | 25.58 | TC= | 65.10 |
| TW | 82.3 | 83.8 | 84.3 | 85.4 | 87.9 | 89.5 | 92.7 | 94.6 | 80.9 | 80.1 | 80.1 | 79.9 | 79.9 | 80.5 | 79.9 | 80.7 |
| TL | 65.6 | 66.4 | 67.2 | 68.0 | 69.6 | 71.1 | 72.7 | 74.3 | 75.8 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 0.36 | 0.34 | 0.35 | 0.34 | 0.32 | 0.32 | 0.30 | 0.29 | 1.16 | 1.40 | 1.40 | 1.46 | 1.46 | 1.28 | 1.46 | 1.22 |
| RUN | NO.=250 | S= | 69.10 | AQ= | 5.931 | DELTSUB= | | 15.50QC= | 0.9000 | T1= | 21.10 | | T2= | 28.05 | TC= | 67.15 |
| TW | 79.6 | 81.4 | 82.5 | 84.9 | 89.5 | 85.4 | 81.4 | 80.9 | 80.7 | 80.7 | 80.7 | 80.5 | 80.5 | 81.1 | 80.7 | 81.6 |
| TL | 62.9 | 64.9 | 66.8 | 68.8 | 72.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.35 | 0.36 | 0.38 | 0.37 | 0.35 | 0.67 | 1.21 | 1.33 | 1.41 | 1.41 | 1.41 | 1.48 | 1.48 | 1.28 | 1.41 | 1.16 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=251 S= 75.35 AQ= 5.931 DELTSUB= 12.80QC= 0.9000 T1= 20.10 T2= 25.14 TC= 63.50 | | | | | | | | | | | | | | | | |
| TW | 82.5 | 83.6 | 84.1 | 85.8 | 89.1 | 91.4 | 95.2 | 98.1 | 86.2 | 80.9 | 80.7 | 80.5 | 80.7 | 80.9 | 80.9 | 81.4 |
| TL | 64.6 | 65.5 | 66.4 | 67.4 | 69.2 | 71.0 | 72.8 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.33 | 0.33 | 0.34 | 0.32 | 0.30 | 0.29 | 0.27 | 0.25 | 0.61 | 1.33 | 1.41 | 1.48 | 1.41 | 1.33 | 1.33 | 1.21 |
| RUN NO.=252 S= 78.13 AQ= 8.448 DELTSUB= 3.30QC= 0.9000 T1= 20.85 T2= 28.82 TC= 67.85 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 93.8 | 95.6 | 97.3 | 100.1 | 101.1 | 101.6 | 83.6 | 83.6 | 82.9 | 82.1 | 81.8 | 81.8 | 82.1 | 81.8 | 82.9 |
| TL | 73.5 | 73.8 | 74.0 | 74.3 | 74.9 | 75.4 | 76.0 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.49 | 0.42 | 0.39 | 0.37 | 0.34 | 0.33 | 0.33 | 1.19 | 1.19 | 1.31 | 1.52 | 1.59 | 1.59 | 1.52 | 1.59 | 1.31 |
| RUN NO.=253 S= 71.88 AQ= 11.373 DELTSUB= 2.45QC= 0.9000 T1= 21.10 T2= 37.49 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 96.5 | 101.6 | 82.3 | 82.5 | 83.4 | 82.7 | 83.8 | 85.1 | 84.3 | 83.8 | 83.6 | 83.4 | 83.4 | 84.3 | 83.6 | 84.9 |
| TL | 75.1 | 75.9 | 76.7 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| HT | 0.53 | 0.44 | 2.07 | 1.98 | 1.72 | 1.91 | 1.61 | 1.36 | 1.52 | 1.61 | 1.66 | 1.72 | 1.72 | 1.52 | 1.66 | 1.40 |
| RUN NO.=254 S= 61.46 AQ= 14.689 DELTSUB= 2.80QC= 1.8500 T1= 21.10 T2= 31.82 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 83.1 | 82.5 | 82.5 | 82.9 | 84.0 | 83.6 | 84.9 | 85.6 | 85.1 | 85.1 | 84.9 | 84.6 | 84.6 | 85.8 | 84.9 | 86.6 |
| TL | 75.1 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.82 | 2.44 | 2.45 | 2.28 | 1.96 | 2.07 | 1.75 | 1.62 | 1.71 | 1.71 | 1.75 | 1.80 | 1.80 | 1.59 | 1.75 | 1.45 |
| RUN NO.=255 S= 66.32 AQ= 8.572 DELTSUB= 7.05QC= 0.9000 T1= 22.35 T2= 32.33 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 95.0 | 94.6 | 93.6 | 97.8 | 83.8 | 83.4 | 82.7 | 82.3 | 82.3 | 82.1 | 82.3 | 82.3 | 82.7 | 82.3 | 83.4 |
| TL | 70.3 | 71.2 | 72.1 | 73.0 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.38 | 0.36 | 0.38 | 0.42 | 0.37 | 1.17 | 1.25 | 1.38 | 1.49 | 1.49 | 1.54 | 1.49 | 1.49 | 1.38 | 1.49 | 1.25 |
| RUN NO.=256 S= 60.07 AQ= 11.445 DELTSUB= 4.90QC= 0.9000 T1= 21.80 T2= 35.05 TC= 69.45 | | | | | | | | | | | | | | | | |
| TW | 82.3 | 82.5 | 82.9 | 83.1 | 84.7 | 84.1 | 82.9 | 82.7 | 82.3 | 82.1 | 82.1 | 82.5 | 82.3 | 82.3 | 83.4 | 84.9 |
| TL | 72.2 | 72.8 | 73.4 | 74.0 | 75.3 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.13 | 1.18 | 1.20 | 1.26 | 1.21 | 1.52 | 1.77 | 1.85 | 1.97 | 2.06 | 2.06 | 1.91 | 1.97 | 1.97 | 1.67 | 1.36 |
| RUN NO.=257 S= 55.21 AQ= 14.854 DELTSUB= 3.55QC= 0.9000 T1= 21.80 T2= 39.02 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 83.6 | 84.1 | 84.3 | 84.4 | 86.4 | 85.8 | 83.8 | 84.1 | 83.4 | 83.4 | 83.4 | 83.6 | 83.8 | 83.6 | 85.1 | 86.6 |
| TL | 73.4 | 73.8 | 74.3 | 74.7 | 75.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.46 | 1.45 | 1.49 | 1.53 | 1.37 | 1.60 | 2.03 | 1.97 | 2.17 | 2.17 | 2.17 | 2.09 | 2.03 | 2.09 | 1.73 | 1.46 |
| RUN NO.=258 S= 53.82 AQ= 5.957 DELTSUB= 6.65QC= 0.9000 T1= 21.60 T2= 30.31 TC= 72.05 | | | | | | | | | | | | | | | | |
| TW | 84.1 | 81.1 | 80.5 | 79.9 | 80.1 | 79.9 | 79.9 | 80.1 | 79.7 | 79.7 | 79.4 | 79.4 | 79.2 | 79.4 | 79.4 | 80.5 |
| TL | 72.1 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.50 | 1.03 | 1.17 | 1.32 | 1.27 | 1.32 | 1.32 | 1.27 | 1.39 | 1.39 | 1.47 | 1.47 | 1.57 | 1.47 | 1.47 | 1.17 |
| RUN NO.=259 S= 52.43 AQ= 11.517 DELTSUB= 8.40QC= 0.9000 T1= 21.80 T2= 36.42 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 81.6 | 83.6 | 87.9 | 88.4 | 84.1 | 82.7 | 82.5 | 82.9 | 82.7 | 82.9 | 82.7 | 82.7 | 82.1 | 82.1 | 82.7 | 81.8 |
| TL | 69.3 | 70.7 | 72.1 | 73.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.94 | 0.89 | 0.72 | 0.77 | 1.48 | 1.79 | 1.84 | 1.72 | 1.79 | 1.72 | 1.79 | 1.79 | 1.99 | 1.99 | 1.79 | 2.08 |
| RUN NO.=260 S= 55.21 AQ= 8.634 DELTSUB= 44.45QC= 0.9000 T1= 21.35 T2= 31.31 TC= 69.90 | | | | | | | | | | | | | | | | |
| TW | 63.5 | 71.2 | 77.4 | 84.3 | 90.8 | 81.6 | 82.1 | 82.1 | 81.9 | 81.6 | 81.9 | 81.9 | 81.9 | 82.5 | 82.5 | 82.3 |
| TL | 37.4 | 43.0 | 48.5 | 54.1 | 65.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.33 | 0.31 | 0.30 | 0.29 | 0.34 | 1.62 | 1.50 | 1.50 | 1.56 | 1.63 | 1.56 | 1.56 | 1.56 | 1.39 | 1.39 | 1.44 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=261 | S= 50.35 | AQ= 8.479 | DELTSUB= 4.65QC= 0.9000 | T1= 20.60 | T2= 32.81 | TC= 67.85 | | | | | | | | | | |
| TW | 82.3 | 84.9 | 81.8 | 80.9 | 81.4 | 80.9 | 80.9 | 81.1 | 80.9 | 80.7 | 80.7 | 80.7 | 80.2 | 80.2 | 80.7 | 82.1 |
| TL | 72.3 | 73.9 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.85 | 0.77 | 1.32 | 1.53 | 1.41 | 1.53 | 1.53 | 1.47 | 1.53 | 1.60 | 1.60 | 1.60 | 1.77 | 1.77 | 1.60 | 1.28 |
| RUN NO.=262 | S= 48.26 | AQ= 14.854 | DELTSUB= 6.85QC= 0.9000 | T1= 21.35 | T2= 41.86 | TC= 69.20 | | | | | | | | | | |
| TW | 83.1 | 85.4 | 89.1 | 87.5 | 84.9 | 84.1 | 84.1 | 84.3 | 84.4 | 84.3 | 84.4 | 84.3 | 83.6 | 83.1 | 84.1 | 82.3 |
| TL | 71.1 | 72.8 | 74.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.23 | 1.19 | 1.02 | 1.32 | 1.72 | 1.90 | 1.90 | 1.86 | 1.81 | 1.86 | 1.81 | 1.86 | 2.02 | 2.15 | 1.90 | 2.46 |
| RUN NO.=263 | S= 44.79 | AQ= 18.800 | DELTSUB= 6.00QC= 1.8500 | T1= 21.35 | T2= 34.05 | TC= 68.05 | | | | | | | | | | |
| TW | 84.3 | 86.4 | 89.3 | 87.9 | 86.4 | 85.6 | 85.8 | 85.8 | 85.8 | 85.6 | 85.8 | 85.6 | 84.7 | 84.7 | 85.1 | 82.9 |
| TL | 71.7 | 73.2 | 74.7 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.50 | 1.42 | 1.29 | 1.61 | 1.84 | 2.02 | 1.97 | 1.97 | 1.97 | 2.02 | 1.97 | 2.02 | 2.22 | 2.22 | 2.12 | 2.83 |
| RUN NO.=264 | S= 38.54 | AQ= 18.800 | DELTSUB= 8.00QC= 1.8500 | T1= 20.35 | T2= 33.56 | TC= 67.40 | | | | | | | | | | |
| TW | 84.3 | 86.9 | 86.4 | 85.4 | 85.4 | 84.4 | 85.1 | 85.1 | 84.9 | 84.9 | 84.9 | 84.7 | 84.3 | 83.8 | 84.4 | 82.3 |
| TL | 70.3 | 72.9 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 |
| HT | 1.34 | 1.35 | 1.73 | 1.93 | 1.93 | 2.12 | 1.98 | 1.98 | 2.02 | 2.02 | 2.02 | 2.07 | 2.17 | 2.29 | 2.12 | 2.81 |
| RUN NO.=265 | S= 33.68 | AQ= 18.800 | DELTSUB= 18.55QC= 1.9500 | T1= 20.60 | T2= 32.58 | TC= 69.00 | | | | | | | | | | |
| TW | 82.3 | 85.6 | 85.8 | 85.1 | 85.1 | 84.7 | 85.4 | 85.8 | 85.8 | 85.8 | 86.0 | 85.6 | 85.1 | 84.7 | 85.6 | 83.1 |
| TL | 62.1 | 66.8 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.93 | 1.00 | 1.31 | 2.08 | 2.08 | 2.17 | 2.02 | 1.93 | 1.93 | 1.93 | 1.89 | 1.98 | 2.08 | 2.17 | 1.98 | 2.65 |
| RUN NO.=266 | S= 28.13 | AQ= 18.800 | DELTSUB= 11.45QC= 1.8500 | T1= 20.35 | T2= 33.46 | TC= 69.20 | | | | | | | | | | |
| TW | 83.6 | 84.9 | 84.7 | 84.4 | 84.9 | 84.7 | 84.9 | 85.4 | 85.4 | 85.4 | 85.4 | 85.1 | 83.4 | 83.8 | 84.9 | 129.8 |
| TL | 68.2 | 72.1 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 1.22 | 1.46 | 2.12 | 2.19 | 2.08 | 2.12 | 2.08 | 1.98 | 1.98 | 1.98 | 1.98 | 2.03 | 2.51 | 2.36 | 2.08 | 0.35 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=151 S= 73.26 AQ= 15.638 DELTSUB= 14.35QC= 0.9000 T1= 20.60 T2= 34.14 TC= 48.90 | | | | | | | | | | | | | | | | |
| TW | 97.9 | 100.9 | 102.4 | 102.0 | 106.0 | 108.1 | 111.7 | 112.9 | 103.6 | 102.4 | 102.0 | 102.0 | 102.0 | 102.4 | 102.4 | 102.8 |
| TL | 84.8 | 85.8 | 86.9 | 87.9 | 89.9 | 92.0 | 94.0 | 96.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 |
| HT | 1.19 | 1.04 | 1.01 | 1.11 | 0.97 | 0.97 | 0.89 | 0.93 | 2.84 | 3.68 | 4.06 | 4.06 | 4.06 | 3.68 | 3.68 | 3.36 |
| RUN NO.=152 S= 73.96 AQ= 15.638 DELTSUB= 62.25QC= 0.9000 T1= 20.10 T2= 33.65 TC= 48.20 | | | | | | | | | | | | | | | | |
| TW | 60.3 | 65.8 | 69.4 | 73.6 | 83.1 | 90.8 | 100.3 | 109.4 | 103.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.8 | 102.6 |
| TL | 39.9 | 44.4 | 48.8 | 53.3 | 62.2 | 71.1 | 79.9 | 88.8 | 97.7 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 |
| HT | 0.77 | 0.73 | 0.76 | 0.77 | 0.75 | 0.79 | 0.77 | 0.76 | 2.73 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.10 | 3.22 |
| SYSTEM-ACETONE | | | | | | | | | | | | | | | | |
| RUN NO.=153 S= 89.24 AQ= 8.355 DELTSUB= 6.75QC= 0.9000 T1= 23.55 T2= 28.48 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 70.1 | 73.9 | 75.9 | 76.3 | 75.4 | 74.9 | 76.6 | 78.1 | 78.8 | 79.9 | 62.1 | 61.4 | 61.2 | 62.1 | 61.4 | 62.6 |
| TL | 50.0 | 50.4 | 50.8 | 51.2 | 51.9 | 52.7 | 53.4 | 54.2 | 54.9 | 55.7 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.42 | 0.36 | 0.33 | 0.33 | 0.36 | 0.37 | 0.36 | 0.35 | 0.35 | 0.34 | 1.47 | 1.65 | 1.74 | 1.47 | 1.65 | 1.35 |
| RUN NO.=154 S= 93.40 AQ= 8.355 DELTSUB= 14.20QC= 0.9000 T1= 23.80 T2= 28.73 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 63.7 | 65.6 | 64.9 | 64.4 | 66.4 | 68.3 | 70.5 | 72.3 | 73.9 | 75.6 | 64.4 | 62.8 | 62.1 | 62.3 | 61.7 | 63.0 |
| TL | 43.2 | 44.0 | 44.8 | 45.6 | 47.1 | 48.7 | 50.3 | 51.9 | 53.4 | 55.0 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.41 | 0.39 | 0.42 | 0.44 | 0.43 | 0.43 | 0.41 | 0.41 | 0.41 | 0.41 | 1.07 | 1.35 | 1.52 | 1.45 | 1.65 | 1.31 |
| RUN NO.=155 S= 93.40 AQ= 11.228 DELTSUB= 10.65QC= 0.9000 T1= 23.30 T2= 29.93 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 71.1 | 76.1 | 77.9 | 78.3 | 77.9 | 77.6 | 80.1 | 81.8 | 82.9 | 84.0 | 64.4 | 64.6 | 63.7 | 63.9 | 63.3 | 64.6 |
| TL | 46.3 | 46.9 | 47.5 | 48.1 | 49.3 | 50.5 | 51.7 | 52.9 | 54.0 | 55.2 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.45 | 0.38 | 0.37 | 0.37 | 0.39 | 0.41 | 0.40 | 0.39 | 0.39 | 0.39 | 1.40 | 1.37 | 1.54 | 1.49 | 1.64 | 1.37 |
| RUN NO.=156 S= 93.40 AQ= 11.228 DELTSUB= 10.35QC= 0.9000 T1= 23.30 T2= 29.92 TC= 52.65 | | | | | | | | | | | | | | | | |
| TW | 70.9 | 76.5 | 78.6 | 79.9 | 79.2 | 78.3 | 80.1 | 82.5 | 83.8 | 85.3 | 64.6 | 64.1 | 63.9 | 64.1 | 63.3 | 64.9 |
| TL | 46.8 | 47.4 | 48.0 | 48.6 | 49.7 | 50.9 | 52.0 | 53.2 | 54.3 | 55.5 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.47 | 0.39 | 0.37 | 0.36 | 0.38 | 0.41 | 0.40 | 0.38 | 0.38 | 0.38 | 1.40 | 1.49 | 1.53 | 1.49 | 1.69 | 1.36 |
| RUN NO.=157 S= 99.65 AQ= 8.355 DELTSUB= 17.70QC= 0.9000 T1= 23.05 T2= 27.97 TC= 52.70 | | | | | | | | | | | | | | | | |
| TW | 60.5 | 61.4 | 61.0 | 60.3 | 63.5 | 65.8 | 67.4 | 69.7 | 71.2 | 72.9 | 70.7 | 65.3 | 65.1 | 63.0 | 61.9 | 63.0 |
| TL | 39.9 | 40.9 | 41.8 | 42.8 | 44.8 | 46.8 | 48.7 | 50.7 | 52.7 | 54.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.41 | 0.41 | 0.44 | 0.48 | 0.45 | 0.44 | 0.45 | 0.44 | 0.45 | 0.46 | 0.59 | 0.96 | 0.98 | 1.31 | 1.58 | 1.31 |
| RUN NO.=158 S= 96.88 AQ= 8.294 DELTSUB= 11.05QC= 0.9000 T1= 22.30 T2= 31.67 TC= 53.35 | | | | | | | | | | | | | | | | |
| TW | 64.6 | 66.7 | 67.9 | 68.5 | 70.5 | 63.7 | 63.5 | 62.6 | 62.3 | 62.1 | 61.9 | 62.1 | 62.3 | 61.7 | 61.9 | 62.3 |
| TL | 46.7 | 48.1 | 49.4 | 50.8 | 53.6 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 |
| HT | 0.46 | 0.44 | 0.45 | 0.47 | 0.49 | 1.13 | 1.16 | 1.33 | 1.38 | 1.44 | 1.49 | 1.44 | 1.38 | 1.56 | 1.49 | 1.38 |
| RUN NO.=159 S= 82.29 AQ= 8.108 DELTSUB= 1.65QC= 0.9000 T1= 21.60 T2= 31.73 TC= 51.50 | | | | | | | | | | | | | | | | |
| TW | 68.8 | 71.9 | 74.1 | 76.1 | 74.8 | 64.2 | 64.4 | 63.9 | 63.3 | 62.8 | 61.7 | 61.4 | 61.4 | 61.2 | 61.4 | 62.1 |
| TL | 55.0 | 55.3 | 55.6 | 55.8 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.59 | 0.49 | 0.44 | 0.40 | 0.44 | 1.04 | 1.01 | 1.07 | 1.18 | 1.27 | 1.54 | 1.61 | 1.61 | 1.69 | 1.61 | 1.42 |
| RUN NO.=160 S= 79.51 AQ= 8.108 DELTSUB= 1.40QC= 0.9000 T1= 22.10 T2= 32.18 TC= 53.15 | | | | | | | | | | | | | | | | |
| TW | 69.4 | 73.2 | 75.4 | 77.4 | 72.8 | 64.6 | 64.6 | 64.4 | 63.5 | 62.8 | 62.3 | 62.1 | 61.9 | 61.7 | 62.3 | 62.8 |
| TL | 55.7 | 55.9 | 56.2 | 56.4 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 |
| HT | 0.59 | 0.47 | 0.42 | 0.39 | 0.51 | 1.05 | 1.05 | 1.07 | 1.22 | 1.36 | 1.47 | 1.54 | 1.61 | 1.69 | 1.47 | 1.36 |

RUN NO.=161 S= 96.88 AQ= 3.714 DELTSUB= 2.80QC= 0.9000 T1= 19.60 T2= 22.17 TC= 53.60

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 60.1 | 62.1 | 62.8 | 63.5 | 65.6 | 66.0 | 66.7 | 67.4 | 68.3 | 61.2 | 60.5 | 59.8 | 59.6 | 59.6 | 59.3 | 59.6 |
| TL | 53.1 | 53.2 | 53.4 | 53.6 | 53.9 | 54.3 | 54.6 | 55.0 | 55.3 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 |
| HT | 0.53 | 0.42 | 0.40 | 0.38 | 0.32 | 0.32 | 0.31 | 0.30 | 0.29 | 0.67 | 0.77 | 0.89 | 0.95 | 0.95 | 1.02 | 0.95 |

RUN NO.=162 S= 90.63 AQ= 5.802 DELTSUB= 1.10QC= 0.9000 T1= 20.80 T2= 25.52 TC= 51.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 64.4 | 66.9 | 69.4 | 71.4 | 75.4 | 76.9 | 78.3 | 79.0 | 78.6 | 62.6 | 61.6 | 61.2 | 61.2 | 61.4 | 61.2 | 61.6 |
| TL | 55.8 | 55.9 | 55.9 | 56.0 | 56.2 | 56.3 | 56.5 | 56.6 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 |
| HT | 0.67 | 0.53 | 0.43 | 0.38 | 0.30 | 0.28 | 0.27 | 0.26 | 0.27 | 1.00 | 1.21 | 1.32 | 1.32 | 1.26 | 1.32 | 1.21 |

RUN NO.=163 S= 73.96 AQ= 3.548 DELTSUB= 1.40QC= 0.9000 T1= 19.85 T2= 24.29 TC= 51.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 65.8 | 67.4 | 67.6 | 67.9 | 61.4 | 60.3 | 60.3 | 60.1 | 59.6 | 59.6 | 59.6 | 59.3 | 59.3 | 59.6 | 59.6 | 59.8 |
| TL | 55.0 | 55.2 | 55.5 | 55.7 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.33 | 0.29 | 0.29 | 0.29 | 0.67 | 0.86 | 0.86 | 0.91 | 1.03 | 1.03 | 1.03 | 1.11 | 1.11 | 1.03 | 1.03 | 0.96 |

RUN NO.=164 S= 74.65 AQ= 5.673 DELTSUB= 2.10QC= 0.9000 T1= 20.10 T2= 27.16 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 68.1 | 70.9 | 71.9 | 72.1 | 63.0 | 62.8 | 62.3 | 61.7 | 61.2 | 61.0 | 61.0 | 60.6 | 60.6 | 60.6 | 60.8 | 61.2 |
| TL | 54.7 | 55.0 | 55.4 | 55.7 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.42 | 0.36 | 0.34 | 0.35 | 0.86 | 0.89 | 0.95 | 1.08 | 1.18 | 1.23 | 1.23 | 1.37 | 1.37 | 1.37 | 1.30 | 1.18 |

RUN NO.=165 S= 76.04 AQ= 8.232 DELTSUB= 1.65QC= 0.9000 T1= 20.10 T2= 30.34 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 70.3 | 73.6 | 75.6 | 76.9 | 63.7 | 63.7 | 64.4 | 63.7 | 62.8 | 62.3 | 62.1 | 61.9 | 61.7 | 61.4 | 61.9 | 62.8 |
| TL | 55.0 | 55.3 | 55.6 | 55.8 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.54 | 0.45 | 0.41 | 0.39 | 1.13 | 1.13 | 1.03 | 1.13 | 1.29 | 1.38 | 1.44 | 1.50 | 1.55 | 1.63 | 1.50 | 1.29 |

RUN NO.=166 S= 71.18 AQ= 11.120 DELTSUB= 1.40QC= 0.9000 T1= 20.35 T2= 34.26 TC= 51.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 72.1 | 76.9 | 80.9 | 82.9 | 63.7 | 63.9 | 64.9 | 64.1 | 63.5 | 63.0 | 62.8 | 62.3 | 62.3 | 62.1 | 62.8 | 63.9 |
| TL | 55.0 | 55.2 | 55.5 | 55.7 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.65 | 0.51 | 0.44 | 0.41 | 1.47 | 1.43 | 1.28 | 1.39 | 1.51 | 1.62 | 1.67 | 1.79 | 1.79 | 1.87 | 1.67 | 1.43 |

RUN NO.=167 S= 73.26 AQ= 8.294 DELTSUB= 26.70QC= 0.9000 T1= 22.55 T2= 30.13 TC= 53.10

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 53.8 | 53.1 | 56.2 | 57.8 | 60.8 | 62.8 | 66.4 | 63.0 | 62.3 | 61.9 | 61.9 | 61.7 | 61.7 | 62.1 | 61.9 | 62.8 |
| TL | 31.9 | 34.1 | 36.4 | 38.6 | 43.0 | 47.5 | 51.9 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.38 | 0.44 | 0.42 | 0.43 | 0.47 | 0.54 | 0.57 | 1.26 | 1.39 | 1.51 | 1.51 | 1.58 | 1.58 | 1.46 | 1.51 | 1.30 |

RUN NO.=168 S= 68.40 AQ= 8.355 DELTSUB= 18.50QC= 0.9000 T1= 21.80 T2= 30.36 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 59.6 | 60.5 | 61.9 | 61.0 | 65.1 | 68.5 | 62.8 | 61.9 | 61.9 | 61.4 | 61.4 | 61.4 | 61.4 | 61.9 | 61.4 | 62.3 |
| TL | 39.5 | 41.3 | 43.2 | 45.0 | 48.7 | 52.4 | 56.1 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.42 | 0.44 | 0.45 | 0.52 | 0.51 | 0.52 | 1.25 | 1.45 | 1.45 | 1.58 | 1.58 | 1.58 | 1.58 | 1.45 | 1.58 | 1.35 |

RUN NO.=169 S= 76.04 AQ= 8.294 DELTSUB= 0.95QC= 0.9000 T1= 21.60 T2= 31.01 TC= 52.20

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 69.2 | 72.1 | 74.5 | 76.8 | 81.7 | 63.5 | 62.3 | 62.1 | 61.7 | 61.4 | 61.2 | 61.4 | 61.2 | 61.2 | 61.7 | 62.1 |
| TL | 55.3 | 55.4 | 55.6 | 55.7 | 55.9 | 56.1 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.60 | 0.50 | 0.44 | 0.39 | 0.32 | 1.13 | 1.34 | 1.39 | 1.51 | 1.56 | 1.64 | 1.56 | 1.64 | 1.64 | 1.51 | 1.39 |

RUN NO.=170 S= 73.96 AQ= 11.228 DELTSUB= 20.90QC= 0.9000 T1= 22.80 T2= 33.06 TC= 53.35

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 66.9 | 63.7 | 63.0 | 61.0 | 63.3 | 64.6 | 69.3 | 66.0 | 64.2 | 63.3 | 63.3 | 63.3 | 63.3 | 63.7 | 63.7 | 64.9 |
| TL | 37.4 | 39.2 | 40.9 | 42.7 | 46.1 | 49.6 | 53.1 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.38 | 0.46 | 0.51 | 0.61 | 0.66 | 0.75 | 0.70 | 1.19 | 1.48 | 1.69 | 1.69 | 1.69 | 1.69 | 1.58 | 1.58 | 1.36 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=231 S= 53.13 AQ= 8.727 DELTSUB= 10.40QC= 0.9000 T1= 19.85 T2= 33.51 TC= 58.90 | | | | | | | | | | | | | | | | |
| TW | 117.6 | 117.4 | 119.6 | 122.8 | 119.1 | 117.4 | 117.1 | 117.6 | 117.6 | 117.6 | 117.6 | 117.6 | 117.8 | 118.4 | 118.2 | 119.4 |
| TL | 102.0 | 103.7 | 105.5 | 107.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.56 | 0.64 | 0.61 | 0.56 | 1.04 | 1.30 | 1.34 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.23 | 1.13 | 1.16 | 0.99 |
| RUN NO.=232 S= 53.13 AQ= 5.957 DELTSUB= 12.40QC= 0.9000 T1= 19.85 T2= 30.18 TC= 55.00 | | | | | | | | | | | | | | | | |
| TW | 116.3 | 116.3 | 119.4 | 117.6 | 116.1 | 115.5 | 115.9 | 116.3 | 116.1 | 116.3 | 116.3 | 116.3 | 116.3 | 116.9 | 116.7 | 117.6 |
| TL | 101.8 | 104.9 | 108.0 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 |
| HT | 0.41 | 0.52 | 0.52 | 0.92 | 1.19 | 1.35 | 1.24 | 1.15 | 1.19 | 1.15 | 1.15 | 1.15 | 1.15 | 1.03 | 1.06 | 0.92 |
| RUN NO.=233 S= 53.13 AQ= 3.734 DELTSUB= 17.10QC= 0.9000 T1= 19.85 T2= 26.23 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 110.6 | 116.5 | 117.4 | 116.3 | 115.1 | 114.7 | 115.1 | 115.3 | 115.3 | 115.3 | 115.3 | 115.3 | 115.5 | 115.7 | 115.5 | 115.9 |
| TL | 98.9 | 103.2 | 107.5 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 |
| HT | 0.32 | 0.28 | 0.38 | 0.81 | 1.10 | 1.24 | 1.10 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 0.98 | 0.93 | 0.98 | 0.89 |
| RUN NO.=234 S= 35.07 AQ= 14.895 DELTSUB= 17.75QC= 1.8500 T1= 20.10 T2= 31.37 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.9 | 121.3 | 121.1 | 120.3 | 119.9 | 120.3 | 120.7 | 120.9 | 121.1 | 121.3 | 121.5 | 122.6 | 124.1 | 123.9 | 127.1 |
| TL | 97.1 | 100.1 | 103.0 | 106.0 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.85 | 0.72 | 0.82 | 0.99 | 1.78 | 1.87 | 1.78 | 1.69 | 1.66 | 1.62 | 1.58 | 1.55 | 1.40 | 1.23 | 1.25 | 0.98 |
| RUN NO.=235 S= 35.07 AQ= 14.895 DELTSUB= 18.60QC= 1.8500 T1= 20.10 T2= 32.36 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.3 | 121.1 | 120.9 | 120.3 | 119.9 | 120.3 | 120.9 | 120.9 | 121.1 | 121.5 | 121.5 | 122.6 | 124.3 | 124.3 | 127.1 |
| TL | 98.0 | 102.6 | 107.3 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.89 | 0.85 | 1.08 | 1.66 | 1.78 | 1.87 | 1.78 | 1.66 | 1.66 | 1.62 | 1.55 | 1.55 | 1.40 | 1.21 | 1.21 | 0.98 |
| SYSTEM-ETHYL ACETATE | | | | | | | | | | | | | | | | |
| RUN NO.=236 S= 97.57 AQ= 8.634 DELTSUB= 20.90QC= 0.9000 T1= 21.80 T2= 29.11 TC= 63.70 | | | | | | | | | | | | | | | | |
| TW | 79.9 | 80.3 | 79.0 | 78.8 | 82.9 | 84.1 | 86.6 | 87.5 | 82.3 | 81.8 | 81.8 | 81.6 | 82.5 | 82.5 | 82.1 | 82.9 |
| TL | 56.7 | 58.2 | 59.7 | 61.2 | 64.2 | 67.1 | 70.1 | 73.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.37 | 0.39 | 0.45 | 0.49 | 0.46 | 0.51 | 0.52 | 0.60 | 1.39 | 1.51 | 1.51 | 1.58 | 1.35 | 1.35 | 1.45 | 1.26 |
| RUN NO.=237 S= 97.57 AQ= 8.634 DELTSUB= 32.75QC= 0.9000 T1= 21.80 T2= 28.91 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 71.9 | 66.9 | 67.9 | 70.3 | 73.6 | 76.3 | 80.1 | 82.9 | 82.7 | 82.5 | 82.5 | 82.5 | 83.1 | 82.9 | 82.3 | 83.4 |
| TL | 45.7 | 48.0 | 50.4 | 52.7 | 57.4 | 62.1 | 66.7 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.33 | 0.46 | 0.49 | 0.49 | 0.53 | 0.61 | 0.65 | 0.75 | 1.30 | 1.35 | 1.35 | 1.35 | 1.22 | 1.26 | 1.39 | 1.18 |
| RUN NO.=238 S= 97.57 AQ= 8.572 DELTSUB= 39.40QC= 0.9000 T1= 21.80 T2= 27.71 TC= 75.20 | | | | | | | | | | | | | | | | |
| TW | 64.2 | 60.8 | 61.7 | 64.6 | 68.8 | 72.5 | 76.5 | 80.8 | 82.7 | 82.5 | 82.5 | 82.3 | 82.9 | 82.7 | 82.5 | 83.4 |
| TL | 39.2 | 41.6 | 44.1 | 46.5 | 51.5 | 56.4 | 61.3 | 66.2 | 71.2 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.34 | 0.45 | 0.49 | 0.47 | 0.50 | 0.53 | 0.56 | 0.59 | 0.74 | 1.34 | 1.34 | 1.38 | 1.25 | 1.30 | 1.34 | 1.17 |
| RUN NO.=239 S= 96.18 AQ= 14.937 DELTSUB= 9.65QC= 0.9000 T1= 21.80 T2= 43.49 TC= 66.90 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 99.6 | 84.3 | 83.8 | 85.6 | 84.7 | 85.8 | 83.8 | 83.6 | 83.4 | 83.8 | 85.4 | 84.9 | 86.0 | 85.1 | 86.0 |
| TL | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.64 | 0.56 | 1.83 | 1.94 | 1.58 | 1.74 | 1.54 | 1.94 | 1.99 | 2.06 | 1.94 | 1.61 | 1.70 | 1.51 | 1.66 | 1.51 |
| RUN NO.=240 S= 97.57 AQ= 11.553 DELTSUB= 7.25QC= 0.9000 T1= 21.60 T2= 36.51 TC= 66.00 | | | | | | | | | | | | | | | | |
| TW | 89.3 | 94.6 | 99.0 | 100.1 | 84.7 | 84.4 | 85.1 | 83.8 | 83.6 | 83.1 | 83.4 | 84.7 | 84.1 | 84.9 | 84.1 | 85.1 |
| TL | 70.2 | 71.4 | 72.6 | 73.8 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.61 | 0.50 | 0.44 | 0.44 | 1.37 | 1.41 | 1.31 | 1.53 | 1.57 | 1.67 | 1.63 | 1.37 | 1.48 | 1.34 | 1.48 | 1.31 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=241 | S= | 96.18 | AQ= | 3.775 | DELTSUB= | | 10.55QC= | 0.9000 | T1= | 21.30 | | T2= | 24.90 | TC= | 65.55 |
| TW | 75.6 | 77.6 | 78.6 | 79.2 | 80.5 | 81.4 | 83.4 | 82.9 | 82.3 | 84.3 | 82.9 | 80.5 | 80.1 | 80.1 | 79.4 | 80.1 |
| TL | 66.4 | 67.3 | 68.2 | 69.1 | 70.8 | 72.6 | 74.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.41 | 0.37 | 0.36 | 0.37 | 0.39 | 0.43 | 0.42 | 0.55 | 0.61 | 0.46 | 0.55 | 0.86 | 0.96 | 0.96 | 1.13 | 0.96 |
| RUN | NO.=242 | S= | 85.07 | AQ= | 8.603 | DELTSUB= | | 2.65QC= | 0.9000 | T1= | 20.80 | | T2= | 30.90 | TC= | 66.45 |
| TW | 87.8 | 91.2 | 94.4 | 96.1 | 96.7 | 82.5 | 82.9 | 82.1 | 82.1 | 82.1 | 82.1 | 81.8 | 81.8 | 82.3 | 82.1 | 83.1 |
| TL | 73.9 | 74.3 | 74.6 | 74.9 | 75.6 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.62 | 0.51 | 0.44 | 0.41 | 0.41 | 1.38 | 1.28 | 1.48 | 1.48 | 1.48 | 1.48 | 1.55 | 1.55 | 1.42 | 1.48 | 1.25 |
| RUN | NO.=243 | S= | 89.24 | AQ= | 5.931 | DELTSUB= | | 4.900C= | 0.9000 | T1= | 21.30 | | T2= | 27.01 | TC= | 63.50 |
| TW | 84.9 | 88.4 | 88.9 | 89.3 | 91.4 | 91.9 | 92.3 | 84.1 | 83.6 | 84.4 | 82.1 | 81.1 | 80.7 | 80.9 | 80.7 | 81.4 |
| TL | 71.8 | 72.2 | 72.6 | 73.0 | 73.8 | 74.7 | 75.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.45 | 0.37 | 0.37 | 0.36 | 0.34 | 0.35 | 0.35 | 0.76 | 0.81 | 0.73 | 1.03 | 1.22 | 1.35 | 1.28 | 1.35 | 1.16 |
| RUN | NO.=244 | S= | 75.35 | AQ= | 3.817 | DELTSUB= | | 12.85QC= | 0.9000 | T1= | 20.35 | | T2= | 24.62 | TC= | 75.40 |
| TW | 75.4 | 79.2 | 81.6 | 84.3 | 89.1 | 82.3 | 79.9 | 79.9 | 79.4 | 79.2 | 79.2 | 79.0 | 79.0 | 79.4 | 79.0 | 79.9 |
| TL | 64.9 | 66.5 | 68.1 | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.36 | 0.30 | 0.28 | 0.26 | 0.24 | 0.62 | 1.00 | 1.00 | 1.14 | 1.23 | 1.23 | 1.32 | 1.32 | 1.14 | 1.32 | 1.00 |
| RUN | NO.=245 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 32.00QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 83.8 | 81.4 | 81.1 | 84.9 | 89.3 | 83.8 | 85.6 | 87.8 | 89.3 | 86.4 | 85.6 | 84.9 | 85.1 | 85.8 | 85.6 | 83.1 |
| TL | 46.3 | 48.3 | 50.3 | 52.3 | 56.3 | 60.3 | 64.3 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.40 | 0.45 | 0.48 | 0.46 | 0.45 | 0.64 | 0.70 | 0.77 | 0.88 | 1.47 | 1.61 | 1.74 | 1.70 | 1.57 | 1.61 | 2.18 |
| RUN | NO.=246 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 31.80QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 |
| TW | 82.9 | 80.3 | 81.1 | 85.1 | 89.1 | 83.8 | 85.4 | 88.4 | 89.5 | 86.9 | 85.6 | 85.4 | 85.4 | 85.6 | 85.6 | 83.6 |
| TL | 46.5 | 48.5 | 50.5 | 52.4 | 56.4 | 60.4 | 64.4 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.41 | 0.47 | 0.49 | 0.46 | 0.46 | 0.64 | 0.71 | 0.74 | 0.87 | 1.42 | 1.61 | 1.65 | 1.65 | 1.61 | 1.61 | 2.05 |
| RUN | NO.=247 | S= | 72.57 | AQ= | 8.603 | DELTSUB= | | 35.55QC= | 0.9000 | T1= | 21.60 | | T2= | 29.65 | TC= | 69.45 |
| TW | 70.5 | 70.5 | 74.1 | 76.8 | 83.4 | 88.6 | 95.2 | 83.8 | 82.5 | 82.3 | 82.3 | 82.1 | 82.1 | 82.9 | 82.5 | 83.8 |
| TL | 44.0 | 46.9 | 49.9 | 52.9 | 58.8 | 64.7 | 70.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.32 | 0.36 | 0.36 | 0.36 | 0.35 | 0.36 | 0.35 | 1.19 | 1.45 | 1.50 | 1.50 | 1.56 | 1.56 | 1.34 | 1.45 | 1.19 |
| RUN | NO.=248 | S= | 73.26 | AQ= | 8.603 | DELTSUB= | | 40.10QC= | 0.9000 | T1= | 21.85 | | T2= | 29.90 | TC= | 69.45 |
| TW | 65.8 | 66.4 | 70.3 | 73.4 | 80.3 | 86.9 | 94.1 | 88.8 | 82.5 | 82.1 | 81.9 | 81.6 | 81.9 | 82.5 | 82.3 | 83.6 |
| TL | 39.8 | 43.1 | 46.5 | 49.8 | 56.5 | 63.2 | 69.9 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.33 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.35 | 0.70 | 1.45 | 1.56 | 1.62 | 1.70 | 1.62 | 1.45 | 1.50 | 1.22 |
| RUN | NO.=249 | S= | 77.43 | AQ= | 5.931 | DELTSUB= | | 11.00QC= | 0.9000 | T1= | 20.60 | | T2= | 25.58 | TC= | 65.10 |
| TW | 82.3 | 83.8 | 84.3 | 85.4 | 87.9 | 89.5 | 92.7 | 94.6 | 80.9 | 80.1 | 80.1 | 79.9 | 79.9 | 80.5 | 79.9 | 80.7 |
| TL | 65.6 | 66.4 | 67.2 | 68.0 | 69.6 | 71.1 | 72.7 | 74.3 | 75.8 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 0.36 | 0.34 | 0.35 | 0.34 | 0.32 | 0.32 | 0.30 | 0.29 | 1.16 | 1.40 | 1.40 | 1.46 | 1.46 | 1.28 | 1.46 | 1.22 |
| RUN | NO.=250 | S= | 69.10 | AQ= | 5.931 | DELTSUB= | | 15.50QC= | 0.9000 | T1= | 21.10 | | T2= | 28.05 | TC= | 67.15 |
| TW | 79.6 | 81.4 | 82.5 | 84.9 | 89.5 | 85.4 | 81.4 | 80.9 | 80.7 | 80.7 | 80.7 | 80.5 | 80.5 | 81.1 | 80.7 | 81.6 |
| TL | 62.9 | 64.9 | 66.8 | 68.8 | 72.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.35 | 0.36 | 0.38 | 0.37 | 0.35 | 0.67 | 1.21 | 1.33 | 1.41 | 1.41 | 1.41 | 1.48 | 1.48 | 1.28 | 1.41 | 1.16 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=251 S= 75.35 AQ= 5.931 DELTSUB= 12.80QC= 0.9000 T1= 20.10 T2= 25.14 TC= 63.50 | | | | | | | | | | | | | | | | |
| TW | 82.5 | 83.6 | 84.1 | 85.8 | 89.1 | 91.4 | 95.2 | 98.1 | 86.2 | 80.9 | 80.7 | 80.5 | 80.7 | 80.9 | 80.9 | 81.4 |
| TL | 64.6 | 65.5 | 66.4 | 67.4 | 69.2 | 71.0 | 72.8 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.33 | 0.33 | 0.34 | 0.32 | 0.30 | 0.29 | 0.27 | 0.25 | 0.61 | 1.33 | 1.41 | 1.48 | 1.41 | 1.33 | 1.33 | 1.21 |
| RUN NO.=252 S= 78.13 AQ= 8.448 DELTSUB= 3.30QC= 0.9000 T1= 20.85 T2= 28.82 TC= 67.85 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 93.8 | 95.6 | 97.3 | 100.1 | 101.1 | 101.6 | 83.6 | 83.6 | 82.9 | 82.1 | 81.8 | 81.8 | 82.1 | 81.8 | 82.9 |
| TL | 73.5 | 73.8 | 74.0 | 74.3 | 74.9 | 75.4 | 76.0 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.49 | 0.42 | 0.39 | 0.37 | 0.34 | 0.33 | 0.33 | 1.19 | 1.19 | 1.31 | 1.52 | 1.59 | 1.59 | 1.52 | 1.59 | 1.31 |
| RUN NO.=253 S= 71.88 AQ= 11.373 DELTSUB= 2.45QC= 0.9000 T1= 21.10 T2= 37.49 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 96.5 | 101.6 | 82.3 | 82.5 | 83.4 | 82.7 | 83.8 | 85.1 | 84.3 | 83.8 | 83.6 | 83.4 | 83.4 | 84.3 | 83.6 | 84.9 |
| TL | 75.1 | 75.9 | 76.7 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| HT | 0.53 | 0.44 | 2.07 | 1.98 | 1.72 | 1.91 | 1.61 | 1.36 | 1.52 | 1.61 | 1.66 | 1.72 | 1.72 | 1.52 | 1.66 | 1.40 |
| RUN NO.=254 S= 61.46 AQ= 14.689 DELTSUB= 2.80QC= 1.8500 T1= 21.10 T2= 31.82 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 83.1 | 82.5 | 82.5 | 82.9 | 84.0 | 83.6 | 84.9 | 85.6 | 85.1 | 85.1 | 84.9 | 84.6 | 84.6 | 85.8 | 84.9 | 86.6 |
| TL | 75.1 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.82 | 2.44 | 2.45 | 2.28 | 1.96 | 2.07 | 1.75 | 1.62 | 1.71 | 1.71 | 1.75 | 1.80 | 1.80 | 1.59 | 1.75 | 1.45 |
| RUN NO.=255 S= 66.32 AQ= 8.572 DELTSUB= 7.05QC= 0.9000 T1= 22.35 T2= 32.33 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 95.0 | 94.6 | 93.6 | 97.8 | 83.8 | 83.4 | 82.7 | 82.3 | 82.3 | 82.1 | 82.3 | 82.3 | 82.7 | 82.3 | 83.4 |
| TL | 70.3 | 71.2 | 72.1 | 73.0 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.38 | 0.36 | 0.38 | 0.42 | 0.37 | 1.17 | 1.25 | 1.38 | 1.49 | 1.49 | 1.54 | 1.49 | 1.49 | 1.38 | 1.49 | 1.25 |
| RUN NO.=256 S= 60.07 AQ= 11.445 DELTSUB= 4.90QC= 0.9000 T1= 21.80 T2= 35.05 TC= 69.45 | | | | | | | | | | | | | | | | |
| TW | 82.3 | 82.5 | 82.9 | 83.1 | 84.7 | 84.1 | 82.9 | 82.7 | 82.3 | 82.1 | 82.1 | 82.5 | 82.3 | 82.3 | 83.4 | 84.9 |
| TL | 72.2 | 72.8 | 73.4 | 74.0 | 75.3 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.13 | 1.18 | 1.20 | 1.26 | 1.21 | 1.52 | 1.77 | 1.85 | 1.97 | 2.06 | 2.06 | 1.91 | 1.97 | 1.97 | 1.67 | 1.36 |
| RUN NO.=257 S= 55.21 AQ= 14.854 DELTSUB= 3.55QC= 0.9000 T1= 21.80 T2= 39.02 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 83.6 | 84.1 | 84.3 | 84.4 | 86.4 | 85.8 | 83.8 | 84.1 | 83.4 | 83.4 | 83.4 | 83.6 | 83.8 | 83.6 | 85.1 | 86.6 |
| TL | 73.4 | 73.8 | 74.3 | 74.7 | 75.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.46 | 1.45 | 1.49 | 1.53 | 1.37 | 1.60 | 2.03 | 1.97 | 2.17 | 2.17 | 2.17 | 2.09 | 2.03 | 2.09 | 1.73 | 1.46 |
| RUN NO.=258 S= 53.82 AQ= 5.957 DELTSUB= 6.65QC= 0.9000 T1= 21.60 T2= 30.31 TC= 72.05 | | | | | | | | | | | | | | | | |
| TW | 84.1 | 81.1 | 80.5 | 79.9 | 80.1 | 79.9 | 79.9 | 80.1 | 79.7 | 79.7 | 79.4 | 79.4 | 79.2 | 79.4 | 79.4 | 80.5 |
| TL | 72.1 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.50 | 1.03 | 1.17 | 1.32 | 1.27 | 1.32 | 1.32 | 1.27 | 1.39 | 1.39 | 1.47 | 1.47 | 1.57 | 1.47 | 1.47 | 1.17 |
| RUN NO.=259 S= 52.43 AQ= 11.517 DELTSUB= 8.40QC= 0.9000 T1= 21.80 T2= 36.42 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 81.6 | 83.6 | 87.9 | 88.4 | 84.1 | 82.7 | 82.5 | 82.9 | 82.7 | 82.9 | 82.7 | 82.7 | 82.1 | 82.1 | 82.7 | 81.8 |
| TL | 69.3 | 70.7 | 72.1 | 73.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.94 | 0.89 | 0.72 | 0.77 | 1.48 | 1.79 | 1.84 | 1.72 | 1.79 | 1.72 | 1.79 | 1.79 | 1.99 | 1.99 | 1.79 | 2.08 |
| RUN NO.=260 S= 55.21 AQ= 8.634 DELTSUB= 44.45QC= 0.9000 T1= 21.35 T2= 31.31 TC= 69.90 | | | | | | | | | | | | | | | | |
| TW | 63.5 | 71.2 | 77.4 | 84.3 | 90.8 | 81.6 | 82.1 | 82.1 | 81.9 | 81.6 | 81.9 | 81.9 | 81.9 | 82.5 | 82.5 | 82.3 |
| TL | 37.4 | 43.0 | 48.5 | 54.1 | 65.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.33 | 0.31 | 0.30 | 0.29 | 0.34 | 1.62 | 1.50 | 1.50 | 1.56 | 1.63 | 1.56 | 1.56 | 1.56 | 1.39 | 1.39 | 1.44 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=261 | S= | 50.35 | AQ= | 8.479 | DELTSUB= | | 4.65QC= | 0.9000 | | T1= | 20.60 | T2= | 32.81 | TC= | 67.85 |
| TW | 82.3 | 84.9 | 81.8 | 80.9 | 81.4 | 80.9 | 80.9 | 81.1 | 80.9 | 80.7 | 80.7 | 80.7 | 80.2 | 80.2 | 80.7 | 82.1 |
| TL | 72.3 | 73.9 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.85 | 0.77 | 1.32 | 1.53 | 1.41 | 1.53 | 1.53 | 1.47 | 1.53 | 1.60 | 1.60 | 1.60 | 1.77 | 1.77 | 1.60 | 1.28 |
| RUN | NO.=262 | S= | 48.26 | AQ= | 14.854 | DELTSUB= | | 6.85QC= | 0.9000 | | T1= | 21.35 | T2= | 41.86 | TC= | 69.20 |
| TW | 83.1 | 85.4 | 89.1 | 87.5 | 84.9 | 84.1 | 84.1 | 84.3 | 84.4 | 84.3 | 84.4 | 84.3 | 83.6 | 83.1 | 84.1 | 82.3 |
| TL | 71.1 | 72.8 | 74.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.23 | 1.19 | 1.02 | 1.32 | 1.72 | 1.90 | 1.90 | 1.86 | 1.81 | 1.86 | 1.81 | 1.86 | 2.02 | 2.15 | 1.90 | 2.46 |
| RUN | NO.=263 | S= | 44.79 | AQ= | 18.800 | DELTSUB= | | 6.00QC= | 1.8500 | | T1= | 21.35 | T2= | 34.05 | TC= | 68.05 |
| TW | 84.3 | 86.4 | 89.3 | 87.9 | 86.4 | 85.6 | 85.8 | 85.8 | 85.8 | 85.6 | 85.8 | 85.6 | 84.7 | 84.7 | 85.1 | 82.9 |
| TL | 71.7 | 73.2 | 74.7 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.50 | 1.42 | 1.29 | 1.61 | 1.84 | 2.02 | 1.97 | 1.97 | 1.97 | 2.02 | 1.97 | 2.02 | 2.22 | 2.22 | 2.12 | 2.83 |
| RUN | NO.=264 | S= | 38.54 | AQ= | 18.800 | DELTSUB= | | 8.00QC= | 1.8500 | | T1= | 20.35 | T2= | 33.56 | TC= | 67.40 |
| TW | 84.3 | 86.9 | 86.4 | 85.4 | 85.4 | 84.4 | 85.1 | 85.1 | 84.9 | 84.9 | 84.9 | 84.7 | 84.3 | 83.8 | 84.4 | 82.3 |
| TL | 70.3 | 72.9 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 |
| HT | 1.34 | 1.35 | 1.73 | 1.93 | 1.93 | 2.12 | 1.98 | 1.98 | 2.02 | 2.02 | 2.02 | 2.07 | 2.17 | 2.29 | 2.12 | 2.81 |
| RUN | NO.=265 | S= | 33.68 | AQ= | 18.800 | DELTSUB= | | 18.55QC= | 1.9500 | | T1= | 20.60 | T2= | 32.58 | TC= | 69.00 |
| TW | 82.3 | 85.6 | 85.8 | 85.1 | 85.1 | 84.7 | 85.4 | 85.8 | 85.8 | 85.8 | 86.0 | 85.6 | 85.1 | 84.7 | 85.6 | 83.1 |
| TL | 62.1 | 66.8 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.93 | 1.00 | 1.31 | 2.08 | 2.08 | 2.17 | 2.02 | 1.93 | 1.93 | 1.93 | 1.89 | 1.98 | 2.08 | 2.17 | 1.98 | 2.65 |
| RUN | NO.=266 | S= | 28.13 | AQ= | 18.800 | DELTSUB= | | 11.45QC= | 1.8500 | | T1= | 20.35 | T2= | 33.46 | TC= | 69.20 |
| TW | 83.6 | 84.9 | 84.7 | 84.4 | 84.9 | 84.7 | 84.9 | 85.4 | 85.4 | 85.4 | 85.4 | 85.1 | 83.4 | 83.8 | 84.9 | 129.8 |
| TL | 68.2 | 72.1 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 1.22 | 1.46 | 2.12 | 2.19 | 2.08 | 2.12 | 2.08 | 1.98 | 1.98 | 1.98 | 1.98 | 2.03 | 2.51 | 2.36 | 2.08 | 0.35 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 61 S= 97.57 AQ= 8.572 DELTSUB= 2.95QC= 1.4000 T1= 21.80 T2= 25.38 TC= 33.50 | | | | | | | | | | | | | | | | |
| TW | 103.1 | 106.0 | 106.8 | 108.3 | 109.3 | 110.7 | 111.3 | 112.3 | 111.7 | 113.1 | 110.7 | 109.9 | 109.3 | 106.4 | 103.9 | 103.3 |
| TL | 97.1 | 97.2 | 97.4 | 97.6 | 97.9 | 98.2 | 98.5 | 98.9 | 99.2 | 99.5 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.43 | 0.98 | 0.91 | 0.80 | 0.75 | 0.69 | 0.67 | 0.64 | 0.69 | 0.63 | 0.79 | 0.85 | 0.91 | 1.31 | 2.14 | 2.52 |
| RUN NO.= 62 S= 96.88 AQ= 8.572 DELTSUB= 2.30QC= 1.4000 T1= 21.80 T2= 26.05 TC= 33.05 | | | | | | | | | | | | | | | | |
| TW | 102.6 | 104.2 | 105.2 | 105.8 | 107.8 | 109.2 | 110.0 | 109.4 | 111.2 | 110.6 | 109.4 | 106.2 | 104.2 | 103.6 | 103.2 | 103.2 |
| TL | 97.9 | 98.0 | 98.2 | 98.3 | 98.6 | 98.9 | 99.2 | 99.5 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.82 | 1.39 | 1.22 | 1.15 | 0.93 | 0.83 | 0.79 | 0.86 | 0.75 | 0.81 | 0.92 | 1.39 | 2.07 | 2.41 | 2.72 | 2.72 |
| RUN NO.= 63 S= 96.18 AQ= 11.300 DELTSUB= 1.70QC= 1.8800 T1= 21.60 T2= 25.73 TC= 39.30 | | | | | | | | | | | | | | | | |
| TW | 103.6 | 106.2 | 106.6 | 107.4 | 108.4 | 110.2 | 112.0 | 114.9 | 115.9 | 107.8 | 105.8 | 104.8 | 104.6 | 104.0 | 104.0 | 104.0 |
| TL | 98.5 | 98.6 | 98.7 | 98.8 | 99.0 | 99.2 | 99.4 | 99.6 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.18 | 1.48 | 1.42 | 1.31 | 1.20 | 1.03 | 0.90 | 0.74 | 0.70 | 1.46 | 1.97 | 2.38 | 2.48 | 2.86 | 2.86 | 2.86 |
| RUN NO.= 64 S= 97.57 AQ= 14.524 DELTSUB= 1.70QC= 1.8800 T1= 21.60 T2= 27.73 TC= 39.80 | | | | | | | | | | | | | | | | |
| TW | 103.8 | 105.4 | 106.4 | 108.4 | 109.8 | 111.2 | 113.2 | 115.0 | 113.8 | 110.8 | 109.6 | 107.6 | 107.2 | 106.8 | 104.8 | 104.8 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.9 | 99.1 | 99.4 | 99.6 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 2.63 | 2.07 | 1.84 | 1.49 | 1.33 | 1.20 | 1.05 | 0.94 | 1.04 | 1.33 | 1.49 | 1.87 | 1.98 | 2.09 | 2.93 | 2.93 |
| RUN NO.= 65 S= 98.96 AQ= 11.300 DELTSUB= 2.10QC= 1.8800 T1= 21.60 T2= 25.73 TC= 39.30 | | | | | | | | | | | | | | | | |
| TW | 103.4 | 105.8 | 105.8 | 106.8 | 109.8 | 110.8 | 111.8 | 114.4 | 114.6 | 112.0 | 110.0 | 109.8 | 108.0 | 107.0 | 105.4 | 104.8 |
| TL | 98.3 | 98.4 | 98.5 | 98.7 | 98.9 | 99.2 | 99.5 | 99.7 | 100.0 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 2.19 | 1.53 | 1.56 | 1.39 | 1.04 | 0.97 | 0.92 | 0.77 | 0.77 | 0.96 | 1.16 | 1.18 | 1.46 | 1.67 | 2.19 | 2.48 |
| RUN NO.= 66 S= 98.26 AQ= 8.510 DELTSUB= 1.90QC= 1.8800 T1= 21.40 T2= 24.50 TC= 41.00 | | | | | | | | | | | | | | | | |
| TW | 102.2 | 104.1 | 104.1 | 106.0 | 107.5 | 108.8 | 109.8 | 112.9 | 112.9 | 108.9 | 107.1 | 106.8 | 105.3 | 104.9 | 103.9 | 103.9 |
| TL | 98.3 | 98.4 | 98.5 | 98.6 | 98.9 | 99.1 | 99.3 | 99.6 | 99.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 2.16 | 1.49 | 1.52 | 1.15 | 0.99 | 0.88 | 0.81 | 0.64 | 0.65 | 0.96 | 1.22 | 1.26 | 1.62 | 1.75 | 2.21 | 2.21 |
| RUN NO.= 67 S= 98.96 AQ= 5.880 DELTSUB= 3.80QC= 1.4000 T1= 21.40 T2= 23.83 TC= 40.75 | | | | | | | | | | | | | | | | |
| TW | 100.3 | 103.1 | 102.9 | 104.5 | 105.0 | 106.6 | 107.9 | 109.1 | 109.1 | 109.1 | 108.9 | 108.8 | 107.1 | 105.1 | 103.6 | 103.1 |
| TL | 96.5 | 96.7 | 96.9 | 97.1 | 97.5 | 97.9 | 98.4 | 98.8 | 99.2 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.55 | 0.92 | 0.99 | 0.79 | 0.79 | 0.67 | 0.62 | 0.57 | 0.59 | 0.62 | 0.66 | 0.68 | 0.83 | 1.15 | 1.63 | 1.96 |
| RUN NO.= 68 S= 92.71 AQ= 14.111 DELTSUB= 2.55QC= 2.8000 T1= 20.10 T2= 23.62 TC= 29.70 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 107.7 | 107.4 | 109.6 | 110.4 | 113.1 | 115.3 | 116.9 | 119.2 | 105.8 | 106.0 | 106.0 | 105.1 | 104.9 | 104.7 | 104.9 |
| TL | 98.3 | 98.5 | 98.6 | 98.8 | 99.1 | 99.4 | 99.7 | 100.1 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.12 | 1.53 | 1.60 | 1.31 | 1.24 | 1.03 | 0.91 | 0.84 | 0.75 | 2.79 | 2.66 | 2.66 | 3.17 | 3.32 | 3.53 | 3.32 |
| RUN NO.= 69 S= 92.71 AQ= 14.111 DELTSUB= 2.55QC= 2.8000 T1= 21.10 T2= 24.62 TC= 29.70 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 107.3 | 107.9 | 109.4 | 111.7 | 112.8 | 113.6 | 117.1 | 118.6 | 106.6 | 106.2 | 105.8 | 105.4 | 105.1 | 104.9 | 104.9 |
| TL | 98.3 | 98.5 | 98.6 | 98.8 | 99.1 | 99.4 | 99.7 | 100.1 | 100.4 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 | 100.7 |
| HT | 2.12 | 1.61 | 1.52 | 1.34 | 1.12 | 1.06 | 1.02 | 0.83 | 0.77 | 2.39 | 2.57 | 2.79 | 3.03 | 3.17 | 3.32 | 3.32 |
| RUN NO.= 70 S= 96.18 AQ= 14.400 DELTSUB= 3.40QC= 5.7000 T1= 23.00 T2= 25.29 TC= 35.65 | | | | | | | | | | | | | | | | |
| TW | 105.6 | 107.6 | 108.0 | 108.6 | 111.4 | 113.6 | 114.6 | 112.1 | 108.4 | 108.3 | 107.4 | 106.1 | 104.6 | 104.4 | 104.0 | 104.0 |
| TL | 97.3 | 97.6 | 97.9 | 98.2 | 98.7 | 99.3 | 99.9 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 | 100.4 |
| HT | 1.75 | 1.44 | 1.43 | 1.38 | 1.13 | 1.01 | 0.98 | 1.23 | 1.80 | 1.85 | 2.07 | 2.53 | 3.43 | 3.60 | 4.06 | 4.06 |

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Z     0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40
RUN NO.= 71   S=   89.24   AQ= 14.400   DELTSUB=    3.80QC= 5.7000   T1=   23.75      T2=   26.33   TC= 32.75
TW 105.7 106.6 109.1 110.9 113.0 115.1 109.1 108.1 107.6 107.6 105.6 104.7 104.5 104.3 104.3 104.3
TL  97.4  97.8  98.2  98.6  99.3 100.1 100.8 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9
HT   1.74  1.65  1.31  1.17  1.05  0.96  1.73  1.99  2.13  2.13  3.06  3.74  3.95  4.17  4.17  4.17
RUN NO.= 72   S=   89.24   AQ= 14.400   DELTSUB=    3.80QC= 5.7000   T1=   23.75      T2=   26.33   TC= 33.25
TW 105.8 108.3 109.4 111.8 113.4 113.4 109.1 108.9 109.1 107.4 105.8 104.7 104.7 104.7 104.3 104.3
TL  97.7  98.1  98.5  98.9  99.6 100.4 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1
HT   1.80  1.41  1.33  1.12  1.05  1.11  1.80  1.85  1.80  2.29  3.13  4.06  4.06  4.06  4.57  4,57
RUN NO.= 73   S=   81.60   AQ= 14.400   DELTSUB=    4.25QC= 5.7000   T1=   24.30      T2=   27.15   TC= 34.50
TW 106.2 108.5 110.4 111.8 114.3 111.3 110.0 109.4 109.4 106.4 105.1 105.1 104.7 104.7 104.5 104.5
TL  97.4  98.0  98.5  99.0 100.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1
HT   1.64  1.37  1.20  1.13  1.02  1.42  1.63  1.76  1.76  2.74  3.65  3.65  4.06  4.06  4.30  4.30
RUN NO.= 74   S=   89.93   AQ= 14.400   DELTSUB=   62.75QC= 5.7000   T1=   23.80      T2=   25.00   TC= 34.50
TW  64.1  67.4  70.5  73.4  77.4  84.3  91.3  98.2 103.4 110.0 112.6 105.4 104.8 104.3 104.1 104.3
TL  41.3  44.5  47.6  50.7  57.0  63.2  69.5  75.8  82.0  88.3  94.6 100.8 100.9 100.9 100.9 100.9
HT   0.63  0.63  0.63  0.64  0.71  0.69  0.66  0.64  0.67  0.66  0.80  3.18  3.79  4.30  4.65  4.30
RUN NO.= 75   S=   89.24   AQ=  8.170   DELTSUB=    2.15QC= 5.7000   T1=   20.10      T2=   21.10   TC= 30.45
TW 102.8 105.4 106.2 107.1 109.8 110.6 112.6 113.8 113.8 108.9 104.8 103.4 103.1 103.1 102.6 102.8
TL  97.6  97.8  97.9  98.0  98.3  98.6  98.8  99.1  99.4  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.58  1.08  0.98  0.91  0.71  0.68  0.60  0.56  0.57  0.88  1.60  2.15  2.40  2.40  2.77  2.59
RUN NO.= 76   S=   89.24   AQ= 14.400   DELTSUB=    3.10QC= 5.7000   T1=   22.80      T2=   24.83   TC= 35.00
TW 103.6 106.6 107.1 108.9 111.1 111.7 114.9 115.9 110.6 109.1 107.7 106.2 105.1 104.9 104.5 104.8
TL  98.8  99.0  99.2  99.4  99.9 100.3 100.8 101.2 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   2.95  1.89  1.84  1.51  1.28  1.27  1.02  0.98  1.60  1.92  2.38  3.16  4.11  4.43  5.05  4.65
RUN NO.= 77   S=   88.54   AQ= 14.400   DELTSUB=    4.00QC= 4.7500   T1=   22.80      T2=   25.55   TC= 35.70
TW 104.5 107.1 108.9 110.5 113.2 114.4 114.3 109.1 108.6 108.9 105.8 104.1 103.3 103.3 103.3 103.3
TL  95.5  95.9  96.2  96.5  97.2  97.9  98.5  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2
HT   1.61  1.29  1.13  1.03  0.90  0.87  0.92  1.45  1.54  1.48  2.18  2.94  3.56  3.56  3.56  3.56
RUN NO.= 78   S=   76.04   AQ= 14.400   DELTSUB=   70.70QC= 4.7500   T1=   22.80      T2=   25.24   TC= 31.10
TW  56.2  61.0  65.1  69.9  78.8  88.8  97.9 108.8 106.0 103.9 103.9 103.6 103.6 103.6 103.6 103.6
TL  34.0  39.0  44.1  49.1  59.2  69.3  79.4  89.5  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   0.65  0.66  0.69  0.69  0.74  0.74  0.78  0.75  2.25  3.39  3.39  3.60  3.60  3.60  3.60  3.60
RUN NO.= 79   S=   87.85   AQ= 14.400   DELTSUB=    2.55QC= 5.7000   T1=   24.50      T2=   26.53   TC= 36.20
TW 106.0 107.7 108.3 110.6 113.2 115.1 115.9 116.1 108.8 107.7 107.9 106.9 106.2 106.0 105.8 105.8
TL 100.0 100.2 100.4 100.6 100.9 101.3 101.7 102.0 102.4 102.4 102.4 102.4 102.4 102.4 102.4 102.4
HT   2.41  1.92  1.82  1.43  1.17  1.04  1.01  1.02  2.27  2.72  2.62  3.24  3.79  4.00  4.24  4.24
RUN NO.= 80   S=   87.85   AQ= 14.400   DELTSUB=   44.80QC= 5.7000   T1=   25.30      T2=   26.78   TC= 34.00
TW  78.3  81.6  83.6  84.7  89.1  95.2 100.3 104.3 108.8 114.9 112.6 106.6 106.2 106.0 106.0 106.0
TL  60.5  63.0  65.4  67.9  72.9  77.9  82.8  87.8  92.8  97.7 102.7 102.8 102.8 102.8 102.8 102.8
HT   0.81  0.77  0.79  0.86  0.89  0.83  0.83  0.87  0.90  0.84  1.46  3.79  4.24  4.50  4.50  4.50
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 Z   0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40

RUN NO.= 81   S=   89.24   AQ= 14.111   DELTSUB=    1.30QC= 5.7000   T1=  20.35      T2=  22.63   TC= 26.10
TW 104.5 106.9 107.3 108.1 110.9 111.5 113.0 112.1 110.3 108.3 106.9 105.8 104.5 104.5 104.5 104.5
TL  98.7  98.8  98.9  99.0  99.2  99.4  99.6  99.8  99.9  99.9  99.9  99.9  99.9  99.9  99.9  99.9
HT   2.42  1.75  1.68  1.55  1.21  1.17  1.06  1.15  1.36  1.67  2.02  2.37  3.03  3.03  3.03  3.03

RUN NO.= 82   S=   91.32   AQ= 14.400   DELTSUB=    2.15QC= 5.7000   T1=  23.30      T2=  25.05   TC= 36.70
TW 104.7 106.3 105.6 108.1 108.5 110.6 111.5 111.8 111.9 111.3 106.6 105.8 105.6 105.1 104.7 104.7
TL  99.5  99.7  99.8  99.9 100.2 100.5 100.7 101.0 101.3 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   2.79  2.19  2.51  1.76  1.74  1.42  1.34  1.34  1.35  1.48  2.85  3.43  3.60  4.00  4.57  4.57

RUN NO.= 83   S=   76.74   AQ= 14.400   DELTSUB=    5.70QC= 5.7000   T1=  23.80      T2=  26.66   TC= 31.85
TW 105.6 108.5 109.8 112.1 112.4 111.1 108.5 108.8 106.0 104.9 104.1 103.9 103.9 103.9 103.9 103.9
TL  95.7  96.4  97.1  97.8  99.3 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7 100.7
HT   1.46  1.19  1.14  1.01  1.10  1.38  1.85  1.79  2.72  3.43  4.24  4.50  4.50  4.50  4.50  4.50

RUN NO.= 84   S=   76.74   AQ= 14.400   DELTSUB=    5.50QC= 5.7000   T1=  23.80      T2=  26.65   TC= 32.55
TW 105.8 109.1 110.7 111.8 112.6 109.6 108.8 108.9 105.4 104.1 103.6 103.6 103.6 103.6 103.6 103.6
TL  95.7  96.4  97.0  97.7  99.1 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5
HT   1.43  1.13  1.05  1.03  1.07  1.59  1.75  1.71  2.97  4.00  4.57  4.57  4.57  4.57  4.57  4.57

RUN NO.= 85   S=   74.65   AQ= 14.400   DELTSUB=    5.70QC= 5.7000   T1=  25.30      T2=  28.15   TC= 34.55
TW 107.1 110.5 111.8 113.2 114.3 111.5 110.1 110.3 105.8 104.9 104.9 104.9 104.9 104.9 104.9 104.9
TL  96.6  97.3  98.0  98.7 100.1 101.5 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   1.37  1.09  1.05  0.99  1.02  1.45  1.69  1.66  3.39  4.24  4.24  4.24  4.24  4.24  4.24  4.24

RUN NO.= 86   S=   74.65   AQ= 14.400   DELTSUB=    5.90QC= 5.7000   T1=  25.45      T2=  28.30   TC= 34.85
TW 106.6 110.3 112.4 113.6 114.1 109.6 109.8 108.9 106.0 105.1 105.1 105.1 105.1 105.1 105.1 105.1
TL  96.5  97.2  98.0  98.7 100.2 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6 101.6
HT   1.42  1.10  1.00  0.97  1.04  1.81  1.77  1.97  3.31  4.24  4.24  4.24  4.24  4.24  4.24  4.24

RUN NO.= 87   S=   84.38   AQ= 14.400   DELTSUB=    2.95QC= 5.7000   T1=  24.05      T2=  26.90   TC= 36.20
TW 104.5 106.4 107.3 108.5 110.0 109.4 108.8 107.9 106.6 105.6 105.6 105.1 105.1 105.1 104.9 105.1
TL  99.6  99.9 100.3 100.7 101.4 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1 102.1
HT   2.92  2.23  2.07  1.84  1.68  1.99  2.18  2.50  3.24  4.24  4.24  4.80  4.80  4.80  5.14  4.80

RUN NO.= 88   S=   80.21   AQ= 14.400   DELTSUB=    4.75QC= 5.7000   T1=  23.80      T2=  26.64   TC= 36.45
TW 105.6 108.5 110.3 111.1 113.0 111.1 108.5 109.1 108.3 105.4 104.3 104.1 103.9 103.9 103.9 103.9
TL  96.3  96.9  97.5  98.1  99.3 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5 100.5
HT   1.56  1.25  1.13  1.11  1.05  1.36  1.80  1.66  1.85  2.97  3.79  4.00  4.24  4.24  4.24  4.24

RUN NO.= 89   S=   78.82   AQ= 14.400   DELTSUB=    4.65QC= 5.7000   T1=  24.05      T2=  26.87   TC= 39.80
TW 105.8 108.1 110.1 111.9 114.9 111.3 108.9 109.4 108.9 106.4 104.9 104.7 104.5 104.5 104.3 104.3
TL  96.8  97.4  98.0  98.6  99.7 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9 100.9
HT   1.61  1.35  1.19  1.08  0.95  1.38  1.80  1.70  1.80  2.62  3.60  3.79  4.00  4.00  4.24  4.24

RUN NO.= 90   S=   80.90   AQ= 14.400   DELTSUB=    5.05QC= 5.7000   T1=  24.55      T2=  27.38   TC= 39.05
TW 106.0 108.9 110.7 112.8 114.9 110.4 108.9 109.4 107.9 105.6 104.7 104.5 104.5 104.5 104.5 104.5
TL  96.7  97.3  97.9  98.6  99.8 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1
HT   1.55  1.24  1.13  1.01  0.96  1.54  1.85  1.75  2.12  3.24  4.00  4.24  4.24  4.24  4.24  4.24
```

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.= 91 S= 89.24 AQ= 11.120 DELTSUB= 1.45QC= 5.7000 T1= 20.30 T2= 21.64 TC= 38.40 | | | | | | | | | | | | | | | | |
| TW | 104.1 | 106.9 | 107.4 | 108.9 | 110.9 | 112.1 | 114.0 | 115.3 | 117.8 | 107.9 | 104.9 | 104.1 | 103.9 | 103.9 | 103.6 | 103.6 |
| TL | 98.9 | 99.0 | 99.1 | 99.2 | 99.3 | 99.5 | 99.7 | 99.9 | 100.1 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 2.13 | 1.41 | 1.33 | 1.14 | 0.96 | 0.88 | 0.78 | 0.72 | 0.63 | 1.45 | 2.37 | 2.89 | 3.05 | 3.05 | 3.27 | 3.27 |
| RUN NO.= 92 S= 89.24 AQ= 5.673 DELTSUB= 1.00QC= 5.7000 T1= 20.60 T2= 21.40 TC= 35.70 | | | | | | | | | | | | | | | | |
| TW | 101.6 | 103.6 | 103.6 | 105.1 | 106.6 | 107.1 | 107.3 | 108.1 | 107.3 | 105.8 | 103.6 | 103.6 | 102.9 | 102.9 | 102.2 | 102.0 |
| TL | 98.9 | 98.9 | 99.0 | 99.1 | 99.2 | 99.4 | 99.5 | 99.7 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 |
| HT | 2.12 | 1.21 | 1.22 | 0.94 | 0.76 | 0.73 | 0.73 | 0.67 | 0.76 | 0.95 | 1.47 | 1.47 | 1.86 | 1.86 | 2.36 | 2.58 |
| RUN NO.= 93 S= 75.35 AQ= 11.337 DELTSUB= 5.25QC= 1.4000 T1= 19.85 T2= 27.30 TC= 27.55 | | | | | | | | | | | | | | | | |
| TW | 105.8 | 108.8 | 109.8 | 111.5 | 111.7 | 111.5 | 113.4 | 107.7 | 104.3 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 95.4 | 95.9 | 96.3 | 96.7 | 97.6 | 98.5 | 99.4 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.09 | 0.88 | 0.84 | 0.77 | 0.81 | 0.87 | 0.81 | 1.52 | 2.80 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| RUN NO.= 94 S= 76.04 AQ= 8.603 DELTSUB= 5.25QC= 1.4000 T1= 20.80 T2= 26.47 TC= 25.80 | | | | | | | | | | | | | | | | |
| TW | 103.3 | 105.1 | 106.8 | 107.9 | 108.8 | 110.0 | 111.7 | 107.1 | 103.9 | 103.4 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 95.4 | 95.9 | 96.3 | 96.7 | 97.6 | 98.5 | 99.4 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.10 | 0.93 | 0.82 | 0.77 | 0.77 | 0.75 | 0.70 | 1.26 | 2.36 | 2.69 | 2.87 | 2.87 | 2.87 | 2.87 | 2.87 | 2.87 |
| RUN NO.= 95 S= 73.96 AQ= 5.906 DELTSUB= 5.25QC= 1.4000 T1= 21.55 T2= 25.45 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 99.4 | 101.6 | 102.4 | 103.3 | 106.4 | 107.3 | 107.7 | 104.5 | 103.0 | 102.8 | 102.8 | 102.6 | 102.6 | 102.4 | 102.4 | 102.4 |
| TL | 95.4 | 95.9 | 96.3 | 96.7 | 97.6 | 98.5 | 99.4 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.49 | 1.04 | 0.97 | 0.91 | 0.67 | 0.67 | 0.71 | 1.39 | 2.15 | 2.32 | 2.32 | 2.51 | 2.51 | 2.75 | 2.75 | 2.75 |
| RUN NO.= 96 S= 75.35 AQ= 8.541 DELTSUB= 31.75QC= 0.9000 T1= 21.10 T2= 29.84 TC= 26.80 | | | | | | | | | | | | | | | | |
| TW | 82.5 | 85.3 | 87.1 | 93.1 | 96.3 | 102.0 | 107.9 | 104.9 | 103.1 | 103.1 | 103.1 | 103.1 | 103.1 | 103.1 | 103.1 | 103.1 |
| TL | 71.1 | 73.8 | 76.4 | 79.1 | 84.4 | 89.6 | 94.9 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.75 | 0.74 | 0.80 | 0.61 | 0.72 | 0.69 | 0.66 | 1.80 | 3.05 | 3.05 | 3.05 | 3.05 | 3.05 | 3.05 | 3.05 | 3.05 |
| RUN NO.= 97 S= 74.65 AQ= 5.906 DELTSUB= 31.95QC= 0.9000 T1= 20.80 T2= 26.85 TC= 25.55 | | | | | | | | | | | | | | | | |
| TW | 77.9 | 81.6 | 84.7 | 88.4 | 95.6 | 101.8 | 105.6 | 103.3 | 102.8 | 102.8 | 102.8 | 102.6 | 102.6 | 102.6 | 102.6 | 102.6 |
| TL | 70.8 | 73.4 | 76.1 | 78.7 | 84.0 | 89.4 | 94.7 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.83 | 0.72 | 0.68 | 0.61 | 0.51 | 0.48 | 0.54 | 1.81 | 2.15 | 2.15 | 2.15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 |
| RUN NO.= 98 S= 75.35 AQ= 3.652 DELTSUB= 20.60QC= 0.9000 T1= 21.10 T2= 25.30 TC= 24.55 | | | | | | | | | | | | | | | | |
| TW | 80.9 | 85.1 | 88.6 | 93.3 | 102.0 | 103.0 | 102.6 | 102.8 | 102.6 | 102.6 | 102.6 | 102.4 | 102.2 | 102.2 | 102.2 | 102.2 |
| TL | 81.7 | 83.8 | 85.8 | 87.9 | 92.0 | 96.1 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | -4.81 | 2.74 | 1.32 | 0.67 | 0.37 | 0.53 | 1.55 | 1.43 | 1.55 | 1.55 | 1.55 | 1.70 | 1.87 | 1.87 | 1.87 | 1.87 |
| RUN NO.= 99 S= 75.35 AQ= 3.652 DELTSUB= 31.75QC= 0.9000 T1= 21.30 T2= 25.49 TC= 24.80 | | | | | | | | | | | | | | | | |
| TW | 78.6 | 82.9 | 86.9 | 91.6 | 101.6 | 103.3 | 103.0 | 103.0 | 102.8 | 102.8 | 102.6 | 102.6 | 102.6 | 102.2 | 102.2 | 102.2 |
| TL | 71.7 | 74.8 | 78.0 | 81.2 | 87.5 | 93.8 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.53 | 0.45 | 0.41 | 0.35 | 0.26 | 0.39 | 1.27 | 1.33 | 1.43 | 1.43 | 1.55 | 1.55 | 1.55 | 1.87 | 1.87 | 1.87 |
| RUN NO.=100 S= 74.65 AQ= 3.652 DELTSUB= 41.35QC= 0.9000 T1= 21.30 T2= 25.94 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 72.9 | 79.0 | 84.4 | 90.1 | 101.1 | 102.8 | 102.8 | 102.8 | 102.6 | 102.6 | 102.6 | 102.4 | 102.2 | 102.2 | 102.2 | 102.2 |
| TL | 64.0 | 69.2 | 74.3 | 79.5 | 89.8 | 100.0 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.41 | 0.37 | 0.36 | 0.34 | 0.32 | 1.32 | 1.43 | 1.43 | 1.55 | 1.55 | 1.55 | 1.70 | 1.87 | 1.87 | 1.87 | 1.87 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=101 S= 73.96 AQ= 5.906 DELTSUB= 42.50QC= 0.9000 T1= 21.30 T2= 27.37 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 70.5 | 74.9 | 79.2 | 84.3 | 94.4 | 102.2 | 103.9 | 103.4 | 103.2 | 103.2 | 103.0 | 103.0 | 102.8 | 102.6 | 102.4 | 102.4 |
| TL | 61.3 | 64.8 | 68.4 | 71.9 | 79.0 | 86.0 | 93.1 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.64 | 0.58 | 0.54 | 0.48 | 0.38 | 0.37 | 0.55 | 1.84 | 2.00 | 2.00 | 2.15 | 2.15 | 2.32 | 2.51 | 2.75 | 2.75 |
| RUN NO.=102 S= 72.57 AQ= 8.448 DELTSUB= 40.45QC= 0.9000 T1= 21.30 T2= 29.98 TC= 24.05 | | | | | | | | | | | | | | | | |
| TW | 71.4 | 75.9 | 79.9 | 84.7 | 92.9 | 100.7 | 107.9 | 104.1 | 103.4 | 103.4 | 103.4 | 103.3 | 103.3 | 103.3 | 103.1 | 103.1 |
| TL | 63.0 | 66.3 | 69.7 | 73.1 | 79.8 | 86.5 | 93.3 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.89 | 0.83 | 0.73 | 0.64 | 0.60 | 0.58 | 2.06 | 2.48 | 2.48 | 2.48 | 2.64 | 2.64 | 2.64 | 2.82 | 2.82 |
| RUN NO.=103 S= 71.88 AQ= 11.337 DELTSUB= 39.70QC= 0.9000 T1= 21.30 T2= 32.95 TC= 24.30 | | | | | | | | | | | | | | | | |
| TW | 76.5 | 80.7 | 83.8 | 87.9 | 94.4 | 100.7 | 108.5 | 105.4 | 104.1 | 104.1 | 104.1 | 104.1 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 63.9 | 67.2 | 70.5 | 73.8 | 80.4 | 87.0 | 93.6 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.90 | 0.84 | 0.85 | 0.80 | 0.81 | 0.83 | 0.76 | 2.21 | 2.94 | 2.94 | 2.94 | 2.94 | 3.11 | 3.11 | 3.11 | 3.11 |
| RUN NO.=104 S= 71.18 AQ= 14.483 DELTSUB= 39.75QC= 0.9000 T1= 21.10 T2= 35.95 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 78.3 | 83.1 | 86.2 | 89.9 | 96.7 | 102.8 | 109.8 | 106.6 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 |
| TL | 63.6 | 66.9 | 70.2 | 73.5 | 80.1 | 86.8 | 93.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.99 | 0.89 | 0.91 | 0.88 | 0.88 | 0.90 | 0.88 | 2.19 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 | 3.25 |
| RUN NO.=105 S= 75.35 AQ= 14.111 DELTSUB= 4.85QC= 4.7500 T1= 20.60 T2= 23.98 TC= 28.10 | | | | | | | | | | | | | | | | |
| TW | 105.8 | 110.0 | 110.6 | 113.8 | 115.3 | 115.1 | 111.9 | 108.9 | 104.7 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 | 104.1 | 104.1 |
| TL | 95.6 | 96.2 | 96.8 | 97.4 | 98.6 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.38 | 1.02 | 1.02 | 0.86 | 0.85 | 0.93 | 1.17 | 1.55 | 2.91 | 3.17 | 3.17 | 3.17 | 3.17 | 3.17 | 3.32 | 3.32 |
| RUN NO.=106 S= 75.35 AQ= 11.048 DELTSUB= 7.15QC= 4.7500 T1= 20.60 T2= 22.74 TC= 27.10 | | | | | | | | | | | | | | | | |
| TW | 103.9 | 107.3 | 108.5 | 109.8 | 109.4 | 110.9 | 112.6 | 107.5 | 104.1 | 103.6 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 |
| TL | 93.3 | 93.9 | 94.5 | 95.1 | 96.3 | 97.5 | 98.7 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.05 | 0.83 | 0.79 | 0.75 | 0.84 | 0.83 | 0.79 | 1.44 | 2.60 | 2.91 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 |
| RUN NO.=107 S= 75.35 AQ= 8.355 DELTSUB= 12.75QC= 1.8500 T1= 21.10 T2= 25.27 TC= 25.05 | | | | | | | | | | | | | | | | |
| TW | 97.1 | 99.9 | 100.7 | 102.2 | 105.6 | 108.8 | 111.5 | 108.3 | 104.9 | 103.9 | 103.4 | 103.4 | 103.4 | 103.3 | 103.3 | 103.4 |
| TL | 88.8 | 89.9 | 90.9 | 92.0 | 94.1 | 96.2 | 98.4 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 | 100.5 |
| HT | 1.01 | 0.84 | 0.86 | 0.82 | 0.73 | 0.67 | 0.64 | 1.07 | 1.88 | 2.46 | 2.83 | 2.83 | 2.83 | 3.04 | 3.04 | 2.83 |
| RUN NO.=108 S= 75.35 AQ= 8.232 DELTSUB= 9.05QC= 4.7500 T1= 20.60 T2= 22.20 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 100.1 | 102.0 | 102.0 | 103.4 | 105.6 | 107.3 | 110.3 | 104.5 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 91.6 | 92.3 | 93.1 | 93.8 | 95.3 | 96.8 | 98.4 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 0.97 | 0.85 | 0.92 | 0.85 | 0.81 | 0.79 | 0.69 | 1.77 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 | 2.79 |
| RUN NO.=109 S= 75.35 AQ= 5.673 DELTSUB= 9.50QC= 4.7500 T1= 20.35 T2= 21.45 TC= 25.30 | | | | | | | | | | | | | | | | |
| TW | 95.6 | 98.1 | 98.6 | 101.1 | 104.3 | 105.8 | 106.9 | 103.4 | 102.0 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 |
| TL | 90.9 | 91.7 | 92.5 | 93.3 | 94.9 | 96.5 | 98.0 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.20 | 0.88 | 0.93 | 0.73 | 0.60 | 0.61 | 0.64 | 1.48 | 2.41 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 | 2.70 |
| RUN NO.=110 S= 75.35 AQ= 14.524 DELTSUB= 1.90QC= 1.8800 T1= 21.80 T2= 30.62 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 106.6 | 109.1 | 109.8 | 112.1 | 114.2 | 108.9 | 107.1 | 106.6 | 104.9 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 |
| TL | 98.6 | 98.8 | 99.1 | 99.3 | 99.8 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.81 | 1.41 | 1.35 | 1.13 | 1.01 | 1.67 | 2.14 | 2.29 | 3.09 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

RUN NO.=111 S= 75.35 AQ= 11.481 DELTSUB= 1.90QC= 1.8800 T1= 20.80 T2= 27.77 TC= 25.80

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 106.2 | 108.8 | 109.4 | 111.7 | 114.4 | 110.6 | 108.1 | 105.8 | 104.8 | 104.1 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 98.6 | 98.8 | 99.1 | 99.3 | 99.8 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 1.51 | 1.16 | 1.11 | 0.93 | 0.78 | 1.10 | 1.46 | 2.07 | 2.55 | 2.98 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 |

RUN NO.=112 S= 75.35 AQ= 8.603 DELTSUB= 1.70QC= 1.4000 T1= 20.80 T2= 27.82 TC= 25.80

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 104.8 | 107.4 | 109.4 | 110.0 | 112.8 | 111.1 | 106.9 | 105.1 | 103.9 | 103.6 | 103.4 | 103.3 | 103.3 | 103.1 | 103.1 | 103.1 |
| TL | 98.6 | 98.8 | 99.0 | 99.2 | 99.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.39 | 0.99 | 0.83 | 0.80 | 0.66 | 0.78 | 1.27 | 1.69 | 2.23 | 2.39 | 2.53 | 2.69 | 2.69 | 2.87 | 2.87 | 2.87 |

RUN NO.=113 S= 76.04 AQ= 5.931 DELTSUB= 2.15QC= 0.9000 T1= 20.80 T2= 28.33 TC= 25.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 103.3 | 104.8 | 105.6 | 107.3 | 108.5 | 108.3 | 105.6 | 104.5 | 103.1 | 102.6 | 102.6 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 |
| TL | 98.2 | 98.4 | 98.7 | 99.0 | 99.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.17 | 0.94 | 0.87 | 0.72 | 0.66 | 0.72 | 1.08 | 1.33 | 1.98 | 2.33 | 2.33 | 2.52 | 2.52 | 2.52 | 2.52 | 2.52 |

RUN NO.=114 S= 75.35 AQ= 3.693 DELTSUB= 2.15QC= 0.9000 T1= 21.30 T2= 25.99 TC= 25.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 100.7 | 102.4 | 102.8 | 103.9 | 105.4 | 103.2 | 102.8 | 102.6 | 102.2 | 102.0 | 101.8 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| TL | 98.2 | 98.4 | 98.7 | 99.0 | 99.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.46 | 0.93 | 0.90 | 0.75 | 0.63 | 1.17 | 1.34 | 1.45 | 1.72 | 1.89 | 2.17 | 2.46 | 2.46 | 2.46 | 2.46 | 2.46 |

RUN NO.=115 S= 75.35 AQ= 14.524 DELTSUB= 9.50QC= 0.9000 T1= 20.80 T2= 35.67 TC= 26.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 104.3 | 107.7 | 108.5 | 108.8 | 109.1 | 112.4 | 113.8 | 109.6 | 104.9 | 104.5 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 91.3 | 92.1 | 92.9 | 93.7 | 95.3 | 96.9 | 98.5 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.12 | 0.93 | 0.93 | 0.97 | 1.05 | 0.94 | 0.95 | 1.52 | 2.96 | 3.26 | 3.26 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

RUN NO.=116 S= 75.35 AQ= 14.524 DELTSUB= 19.75QC= 0.9000 T1= 20.80 T2= 33.90 TC= 26.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 94.6 | 98.8 | 100.3 | 100.5 | 104.5 | 107.7 | 111.3 | 113.6 | 106.0 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 81.7 | 83.1 | 84.5 | 85.9 | 88.8 | 91.6 | 94.4 | 97.2 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.13 | 0.93 | 0.92 | 1.00 | 0.92 | 0.90 | 0.86 | 0.89 | 2.43 | 3.26 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

RUN NO.=117 S= 75.35 AQ= 11.445 DELTSUB= 20.60QC= 0.9000 T1= 20.80 T2= 31.12 TC= 26.55

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 94.1 | 96.3 | 97.3 | 98.6 | 102.6 | 105.4 | 110.0 | 111.5 | 105.4 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 80.9 | 82.4 | 83.9 | 85.3 | 88.3 | 91.2 | 94.2 | 97.1 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.87 | 0.83 | 0.85 | 0.87 | 0.80 | 0.81 | 0.72 | 0.79 | 2.15 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 | 2.97 |

RUN NO.=118 S= 74.65 AQ= 8.541 DELTSUB= 19.55QC= 0.9000 T1= 20.60 T2= 29.35 TC= 25.55

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 89.3 | 93.3 | 95.6 | 97.3 | 101.4 | 104.5 | 109.1 | 104.9 | 103.4 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 82.1 | 83.8 | 85.4 | 87.0 | 90.3 | 93.5 | 96.8 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.20 | 0.89 | 0.83 | 0.83 | 0.77 | 0.78 | 0.69 | 1.73 | 2.51 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 |

RUN NO.=119 S= 73.96 AQ= 5.931 DELTSUB= 21.25QC= 0.9000 T1= 21.30 T2= 27.38 TC= 26.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 89.1 | 91.9 | 94.1 | 96.6 | 101.6 | 105.4 | 106.6 | 104.3 | 103.4 | 103.3 | 103.3 | 103.3 | 103.1 | 103.1 | 103.1 | 103.1 |
| TL | 80.8 | 82.5 | 84.3 | 86.1 | 89.6 | 93.2 | 96.7 | 100.2 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.72 | 0.64 | 0.60 | 0.56 | 0.50 | 0.49 | 0.60 | 1.46 | 1.85 | 1.98 | 1.98 | 1.98 | 2.12 | 2.12 | 2.12 | 2.12 |

RUN NO.=120 S= 73.26 AQ= 14.524 DELTSUB= 28.00QC= 0.9000 T1= 20.80 T2= 35.67 TC= 26.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 86.4 | 90.6 | 92.3 | 95.2 | 99.6 | 105.8 | 111.3 | 107.7 | 105.1 | 104.5 | 104.7 | 104.3 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 74.4 | 76.7 | 79.0 | 81.4 | 86.0 | 90.7 | 95.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.21 | 1.05 | 1.10 | 1.05 | 1.07 | 0.96 | 0.91 | 1.89 | 2.85 | 3.26 | 3.12 | 3.42 | 3.42 | 3.42 | 3.42 | 3.42 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=121 | S= 73.26 | AQ= 11.337 | DELTSUB= 30.80 | QC= 0.9000 | T1= 20.60 | T2= 32.21 | TC= 26.30 | | | | | | | | | |
| TW | 83.1 | 87.1 | 88.8 | 92.3 | 98.1 | 103.3 | 109.4 | 105.8 | 103.9 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 71.8 | 74.4 | 76.9 | 79.5 | 84.6 | 89.8 | 94.9 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.89 | 0.96 | 0.89 | 0.84 | 0.84 | 0.78 | 1.96 | 2.94 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 | 3.15 |
| RUN NO.=122 | S= 51.74 | AQ= 14.483 | DELTSUB= 1.30 | QC= 1.4000 | T1= 19.60 | T2= 34.24 | TC= 25.80 | | | | | | | | | |
| TW | 108.1 | 108.8 | 105.8 | 105.4 | 103.6 | 103.1 | 103.3 | 103.6 | 103.4 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.9 | 103.9 |
| TL | 98.8 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.55 | 1.52 | 2.35 | 2.52 | 3.62 | 4.26 | 4.02 | 3.62 | 3.81 | 3.81 | 3.62 | 3.62 | 3.62 | 3.62 | 3.45 | 3.45 |
| RUN NO.=123 | S= 53.13 | AQ= 11.300 | DELTSUB= 1.90 | QC= 1.4000 | T1= 20.10 | T2= 31.52 | TC= 26.05 | | | | | | | | | |
| TW | 108.1 | 108.3 | 107.3 | 104.1 | 103.2 | 102.8 | 102.8 | 103.2 | 103.0 | 103.0 | 103.2 | 103.2 | 103.2 | 103.2 | 103.2 | 103.2 |
| TL | 98.6 | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.19 | 1.24 | 1.52 | 2.66 | 3.37 | 3.83 | 3.83 | 3.37 | 3.59 | 3.59 | 3.37 | 3.37 | 3.37 | 3.37 | 3.37 | 3.37 |
| RUN NO.=124 | S= 53.82 | AQ= 8.417 | DELTSUB= 1.90 | QC= 1.4000 | T1= 20.35 | T2= 28.86 | TC= 25.55 | | | | | | | | | |
| TW | 106.0 | 107.3 | 104.7 | 103.0 | 102.8 | 102.4 | 102.6 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 98.6 | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.13 | 1.05 | 1.73 | 2.67 | 2.85 | 3.30 | 3.06 | 2.67 | 2.67 | 2.67 | 2.67 | 2.67 | 2.85 | 2.85 | 2.85 | 2.85 |
| RUN NO.=125 | S= 53.82 | AQ= 5.880 | DELTSUB= 1.25 | QC= 0.9000 | T1= 20.35 | T2= 30.01 | TC= 22.10 | | | | | | | | | |
| TW | 104.3 | 103.3 | 102.2 | 101.9 | 102.2 | 101.9 | 101.9 | 102.4 | 101.9 | 101.9 | 102.2 | 101.9 | 101.9 | 101.9 | 101.9 | 101.9 |
| TL | 99.2 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.16 | 1.72 | 2.50 | 2.80 | 2.50 | 2.80 | 2.80 | 2.31 | 2.80 | 2.80 | 2.50 | 2.80 | 2.80 | 2.80 | 2.80 | 2.80 |
| RUN NO.=126 | S= 54.51 | AQ= 5.880 | DELTSUB= 1.50 | QC= 0.9000 | T1= 20.60 | T2= 29.90 | TC= 22.10 | | | | | | | | | |
| TW | 103.3 | 103.4 | 100.7 | 101.6 | 101.9 | 101.8 | 102.2 | 102.4 | 102.2 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.2 | 102.2 |
| TL | 98.8 | 99.3 | 99.8 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.33 | 1.43 | 6.78 | 3.46 | 2.80 | 3.09 | 2.50 | 2.31 | 2.50 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.50 | 2.50 |
| RUN NO.=127 | S= 50.35 | AQ= 14.483 | DELTSUB= 4.00 | QC= 0.9000 | T1= 20.80 | T2= 43.59 | TC= 25.80 | | | | | | | | | |
| TW | 108.5 | 112.1 | 110.9 | 107.1 | 104.3 | 103.6 | 103.9 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 97.4 | 98.7 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.30 | 1.08 | 1.34 | 2.07 | 3.41 | 4.02 | 3.81 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.41 | 3.41 | 3.41 | 3.41 |
| RUN NO.=128 | S= 51.04 | AQ= 11.337 | DELTSUB= 10.80 | QC= 0.9000 | T1= 20.60 | T2= 38.42 | TC= 26.30 | | | | | | | | | |
| TW | 104.7 | 108.5 | 107.7 | 104.7 | 103.4 | 103.1 | 103.1 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 |
| TL | 92.8 | 96.4 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.95 | 0.94 | 1.46 | 2.44 | 3.33 | 3.78 | 3.78 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| RUN NO.=129 | S= 51.74 | AQ= 8.448 | DELTSUB= 11.85 | QC= 0.9000 | T1= 20.60 | T2= 33.88 | TC= 26.05 | | | | | | | | | |
| TW | 102.0 | 106.8 | 104.1 | 102.6 | 102.4 | 102.4 | 102.6 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 91.9 | 95.8 | 99.7 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 0.84 | 0.77 | 1.94 | 3.07 | 3.31 | 3.31 | 3.07 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 |
| RUN NO.=130 | S= 50.35 | AQ= 14.483 | DELTSUB= 19.35 | QC= 0.9000 | T1= 20.60 | T2= 40.72 | TC= 26.30 | | | | | | | | | |
| TW | 99.2 | 104.3 | 108.3 | 110.4 | 104.3 | 103.6 | 103.9 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 | 104.1 |
| TL | 83.9 | 87.1 | 90.3 | 93.6 | 100.0 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.95 | 0.84 | 0.81 | 0.86 | 3.35 | 4.02 | 3.81 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 | 3.58 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=131 S= 51.74 AQ= 11.300 DELTSUB= 19.75QC= 0.9000 T1= 20.60 T2= 37.67 TC= 26.55 | | | | | | | | | | | | | | | | |
| TW | 96.3 | 102.6 | 107.7 | 104.7 | 103.4 | 103.3 | 103.3 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 85.2 | 90.1 | 95.0 | 99.9 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.02 | 0.91 | 0.89 | 2.37 | 3.32 | 3.53 | 3.53 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 | 3.14 |
| RUN NO.=132 S= 51.74 AQ= 8.541 DELTSUB= 19.30QC= 0.9000 T1= 20.60 T2= 34.03 TC= 26.30 | | | | | | | | | | | | | | | | |
| TW | 95.6 | 104.3 | 103.4 | 103.1 | 102.8 | 102.8 | 102.8 | 103.1 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 103.1 |
| TL | 87.1 | 93.5 | 99.9 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 1.00 | 0.79 | 2.43 | 2.85 | 3.11 | 3.11 | 3.11 | 2.85 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 3.11 | 2.85 |
| RUN NO.=133 S= 51.04 AQ= 11.300 DELTSUB= 28.65QC= 0.9000 T1= 20.80 T2= 37.89 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 92.3 | 100.9 | 106.4 | 104.1 | 103.6 | 103.3 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 78.7 | 85.8 | 93.0 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.84 | 0.75 | 0.84 | 2.82 | 3.32 | 3.77 | 3.53 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 |
| RUN NO.=134 S= 51.74 AQ= 8.448 DELTSUB= 32.00QC= 0.9000 T1= 20.60 T2= 33.37 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 91.2 | 102.2 | 103.6 | 103.1 | 102.8 | 102.8 | 102.8 | 103.1 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| TL | 76.0 | 83.9 | 91.9 | 99.8 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 | 100.1 |
| HT | 0.56 | 0.46 | 0.72 | 2.63 | 3.07 | 3.07 | 3.07 | 2.82 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 | 3.07 |
| RUN NO.=135 S= 50.35 AQ= 14.483 DELTSUB= 40.65QC= 0.9000 T1= 20.60 T2= 40.74 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 83.6 | 93.1 | 100.3 | 107.9 | 103.9 | 103.6 | 103.6 | 104.1 | 103.9 | 103.9 | 104.1 | 104.1 | 104.3 | 104.3 | 104.3 | 104.3 |
| TL | 66.4 | 73.1 | 79.9 | 86.6 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.84 | 0.72 | 0.71 | 0.68 | 3.90 | 4.26 | 4.26 | 3.76 | 4.02 | 4.02 | 3.76 | 3.76 | 3.58 | 3.58 | 3.58 | 3.58 |
| RUN NO.=136 S= 50.35 AQ= 11.300 DELTSUB= 41.55QC= 0.9000 T1= 20.80 T2= 36.51 TC= 26.05 | | | | | | | | | | | | | | | | |
| TW | 84.7 | 94.4 | 102.6 | 105.6 | 103.4 | 103.4 | 103.4 | 103.6 | 103.6 | 103.6 | 103.9 | 103.9 | 103.6 | 103.9 | 103.9 | 103.9 |
| TL | 65.6 | 72.5 | 79.4 | 86.3 | 100.1 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 | 100.3 |
| HT | 0.59 | 0.52 | 0.49 | 0.59 | 3.36 | 3.53 | 3.53 | 3.32 | 3.32 | 3.32 | 3.14 | 3.14 | 3.32 | 3.14 | 3.14 | 3.14 |
| RUN NO.=137 S= 52.43 AQ= 14.111 DELTSUB= 8.45QC= 4.7500 T1= 21.10 T2= 24.80 TC= 28.35 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 108.9 | 111.5 | 111.5 | 105.6 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 | 103.9 |
| TL | 92.6 | 94.0 | 95.4 | 96.8 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.15 | 0.94 | 0.88 | 0.96 | 2.36 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 | 3.32 |
| RUN NO.=138 S= 52.43 AQ= 11.012 DELTSUB= 14.90QC= 4.7500 T1= 21.10 T2= 24.25 TC= 27.10 | | | | | | | | | | | | | | | | |
| TW | 100.3 | 106.0 | 108.9 | 105.6 | 103.4 | 102.8 | 103.1 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 | 103.3 |
| TL | 88.6 | 92.3 | 96.1 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 | 99.8 |
| HT | 0.94 | 0.81 | 0.85 | 1.90 | 3.02 | 3.67 | 3.39 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 | 3.19 |
| RUN NO.=139 S= 48.26 AQ= 14.400 DELTSUB= 28.70QC= 4.7500 T1= 21.60 T2= 25.68 TC= 31.85 | | | | | | | | | | | | | | | | |
| TW | 95.6 | 102.1 | 108.9 | 106.6 | 103.6 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 | 103.0 |
| TL | 77.1 | 84.3 | 91.4 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 | 98.6 |
| HT | 0.78 | 0.81 | 0.82 | 1.80 | 2.85 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 | 3.27 |
| RUN NO.=140 S= 48.26 AQ= 14.400 DELTSUB= 72.85QC= 4.7500 T1= 23.05 T2= 26.78 TC= 35.25 | | | | | | | | | | | | | | | | |
| TW | 67.6 | 84.3 | 99.0 | 105.8 | 103.4 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 |
| TL | 38.9 | 50.9 | 63.0 | 75.1 | 99.2 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 0.50 | 0.43 | 0.40 | 0.47 | 3.40 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=141 S= 99.65 AQ= 8.974 DELTSUB= 3.45QC= 0.9000 T1= 24.05 T2= 27.48 TC= 73.20 | | | | | | | | | | | | | | | | |
| TW | 101.4 | 103.4 | 104.5 | 106.0 | 108.3 | 108.5 | 108.9 | 109.1 | 109.4 | 110.4 | 110.9 | 110.9 | 104.1 | 103.6 | 102.8 | 103.3 |
| TL | 96.7 | 96.8 | 97.0 | 97.1 | 97.4 | 97.8 | 98.1 | 98.4 | 98.7 | 99.0 | 99.3 | 99.6 | 99.9 | 99.9 | 99.9 | 99.9 |
| HT | 1.91 | 1.35 | 1.19 | 1.01 | 0.83 | 0.84 | 0.82 | 0.83 | 0.84 | 0.78 | 0.78 | 0.80 | 2.16 | 2.43 | 3.15 | 2.72 |
| RUN NO.=142 S= 93.40 AQ= 11.950 DELTSUB= 2.35QC= 0.9000 T1= 24.05 T2= 35.85 TC= 47.45 | | | | | | | | | | | | | | | | |
| TW | 103.1 | 104.7 | 105.8 | 106.9 | 108.8 | 110.9 | 112.6 | 112.1 | 108.5 | 107.3 | 106.0 | 103.9 | 103.1 | 103.1 | 102.2 | 103.1 |
| TL | 97.3 | 97.5 | 97.7 | 97.9 | 98.3 | 98.7 | 99.1 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 2.08 | 1.66 | 1.47 | 1.33 | 1.14 | 0.98 | 0.89 | 0.94 | 1.32 | 1.53 | 1.82 | 2.69 | 3.32 | 3.32 | 4.35 | 3.32 |
| RUN NO.=143 S= 90.63 AQ= 15.638 DELTSUB= 1.50QC= 1.4000 T1= 22.10 T2= 33.01 TC= 58.00 | | | | | | | | | | | | | | | | |
| TW | 104.7 | 106.6 | 107.9 | 108.9 | 111.9 | 113.4 | 110.9 | 110.3 | 108.1 | 106.9 | 106.0 | 104.5 | 104.3 | 104.5 | 104.5 | 104.5 |
| TL | 98.3 | 98.4 | 98.6 | 98.7 | 99.0 | 99.3 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 2.44 | 1.92 | 1.68 | 1.53 | 1.22 | 1.11 | 1.39 | 1.48 | 1.85 | 2.17 | 2.46 | 3.22 | 3.36 | 3.22 | 3.22 | 3.22 |
| RUN NO.=144 S= 73.96 AQ= 19.589 DELTSUB= 3.35QC= 1.8500 T1= 21.10 T2= 32.51 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 104.9 | 107.4 | 110.0 | 111.7 | 113.6 | 112.9 | 106.9 | 106.2 | 105.1 | 104.1 | 103.6 | 103.6 | 103.9 | 104.5 | 104.5 | 104.7 |
| TL | 96.1 | 96.5 | 96.9 | 97.3 | 98.2 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 | 99.0 |
| HT | 2.21 | 1.79 | 1.50 | 1.36 | 1.27 | 1.40 | 2.50 | 2.72 | 3.19 | 3.84 | 4.21 | 4.21 | 4.00 | 3.56 | 3.56 | 3.44 |
| RUN NO.=145 S= 70.49 AQ= 24.086 DELTSUB= 3.55QC= 1.8500 T1= 21.35 T2= 36.38 TC= 72.50 | | | | | | | | | | | | | | | | |
| TW | 107.2 | 109.6 | 110.6 | 110.9 | 109.4 | 109.9 | 109.9 | 108.3 | 106.2 | 104.7 | 104.5 | 104.5 | 104.5 | 105.1 | 105.1 | 105.4 |
| TL | 96.2 | 96.8 | 97.4 | 98.0 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| HT | 2.20 | 1.89 | 1.83 | 1.88 | 2.37 | 2.26 | 2.26 | 2.65 | 3.44 | 4.38 | 4.54 | 4.54 | 4.54 | 4.05 | 4.05 | 3.92 |
| RUN NO.=146 S= 76.04 AQ= 11.950 DELTSUB= 16.25QC= 0.9000 T1= 21.60 T2= 32.05 TC= 44.10 | | | | | | | | | | | | | | | | |
| TW | 96.3 | 98.6 | 99.4 | 100.3 | 104.1 | 105.8 | 109.4 | 112.6 | 104.5 | 103.5 | 103.5 | 103.3 | 103.3 | 103.5 | 103.5 | 103.5 |
| TL | 84.3 | 85.5 | 86.6 | 87.8 | 90.1 | 92.4 | 94.7 | 97.1 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.00 | 0.91 | 0.94 | 0.96 | 0.85 | 0.89 | 0.82 | 0.77 | 2.34 | 2.91 | 2.91 | 3.10 | 3.10 | 2.91 | 2.91 | 2.91 |
| RUN NO.=147 S= 71.88 AQ= 15.638 DELTSUB= 4.85QC= 0.9000 T1= 21.10 T2= 40.12 TC= 50.60 | | | | | | | | | | | | | | | | |
| TW | 106.4 | 110.3 | 112.1 | 113.1 | 114.3 | 112.9 | 108.1 | 106.9 | 104.3 | 103.9 | 103.9 | 103.7 | 103.7 | 104.1 | 104.1 | 104.1 |
| TL | 95.2 | 95.8 | 96.4 | 97.0 | 98.2 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 | 99.4 |
| HT | 1.40 | 1.08 | 0.99 | 0.97 | 0.98 | 1.16 | 1.81 | 2.11 | 3.22 | 3.51 | 3.51 | 3.68 | 3.68 | 3.36 | 3.36 | 3.36 |
| RUN NO.=148 S= 55.90 AQ= 19.542 DELTSUB= 8.65QC= 1.5000 T1= 23.05 T2= 37.17 TC= 56.60 | | | | | | | | | | | | | | | | |
| TW | 108.5 | 111.5 | 110.6 | 111.7 | 113.4 | 104.1 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.6 | 103.9 | 104.5 | 103.6 | 104.5 |
| TL | 92.1 | 93.2 | 94.2 | 95.3 | 97.5 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.19 | 1.07 | 1.19 | 1.19 | 1.23 | 4.38 | 4.89 | 4.89 | 4.89 | 4.89 | 4.89 | 4.89 | 4.60 | 4.03 | 4.89 | 4.03 |
| RUN NO.=149 S= 52.43 AQ= 23.932 DELTSUB= 6.95QC= 1.4000 T1= 24.05 T2= 46.50 TC= 70.05 | | | | | | | | | | | | | | | | |
| TW | 110.0 | 110.0 | 109.4 | 108.9 | 109.6 | 104.8 | 104.3 | 104.5 | 104.3 | 104.3 | 104.3 | 104.3 | 104.5 | 105.4 | 105.1 | 105.8 |
| TL | 95.0 | 97.3 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.60 | 1.89 | 2.45 | 2.57 | 2.41 | 4.69 | 5.15 | 4.93 | 5.15 | 5.15 | 5.15 | 5.15 | 4.93 | 4.20 | 4.35 | 3.89 |
| RUN NO.=150 S= 36.46 AQ= 23.932 DELTSUB= 21.55QC= 1.8500 T1= 23.30 T2= 40.47 TC= 63.95 | | | | | | | | | | | | | | | | |
| TW | 106.9 | 107.9 | 103.6 | 103.4 | 103.9 | 103.6 | 103.6 | 104.3 | 104.1 | 104.3 | 104.3 | 104.3 | 104.9 | 105.6 | 105.4 | 106.4 |
| TL | 85.3 | 92.4 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 | 99.6 |
| HT | 1.11 | 1.55 | 5.89 | 6.30 | 5.63 | 5.98 | 5.98 | 5.15 | 5.38 | 5.15 | 5.15 | 5.15 | 4.52 | 4.02 | 4.20 | 3.55 |

```
Z     0.05  0.10  0.15  0.20  0.30  0.40  0.50  0.60  0.70  0.80  0.90  1.00  1.10  1.20  1.30  1.40

RUN NO.=141   S=   99.65   AQ=   8.974   DELTSUB=    3.45QC= 0.9000   T1=  24.05      T2=   27.48   TC= 73.20
TW 101.4 103.4 104.5 106.0 108.3 108.5 108.9 109.1 109.4 110.4 110.9 110.9 104.1 103.6 102.8 103.3
TL   96.7  96.8  97.0  97.1  97.4  97.8  98.1  98.4  98.7  99.0  99.3  99.6  99.9  99.9  99.9  99.9
HT   1.91  1.35  1.19  1.01  0.83  0.84  0.82  0.83  0.84  0.78  0.78  0.80  2.16  2.43  3.15  2.72

RUN NO.=142   S=   93.40   AQ=  11.950   DELTSUB=    2.35QC= 0.9000   T1=  24.05      T2=   35.85   TC= 47.45
TW 103.1 104.7 105.8 106.9 108.8 110.9 112.6 112.1 108.5 107.3 106.0 103.9 103.1 103.1 102.2 103.1
TL   97.3  97.5  97.7  97.9  98.3  98.7  99.1  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   2.08  1.66  1.47  1.33  1.14  0.98  0.89  0.94  1.32  1.53  1.82  2.69  3.32  3.32  4.35  3.32

RUN NO.=143   S=   90.63   AQ=  15.638   DELTSUB=    1.50QC= 1.4000   T1=  22.10      T2=   33.01   TC= 58.00
TW 104.7 106.6 107.9 108.9 111.9 113.4 110.9 110.3 108.1 106.9 106.0 104.5 104.3 104.5 104.5 104.5
TL   98.3  98.4  98.6  98.7  99.0  99.3  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   2.44  1.92  1.68  1.53  1.22  1.11  1.39  1.48  1.85  2.17  2.46  3.22  3.36  3.22  3.22  3.22

RUN NO.=144   S=   73.96   AQ=  19.589   DELTSUB=    3.35QC= 1.8500   T1=  21.10      T2=   32.51   TC= 59.15
TW 104.9 107.4 110.0 111.7 113.6 112.9 106.9 106.2 105.1 104.1 103.6 103.6 103.9 104.5 104.5 104.7
TL   96.1  96.5  96.9  97.3  98.2  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0  99.0
HT   2.21  1.79  1.50  1.36  1.27  1.40  2.50  2.72  3.19  3.84  4.21  4.21  4.00  3.56  3.56  3.44

RUN NO.=145   S=   70.49   AQ=  24.086   DELTSUB=    3.55QC= 1.8500   T1=  21.35      T2=   36.38   TC= 72.50
TW 107.2 109.6 110.6 110.9 109.4 109.9 109.9 108.3 106.2 104.7 104.5 104.5 104.5 105.1 105.1 105.4
TL   96.2  96.8  97.4  98.0  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2  99.2
HT   2.20  1.89  1.83  1.88  2.37  2.26  2.26  2.65  3.44  4.38  4.54  4.54  4.54  4.05  4.05  3.92

RUN NO.=146   S=   76.04   AQ=  11.950   DELTSUB=   16.25QC= 0.9000   T1=  21.60      T2=   32.05   TC= 44.10
TW   96.3  98.6  99.4 100.3 104.1 105.8 109.4 112.6 104.5 103.5 103.5 103.3 103.3 103.5 103.5 103.5
TL   84.3  85.5  86.6  87.8  90.1  92.4  94.7  97.1  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   1.00  0.91  0.94  0.96  0.85  0.89  0.82  0.77  2.34  2.91  2.91  3.10  3.10  2.91  2.91  2.91

RUN NO.=147   S=   71.88   AQ=  15.638   DELTSUB=    4.85QC= 0.9000   T1=  21.10      T2=   40.12   TC= 50.60
TW 106.4 110.3 112.1 113.1 114.3 112.9 108.1 106.9 104.3 103.9 103.9 103.7 103.7 104.1 104.1 104.1
TL   95.2  95.8  96.4  97.0  98.2  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4  99.4
HT   1.40  1.08  0.99  0.97  0.98  1.16  1.81  2.11  3.22  3.51  3.51  3.68  3.68  3.36  3.36  3.36

RUN NO.=148   S=   55.90   AQ=  19.542   DELTSUB=    8.65QC= 1.5000   T1=  23.05      T2=   37.17   TC= 56.60
TW 108.5 111.5 110.6 111.7 113.4 104.1 103.6 103.6 103.6 103.6 103.6 103.6 103.9 104.5 103.6 104.5
TL   92.1  93.2  94.2  95.3  97.5  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.19  1.07  1.19  1.19  1.23  4.38  4.89  4.89  4.89  4.89  4.89  4.89  4.60  4.03  4.89  4.03

RUN NO.=149   S=   52.43   AQ=  23.932   DELTSUB=    6.95QC= 1.4000   T1=  24.05      T2=   46.50   TC= 70.05
TW 110.0 110.0 109.4 108.9 109.6 104.8 104.3 104.5 104.3 104.3 104.3 104.3 104.5 105.4 105.1 105.8
TL   95.0  97.3  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.60  1.89  2.45  2.57  2.41  4.69  5.15  4.93  5.15  5.15  5.15  5.15  4.93  4.20  4.35  3.89

RUN NO.=150   S=   36.46   AQ=  23.932   DELTSUB=   21.55QC= 1.8500   T1=  23.30      T2=   40.47   TC= 63.95
TW 106.9 107.9 103.6 103.4 103.9 103.6 103.6 104.3 104.1 104.3 104.3 104.3 104.9 105.6 105.4 106.4
TL   85.3  92.4  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6  99.6
HT   1.11  1.55  5.89  6.30  5.63  5.98  5.98  5.15  5.38  5.15  5.15  5.15  4.52  4.02  4.20  3.55
```

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

RUN NO.=231 S= 53.13 AQ= 8.727 DELTSUB= 10.40QC= 0.9000 T1= 19.85 T2= 33.51 TC= 58.90

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 117.6 | 117.4 | 119.6 | 122.8 | 119.1 | 117.4 | 117.1 | 117.6 | 117.6 | 117.6 | 117.6 | 117.6 | 117.8 | 118.4 | 118.2 | 119.4 |
| TL | 102.0 | 103.7 | 105.5 | 107.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.56 | 0.64 | 0.61 | 0.56 | 1.04 | 1.30 | 1.34 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.23 | 1.13 | 1.16 | 0.99 |

RUN NO.=232 S= 53.13 AQ= 5.957 DELTSUB= 12.40QC= 0.9000 T1= 19.85 T2= 30.18 TC= 55.00

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 116.3 | 116.3 | 119.4 | 117.6 | 116.1 | 115.5 | 115.9 | 116.3 | 116.1 | 116.3 | 116.3 | 116.3 | 116.3 | 116.9 | 116.7 | 117.6 |
| TL | 101.8 | 104.9 | 108.0 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 |
| HT | 0.41 | 0.52 | 0.52 | 0.92 | 1.19 | 1.35 | 1.24 | 1.15 | 1.19 | 1.15 | 1.15 | 1.15 | 1.15 | 1.03 | 1.06 | 0.92 |

RUN NO.=233 S= 53.13 AQ= 3.734 DELTSUB= 17.10QC= 0.9000 T1= 19.85 T2= 26.23 TC= 59.15

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 110.6 | 116.5 | 117.4 | 116.3 | 115.1 | 114.7 | 115.1 | 115.3 | 115.3 | 115.3 | 115.3 | 115.3 | 115.5 | 115.7 | 115.5 | 115.9 |
| TL | 98.9 | 103.2 | 107.5 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 |
| HT | 0.32 | 0.28 | 0.38 | 0.81 | 1.10 | 1.24 | 1.10 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 0.98 | 0.93 | 0.98 | 0.89 |

RUN NO.=234 S= 35.07 AQ= 14.895 DELTSUB= 17.75QC= 1.8500 T1= 20.10 T2= 31.37 TC= 61.65

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 114.6 | 120.9 | 121.3 | 121.1 | 120.3 | 119.9 | 120.3 | 120.7 | 120.9 | 121.1 | 121.3 | 121.5 | 122.6 | 124.1 | 123.9 | 127.1 |
| TL | 97.1 | 100.1 | 103.0 | 106.0 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.85 | 0.72 | 0.82 | 0.99 | 1.78 | 1.87 | 1.78 | 1.69 | 1.66 | 1.62 | 1.58 | 1.55 | 1.40 | 1.23 | 1.25 | 0.98 |

RUN NO.=235 S= 35.07 AQ= 14.895 DELTSUB= 18.60QC= 1.8500 T1= 20.10 T2= 32.36 TC= 61.65

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 114.6 | 120.3 | 121.1 | 120.9 | 120.3 | 119.9 | 120.3 | 120.9 | 120.9 | 121.1 | 121.5 | 121.5 | 122.6 | 124.3 | 124.3 | 127.1 |
| TL | 98.0 | 102.6 | 107.3 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.89 | 0.85 | 1.08 | 1.66 | 1.78 | 1.87 | 1.78 | 1.66 | 1.66 | 1.62 | 1.55 | 1.55 | 1.40 | 1.21 | 1.21 | 0.98 |

SYSTEM-ETHYL ACETATE

RUN NO.=236 S= 97.57 AQ= 8.634 DELTSUB= 20.90QC= 0.9000 T1= 21.80 T2= 29.11 TC= 63.70

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 79.9 | 80.3 | 79.0 | 78.8 | 82.9 | 84.1 | 86.6 | 87.5 | 82.3 | 81.8 | 81.8 | 81.6 | 82.5 | 82.5 | 82.1 | 82.9 |
| TL | 56.7 | 58.2 | 59.7 | 61.2 | 64.2 | 67.1 | 70.1 | 73.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.37 | 0.39 | 0.45 | 0.49 | 0.46 | 0.51 | 0.52 | 0.60 | 1.39 | 1.51 | 1.51 | 1.58 | 1.35 | 1.35 | 1.45 | 1.26 |

RUN NO.=237 S= 97.57 AQ= 8.634 DELTSUB= 32.75QC= 0.9000 T1= 21.80 T2= 28.91 TC= 69.00

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 71.9 | 66.9 | 67.9 | 70.3 | 73.6 | 76.3 | 80.1 | 82.9 | 82.7 | 82.5 | 82.5 | 82.5 | 83.1 | 82.9 | 82.3 | 83.4 |
| TL | 45.7 | 48.0 | 50.4 | 52.7 | 57.4 | 62.1 | 66.7 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.33 | 0.46 | 0.49 | 0.49 | 0.53 | 0.61 | 0.65 | 0.75 | 1.30 | 1.35 | 1.35 | 1.35 | 1.22 | 1.26 | 1.39 | 1.18 |

RUN NO.=238 S= 97.57 AQ= 8.572 DELTSUB= 39.40QC= 0.9000 T1= 21.80 T2= 27.71 TC= 75.20

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 64.2 | 60.8 | 61.7 | 64.6 | 68.8 | 72.5 | 76.5 | 80.8 | 82.7 | 82.5 | 82.5 | 82.3 | 82.9 | 82.7 | 82.5 | 83.4 |
| TL | 39.2 | 41.6 | 44.1 | 46.5 | 51.5 | 56.4 | 61.3 | 66.2 | 71.2 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.34 | 0.45 | 0.49 | 0.47 | 0.50 | 0.53 | 0.56 | 0.59 | 0.74 | 1.34 | 1.34 | 1.38 | 1.25 | 1.30 | 1.34 | 1.17 |

RUN NO.=239 S= 96.18 AQ= 14.937 DELTSUB= 9.65QC= 0.9000 T1= 21.80 T2= 43.49 TC= 66.90

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 93.1 | 99.6 | 84.3 | 83.8 | 85.6 | 84.7 | 85.8 | 83.8 | 83.6 | 83.4 | 83.8 | 85.4 | 84.9 | 86.0 | 85.1 | 86.0 |
| TL | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.64 | 0.56 | 1.83 | 1.94 | 1.58 | 1.74 | 1.54 | 1.94 | 1.99 | 2.06 | 1.94 | 1.61 | 1.70 | 1.51 | 1.66 | 1.51 |

RUN NO.=240 S= 97.57 AQ= 11.553 DELTSUB= 7.25QC= 0.9000 T1= 21.60 T2= 36.51 TC= 66.00

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 89.3 | 94.6 | 99.0 | 100.1 | 84.7 | 84.4 | 85.1 | 83.8 | 83.6 | 83.1 | 83.4 | 84.7 | 84.1 | 84.9 | 84.1 | 85.1 |
| TL | 70.2 | 71.4 | 72.6 | 73.8 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.61 | 0.50 | 0.44 | 0.44 | 1.37 | 1.41 | 1.31 | 1.53 | 1.57 | 1.67 | 1.63 | 1.37 | 1.48 | 1.34 | 1.48 | 1.31 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=241 | S= | 96.18 | AQ= | 3.775 | DELTSUB= | | 10.55QC= | 0.9000 | | T1= | 21.30 | T2= | 24.90 | TC= | 65.55 |
| TW | 75.6 | 77.6 | 78.6 | 79.2 | 80.5 | 81.4 | 83.4 | 82.9 | 82.3 | 84.3 | 82.9 | 80.5 | 80.1 | 80.1 | 79.4 | 80.1 |
| TL | 66.4 | 67.3 | 68.2 | 69.1 | 70.8 | 72.6 | 74.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.41 | 0.37 | 0.36 | 0.37 | 0.39 | 0.43 | 0.42 | 0.55 | 0.61 | 0.46 | 0.55 | 0.86 | 0.96 | 0.96 | 1.13 | 0.96 |
| RUN | NO.=242 | S= | 85.07 | AQ= | 8.603 | DELTSUB= | | 2.65QC= | 0.9000 | | T1= | 20.80 | T2= | 30.90 | TC= | 66.45 |
| TW | 87.8 | 91.2 | 94.4 | 96.1 | 96.7 | 82.5 | 82.9 | 82.1 | 82.1 | 82.1 | 82.1 | 81.8 | 81.8 | 82.3 | 82.1 | 83.1 |
| TL | 73.9 | 74.3 | 74.6 | 74.9 | 75.6 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.62 | 0.51 | 0.44 | 0.41 | 0.41 | 1.38 | 1.28 | 1.48 | 1.48 | 1.48 | 1.48 | 1.55 | 1.55 | 1.42 | 1.48 | 1.25 |
| RUN | NO.=243 | S= | 89.24 | AQ= | 5.931 | DELTSUB= | | 4.900C= | 0.9000 | | T1= | 21.30 | T2= | 27.01 | TC= | 63.50 |
| TW | 84.9 | 88.4 | 88.9 | 89.3 | 91.4 | 91.9 | 92.3 | 84.1 | 83.6 | 84.4 | 82.1 | 81.1 | 80.7 | 80.9 | 80.7 | 81.4 |
| TL | 71.8 | 72.2 | 72.6 | 73.0 | 73.8 | 74.7 | 75.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.45 | 0.37 | 0.37 | 0.36 | 0.34 | 0.35 | 0.35 | 0.76 | 0.81 | 0.73 | 1.03 | 1.22 | 1.35 | 1.28 | 1.35 | 1.16 |
| RUN | NO.=244 | S= | 75.35 | AQ= | 3.817 | DELTSUB= | | 12.85QC= | 0.9000 | | T1= | 20.35 | T2= | 24.62 | TC= | 75.40 |
| TW | 75.4 | 79.2 | 81.6 | 84.3 | 89.1 | 82.3 | 79.9 | 79.9 | 79.4 | 79.2 | 79.2 | 79.0 | 79.0 | 79.4 | 79.0 | 79.9 |
| TL | 64.9 | 66.5 | 68.1 | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.36 | 0.30 | 0.28 | 0.26 | 0.24 | 0.62 | 1.00 | 1.00 | 1.14 | 1.23 | 1.23 | 1.32 | 1.32 | 1.14 | 1.32 | 1.00 |
| RUN | NO.=245 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 32.00QC= | 0.9000 | | T1= | 21.10 | T2= | 31.73 | TC= | 69.45 |
| TW | 83.8 | 81.4 | 81.1 | 84.9 | 89.3 | 83.8 | 85.6 | 87.8 | 89.3 | 86.4 | 85.6 | 84.9 | 85.1 | 85.8 | 85.6 | 83.1 |
| TL | 46.3 | 48.3 | 50.3 | 52.3 | 56.3 | 60.3 | 64.3 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.40 | 0.45 | 0.48 | 0.46 | 0.45 | 0.64 | 0.70 | 0.77 | 0.88 | 1.47 | 1.61 | 1.74 | 1.70 | 1.57 | 1.61 | 2.18 |
| RUN | NO.=246 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | | 31.80QC= | 0.9000 | | T1= | 21.10 | T2= | 31.73 | TC= | 69.45 |
| TW | 82.9 | 80.3 | 81.1 | 85.1 | 89.1 | 83.8 | 85.4 | 88.4 | 89.5 | 86.9 | 85.6 | 85.4 | 85.4 | 85.6 | 85.6 | 83.6 |
| TL | 46.5 | 48.5 | 50.5 | 52.4 | 56.4 | 60.4 | 64.4 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.41 | 0.47 | 0.49 | 0.46 | 0.46 | 0.64 | 0.71 | 0.74 | 0.87 | 1.42 | 1.61 | 1.65 | 1.65 | 1.61 | 1.61 | 2.05 |
| RUN | NO.=247 | S= | 72.57 | AQ= | 8.603 | DELTSUB= | | 35.55QC= | 0.9000 | | T1= | 21.60 | T2= | 29.65 | TC= | 69.45 |
| TW | 70.5 | 70.5 | 74.1 | 76.8 | 83.4 | 88.6 | 95.2 | 83.8 | 82.5 | 82.3 | 82.3 | 82.1 | 82.1 | 82.9 | 82.5 | 83.8 |
| TL | 44.0 | 46.9 | 49.9 | 52.9 | 58.8 | 64.7 | 70.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.32 | 0.36 | 0.36 | 0.36 | 0.35 | 0.36 | 0.35 | 1.19 | 1.45 | 1.50 | 1.50 | 1.56 | 1.56 | 1.34 | 1.45 | 1.19 |
| RUN | NO.=248 | S= | 73.26 | AQ= | 8.603 | DELTSUB= | | 40.10QC= | 0.9000 | | T1= | 21.85 | T2= | 29.90 | TC= | 69.45 |
| TW | 65.8 | 66.4 | 70.3 | 73.4 | 80.3 | 86.9 | 94.1 | 88.8 | 82.5 | 82.1 | 81.9 | 81.6 | 81.9 | 82.5 | 82.3 | 83.6 |
| TL | 39.8 | 43.1 | 46.5 | 49.8 | 56.5 | 63.2 | 69.9 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.33 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.35 | 0.70 | 1.45 | 1.56 | 1.62 | 1.70 | 1.62 | 1.45 | 1.50 | 1.22 |
| RUN | NO.=249 | S= | 77.43 | AQ= | 5.931 | DELTSUB= | | 11.00QC= | 0.9000 | | T1= | 20.60 | T2= | 25.58 | TC= | 65.10 |
| TW | 82.3 | 83.8 | 84.3 | 85.4 | 87.9 | 89.5 | 92.7 | 94.6 | 80.9 | 80.1 | 80.1 | 79.9 | 79.9 | 80.5 | 79.9 | 80.7 |
| TL | 65.6 | 66.4 | 67.2 | 68.0 | 69.6 | 71.1 | 72.7 | 74.3 | 75.8 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 0.36 | 0.34 | 0.35 | 0.34 | 0.32 | 0.32 | 0.30 | 0.29 | 1.16 | 1.40 | 1.40 | 1.46 | 1.46 | 1.28 | 1.46 | 1.22 |
| RUN | NO.=250 | S= | 69.10 | AQ= | 5.931 | DELTSUB= | | 15.50QC= | 0.9000 | | T1= | 21.10 | T2= | 28.05 | TC= | 67.15 |
| TW | 79.6 | 81.4 | 82.5 | 84.9 | 89.5 | 85.4 | 81.4 | 80.9 | 80.7 | 80.7 | 80.7 | 80.5 | 80.5 | 81.1 | 80.7 | 81.6 |
| TL | 62.9 | 64.9 | 66.8 | 68.8 | 72.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.35 | 0.36 | 0.38 | 0.37 | 0.35 | 0.67 | 1.21 | 1.33 | 1.41 | 1.41 | 1.41 | 1.48 | 1.48 | 1.28 | 1.41 | 1.16 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=251 S= 75.35 AQ= 5.931 DELTSUB= 12.80QC= 0.9000 T1= 20.10 T2= 25.14 TC= 63.50 | | | | | | | | | | | | | | | | |
| TW | 82.5 | 83.6 | 84.1 | 85.8 | 89.1 | 91.4 | 95.2 | 98.1 | 86.2 | 80.9 | 80.7 | 80.5 | 80.7 | 80.9 | 80.9 | 81.4 |
| TL | 64.6 | 65.5 | 66.4 | 67.4 | 69.2 | 71.0 | 72.8 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.33 | 0.33 | 0.34 | 0.32 | 0.30 | 0.29 | 0.27 | 0.25 | 0.61 | 1.33 | 1.41 | 1.48 | 1.41 | 1.33 | 1.33 | 1.21 |
| RUN NO.=252 S= 78.13 AQ= 8.448 DELTSUB= 3.30QC= 0.9000 T1= 20.85 T2= 28.82 TC= 67.85 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 93.8 | 95.6 | 97.3 | 100.1 | 101.1 | 101.6 | 83.6 | 83.6 | 82.9 | 82.1 | 81.8 | 81.8 | 82.1 | 81.8 | 82.9 |
| TL | 73.5 | 73.8 | 74.0 | 74.3 | 74.9 | 75.4 | 76.0 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.49 | 0.42 | 0.39 | 0.37 | 0.34 | 0.33 | 0.33 | 1.19 | 1.19 | 1.31 | 1.52 | 1.59 | 1.59 | 1.52 | 1.59 | 1.31 |
| RUN NO.=253 S= 71.88 AQ= 11.373 DELTSUB= 2.45QC= 0.9000 T1= 21.10 T2= 37.49 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 96.5 | 101.6 | 82.3 | 82.5 | 83.4 | 82.7 | 83.8 | 85.1 | 84.3 | 83.8 | 83.6 | 83.4 | 83.4 | 84.3 | 83.6 | 84.9 |
| TL | 75.1 | 75.9 | 76.7 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| HT | 0.53 | 0.44 | 2.07 | 1.98 | 1.72 | 1.91 | 1.61 | 1.36 | 1.52 | 1.61 | 1.66 | 1.72 | 1.72 | 1.52 | 1.66 | 1.40 |
| RUN NO.=254 S= 61.46 AQ= 14.689 DELTSUB= 2.80QC= 1.8500 T1= 21.10 T2= 31.82 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 83.1 | 82.5 | 82.5 | 82.9 | 84.0 | 83.6 | 84.9 | 85.6 | 85.1 | 85.1 | 84.9 | 84.6 | 84.6 | 85.8 | 84.9 | 86.6 |
| TL | 75.1 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.82 | 2.44 | 2.45 | 2.28 | 1.96 | 2.07 | 1.75 | 1.62 | 1.71 | 1.71 | 1.75 | 1.80 | 1.80 | 1.59 | 1.75 | 1.45 |
| RUN NO.=255 S= 66.32 AQ= 8.572 DELTSUB= 7.05QC= 0.9000 T1= 22.35 T2= 32.33 TC= 68.30 | | | | | | | | | | | | | | | | |
| TW | 92.7 | 95.0 | 94.6 | 93.6 | 97.8 | 83.8 | 83.4 | 82.7 | 82.3 | 82.3 | 82.1 | 82.3 | 82.3 | 82.7 | 82.3 | 83.4 |
| TL | 70.3 | 71.2 | 72.1 | 73.0 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.38 | 0.36 | 0.38 | 0.42 | 0.37 | 1.17 | 1.25 | 1.38 | 1.49 | 1.49 | 1.54 | 1.49 | 1.49 | 1.38 | 1.49 | 1.25 |
| RUN NO.=256 S= 60.07 AQ= 11.445 DELTSUB= 4.90QC= 0.9000 T1= 21.80 T2= 35.05 TC= 69.45 | | | | | | | | | | | | | | | | |
| TW | 82.3 | 82.5 | 82.9 | 83.1 | 84.7 | 84.1 | 82.9 | 82.7 | 82.3 | 82.1 | 82.1 | 82.5 | 82.3 | 82.3 | 83.4 | 84.9 |
| TL | 72.2 | 72.8 | 73.4 | 74.0 | 75.3 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.13 | 1.18 | 1.20 | 1.26 | 1.21 | 1.52 | 1.77 | 1.85 | 1.97 | 2.06 | 2.06 | 1.91 | 1.97 | 1.97 | 1.67 | 1.36 |
| RUN NO.=257 S= 55.21 AQ= 14.854 DELTSUB= 3.55QC= 0.9000 T1= 21.80 T2= 39.02 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 83.6 | 84.1 | 84.3 | 84.4 | 86.4 | 85.8 | 83.8 | 84.1 | 83.4 | 83.4 | 83.4 | 83.6 | 83.8 | 83.6 | 85.1 | 86.6 |
| TL | 73.4 | 73.8 | 74.3 | 74.7 | 75.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.46 | 1.45 | 1.49 | 1.53 | 1.37 | 1.60 | 2.03 | 1.97 | 2.17 | 2.17 | 2.17 | 2.09 | 2.03 | 2.09 | 1.73 | 1.46 |
| RUN NO.=258 S= 53.82 AQ= 5.957 DELTSUB= 6.65QC= 0.9000 T1= 21.60 T2= 30.31 TC= 72.05 | | | | | | | | | | | | | | | | |
| TW | 84.1 | 81.1 | 80.5 | 79.9 | 80.1 | 79.9 | 79.9 | 80.1 | 79.7 | 79.7 | 79.4 | 79.4 | 79.2 | 79.4 | 79.4 | 80.5 |
| TL | 72.1 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.50 | 1.03 | 1.17 | 1.32 | 1.27 | 1.32 | 1.32 | 1.27 | 1.39 | 1.39 | 1.47 | 1.47 | 1.57 | 1.47 | 1.47 | 1.17 |
| RUN NO.=259 S= 52.43 AQ= 11.517 DELTSUB= 8.40QC= 0.9000 T1= 21.80 T2= 36.42 TC= 69.20 | | | | | | | | | | | | | | | | |
| TW | 81.6 | 83.6 | 87.9 | 88.4 | 84.1 | 82.7 | 82.5 | 82.9 | 82.7 | 82.9 | 82.7 | 82.7 | 82.1 | 82.1 | 82.7 | 81.8 |
| TL | 69.3 | 70.7 | 72.1 | 73.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.94 | 0.89 | 0.72 | 0.77 | 1.48 | 1.79 | 1.84 | 1.72 | 1.79 | 1.72 | 1.79 | 1.79 | 1.99 | 1.99 | 1.79 | 2.08 |
| RUN NO.=260 S= 55.21 AQ= 8.634 DELTSUB= 44.45QC= 0.9000 T1= 21.35 T2= 31.31 TC= 69.90 | | | | | | | | | | | | | | | | |
| TW | 63.5 | 71.2 | 77.4 | 84.3 | 90.8 | 81.6 | 82.1 | 82.1 | 81.9 | 81.6 | 81.9 | 81.9 | 81.9 | 82.5 | 82.5 | 82.3 |
| TL | 37.4 | 43.0 | 48.5 | 54.1 | 65.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.33 | 0.31 | 0.30 | 0.29 | 0.34 | 1.62 | 1.50 | 1.50 | 1.56 | 1.63 | 1.56 | 1.56 | 1.56 | 1.39 | 1.39 | 1.44 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=261 | S= | 50.35 | AQ= | 8.479 | DELTSUB= | | 4.65QC= | 0.9000 | | T1= | 20.60 | | T2= | 32.81 | TC= 67.85 |
| TW | 82.3 | 84.9 | 81.8 | 80.9 | 81.4 | 80.9 | 80.9 | 81.1 | 80.9 | 80.7 | 80.7 | 80.7 | 80.2 | 80.2 | 80.7 | 82.1 |
| TL | 72.3 | 73.9 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.85 | 0.77 | 1.32 | 1.53 | 1.41 | 1.53 | 1.53 | 1.47 | 1.53 | 1.60 | 1.60 | 1.60 | 1.77 | 1.77 | 1.60 | 1.28 |
| RUN | NO.=262 | S= | 48.26 | AQ= | 14.854 | DELTSUB= | | 6.85QC= | 0.9000 | | T1= | 21.35 | | T2= | 41.86 | TC= 69.20 |
| TW | 83.1 | 85.4 | 89.1 | 87.5 | 84.9 | 84.1 | 84.1 | 84.3 | 84.4 | 84.3 | 84.4 | 84.3 | 83.6 | 83.1 | 84.1 | 82.3 |
| TL | 71.1 | 72.8 | 74.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.23 | 1.19 | 1.02 | 1.32 | 1.72 | 1.90 | 1.90 | 1.86 | 1.81 | 1.86 | 1.81 | 1.86 | 2.02 | 2.15 | 1.90 | 2.46 |
| RUN | NO.=263 | S= | 44.79 | AQ= | 18.800 | DELTSUB= | | 6.00QC= | 1.8500 | | T1= | 21.35 | | T2= | 34.05 | TC= 68.05 |
| TW | 84.3 | 86.4 | 89.3 | 87.9 | 86.4 | 85.6 | 85.8 | 85.8 | 85.8 | 85.6 | 85.8 | 85.6 | 84.7 | 84.7 | 85.1 | 82.9 |
| TL | 71.7 | 73.2 | 74.7 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.50 | 1.42 | 1.29 | 1.61 | 1.84 | 2.02 | 1.97 | 1.97 | 1.97 | 2.02 | 1.97 | 2.02 | 2.22 | 2.22 | 2.12 | 2.83 |
| RUN | NO.=264 | S= | 38.54 | AQ= | 18.800 | DELTSUB= | | 8.00QC= | 1.8500 | | T1= | 20.35 | | T2= | 33.56 | TC= 67.40 |
| TW | 84.3 | 86.9 | 86.4 | 85.4 | 85.4 | 84.4 | 85.1 | 85.1 | 84.9 | 84.9 | 84.9 | 84.7 | 84.3 | 83.8 | 84.4 | 82.3 |
| TL | 70.3 | 72.9 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 |
| HT | 1.34 | 1.35 | 1.73 | 1.93 | 1.93 | 2.12 | 1.98 | 1.98 | 2.02 | 2.02 | 2.02 | 2.07 | 2.17 | 2.29 | 2.12 | 2.81 |
| RUN | NO.=265 | S= | 33.68 | AQ= | 18.800 | DELTSUB= | | 18.55QC= | 1.9500 | | T1= | 20.60 | | T2= | 32.58 | TC= 69.00 |
| TW | 82.3 | 85.6 | 85.8 | 85.1 | 85.1 | 84.7 | 85.4 | 85.8 | 85.8 | 85.8 | 86.0 | 85.6 | 85.1 | 84.7 | 85.6 | 83.1 |
| TL | 62.1 | 66.8 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.93 | 1.00 | 1.31 | 2.08 | 2.08 | 2.17 | 2.02 | 1.93 | 1.93 | 1.93 | 1.89 | 1.98 | 2.08 | 2.17 | 1.98 | 2.65 |
| RUN | NO.=266 | S= | 28.13 | AQ= | 18.800 | DELTSUB= | | 11.45QC= | 1.8500 | | T1= | 20.35 | | T2= | 33.46 | TC= 69.20 |
| TW | 83.6 | 84.9 | 84.7 | 84.4 | 84.9 | 84.7 | 84.9 | 85.4 | 85.4 | 85.4 | 85.4 | 85.1 | 83.4 | 83.8 | 84.9 | 129.8 |
| TL | 68.2 | 72.1 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 1.22 | 1.46 | 2.12 | 2.19 | 2.08 | 2.12 | 2.08 | 1.98 | 1.98 | 1.98 | 1.98 | 2.03 | 2.51 | 2.36 | 2.08 | 0.35 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=151 S= 73.26 AQ= 15.638 DELTSUB= 14.35QC= 0.9000 T1= 20.60 T2= 34.14 TC= 48.90 | | | | | | | | | | | | | | | | |
| TW | 97.9 | 100.9 | 102.4 | 102.0 | 106.0 | 108.1 | 111.7 | 112.9 | 103.6 | 102.4 | 102.0 | 102.0 | 102.0 | 102.4 | 102.4 | 102.8 |
| TL | 84.8 | 85.8 | 86.9 | 87.9 | 89.9 | 92.0 | 94.0 | 96.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 | 98.1 |
| HT | 1.19 | 1.04 | 1.01 | 1.11 | 0.97 | 0.97 | 0.89 | 0.93 | 2.84 | 3.68 | 4.06 | 4.06 | 4.06 | 3.68 | 3.68 | 3.36 |
| RUN NO.=152 S= 73.96 AQ= 15.638 DELTSUB= 62.25QC= 0.9000 T1= 20.10 T2= 33.65 TC= 48.20 | | | | | | | | | | | | | | | | |
| TW | 60.3 | 65.8 | 69.4 | 73.6 | 83.1 | 90.8 | 100.3 | 109.4 | 103.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.4 | 102.8 | 102.6 |
| TL | 39.9 | 44.4 | 48.8 | 53.3 | 62.2 | 71.1 | 79.9 | 88.8 | 97.7 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 |
| HT | 0.77 | 0.73 | 0.76 | 0.77 | 0.75 | 0.79 | 0.77 | 0.76 | 2.73 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.10 | 3.22 |
| SYSTEM-ACETONE | | | | | | | | | | | | | | | | |
| RUN NO.=153 S= 89.24 AQ= 8.355 DELTSUB= 6.75QC= 0.9000 T1= 23.55 T2= 28.48 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 70.1 | 73.9 | 75.9 | 76.3 | 75.4 | 74.9 | 76.6 | 78.1 | 78.8 | 79.9 | 62.1 | 61.4 | 61.2 | 62.1 | 61.4 | 62.6 |
| TL | 50.0 | 50.4 | 50.8 | 51.2 | 51.9 | 52.7 | 53.4 | 54.2 | 54.9 | 55.7 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.42 | 0.36 | 0.33 | 0.33 | 0.36 | 0.37 | 0.36 | 0.35 | 0.35 | 0.34 | 1.47 | 1.65 | 1.74 | 1.47 | 1.65 | 1.35 |
| RUN NO.=154 S= 93.40 AQ= 8.355 DELTSUB= 14.20QC= 0.9000 T1= 23.80 T2= 28.73 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 63.7 | 65.6 | 64.9 | 64.4 | 66.4 | 68.3 | 70.5 | 72.3 | 73.9 | 75.6 | 64.4 | 62.8 | 62.1 | 62.3 | 61.7 | 63.0 |
| TL | 43.2 | 44.0 | 44.8 | 45.6 | 47.1 | 48.7 | 50.3 | 51.9 | 53.4 | 55.0 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.41 | 0.39 | 0.42 | 0.44 | 0.43 | 0.43 | 0.41 | 0.41 | 0.41 | 0.41 | 1.07 | 1.35 | 1.52 | 1.45 | 1.65 | 1.31 |
| RUN NO.=155 S= 93.40 AQ= 11.228 DELTSUB= 10.65QC= 0.9000 T1= 23.30 T2= 29.93 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 71.1 | 76.1 | 77.9 | 78.3 | 77.9 | 77.6 | 80.1 | 81.8 | 82.9 | 84.0 | 64.4 | 64.6 | 63.7 | 63.9 | 63.3 | 64.6 |
| TL | 46.3 | 46.9 | 47.5 | 48.1 | 49.3 | 50.5 | 51.7 | 52.9 | 54.0 | 55.2 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.45 | 0.38 | 0.37 | 0.37 | 0.39 | 0.41 | 0.40 | 0.39 | 0.39 | 0.39 | 1.40 | 1.37 | 1.54 | 1.49 | 1.64 | 1.37 |
| RUN NO.=156 S= 93.40 AQ= 11.228 DELTSUB= 10.35QC= 0.9000 T1= 23.30 T2= 29.92 TC= 52.65 | | | | | | | | | | | | | | | | |
| TW | 70.9 | 76.5 | 78.6 | 79.9 | 79.2 | 78.3 | 80.1 | 82.5 | 83.8 | 85.3 | 64.6 | 64.1 | 63.9 | 64.1 | 63.3 | 64.9 |
| TL | 46.8 | 47.4 | 48.0 | 48.6 | 49.7 | 50.9 | 52.0 | 53.2 | 54.3 | 55.5 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.47 | 0.39 | 0.37 | 0.36 | 0.38 | 0.41 | 0.40 | 0.38 | 0.38 | 0.38 | 1.40 | 1.49 | 1.53 | 1.49 | 1.69 | 1.36 |
| RUN NO.=157 S= 99.65 AQ= 8.355 DELTSUB= 17.70QC= 0.9000 T1= 23.05 T2= 27.97 TC= 52.70 | | | | | | | | | | | | | | | | |
| TW | 60.5 | 61.4 | 61.0 | 60.3 | 63.5 | 65.8 | 67.4 | 69.7 | 71.2 | 72.9 | 70.7 | 65.3 | 65.1 | 63.0 | 61.9 | 63.0 |
| TL | 39.9 | 40.9 | 41.8 | 42.8 | 44.8 | 46.8 | 48.7 | 50.7 | 52.7 | 54.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.41 | 0.41 | 0.44 | 0.48 | 0.45 | 0.44 | 0.45 | 0.44 | 0.45 | 0.46 | 0.59 | 0.96 | 0.98 | 1.31 | 1.58 | 1.31 |
| RUN NO.=158 S= 96.88 AQ= 8.294 DELTSUB= 11.05QC= 0.9000 T1= 22.30 T2= 31.67 TC= 53.35 | | | | | | | | | | | | | | | | |
| TW | 64.6 | 66.7 | 67.9 | 68.5 | 70.5 | 63.7 | 63.5 | 62.6 | 62.3 | 62.1 | 61.9 | 62.1 | 62.3 | 61.7 | 61.9 | 62.3 |
| TL | 46.7 | 48.1 | 49.4 | 50.8 | 53.6 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 | 56.3 |
| HT | 0.46 | 0.44 | 0.45 | 0.47 | 0.49 | 1.13 | 1.16 | 1.33 | 1.38 | 1.44 | 1.49 | 1.44 | 1.38 | 1.56 | 1.49 | 1.38 |
| RUN NO.=159 S= 82.29 AQ= 8.108 DELTSUB= 1.65QC= 0.9000 T1= 21.60 T2= 31.73 TC= 51.50 | | | | | | | | | | | | | | | | |
| TW | 68.8 | 71.9 | 74.1 | 76.1 | 74.8 | 64.2 | 64.4 | 63.9 | 63.3 | 62.8 | 61.7 | 61.4 | 61.4 | 61.2 | 61.4 | 62.1 |
| TL | 55.0 | 55.3 | 55.6 | 55.8 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.59 | 0.49 | 0.44 | 0.40 | 0.44 | 1.04 | 1.01 | 1.07 | 1.18 | 1.27 | 1.54 | 1.61 | 1.61 | 1.69 | 1.61 | 1.42 |
| RUN NO.=160 S= 79.51 AQ= 8.108 DELTSUB= 1.40QC= 0.9000 T1= 22.10 T2= 32.18 TC= 53.15 | | | | | | | | | | | | | | | | |
| TW | 69.4 | 73.2 | 75.4 | 77.4 | 72.8 | 64.6 | 64.6 | 64.4 | 63.5 | 62.8 | 62.3 | 62.1 | 61.9 | 61.7 | 62.3 | 62.8 |
| TL | 55.7 | 55.9 | 56.2 | 56.4 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 |
| HT | 0.59 | 0.47 | 0.42 | 0.39 | 0.51 | 1.05 | 1.05 | 1.07 | 1.22 | 1.36 | 1.47 | 1.54 | 1.61 | 1.69 | 1.47 | 1.36 |

RUN NO.=161 S= 96.88 AQ= 3.714 DELTSUB= 2.80QC= 0.9000 T1= 19.60 T2= 22.17 TC= 53.60

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 60.1 | 62.1 | 62.8 | 63.5 | 65.6 | 66.0 | 66.7 | 67.4 | 68.3 | 61.2 | 60.5 | 59.8 | 59.6 | 59.6 | 59.3 | 59.6 |
| TL | 53.1 | 53.2 | 53.4 | 53.6 | 53.9 | 54.3 | 54.6 | 55.0 | 55.3 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 |
| HT | 0.53 | 0.42 | 0.40 | 0.38 | 0.32 | 0.32 | 0.31 | 0.30 | 0.29 | 0.67 | 0.77 | 0.89 | 0.95 | 0.95 | 1.02 | 0.95 |

RUN NO.=162 S= 90.63 AQ= 5.802 DELTSUB= 1.10QC= 0.9000 T1= 20.80 T2= 25.52 TC= 51.30

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 64.4 | 66.9 | 69.4 | 71.4 | 75.4 | 76.9 | 78.3 | 79.0 | 78.6 | 62.6 | 61.6 | 61.2 | 61.2 | 61.4 | 61.2 | 61.6 |
| TL | 55.8 | 55.9 | 55.9 | 56.0 | 56.2 | 56.3 | 56.5 | 56.6 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 | 56.8 |
| HT | 0.67 | 0.53 | 0.43 | 0.38 | 0.30 | 0.28 | 0.27 | 0.26 | 0.27 | 1.00 | 1.21 | 1.32 | 1.32 | 1.26 | 1.32 | 1.21 |

RUN NO.=163 S= 73.96 AQ= 3.548 DELTSUB= 1.40QC= 0.9000 T1= 19.85 T2= 24.29 TC= 51.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 65.8 | 67.4 | 67.6 | 67.9 | 61.4 | 60.3 | 60.3 | 60.1 | 59.6 | 59.6 | 59.6 | 59.3 | 59.3 | 59.6 | 59.6 | 59.8 |
| TL | 55.0 | 55.2 | 55.5 | 55.7 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.33 | 0.29 | 0.29 | 0.29 | 0.67 | 0.86 | 0.86 | 0.91 | 1.03 | 1.03 | 1.03 | 1.11 | 1.11 | 1.03 | 1.03 | 0.96 |

RUN NO.=164 S= 74.65 AQ= 5.673 DELTSUB= 2.10QC= 0.9000 T1= 20.10 T2= 27.16 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 68.1 | 70.9 | 71.9 | 72.1 | 63.0 | 62.8 | 62.3 | 61.7 | 61.2 | 61.0 | 61.0 | 60.6 | 60.6 | 60.6 | 60.8 | 61.2 |
| TL | 54.7 | 55.0 | 55.4 | 55.7 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.42 | 0.36 | 0.34 | 0.35 | 0.86 | 0.89 | 0.95 | 1.08 | 1.18 | 1.23 | 1.23 | 1.37 | 1.37 | 1.37 | 1.30 | 1.18 |

RUN NO.=165 S= 76.04 AQ= 8.232 DELTSUB= 1.65QC= 0.9000 T1= 20.10 T2= 30.34 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 70.3 | 73.6 | 75.6 | 76.9 | 63.7 | 63.7 | 64.4 | 63.7 | 62.8 | 62.3 | 62.1 | 61.9 | 61.7 | 61.4 | 61.9 | 62.8 |
| TL | 55.0 | 55.3 | 55.6 | 55.8 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.54 | 0.45 | 0.41 | 0.39 | 1.13 | 1.13 | 1.03 | 1.13 | 1.29 | 1.38 | 1.44 | 1.50 | 1.55 | 1.63 | 1.50 | 1.29 |

RUN NO.=166 S= 71.18 AQ= 11.120 DELTSUB= 1.40QC= 0.9000 T1= 20.35 T2= 34.26 TC= 51.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 72.1 | 76.9 | 80.9 | 82.9 | 63.7 | 63.9 | 64.9 | 64.1 | 63.5 | 63.0 | 62.8 | 62.3 | 62.3 | 62.1 | 62.8 | 63.9 |
| TL | 55.0 | 55.2 | 55.5 | 55.7 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.65 | 0.51 | 0.44 | 0.41 | 1.47 | 1.43 | 1.28 | 1.39 | 1.51 | 1.62 | 1.67 | 1.79 | 1.79 | 1.87 | 1.67 | 1.43 |

RUN NO.=167 S= 73.26 AQ= 8.294 DELTSUB= 26.70QC= 0.9000 T1= 22.55 T2= 30.13 TC= 53.10

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 53.8 | 53.1 | 56.2 | 57.8 | 60.8 | 62.8 | 66.4 | 63.0 | 62.3 | 61.9 | 61.9 | 61.7 | 61.7 | 62.1 | 61.9 | 62.8 |
| TL | 31.9 | 34.1 | 36.4 | 38.6 | 43.0 | 47.5 | 51.9 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.38 | 0.44 | 0.42 | 0.43 | 0.47 | 0.54 | 0.57 | 1.26 | 1.39 | 1.51 | 1.51 | 1.58 | 1.58 | 1.46 | 1.51 | 1.30 |

RUN NO.=168 S= 68.40 AQ= 8.355 DELTSUB= 18.50QC= 0.9000 T1= 21.80 T2= 30.36 TC= 52.45

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 59.6 | 60.5 | 61.9 | 61.0 | 65.1 | 68.5 | 62.8 | 61.9 | 61.9 | 61.4 | 61.4 | 61.4 | 61.4 | 61.9 | 61.4 | 62.3 |
| TL | 39.5 | 41.3 | 43.2 | 45.0 | 48.7 | 52.4 | 56.1 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.42 | 0.44 | 0.45 | 0.52 | 0.51 | 0.52 | 1.25 | 1.45 | 1.45 | 1.58 | 1.58 | 1.58 | 1.58 | 1.45 | 1.58 | 1.35 |

RUN NO.=169 S= 76.04 AQ= 8.294 DELTSUB= 0.95QC= 0.9000 T1= 21.60 T2= 31.01 TC= 52.20

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 69.2 | 72.1 | 74.5 | 76.8 | 81.7 | 63.5 | 62.3 | 62.1 | 61.7 | 61.4 | 61.2 | 61.4 | 61.2 | 61.2 | 61.7 | 62.1 |
| TL | 55.3 | 55.4 | 55.6 | 55.7 | 55.9 | 56.1 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.60 | 0.50 | 0.44 | 0.39 | 0.32 | 1.13 | 1.34 | 1.39 | 1.51 | 1.56 | 1.64 | 1.56 | 1.64 | 1.64 | 1.51 | 1.39 |

RUN NO.=170 S= 73.96 AQ= 11.228 DELTSUB= 20.90QC= 0.9000 T1= 22.80 T2= 33.06 TC= 53.35

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 66.9 | 63.7 | 63.0 | 61.0 | 63.3 | 64.6 | 69.3 | 66.0 | 64.2 | 63.3 | 63.3 | 63.3 | 63.3 | 63.7 | 63.7 | 64.9 |
| TL | 37.4 | 39.2 | 40.9 | 42.7 | 46.1 | 49.6 | 53.1 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.38 | 0.46 | 0.51 | 0.61 | 0.66 | 0.75 | 0.70 | 1.19 | 1.48 | 1.69 | 1.69 | 1.69 | 1.69 | 1.58 | 1.58 | 1.36 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=171 S= 73.26 AQ= 14.483 DELTSUB= 14.90QC= 0.9000 T1= 23.10 T2= 36.34 TC= 53.35 | | | | | | | | | | | | | | | | |
| TW | 78.6 | 79.2 | 76.3 | 63.7 | 66.0 | 68.1 | 70.3 | 67.9 | 65.8 | 64.6 | 64.9 | 64.9 | 65.1 | 65.5 | 65.5 | 66.7 |
| TL | 42.9 | 44.2 | 45.4 | 46.7 | 49.2 | 51.6 | 54.1 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.41 | 0.41 | 0.47 | 0.85 | 0.86 | 0.88 | 0.90 | 1.29 | 1.58 | 1.81 | 1.76 | 1.76 | 1.70 | 1.63 | 1.63 | 1.43 |
| RUN NO.=172 S= 80.21 AQ= 14.524 DELTSUB= 7.50QC= 0.9000 T1= 23.80 T2= 43.42 TC= 52.90 | | | | | | | | | | | | | | | | |
| TW | 76.5 | 83.8 | 87.3 | 64.1 | 64.6 | 63.5 | 63.7 | 63.5 | 63.5 | 63.7 | 64.4 | 64.1 | 64.4 | 64.8 | 64.4 | 66.0 |
| TL | 50.8 | 52.7 | 54.5 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.56 | 0.47 | 0.44 | 1.87 | 1.77 | 2.05 | 1.99 | 2.05 | 2.05 | 1.99 | 1.82 | 1.87 | 1.82 | 1.73 | 1.82 | 1.51 |
| RUN NO.=173 S= 59.38 AQ= 10.831 DELTSUB= 3.10QC= 2.8000 T1= 20.60 T2= 24.48 TC= 57.00 | | | | | | | | | | | | | | | | |
| TW | 63.7 | 63.2 | 63.9 | 63.9 | 65.3 | 64.1 | 63.9 | 63.9 | 63.9 | 63.9 | 63.9 | 63.7 | 64.1 | 64.3 | 63.7 | 65.3 |
| TL | 54.3 | 54.7 | 55.1 | 55.4 | 56.2 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 |
| HT | 1.15 | 1.27 | 1.23 | 1.28 | 1.20 | 1.52 | 1.57 | 1.57 | 1.57 | 1.57 | 1.57 | 1.62 | 1.53 | 1.48 | 1.62 | 1.31 |
| RUN NO.=174 S= 60.07 AQ= 11.053 DELTSUB= 3.50QC= 2.8000 T1= 19.60 T2= 23.94 TC= 56.40 | | | | | | | | | | | | | | | | |
| TW | 78.6 | 84.0 | 85.1 | 85.3 | 72.9 | 63.7 | 62.8 | 62.8 | 62.8 | 63.0 | 63.0 | 63.0 | 63.0 | 63.5 | 63.5 | 64.9 |
| TL | 53.5 | 54.1 | 54.6 | 55.2 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.44 | 0.37 | 0.36 | 0.37 | 0.67 | 1.51 | 1.73 | 1.73 | 1.73 | 1.67 | 1.67 | 1.67 | 1.67 | 1.56 | 1.56 | 1.31 |
| RUN NO.=175 S= 78.82 AQ= 8.355 DELTSUB= 0.90QC= 0.9000 T1= 21.10 T2= 28.78 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 68.1 | 71.6 | 73.9 | 75.2 | 78.1 | 80.7 | 83.8 | 76.1 | 62.8 | 62.3 | 62.3 | 62.1 | 62.1 | 62.6 | 62.1 | 63.0 |
| TL | 55.8 | 55.9 | 55.9 | 56.0 | 56.2 | 56.3 | 56.5 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.68 | 0.53 | 0.47 | 0.44 | 0.38 | 0.34 | 0.31 | 0.43 | 1.35 | 1.45 | 1.45 | 1.52 | 1.52 | 1.39 | 1.52 | 1.31 |
| RUN NO.=176 S= 68.40 AQ= 11.228 DELTSUB= 0.90QC= 1.4000 T1= 21.10 T2= 30.89 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 74.1 | 78.6 | 80.9 | 65.1 | 64.9 | 63.9 | 63.9 | 63.9 | 63.7 | 63.3 | 63.3 | 63.3 | 63.5 | 64.2 | 63.7 | 64.9 |
| TL | 55.9 | 56.2 | 56.4 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.62 | 0.50 | 0.46 | 1.32 | 1.35 | 1.53 | 1.53 | 1.53 | 1.58 | 1.69 | 1.69 | 1.69 | 1.63 | 1.48 | 1.58 | 1.35 |
| RUN NO.=177 S= 59.38 AQ= 14.483 DELTSUB= 0.90QC= 1.4000 T1= 21.10 T2= 34.70 TC= 53.00 | | | | | | | | | | | | | | | | |
| TW | 71.0 | 63.9 | 63.5 | 65.8 | 66.0 | 65.1 | 64.4 | 64.6 | 64.6 | 63.7 | 64.2 | 64.2 | 64.4 | 65.1 | 64.6 | 66.0 |
| TL | 56.2 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.98 | 1.97 | 2.10 | 1.57 | 1.54 | 1.70 | 1.86 | 1.81 | 1.81 | 2.04 | 1.91 | 1.91 | 1.86 | 1.70 | 1.81 | 1.54 |
| RUN NO.=178 S= 55.21 AQ= 14.483 DELTSUB= 0.95QC= 1.8500 T1= 20.35 T2= 30.68 TC= 52.00 | | | | | | | | | | | | | | | | |
| TW | 74.3 | 63.5 | 64.6 | 63.7 | 66.0 | 65.3 | 65.1 | 65.1 | 64.9 | 64.6 | 64.4 | 64.4 | 64.6 | 64.4 | 64.6 | 66.0 |
| TL | 55.9 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 0.79 | 2.04 | 1.77 | 1.98 | 1.51 | 1.63 | 1.66 | 1.66 | 1.71 | 1.77 | 1.81 | 1.81 | 1.77 | 1.81 | 1.77 | 1.51 |
| RUN NO.=179 S= 53.82 AQ= 11.192 DELTSUB= 1.90QC= 1.8500 T1= 20.35 T2= 27.75 TC= 51.05 | | | | | | | | | | | | | | | | |
| TW | 63.1 | 62.3 | 63.7 | 62.8 | 63.9 | 63.5 | 63.5 | 63.5 | 63.5 | 63.3 | 63.3 | 63.3 | 63.1 | 62.8 | 63.3 | 64.1 |
| TL | 54.5 | 55.0 | 55.5 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 | 55.9 |
| HT | 1.31 | 1.52 | 1.36 | 1.63 | 1.41 | 1.48 | 1.48 | 1.48 | 1.48 | 1.53 | 1.53 | 1.53 | 1.58 | 1.63 | 1.53 | 1.36 |
| RUN NO.=180 S= 52.43 AQ= 8.170 DELTSUB= 1.65QC= 0.9000 T1= 20.35 T2= 29.65 TC= 51.75 | | | | | | | | | | | | | | | | |
| TW | 63.1 | 62.1 | 61.9 | 61.4 | 62.3 | 62.1 | 62.1 | 62.1 | 61.9 | 61.9 | 61.9 | 61.9 | 61.7 | 61.9 | 61.7 | 62.8 |
| TL | 55.0 | 55.2 | 55.4 | 55.6 | 56.0 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 1.01 | 1.18 | 1.25 | 1.39 | 1.28 | 1.43 | 1.43 | 1.43 | 1.49 | 1.49 | 1.49 | 1.49 | 1.54 | 1.49 | 1.54 | 1.28 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=181 | S= 44.10 | AQ= 14.483 | DELTSUB= 1.65QC= 1.8500 | T1= 20.80 | T2= 30.33 | TC= 52.70 | | | | | | | | | | |
| TW | 64.9 | 65.1 | 65.3 | 64.1 | 64.9 | 64.6 | 64.6 | 64.9 | 64.9 | 64.6 | 64.6 | 64.6 | 64.6 | 64.6 | 64.9 | 66.7 |
| TL | 55.2 | 55.6 | 56.0 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 | 56.4 |
| HT | 1.50 | 1.52 | 1.56 | 1.87 | 1.71 | 1.77 | 1.77 | 1.71 | 1.71 | 1.77 | 1.77 | 1.77 | 1.77 | 1.77 | 1.71 | 1.41 |
| RUN NO.=182 | S= 48.96 | AQ= 8.170 | DELTSUB= 16.80QC= 0.9000 | T1= 21.60 | T2= 28.18 | TC= 53.15 | | | | | | | | | | |
| TW | 60.6 | 62.1 | 61.9 | 61.4 | 62.3 | 62.3 | 62.3 | 62.6 | 62.1 | 62.1 | 62.1 | 62.1 | 62.1 | 62.3 | 62.3 | 63.5 |
| TL | 41.0 | 42.2 | 43.4 | 44.6 | 47.0 | 49.4 | 51.8 | 54.2 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 |
| HT | 0.42 | 0.41 | 0.44 | 0.48 | 0.53 | 0.63 | 0.77 | 0.98 | 1.48 | 1.49 | 1.49 | 1.49 | 1.49 | 1.42 | 1.42 | 1.18 |
| RUN NO.=183 | S= 55.90 | AQ= 8.355 | DELTSUB= 25.25QC= 0.9000 | T1= 22.05 | T2= 33.32 | TC= 52.90 | | | | | | | | | | |
| TW | 58.0 | 62.8 | 67.6 | 61.4 | 62.1 | 61.4 | 61.7 | 61.7 | 61.4 | 61.2 | 61.4 | 61.4 | 61.4 | 61.7 | 61.4 | 62.6 |
| TL | 37.2 | 43.5 | 49.8 | 56.1 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.40 | 0.43 | 0.47 | 1.57 | 1.40 | 1.58 | 1.51 | 1.51 | 1.58 | 1.65 | 1.58 | 1.58 | 1.58 | 1.51 | 1.58 | 1.30 |
| RUN NO.=184 | S= 54.51 | AQ= 5.699 | DELTSUB= 1.40QC= 0.9000 | T1= 20.10 | T2= 28.31 | TC= 55.70 | | | | | | | | | | |
| TW | 61.2 | 60.8 | 60.3 | 60.1 | 61.0 | 60.8 | 60.8 | 61.0 | 60.8 | 60.6 | 60.6 | 60.6 | 60.6 | 60.6 | 60.8 | 61.4 |
| TL | 55.5 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 | 56.2 |
| HT | 0.99 | 1.24 | 1.37 | 1.46 | 1.18 | 1.24 | 1.24 | 1.18 | 1.24 | 1.30 | 1.30 | 1.30 | 1.30 | 1.30 | 1.24 | 1.08 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=185 | S= 97.57 | AQ= 7.798 | DELTSUB= 31.45QC= 0.9000 | T1= 20.10 | T2= 28.20 | TC= 52.70 | | | | | | | | | | |
| TW | 78.1 | 84.7 | 86.9 | 89.9 | 90.6 | 89.9 | 94.4 | 90.3 | 91.4 | 90.1 | 90.1 | 89.7 | 90.8 | 89.7 | 89.0 | 89.7 |
| TL | 53.7 | 56.3 | 58.9 | 61.5 | 66.8 | 72.0 | 77.3 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.32 | 0.27 | 0.28 | 0.27 | 0.33 | 0.44 | 0.46 | 1.00 | 0.88 | 1.03 | 1.03 | 1.08 | 0.95 | 1.08 | 1.20 | 1.08 |
| RUN NO.=186 | S= 83.68 | AQ= 7.767 | DELTSUB= 3.00QC= 0.9000 | T1= 20.25 | T2= 28.49 | TC= 47.90 | | | | | | | | | | |
| TW | 88.2 | 88.6 | 88.6 | 90.1 | 91.6 | 92.4 | 94.0 | 91.8 | 91.2 | 89.9 | 88.8 | 88.2 | 88.2 | 88.8 | 88.2 | 89.5 |
| TL | 79.8 | 80.0 | 80.3 | 80.5 | 81.0 | 81.5 | 82.0 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.92 | 0.90 | 0.93 | 0.81 | 0.73 | 0.71 | 0.65 | 0.84 | 0.89 | 1.05 | 1.23 | 1.36 | 1.36 | 1.23 | 1.36 | 1.11 |
| RUN NO.=187 | S= 90.63 | AQ= 5.390 | DELTSUB= 5.10QC= 0.9000 | T1= 20.05 | T2= 25.87 | TC= 43.60 | | | | | | | | | | |
| TW | 88.8 | 88.8 | 89.5 | 90.1 | 91.4 | 92.4 | 94.8 | 91.6 | 91.6 | 89.7 | 88.2 | 87.1 | 86.9 | 87.3 | 86.9 | 87.8 |
| TL | 77.8 | 78.2 | 78.7 | 79.1 | 79.9 | 80.8 | 81.6 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.49 | 0.51 | 0.50 | 0.49 | 0.47 | 0.46 | 0.41 | 0.59 | 0.59 | 0.75 | 0.95 | 1.18 | 1.24 | 1.13 | 1.24 | 1.02 |
| RUN NO.=188 | S= 93.40 | AQ= 3.342 | DELTSUB= 4.00QC= 0.9000 | T1= 19.60 | T2= 23.09 | TC= 51.05 | | | | | | | | | | |
| TW | 86.9 | 90.1 | 90.4 | 91.0 | 92.5 | 92.1 | 93.8 | 91.2 | 90.8 | 88.2 | 86.6 | 85.6 | 85.6 | 85.8 | 85.4 | 85.8 |
| TL | 78.4 | 78.8 | 79.1 | 79.4 | 80.1 | 80.8 | 81.4 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 |
| HT | 0.40 | 0.29 | 0.30 | 0.29 | 0.27 | 0.30 | 0.27 | 0.37 | 0.38 | 0.55 | 0.73 | 0.97 | 0.97 | 0.92 | 1.03 | 0.92 |
| RUN NO.=189 | S= 92.71 | AQ= 7.798 | DELTSUB= 1.20QC= 0.9000 | T1= 18.35 | T2= 23.60 | TC= 51.05 | | | | | | | | | | |
| TW | 89.7 | 89.7 | 89.9 | 90.4 | 92.1 | 91.6 | 92.4 | 93.3 | 94.1 | 94.4 | 93.1 | 90.8 | 89.9 | 89.7 | 89.5 | 89.7 |
| TL | 81.8 | 81.8 | 81.9 | 82.0 | 82.1 | 82.2 | 82.4 | 82.5 | 82.6 | 82.8 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 0.98 | 0.99 | 0.97 | 0.93 | 0.78 | 0.83 | 0.77 | 0.72 | 0.68 | 0.67 | 0.76 | 0.99 | 1.11 | 1.15 | 1.18 | 1.15 |
| RUN NO.=190 | S= 97.57 | AQ= 7.767 | DELTSUB= 40.85QC= 0.9000 | T1= 18.70 | T2= 24.90 | TC= 50.35 | | | | | | | | | | |
| TW | 71.6 | 77.4 | 79.2 | 77.4 | 80.1 | 82.7 | 86.4 | 89.9 | 90.8 | 89.7 | 90.1 | 89.7 | 91.4 | 89.7 | 89.3 | 89.3 |
| TL | 43.8 | 46.3 | 48.9 | 51.4 | 56.5 | 61.6 | 66.7 | 71.9 | 77.0 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 |
| HT | 0.28 | 0.25 | 0.26 | 0.30 | 0.33 | 0.37 | 0.40 | 0.43 | 0.56 | 1.02 | 0.96 | 1.02 | 0.83 | 1.02 | 1.08 | 1.08 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=191 | S= 97.57 | AQ= 7.767 | DELTSUB= 40.10 | QC= 0.9000 | T1= 19.10 | T2= 25.23 | TC= 52.70 | | | | | | | | | |
| TW | 71.9 | 78.1 | 81.2 | 82.3 | 82.3 | 85.6 | 89.3 | 90.1 | 91.2 | 89.7 | 89.7 | 89.5 | 90.4 | 89.3 | 88.2 | 89.3 |
| TL | 44.5 | 47.0 | 49.5 | 52.0 | 57.0 | 62.0 | 67.0 | 72.0 | 77.0 | 82.0 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 |
| HT | 0.28 | 0.25 | 0.24 | 0.26 | 0.31 | 0.33 | 0.35 | 0.43 | 0.55 | 1.01 | 1.02 | 1.04 | 0.94 | 1.07 | 1.26 | 1.07 |
| RUN NO.=192 | S= 97.57 | AQ= 7.767 | DELTSUB= 38.65 | QC= 0.9000 | T1= 19.90 | T2= 26.04 | TC= 52.70 | | | | | | | | | |
| TW | 73.2 | 79.4 | 82.7 | 85.1 | 86.2 | 86.4 | 91.8 | 90.6 | 91.6 | 89.9 | 89.7 | 89.7 | 90.8 | 89.4 | 88.8 | 89.7 |
| TL | 46.3 | 48.7 | 51.1 | 53.5 | 58.3 | 63.2 | 68.0 | 72.8 | 77.6 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.29 | 0.25 | 0.25 | 0.25 | 0.28 | 0.33 | 0.33 | 0.44 | 0.56 | 1.05 | 1.08 | 1.08 | 0.94 | 1.12 | 1.23 | 1.08 |
| RUN NO.=193 | S= 96.88 | AQ= 7.798 | DELTSUB= 24.00 | QC= 0.9000 | T1= 20.60 | T2= 28.72 | TC= 52.70 | | | | | | | | | |
| TW | 86.2 | 92.7 | 93.1 | 95.6 | 96.5 | 94.1 | 99.0 | 91.6 | 92.1 | 90.6 | 90.6 | 90.4 | 90.6 | 90.1 | 89.3 | 90.1 |
| TL | 61.1 | 63.1 | 65.1 | 67.1 | 71.1 | 75.1 | 79.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 |
| HT | 0.31 | 0.26 | 0.28 | 0.27 | 0.31 | 0.41 | 0.39 | 0.92 | 0.88 | 1.05 | 1.05 | 1.08 | 1.05 | 1.11 | 1.27 | 1.11 |
| RUN NO.=194 | S= 71.18 | AQ= 14.359 | DELTSUB= 2.60 | QC= 0.9000 | T1= 19.85 | T2= 35.00 | TC= 48.90 | | | | | | | | | |
| TW | 89.5 | 90.4 | 91.9 | 93.3 | 95.6 | 94.6 | 95.4 | 93.1 | 91.9 | 91.9 | 91.4 | 91.2 | 91.4 | 92.3 | 91.4 | 93.1 |
| TL | 79.9 | 80.1 | 80.4 | 80.6 | 81.0 | 81.4 | 81.9 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 |
| HT | 1.50 | 1.41 | 1.25 | 1.13 | 0.98 | 1.09 | 1.06 | 1.33 | 1.50 | 1.50 | 1.58 | 1.61 | 1.58 | 1.44 | 1.58 | 1.33 |
| RUN NO.=195 | S= 73.96 | AQ= 7.798 | DELTSUB= 2.60 | QC= 0.9000 | T1= 18.60 | T2= 28.75 | TC= 49.90 | | | | | | | | | |
| TW | 88.8 | 89.9 | 90.8 | 92.1 | 95.0 | 94.6 | 92.9 | 90.9 | 89.2 | 88.4 | 88.2 | 88.2 | 88.4 | 88.8 | 88.6 | 89.4 |
| TL | 80.2 | 80.5 | 80.9 | 81.2 | 81.8 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.91 | 0.84 | 0.79 | 0.72 | 0.59 | 0.64 | 0.75 | 0.92 | 1.16 | 1.32 | 1.37 | 1.37 | 1.32 | 1.24 | 1.28 | 1.13 |
| RUN NO.=196 | S= 79.51 | AQ= 10.795 | DELTSUB= 2.40 | QC= 0.9000 | T1= 19.85 | T2= 31.24 | TC= 48.90 | | | | | | | | | |
| TW | 88.4 | 89.5 | 89.9 | 90.8 | 92.4 | 93.5 | 94.2 | 91.8 | 90.8 | 90.1 | 89.3 | 88.8 | 89.0 | 89.9 | 89.3 | 90.8 |
| TL | 80.1 | 80.3 | 80.5 | 80.7 | 81.1 | 81.5 | 81.9 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 |
| HT | 1.30 | 1.17 | 1.15 | 1.07 | 0.95 | 0.90 | 0.88 | 1.14 | 1.28 | 1.38 | 1.54 | 1.66 | 1.61 | 1.42 | 1.54 | 1.28 |
| RUN NO.=197 | S= 73.96 | AQ= 7.984 | DELTSUB= 32.35 | QC= 0.9000 | T1= 20.30 | T2= 28.73 | TC= 48.65 | | | | | | | | | |
| TW | 80.5 | 86.6 | 87.9 | 87.1 | 91.4 | 93.1 | 95.0 | 91.4 | 89.2 | 88.4 | 88.4 | 88.4 | 88.4 | 89.0 | 88.2 | 89.7 |
| TL | 52.6 | 55.3 | 58.0 | 60.7 | 66.1 | 71.5 | 76.9 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 |
| HT | 0.29 | 0.25 | 0.27 | 0.30 | 0.32 | 0.37 | 0.44 | 0.87 | 1.15 | 1.30 | 1.30 | 1.30 | 1.30 | 1.18 | 1.34 | 1.07 |
| RUN NO.=198 | S= 73.96 | AQ= 5.416 | DELTSUB= 4.40 | QC= 0.9000 | T1= 17.85 | T2= 24.95 | TC= 47.70 | | | | | | | | | |
| TW | 88.4 | 88.8 | 89.0 | 90.4 | 94.6 | 93.3 | 89.2 | 87.9 | 87.1 | 86.9 | 86.9 | 86.9 | 86.9 | 87.1 | 86.9 | 87.3 |
| TL | 78.2 | 78.7 | 79.3 | 79.8 | 80.9 | 82.0 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 |
| HT | 0.53 | 0.54 | 0.56 | 0.52 | 0.40 | 0.48 | 0.76 | 0.92 | 1.08 | 1.13 | 1.13 | 1.13 | 1.13 | 1.08 | 1.13 | 1.04 |
| RUN NO.=199 | S= 73.96 | AQ= 3.342 | DELTSUB= 7.60 | QC= 0.9000 | T1= 17.60 | T2= 21.91 | TC= 51.50 | | | | | | | | | |
| TW | 86.6 | 89.7 | 90.1 | 91.2 | 93.1 | 89.7 | 87.5 | 86.6 | 86.4 | 85.8 | 85.8 | 85.6 | 85.6 | 85.6 | 85.4 | 85.8 |
| TL | 75.4 | 76.4 | 77.3 | 78.3 | 80.2 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 | 82.1 |
| HT | 0.30 | 0.25 | 0.26 | 0.26 | 0.26 | 0.44 | 0.62 | 0.73 | 0.77 | 0.92 | 0.92 | 0.97 | 0.97 | 0.97 | 1.03 | 0.92 |
| RUN NO.=200 | S= 75.35 | AQ= 13.946 | DELTSUB= 24.00 | QC= 0.9000 | T1= 20.60 | T2= 31.84 | TC= 48.90 | | | | | | | | | |
| TW | 88.6 | 89.3 | 89.9 | 91.6 | 93.3 | 92.9 | 94.4 | 95.3 | 95.6 | 92.3 | 92.1 | 91.6 | 91.9 | 92.7 | 92.7 | 94.8 |
| TL | 60.4 | 61.9 | 63.4 | 64.9 | 67.9 | 70.9 | 73.9 | 76.9 | 79.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 0.49 | 0.51 | 0.53 | 0.52 | 0.55 | 0.63 | 0.68 | 0.76 | 0.89 | 1.49 | 1.52 | 1.59 | 1.56 | 1.42 | 1.42 | 1.17 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=201 S= 75.35 AQ= 14.070 DELTSUB= 32.55QC= 0.9000 T1= 20.60 T2= 31.88 TC= 50.10 | | | | | | | | | | | | | | | | |
| TW | 88.4 | 88.6 | 89.5 | 90.8 | 92.7 | 91.6 | 94.2 | 94.4 | 96.7 | 92.5 | 92.1 | 91.6 | 91.6 | 92.9 | 91.9 | 94.6 |
| TL | 52.4 | 54.4 | 56.5 | 58.5 | 62.6 | 66.6 | 70.7 | 74.8 | 78.8 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 0.39 | 0.41 | 0.43 | 0.44 | 0.47 | 0.56 | 0.60 | 0.72 | 0.79 | 1.46 | 1.54 | 1.61 | 1.61 | 1.41 | 1.57 | 1.20 |
| RUN NO.=202 S= 75.35 AQ= 14.070 DELTSUB= 33.40QC= 0.9000 T1= 20.80 T2= 32.08 TC= 50.30 | | | | | | | | | | | | | | | | |
| TW | 88.6 | 88.8 | 89.9 | 90.8 | 92.5 | 91.9 | 94.4 | 94.6 | 96.7 | 92.7 | 92.3 | 91.6 | 92.1 | 93.1 | 92.5 | 94.8 |
| TL | 51.8 | 53.9 | 56.0 | 58.1 | 62.3 | 66.4 | 70.6 | 74.8 | 79.0 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 |
| HT | 0.38 | 0.40 | 0.42 | 0.43 | 0.47 | 0.55 | 0.59 | 0.71 | 0.79 | 1.47 | 1.54 | 1.66 | 1.58 | 1.41 | 1.50 | 1.21 |
| RUN NO.=203 S= 72.57 AQ= 14.111 DELTSUB= 12.60QC= 0.9000 T1= 20.80 T2= 35.61 TC= 50.70 | | | | | | | | | | | | | | | | |
| TW | 90.4 | 91.6 | 92.9 | 93.5 | 95.2 | 93.3 | 95.6 | 94.6 | 93.1 | 92.3 | 91.6 | 91.6 | 91.6 | 92.7 | 92.1 | 94.4 |
| TL | 71.3 | 72.4 | 73.4 | 74.5 | 76.6 | 78.7 | 80.8 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 0.74 | 0.73 | 0.73 | 0.74 | 0.76 | 0.97 | 0.95 | 1.21 | 1.38 | 1.50 | 1.61 | 1.61 | 1.61 | 1.44 | 1.54 | 1.23 |
| RUN NO.=204 S= 75.35 AQ= 7.984 DELTSUB= 51.80QC= 0.9000 T1= 20.80 T2= 28.31 TC= 46.95 | | | | | | | | | | | | | | | | |
| TW | 66.0 | 72.5 | 75.4 | 76.5 | 85.8 | 87.1 | 90.1 | 91.4 | 89.5 | 89.0 | 88.8 | 88.8 | 88.8 | 89.7 | 89.0 | 90.1 |
| TL | 35.0 | 38.7 | 42.4 | 46.1 | 53.5 | 60.9 | 68.3 | 75.7 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 |
| HT | 0.26 | 0.24 | 0.24 | 0.26 | 0.25 | 0.31 | 0.37 | 0.51 | 1.25 | 1.36 | 1.41 | 1.41 | 1.41 | 1.22 | 1.36 | 1.15 |
| RUN NO.=205 S= 53.13 AQ= 7.953 DELTSUB= 32.15QC= 0.9000 T1= 19.60 T2= 30.89 TC= 51.05 | | | | | | | | | | | | | | | | |
| TW | 82.7 | 87.5 | 87.7 | 92.5 | 89.2 | 88.2 | 88.4 | 88.6 | 88.6 | 88.4 | 88.4 | 88.4 | 88.4 | 89.0 | 88.6 | 89.7 |
| TL | 55.7 | 61.1 | 66.4 | 71.8 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.29 | 0.30 | 0.37 | 0.38 | 1.19 | 1.40 | 1.35 | 1.30 | 1.30 | 1.35 | 1.35 | 1.35 | 1.35 | 1.22 | 1.30 | 1.10 |
| RUN NO.=206 S= 53.13 AQ= 14.276 DELTSUB= 54.20QC= 0.9000 T1= 20.10 T2= 36.71 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 80.5 | 80.3 | 80.1 | 83.4 | 92.5 | 92.7 | 91.8 | 91.6 | 91.4 | 91.2 | 91.2 | 91.2 | 91.4 | 92.3 | 91.8 | 94.6 |
| TL | 33.7 | 39.1 | 44.6 | 50.0 | 60.8 | 71.7 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.31 | 0.35 | 0.40 | 0.43 | 0.45 | 0.68 | 1.54 | 1.57 | 1.60 | 1.64 | 1.64 | 1.64 | 1.60 | 1.46 | 1.54 | 1.18 |
| RUN NO.=207 S= 52.43 AQ= 14.276 DELTSUB= 32.15QC= 0.9000 T1= 19.60 T2= 37.97 TC= 52.20 | | | | | | | | | | | | | | | | |
| TW | 84.3 | 84.9 | 86.9 | 89.0 | 95.2 | 92.5 | 91.8 | 91.8 | 91.6 | 91.6 | 91.4 | 91.4 | 91.4 | 92.3 | 92.3 | 94.6 |
| TL | 54.1 | 58.1 | 62.2 | 66.2 | 74.2 | 82.2 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 |
| HT | 0.47 | 0.53 | 0.58 | 0.63 | 0.68 | 1.39 | 1.49 | 1.49 | 1.53 | 1.53 | 1.56 | 1.56 | 1.56 | 1.43 | 1.43 | 1.16 |
| RUN NO.=208 S= 54.51 AQ= 10.795 DELTSUB= 4.15QC= 0.9000 T1= 20.10 T2= 35.37 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 89.5 | 91.0 | 94.6 | 95.4 | 91.9 | 90.4 | 90.1 | 90.4 | 90.4 | 90.1 | 90.4 | 90.4 | 90.6 | 91.0 | 90.8 | 91.9 |
| TL | 79.7 | 80.4 | 81.1 | 81.8 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 | 83.1 |
| HT | 1.10 | 1.02 | 0.80 | 0.79 | 1.24 | 1.50 | 1.54 | 1.50 | 1.50 | 1.54 | 1.50 | 1.50 | 1.46 | 1.38 | 1.41 | 1.24 |
| RUN NO.=209 S= 53.82 AQ= 13.946 DELTSUB= 3.20QC= 0.9000 T1= 20.10 T2= 39.79 TC= 52.70 | | | | | | | | | | | | | | | | |
| TW | 89.9 | 91.4 | 95.4 | 96.5 | 94.1 | 92.3 | 91.9 | 91.9 | 91.4 | 91.6 | 91.6 | 91.6 | 91.9 | 92.4 | 92.1 | 93.6 |
| TL | 80.2 | 80.8 | 81.3 | 81.8 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 1.44 | 1.31 | 0.99 | 0.95 | 1.24 | 1.49 | 1.56 | 1.56 | 1.64 | 1.60 | 1.60 | 1.60 | 1.56 | 1.46 | 1.52 | 1.31 |
| RUN NO.=210 S= 53.82 AQ= 17.593 DELTSUB= 2.40QC= 0.9000 T1= 19.85 T2= 44.67 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 92.5 | 96.6 | 97.3 | 95.9 | 94.3 | 93.5 | 93.3 | 92.9 | 92.9 | 93.1 | 92.7 | 93.1 | 93.5 | 93.1 | 95.3 |
| TL | 80.5 | 80.9 | 81.3 | 81.7 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 1.75 | 1.52 | 1.15 | 1.13 | 1.32 | 1.50 | 1.60 | 1.63 | 1.69 | 1.69 | 1.66 | 1.72 | 1.66 | 1.60 | 1.66 | 1.38 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=211 S= 53.82 AQ= 21.765 DELTSUB= 1.80QC= 0.9000 T1= 19.85 T2= 50.53 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 90.6 | 93.3 | 97.5 | 98.1 | 97.7 | 95.6 | 95.4 | 95.1 | 94.6 | 94.6 | 94.9 | 94.4 | 94.6 | 95.4 | 94.9 | 96.3 |
| TL | 80.8 | 81.1 | 81.4 | 81.7 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 | 82.3 |
| HT | 2.23 | 1.78 | 1.35 | 1.32 | 1.41 | 1.63 | 1.66 | 1.71 | 1.76 | 1.76 | 1.73 | 1.79 | 1.76 | 1.66 | 1.73 | 1.56 |
| RUN NO.=212 S= 53.82 AQ= 7.767 DELTSUB= 5.70QC= 0.9000 T1= 19.60 T2= 31.55 TC= 52.00 | | | | | | | | | | | | | | | | |
| TW | 88.4 | 90.1 | 93.5 | 90.1 | 89.3 | 88.4 | 88.4 | 88.6 | 88.4 | 88.4 | 88.4 | 88.4 | 88.6 | 89.3 | 88.8 | 89.7 |
| TL | 78.4 | 79.8 | 81.3 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 | 82.7 |
| HT | 0.78 | 0.75 | 0.63 | 1.04 | 1.19 | 1.36 | 1.36 | 1.32 | 1.36 | 1.36 | 1.36 | 1.36 | 1.32 | 1.19 | 1.27 | 1.11 |
| RUN NO.=213 S= 53.13 AQ= 5.390 DELTSUB= 10.00QC= 0.9000 T1= 19.10 T2= 27.70 TC= 52.45 | | | | | | | | | | | | | | | | |
| TW | 87.9 | 88.1 | 86.9 | 86.4 | 86.9 | 86.9 | 87.1 | 87.1 | 87.1 | 86.9 | 86.9 | 86.9 | 87.1 | 87.3 | 87.1 | 87.5 |
| TL | 75.8 | 79.1 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 | 82.5 |
| HT | 0.44 | 0.60 | 1.23 | 1.38 | 1.24 | 1.24 | 1.18 | 1.18 | 1.18 | 1.24 | 1.24 | 1.24 | 1.18 | 1.13 | 1.18 | 1.08 |
| RUN NO.=214 S= 39.24 AQ= 13.946 DELTSUB= 7.05QC= 0.9000 T1= 19.35 T2= 41.47 TC= 54.30 | | | | | | | | | | | | | | | | |
| TW | 90.1 | 92.3 | 92.3 | 91.4 | 91.9 | 91.0 | 91.6 | 91.9 | 91.9 | 91.6 | 92.1 | 91.6 | 92.1 | 92.6 | 92.4 | 94.6 |
| TL | 78.2 | 80.5 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 | 82.9 |
| HT | 1.17 | 1.19 | 1.49 | 1.64 | 1.56 | 1.72 | 1.60 | 1.56 | 1.56 | 1.60 | 1.52 | 1.60 | 1.52 | 1.43 | 1.46 | 1.19 |
| SYSTEM-TOLUENE | | | | | | | | | | | | | | | | |
| RUN NO.=215 S= 93.40 AQ= 6.138 DELTSUB= 11.95QC= 1.4000 T1= 22.80 T2= 27.70 TC= 67.60 | | | | | | | | | | | | | | | | |
| TW | 116.8 | 121.1 | 122.9 | 124.0 | 126.1 | 126.6 | 122.4 | 122.1 | 120.9 | 121.5 | 121.1 | 120.7 | 119.9 | 118.2 | 116.5 | 117.6 |
| TL | 99.9 | 101.1 | 102.3 | 103.5 | 105.9 | 108.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.36 | 0.31 | 0.30 | 0.30 | 0.30 | 0.33 | 0.52 | 0.53 | 0.60 | 0.57 | 0.59 | 0.61 | 0.67 | 0.81 | 1.05 | 0.89 |
| RUN NO.=216 S= 97.57 AQ= 3.734 DELTSUB= 23.55QC= 0.9000 T1= 21.80 T2= 24.51 TC= 63.95 | | | | | | | | | | | | | | | | |
| TW | 102.0 | 105.6 | 106.2 | 106.9 | 109.4 | 111.1 | 114.4 | 117.6 | 119.6 | 121.8 | 120.3 | 120.5 | 117.6 | 116.3 | 115.5 | 115.9 |
| TL | 88.4 | 89.7 | 91.0 | 92.3 | 95.0 | 97.6 | 100.2 | 102.8 | 105.4 | 108.0 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.27 | 0.24 | 0.25 | 0.26 | 0.26 | 0.28 | 0.26 | 0.25 | 0.26 | 0.27 | 0.39 | 0.38 | 0.54 | 0.66 | 0.77 | 0.71 |
| RUN NO.=217 S= 94.10 AQ= 6.163 DELTSUB= 8.65QC= 0.9000 T1= 21.60 T2= 27.69 TC= 65.30 | | | | | | | | | | | | | | | | |
| TW | 118.8 | 119.6 | 119.6 | 119.6 | 120.1 | 120.7 | 122.4 | 123.6 | 122.1 | 122.1 | 121.1 | 120.9 | 119.0 | 117.8 | 117.2 | 117.8 |
| TL | 102.6 | 103.2 | 103.9 | 104.5 | 105.7 | 106.9 | 108.2 | 109.4 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.38 | 0.38 | 0.39 | 0.41 | 0.43 | 0.45 | 0.43 | 0.43 | 0.54 | 0.54 | 0.59 | 0.60 | 0.74 | 0.86 | 0.94 | 0.86 |
| RUN NO.=218 S= 87.15 AQ= 8.696 DELTSUB= 5.55QC= 0.9000 T1= 21.60 T2= 30.53 TC= 56.60 | | | | | | | | | | | | | | | | |
| TW | 119.6 | 119.4 | 119.3 | 119.9 | 119.6 | 120.7 | 123.0 | 124.0 | 122.1 | 122.1 | 120.5 | 119.3 | 118.4 | 118.8 | 118.2 | 119.4 |
| TL | 105.7 | 106.1 | 106.5 | 106.9 | 107.7 | 108.5 | 109.3 | 110.1 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.62 | 0.65 | 0.68 | 0.67 | 0.73 | 0.71 | 0.63 | 0.62 | 0.78 | 0.78 | 0.90 | 1.04 | 1.15 | 1.09 | 1.18 | 1.01 |
| RUN NO.=219 S= 94.10 AQ= 8.696 DELTSUB= 68.25QC= 0.9000 T1= 19.85 T2= 25.10 TC= 59.10 | | | | | | | | | | | | | | | | |
| TW | 80.7 | 86.4 | 85.8 | 88.4 | 95.0 | 100.5 | 107.4 | 113.8 | 120.1 | 126.1 | 131.8 | 124.3 | 121.9 | 119.3 | 118.6 | 119.6 |
| TL | 45.8 | 49.2 | 52.6 | 56.1 | 62.9 | 69.7 | 76.5 | 83.4 | 90.2 | 97.0 | 103.8 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.25 | 0.23 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.64 | 0.77 | 1.01 | 1.09 | 0.97 |
| RUN NO.=220 S= 93.40 AQ= 8.696 DELTSUB= 56.35QC= 0.9000 T1= 20.10 T2= 25.30 TC= 61.20 | | | | | | | | | | | | | | | | |
| TW | 86.2 | 93.8 | 94.6 | 94.8 | 100.7 | 105.4 | 111.1 | 117.1 | 122.4 | 128.1 | 133.6 | 123.8 | 121.9 | 119.4 | 118.8 | 119.9 |
| TL | 57.1 | 59.9 | 62.8 | 65.6 | 71.2 | 76.8 | 82.5 | 88.1 | 93.7 | 99.4 | 105.0 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.30 | 0.26 | 0.27 | 0.30 | 0.29 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.66 | 0.77 | 0.99 | 1.07 | 0.95 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=221 | S= 96.88 | AQ= 5.957 | DELTSUB= 56.80QC= 0.9000 | T1= 20.60 | T2= 24.18 | TC= 60.30 | | | | | | | | | | |
| TW | 79.0 | 84.9 | 86.6 | 87.3 | 92.7 | 97.9 | 104.1 | 109.8 | 115.1 | 120.5 | 125.6 | 123.2 | 120.3 | 117.8 | 117.4 | 117.9 |
| TL | 56.9 | 59.7 | 62.6 | 65.4 | 71.1 | 76.8 | 82.4 | 88.1 | 93.8 | 99.5 | 105.2 | 110.8 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.27 | 0.24 | 0.25 | 0.27 | 0.28 | 0.28 | 0.28 | 0.27 | 0.28 | 0.28 | 0.29 | 0.48 | 0.63 | 0.86 | 0.92 | 0.84 |
| RUN NO.=222 | S= 76.04 | AQ= 2.042 | DELTSUB= 5.75QC= 0.9000 | T1= 21.30 | T2= 24.61 | TC= 50.80 | | | | | | | | | | |
| TW | 109.6 | 113.6 | 114.9 | 115.9 | 114.7 | 113.6 | 114.0 | 114.2 | 114.0 | 114.0 | 114.0 | 113.6 | 113.8 | 113.6 | 113.6 | 113.8 |
| TL | 106.1 | 107.0 | 108.0 | 108.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.58 | 0.31 | 0.30 | 0.29 | 0.53 | 0.74 | 0.65 | 0.61 | 0.65 | 0.65 | 0.65 | 0.74 | 0.69 | 0.74 | 0.74 | 0.69 |
| RUN NO.=223 | S= 76.04 | AQ= 3.734 | DELTSUB= 6.15QC= 0.9000 | T1= 21.10 | T2= 26.24 | TC= 43.10 | | | | | | | | | | |
| TW | 114.9 | 116.7 | 115.7 | 115.9 | 118.2 | 118.8 | 117.1 | 116.3 | 115.3 | 115.1 | 114.9 | 114.7 | 114.9 | 114.9 | 114.7 | 115.1 |
| TL | 105.1 | 105.7 | 106.3 | 107.0 | 108.2 | 109.4 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.38 | 0.34 | 0.40 | 0.42 | 0.37 | 0.40 | 0.57 | 0.66 | 0.80 | 0.84 | 0.88 | 0.92 | 0.88 | 0.88 | 0.92 | 0.84 |
| RUN NO.=224 | S= 76.04 | AQ= 11.589 | DELTSUB= 5.75QC= 0.9000 | T1= 21.60 | T2= 34.91 | TC= 59.85 | | | | | | | | | | |
| TW | 119.3 | 119.6 | 119.9 | 120.3 | 121.8 | 123.8 | 126.3 | 124.2 | 121.9 | 120.9 | 120.1 | 119.4 | 119.6 | 120.3 | 119.9 | 121.5 |
| TL | 105.4 | 105.9 | 106.3 | 106.8 | 107.8 | 108.7 | 109.7 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.84 | 0.84 | 0.86 | 0.86 | 0.83 | 0.77 | 0.70 | 0.86 | 1.03 | 1.13 | 1.23 | 1.32 | 1.29 | 1.21 | 1.26 | 1.07 |
| RUN NO.=225 | S= 69.10 | AQ= 14.854 | DELTSUB= 5.95QC= 0.9000 | T1= 21.80 | T2= 38.73 | TC= 61.65 | | | | | | | | | | |
| TW | 119.6 | 119.6 | 120.1 | 120.5 | 122.8 | 125.0 | 126.4 | 123.6 | 121.8 | 121.1 | 120.5 | 120.3 | 120.7 | 121.5 | 120.9 | 123.0 |
| TL | 105.2 | 105.7 | 106.2 | 106.7 | 107.7 | 108.7 | 109.7 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 1.03 | 1.06 | 1.07 | 1.08 | 0.99 | 0.91 | 0.88 | 1.15 | 1.34 | 1.42 | 1.51 | 1.55 | 1.48 | 1.37 | 1.45 | 1.20 |
| RUN NO.=226 | S= 68.40 | AQ= 14.854 | DELTSUB= 5.95QC= 0.9000 | T1= 21.80 | T2= 36.77 | TC= 61.45 | | | | | | | | | | |
| TW | 120.3 | 120.1 | 119.4 | 120.3 | 122.8 | 123.2 | 122.4 | 123.4 | 121.9 | 121.3 | 120.9 | 121.1 | 121.3 | 122.1 | 121.5 | 123.8 |
| TL | 105.8 | 106.2 | 106.6 | 107.1 | 107.9 | 108.8 | 109.6 | 110.5 | 111.3 | 111.3 | 111.3 | 111.3 | 111.3 | 111.3 | 111.3 | 111.3 |
| HT | 1.03 | 1.07 | 1.16 | 1.13 | 1.00 | 1.03 | 1.17 | 1.15 | 1.39 | 1.49 | 1.55 | 1.52 | 1.49 | 1.37 | 1.46 | 1.19 |
| RUN NO.=227 | S= 76.04 | AQ= 8.696 | DELTSUB= 6.75QC= 0.9000 | T1= 21.10 | T2= 29.97 | TC= 58.20 | | | | | | | | | | |
| TW | 119.4 | 119.1 | 117.4 | 118.2 | 120.4 | 121.5 | 120.7 | 121.5 | 119.6 | 118.6 | 117.8 | 117.6 | 117.8 | 118.4 | 118.0 | 119.4 |
| TL | 104.6 | 105.1 | 105.5 | 106.0 | 107.0 | 108.0 | 108.9 | 109.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.58 | 0.62 | 0.74 | 0.71 | 0.65 | 0.64 | 0.74 | 0.75 | 0.99 | 1.12 | 1.26 | 1.30 | 1.26 | 1.15 | 1.22 | 1.01 |
| RUN NO.=228 | S= 76.74 | AQ= 6.086 | DELTSUB= 5.95QC= 0.9000 | T1= 21.10 | T2= 29.14 | TC= 53.60 | | | | | | | | | | |
| TW | 118.9 | 117.8 | 116.7 | 117.1 | 119.4 | 120.1 | 119.4 | 118.8 | 117.4 | 116.5 | 116.3 | 116.1 | 116.3 | 116.7 | 116.3 | 117.4 |
| TL | 105.5 | 106.1 | 106.7 | 107.3 | 108.5 | 109.7 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.46 | 0.52 | 0.61 | 0.62 | 0.55 | 0.59 | 0.71 | 0.77 | 0.94 | 1.08 | 1.12 | 1.16 | 1.12 | 1.04 | 1.12 | 0.94 |
| RUN NO.=229 | S= 53.13 | AQ= 14.854 | DELTSUB= 5.55QC= 0.9000 | T1= 21.10 | T2= 44.26 | TC= 60.05 | | | | | | | | | | |
| TW | 119.6 | 121.7 | 123.0 | 124.0 | 123.0 | 120.9 | 120.4 | 120.9 | 120.4 | 120.4 | 120.4 | 120.3 | 120.9 | 121.5 | 121.3 | 123.2 |
| TL | 106.2 | 107.2 | 108.1 | 109.0 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 1.11 | 1.02 | 1.00 | 0.99 | 1.22 | 1.48 | 1.55 | 1.49 | 1.55 | 1.55 | 1.55 | 1.58 | 1.49 | 1.39 | 1.42 | 1.20 |
| RUN NO.=230 | S= 53.13 | AQ= 11.625 | DELTSUB= 5.75QC= 0.9000 | T1= 20.30 | T2= 38.30 | TC= 61.65 | | | | | | | | | | |
| TW | 119.4 | 120.6 | 121.9 | 123.2 | 121.5 | 119.4 | 119.1 | 119.4 | 119.4 | 119.4 | 119.4 | 119.3 | 119.6 | 120.3 | 120.1 | 121.9 |
| TL | 106.1 | 107.0 | 108.0 | 108.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 | 110.9 |
| HT | 0.87 | 0.85 | 0.83 | 0.81 | 1.09 | 1.35 | 1.42 | 1.35 | 1.35 | 1.35 | 1.35 | 1.38 | 1.32 | 1.24 | 1.26 | 1.05 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=231 S= 53.13 AQ= 8.727 DELTSUB= 10.40QC= 0.9000 T1= 19.85 T2= 33.51 TC= 58.90 | | | | | | | | | | | | | | | | |
| TW | 117.6 | 117.4 | 119.6 | 122.8 | 119.1 | 117.4 | 117.1 | 117.6 | 117.6 | 117.6 | 117.6 | 117.6 | 117.8 | 118.4 | 118.2 | 119.4 |
| TL | 102.0 | 103.7 | 105.5 | 107.2 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 | 110.6 |
| HT | 0.56 | 0.64 | 0.61 | 0.56 | 1.04 | 1.30 | 1.34 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.23 | 1.13 | 1.16 | 0.99 |
| RUN NO.=232 S= 53.13 AQ= 5.957 DELTSUB= 12.40QC= 0.9000 T1= 19.85 T2= 30.18 TC= 55.00 | | | | | | | | | | | | | | | | |
| TW | 116.3 | 116.3 | 119.4 | 117.6 | 116.1 | 115.5 | 115.9 | 116.3 | 116.1 | 116.3 | 116.3 | 116.3 | 116.3 | 116.9 | 116.7 | 117.6 |
| TL | 101.8 | 104.9 | 108.0 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 | 111.1 |
| HT | 0.41 | 0.52 | 0.52 | 0.92 | 1.19 | 1.35 | 1.24 | 1.15 | 1.19 | 1.15 | 1.15 | 1.15 | 1.15 | 1.03 | 1.06 | 0.92 |
| RUN NO.=233 S= 53.13 AQ= 3.734 DELTSUB= 17.10QC= 0.9000 T1= 19.85 T2= 26.23 TC= 59.15 | | | | | | | | | | | | | | | | |
| TW | 110.6 | 116.5 | 117.4 | 116.3 | 115.1 | 114.7 | 115.1 | 115.3 | 115.3 | 115.3 | 115.3 | 115.3 | 115.5 | 115.7 | 115.5 | 115.9 |
| TL | 98.9 | 103.2 | 107.5 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 | 111.7 |
| HT | 0.32 | 0.28 | 0.38 | 0.81 | 1.10 | 1.24 | 1.10 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 0.98 | 0.93 | 0.98 | 0.89 |
| RUN NO.=234 S= 35.07 AQ= 14.895 DELTSUB= 17.75QC= 1.8500 T1= 20.10 T2= 31.37 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.9 | 121.3 | 121.1 | 120.3 | 119.9 | 120.3 | 120.7 | 120.9 | 121.1 | 121.3 | 121.5 | 122.6 | 124.1 | 123.9 | 127.1 |
| TL | 97.1 | 100.1 | 103.0 | 106.0 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.85 | 0.72 | 0.82 | 0.99 | 1.78 | 1.87 | 1.78 | 1.69 | 1.66 | 1.62 | 1.58 | 1.55 | 1.40 | 1.23 | 1.25 | 0.98 |
| RUN NO.=235 S= 35.07 AQ= 14.895 DELTSUB= 18.60QC= 1.8500 T1= 20.10 T2= 32.36 TC= 61.65 | | | | | | | | | | | | | | | | |
| TW | 114.6 | 120.3 | 121.1 | 120.9 | 120.3 | 119.9 | 120.3 | 120.9 | 120.9 | 121.1 | 121.5 | 121.5 | 122.6 | 124.3 | 124.3 | 127.1 |
| TL | 98.0 | 102.6 | 107.3 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 | 111.9 |
| HT | 0.89 | 0.85 | 1.08 | 1.66 | 1.78 | 1.87 | 1.78 | 1.66 | 1.66 | 1.62 | 1.55 | 1.55 | 1.40 | 1.21 | 1.21 | 0.98 |

SYSTEM-ETHYL ACETATE

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=236 S= 97.57 AQ= 8.634 DELTSUB= 20.90QC= 0.9000 T1= 21.80 T2= 29.11 TC= 63.70 | | | | | | | | | | | | | | | | |
| TW | 79.9 | 80.3 | 79.0 | 78.8 | 82.9 | 84.1 | 86.6 | 87.5 | 82.3 | 81.8 | 81.8 | 81.6 | 82.5 | 82.5 | 82.1 | 82.9 |
| TL | 56.7 | 58.2 | 59.7 | 61.2 | 64.2 | 67.1 | 70.1 | 73.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.37 | 0.39 | 0.45 | 0.49 | 0.46 | 0.51 | 0.52 | 0.60 | 1.39 | 1.51 | 1.51 | 1.58 | 1.35 | 1.35 | 1.45 | 1.26 |
| RUN NO.=237 S= 97.57 AQ= 8.634 DELTSUB= 32.75QC= 0.9000 T1= 21.80 T2= 28.91 TC= 69.00 | | | | | | | | | | | | | | | | |
| TW | 71.9 | 66.9 | 67.9 | 70.3 | 73.6 | 76.3 | 80.1 | 82.9 | 82.7 | 82.5 | 82.5 | 82.5 | 83.1 | 82.9 | 82.3 | 83.4 |
| TL | 45.7 | 48.0 | 50.4 | 52.7 | 57.4 | 62.1 | 66.7 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.33 | 0.46 | 0.49 | 0.49 | 0.53 | 0.61 | 0.65 | 0.75 | 1.30 | 1.35 | 1.35 | 1.35 | 1.22 | 1.26 | 1.39 | 1.18 |
| RUN NO.=238 S= 97.57 AQ= 8.572 DELTSUB= 39.40QC= 0.9000 T1= 21.80 T2= 27.71 TC= 75.20 | | | | | | | | | | | | | | | | |
| TW | 64.2 | 60.8 | 61.7 | 64.6 | 68.8 | 72.5 | 76.5 | 80.8 | 82.7 | 82.5 | 82.5 | 82.3 | 82.9 | 82.7 | 82.5 | 83.4 |
| TL | 39.2 | 41.6 | 44.1 | 46.5 | 51.5 | 56.4 | 61.3 | 66.2 | 71.2 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.34 | 0.45 | 0.49 | 0.47 | 0.50 | 0.53 | 0.56 | 0.59 | 0.74 | 1.34 | 1.34 | 1.38 | 1.25 | 1.30 | 1.34 | 1.17 |
| RUN NO.=239 S= 96.18 AQ= 14.937 DELTSUB= 9.65QC= 0.9000 T1= 21.80 T2= 43.49 TC= 66.90 | | | | | | | | | | | | | | | | |
| TW | 93.1 | 99.6 | 84.3 | 83.8 | 85.6 | 84.7 | 85.8 | 83.8 | 83.6 | 83.4 | 83.8 | 85.4 | 84.9 | 86.0 | 85.1 | 86.0 |
| TL | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.64 | 0.56 | 1.83 | 1.94 | 1.58 | 1.74 | 1.54 | 1.94 | 1.99 | 2.06 | 1.94 | 1.61 | 1.70 | 1.51 | 1.66 | 1.51 |
| RUN NO.=240 S= 97.57 AQ= 11.553 DELTSUB= 7.25QC= 0.9000 T1= 21.60 T2= 36.51 TC= 66.00 | | | | | | | | | | | | | | | | |
| TW | 89.3 | 94.6 | 99.0 | 100.1 | 84.7 | 84.4 | 85.1 | 83.8 | 83.6 | 83.1 | 83.4 | 84.7 | 84.1 | 84.9 | 84.1 | 85.1 |
| TL | 70.2 | 71.4 | 72.6 | 73.8 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.61 | 0.50 | 0.44 | 0.44 | 1.37 | 1.41 | 1.31 | 1.53 | 1.57 | 1.67 | 1.63 | 1.37 | 1.48 | 1.34 | 1.48 | 1.31 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN | NO.=241 | S= | 96.18 | AQ= | 3.775 | DELTSUB= | 10.55QC= | 0.9000 | T1= | 21.30 | | T2= | 24.90 | TC= | 65.55 | |
| TW | 75.6 | 77.6 | 78.6 | 79.2 | 80.5 | 81.4 | 83.4 | 82.9 | 82.3 | 84.3 | 82.9 | 80.5 | 80.1 | 80.1 | 79.4 | 80.1 |
| TL | 66.4 | 67.3 | 68.2 | 69.1 | 70.8 | 72.6 | 74.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.41 | 0.37 | 0.36 | 0.37 | 0.39 | 0.43 | 0.42 | 0.55 | 0.61 | 0.46 | 0.55 | 0.86 | 0.96 | 0.96 | 1.13 | 0.96 |
| RUN | NO.=242 | S= | 85.07 | AQ= | 8.603 | DELTSUB= | 2.65QC= | 0.9000 | T1= | 20.80 | | T2= | 30.90 | TC= | 66.45 | |
| TW | 87.8 | 91.2 | 94.4 | 96.1 | 96.7 | 82.5 | 82.9 | 82.1 | 82.1 | 82.1 | 82.1 | 81.8 | 81.8 | 82.3 | 82.1 | 83.1 |
| TL | 73.9 | 74.3 | 74.6 | 74.9 | 75.6 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.62 | 0.51 | 0.44 | 0.41 | 0.41 | 1.38 | 1.28 | 1.48 | 1.48 | 1.48 | 1.48 | 1.55 | 1.55 | 1.42 | 1.48 | 1.25 |
| RUN | NO.=243 | S= | 89.24 | AQ= | 5.931 | DELTSUB= | 4.90QC= | 0.9000 | T1= | 21.30 | | T2= | 27.01 | TC= | 63.50 | |
| TW | 84.9 | 88.4 | 88.9 | 89.3 | 91.4 | 91.9 | 92.3 | 84.1 | 83.6 | 84.4 | 82.1 | 81.1 | 80.7 | 80.9 | 80.7 | 81.4 |
| TL | 71.8 | 72.2 | 72.6 | 73.0 | 73.8 | 74.7 | 75.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.45 | 0.37 | 0.37 | 0.36 | 0.34 | 0.35 | 0.35 | 0.76 | 0.81 | 0.73 | 1.03 | 1.22 | 1.35 | 1.28 | 1.35 | 1.16 |
| RUN | NO.=244 | S= | 75.35 | AQ= | 3.817 | DELTSUB= | 12.85QC= | 0.9000 | T1= | 20.35 | | T2= | 24.62 | TC= | 75.40 | |
| TW | 75.4 | 79.2 | 81.6 | 84.3 | 89.1 | 82.3 | 79.9 | 79.9 | 79.4 | 79.2 | 79.2 | 79.0 | 79.0 | 79.4 | 79.0 | 79.9 |
| TL | 64.9 | 66.5 | 68.1 | 69.7 | 72.9 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.36 | 0.30 | 0.28 | 0.26 | 0.24 | 0.62 | 1.00 | 1.00 | 1.14 | 1.23 | 1.23 | 1.32 | 1.32 | 1.14 | 1.32 | 1.00 |
| RUN | NO.=245 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | 32.00QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 | |
| TW | 83.8 | 81.4 | 81.1 | 84.9 | 89.3 | 83.8 | 85.6 | 87.8 | 89.3 | 86.4 | 85.6 | 84.9 | 85.1 | 85.8 | 85.6 | 83.1 |
| TL | 46.3 | 48.3 | 50.3 | 52.3 | 56.3 | 60.3 | 64.3 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.40 | 0.45 | 0.48 | 0.46 | 0.45 | 0.64 | 0.70 | 0.77 | 0.88 | 1.47 | 1.61 | 1.74 | 1.70 | 1.57 | 1.61 | 2.18 |
| RUN | NO.=246 | S= | 77.43 | AQ= | 14.937 | DELTSUB= | 31.80QC= | 0.9000 | T1= | 21.10 | | T2= | 31.73 | TC= | 69.45 | |
| TW | 82.9 | 80.3 | 81.1 | 85.1 | 89.1 | 83.8 | 85.4 | 88.4 | 89.5 | 86.9 | 85.6 | 85.4 | 85.4 | 85.6 | 85.6 | 83.6 |
| TL | 46.5 | 48.5 | 50.5 | 52.4 | 56.4 | 60.4 | 64.4 | 68.3 | 72.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.41 | 0.47 | 0.49 | 0.46 | 0.46 | 0.64 | 0.71 | 0.74 | 0.87 | 1.42 | 1.61 | 1.65 | 1.65 | 1.61 | 1.61 | 2.05 |
| RUN | NO.=247 | S= | 72.57 | AQ= | 8.603 | DELTSUB= | 35.55QC= | 0.9000 | T1= | 21.60 | | T2= | 29.65 | TC= | 69.45 | |
| TW | 70.5 | 70.5 | 74.1 | 76.8 | 83.4 | 88.6 | 95.2 | 83.8 | 82.5 | 82.3 | 82.3 | 82.1 | 82.1 | 82.9 | 82.5 | 83.8 |
| TL | 44.0 | 46.9 | 49.9 | 52.9 | 58.8 | 64.7 | 70.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.32 | 0.36 | 0.36 | 0.36 | 0.35 | 0.36 | 0.35 | 1.19 | 1.45 | 1.50 | 1.50 | 1.56 | 1.56 | 1.34 | 1.45 | 1.19 |
| RUN | NO.=248 | S= | 73.26 | AQ= | 8.603 | DELTSUB= | 40.10QC= | 0.9000 | T1= | 21.85 | | T2= | 29.90 | TC= | 69.45 | |
| TW | 65.8 | 66.4 | 70.3 | 73.4 | 80.3 | 86.9 | 94.1 | 88.8 | 82.5 | 82.1 | 81.9 | 81.6 | 81.9 | 82.5 | 82.3 | 83.6 |
| TL | 39.8 | 43.1 | 46.5 | 49.8 | 56.5 | 63.2 | 69.9 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 | 76.6 |
| HT | 0.33 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.35 | 0.70 | 1.45 | 1.56 | 1.62 | 1.70 | 1.62 | 1.45 | 1.50 | 1.22 |
| RUN | NO.=249 | S= | 77.43 | AQ= | 5.931 | DELTSUB= | 11.00QC= | 0.9000 | T1= | 20.60 | | T2= | 25.58 | TC= | 65.10 | |
| TW | 82.3 | 83.8 | 84.3 | 85.4 | 87.9 | 89.5 | 92.7 | 94.6 | 80.9 | 80.1 | 80.1 | 79.9 | 79.9 | 80.5 | 79.9 | 80.7 |
| TL | 65.6 | 66.4 | 67.2 | 68.0 | 69.6 | 71.1 | 72.7 | 74.3 | 75.8 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 0.36 | 0.34 | 0.35 | 0.34 | 0.32 | 0.32 | 0.30 | 0.29 | 1.16 | 1.40 | 1.40 | 1.46 | 1.46 | 1.28 | 1.46 | 1.22 |
| RUN | NO.=250 | S= | 69.10 | AQ= | 5.931 | DELTSUB= | 15.50QC= | 0.9000 | T1= | 21.10 | | T2= | 28.05 | TC= | 67.15 | |
| TW | 79.6 | 81.4 | 82.5 | 84.9 | 89.5 | 85.4 | 81.4 | 80.9 | 80.7 | 80.7 | 80.7 | 80.5 | 80.5 | 81.1 | 80.7 | 81.6 |
| TL | 62.9 | 64.9 | 66.8 | 68.8 | 72.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.35 | 0.36 | 0.38 | 0.37 | 0.35 | 0.67 | 1.21 | 1.33 | 1.41 | 1.41 | 1.41 | 1.48 | 1.48 | 1.28 | 1.41 | 1.16 |

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO.=251 | S= 75.35 | AQ= 5.931 | DELTSUB= 12.80QC= 0.9000 | T1= 20.10 | T2= 25.14 | TC= 63.50 | | | | | | | | | | |
| TW | 82.5 | 83.6 | 84.1 | 85.8 | 89.1 | 91.4 | 95.2 | 98.1 | 86.2 | 80.9 | 80.7 | 80.5 | 80.7 | 80.9 | 80.9 | 81.4 |
| TL | 64.6 | 65.5 | 66.4 | 67.4 | 69.2 | 71.0 | 72.8 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.33 | 0.33 | 0.34 | 0.32 | 0.30 | 0.29 | 0.27 | 0.25 | 0.61 | 1.33 | 1.41 | 1.48 | 1.41 | 1.33 | 1.33 | 1.21 |
| RUN NO.=252 | S= 78.13 | AQ= 8.448 | DELTSUB= 3.30QC= 0.9000 | T1= 20.85 | T2= 28.82 | TC= 67.85 | | | | | | | | | | |
| TW | 90.6 | 93.8 | 95.6 | 97.3 | 100.1 | 101.1 | 101.6 | 83.6 | 83.6 | 82.9 | 82.1 | 81.8 | 81.8 | 82.1 | 81.8 | 82.9 |
| TL | 73.5 | 73.8 | 74.0 | 74.3 | 74.9 | 75.4 | 76.0 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.49 | 0.42 | 0.39 | 0.37 | 0.34 | 0.33 | 0.33 | 1.19 | 1.19 | 1.31 | 1.52 | 1.59 | 1.59 | 1.52 | 1.59 | 1.31 |
| RUN NO.=253 | S= 71.88 | AQ= 11.373 | DELTSUB= 2.45QC= 0.9000 | T1= 21.10 | T2= 37.49 | TC= 69.00 | | | | | | | | | | |
| TW | 96.5 | 101.6 | 82.3 | 82.5 | 83.4 | 82.7 | 83.8 | 85.1 | 84.3 | 83.8 | 83.6 | 83.4 | 83.4 | 84.3 | 83.6 | 84.9 |
| TL | 75.1 | 75.9 | 76.7 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| HT | 0.53 | 0.44 | 2.07 | 1.98 | 1.72 | 1.91 | 1.61 | 1.36 | 1.52 | 1.61 | 1.66 | 1.72 | 1.72 | 1.52 | 1.66 | 1.40 |
| RUN NO.=254 | S= 61.46 | AQ= 14.689 | DELTSUB= 2.80QC= 1.8500 | T1= 21.10 | T2= 31.82 | TC= 68.30 | | | | | | | | | | |
| TW | 83.1 | 82.5 | 82.5 | 82.9 | 84.0 | 83.6 | 84.9 | 85.6 | 85.1 | 85.1 | 84.9 | 84.6 | 84.6 | 85.8 | 84.9 | 86.6 |
| TL | 75.1 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.82 | 2.44 | 2.45 | 2.28 | 1.96 | 2.07 | 1.75 | 1.62 | 1.71 | 1.71 | 1.75 | 1.80 | 1.80 | 1.59 | 1.75 | 1.45 |
| RUN NO.=255 | S= 66.32 | AQ= 8.572 | DELTSUB= 7.05QC= 0.9000 | T1= 22.35 | T2= 32.33 | TC= 68.30 | | | | | | | | | | |
| TW | 92.7 | 95.0 | 94.6 | 93.6 | 97.8 | 83.8 | 83.4 | 82.7 | 82.3 | 82.3 | 82.1 | 82.3 | 82.3 | 82.7 | 82.3 | 83.4 |
| TL | 70.3 | 71.2 | 72.1 | 73.0 | 74.7 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 0.38 | 0.36 | 0.38 | 0.42 | 0.37 | 1.17 | 1.25 | 1.38 | 1.49 | 1.49 | 1.54 | 1.49 | 1.49 | 1.38 | 1.49 | 1.25 |
| RUN NO.=256 | S= 60.07 | AQ= 11.445 | DELTSUB= 4.90QC= 0.9000 | T1= 21.80 | T2= 35.05 | TC= 69.45 | | | | | | | | | | |
| TW | 82.3 | 82.5 | 82.9 | 83.1 | 84.7 | 84.1 | 82.9 | 82.7 | 82.3 | 82.1 | 82.1 | 82.5 | 82.3 | 82.3 | 83.4 | 84.9 |
| TL | 72.2 | 72.8 | 73.4 | 74.0 | 75.3 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.13 | 1.18 | 1.20 | 1.26 | 1.21 | 1.52 | 1.77 | 1.85 | 1.97 | 2.06 | 2.06 | 1.91 | 1.97 | 1.97 | 1.67 | 1.36 |
| RUN NO.=257 | S= 55.21 | AQ= 14.854 | DELTSUB= 3.55QC= 0.9000 | T1= 21.80 | T2= 39.02 | TC= 69.20 | | | | | | | | | | |
| TW | 83.6 | 84.1 | 84.3 | 84.4 | 86.4 | 85.8 | 83.8 | 84.1 | 83.4 | 83.4 | 83.4 | 83.6 | 83.8 | 83.6 | 85.1 | 86.6 |
| TL | 73.4 | 73.8 | 74.3 | 74.7 | 75.6 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| HT | 1.46 | 1.45 | 1.49 | 1.53 | 1.37 | 1.60 | 2.03 | 1.97 | 2.17 | 2.17 | 2.17 | 2.09 | 2.03 | 2.09 | 1.73 | 1.46 |
| RUN NO.=258 | S= 53.82 | AQ= 5.957 | DELTSUB= 6.65QC= 0.9000 | T1= 21.60 | T2= 30.31 | TC= 72.05 | | | | | | | | | | |
| TW | 84.1 | 81.1 | 80.5 | 79.9 | 80.1 | 79.9 | 79.9 | 80.1 | 79.7 | 79.7 | 79.4 | 79.4 | 79.2 | 79.4 | 79.4 | 80.5 |
| TL | 72.1 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.50 | 1.03 | 1.17 | 1.32 | 1.27 | 1.32 | 1.32 | 1.27 | 1.39 | 1.39 | 1.47 | 1.47 | 1.57 | 1.47 | 1.47 | 1.17 |
| RUN NO.=259 | S= 52.43 | AQ= 11.517 | DELTSUB= 8.40QC= 0.9000 | T1= 21.80 | T2= 36.42 | TC= 69.20 | | | | | | | | | | |
| TW | 81.6 | 83.6 | 87.9 | 88.4 | 84.1 | 82.7 | 82.5 | 82.9 | 82.7 | 82.9 | 82.7 | 82.7 | 82.1 | 82.1 | 82.7 | 81.8 |
| TL | 69.3 | 70.7 | 72.1 | 73.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.94 | 0.89 | 0.72 | 0.77 | 1.48 | 1.79 | 1.84 | 1.72 | 1.79 | 1.72 | 1.79 | 1.79 | 1.99 | 1.99 | 1.79 | 2.08 |
| RUN NO.=260 | S= 55.21 | AQ= 8.634 | DELTSUB= 44.45QC= 0.9000 | T1= 21.35 | T2= 31.31 | TC= 69.90 | | | | | | | | | | |
| TW | 63.5 | 71.2 | 77.4 | 84.3 | 90.8 | 81.6 | 82.1 | 82.1 | 81.9 | 81.6 | 81.9 | 81.9 | 81.9 | 82.5 | 82.5 | 82.3 |
| TL | 37.4 | 43.0 | 48.5 | 54.1 | 65.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 0.33 | 0.31 | 0.30 | 0.29 | 0.34 | 1.62 | 1.50 | 1.50 | 1.56 | 1.63 | 1.56 | 1.56 | 1.56 | 1.39 | 1.39 | 1.44 |

RUN NO.=261 S= 50.35 AQ= 8.479 DELTSUB= 4.65QC= 0.9000 T1= 20.60 T2= 32.81 TC= 67.85

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 82.3 | 84.9 | 81.8 | 80.9 | 81.4 | 80.9 | 80.9 | 81.1 | 80.9 | 80.7 | 80.7 | 80.7 | 80.2 | 80.2 | 80.7 | 82.1 |
| TL | 72.3 | 73.9 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 | 75.4 |
| HT | 0.85 | 0.77 | 1.32 | 1.53 | 1.41 | 1.53 | 1.53 | 1.47 | 1.53 | 1.60 | 1.60 | 1.60 | 1.77 | 1.77 | 1.60 | 1.28 |

RUN NO.=262 S= 48.26 AQ= 14.854 DELTSUB= 6.85QC= 0.9000 T1= 21.35 T2= 41.86 TC= 69.20

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 83.1 | 85.4 | 89.1 | 87.5 | 84.9 | 84.1 | 84.1 | 84.3 | 84.4 | 84.3 | 84.4 | 84.3 | 83.6 | 83.1 | 84.1 | 82.3 |
| TL | 71.1 | 72.8 | 74.5 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.23 | 1.19 | 1.02 | 1.32 | 1.72 | 1.90 | 1.90 | 1.86 | 1.81 | 1.86 | 1.81 | 1.86 | 2.02 | 2.15 | 1.90 | 2.46 |

RUN NO.=263 S= 44.79 AQ= 18.800 DELTSUB= 6.00QC= 1.8500 T1= 21.35 T2= 34.05 TC= 68.05

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 84.3 | 86.4 | 89.3 | 87.9 | 86.4 | 85.6 | 85.8 | 85.8 | 85.8 | 85.6 | 85.8 | 85.6 | 84.7 | 84.7 | 85.1 | 82.9 |
| TL | 71.7 | 73.2 | 74.7 | 76.2 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 | 76.3 |
| HT | 1.50 | 1.42 | 1.29 | 1.61 | 1.84 | 2.02 | 1.97 | 1.97 | 1.97 | 2.02 | 1.97 | 2.02 | 2.22 | 2.22 | 2.12 | 2.83 |

RUN NO.=264 S= 38.54 AQ= 18.800 DELTSUB= 8.00QC= 1.8500 T1= 20.35 T2= 33.56 TC= 67.40

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 84.3 | 86.9 | 86.4 | 85.4 | 85.4 | 84.4 | 85.1 | 85.1 | 84.9 | 84.9 | 84.9 | 84.7 | 84.3 | 83.8 | 84.4 | 82.3 |
| TL | 70.3 | 72.9 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 | 75.6 |
| HT | 1.34 | 1.35 | 1.73 | 1.93 | 1.93 | 2.12 | 1.98 | 1.98 | 2.02 | 2.02 | 2.02 | 2.07 | 2.17 | 2.29 | 2.12 | 2.81 |

RUN NO.=265 S= 33.68 AQ= 18.800 DELTSUB= 18.55QC= 1.9500 T1= 20.60 T2= 32.58 TC= 69.00

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 82.3 | 85.6 | 85.8 | 85.1 | 85.1 | 84.7 | 85.4 | 85.8 | 85.8 | 85.8 | 86.0 | 85.6 | 85.1 | 84.7 | 85.6 | 83.1 |
| TL | 62.1 | 66.8 | 71.4 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 | 76.1 |
| HT | 0.93 | 1.00 | 1.31 | 2.08 | 2.08 | 2.17 | 2.02 | 1.93 | 1.93 | 1.93 | 1.89 | 1.98 | 2.08 | 2.17 | 1.98 | 2.65 |

RUN NO.=266 S= 28.13 AQ= 18.800 DELTSUB= 11.45QC= 1.8500 T1= 20.35 T2= 33.46 TC= 69.20

| Z | 0.05 | 0.10 | 0.15 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 | 1.10 | 1.20 | 1.30 | 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TW | 83.6 | 84.9 | 84.7 | 84.4 | 84.9 | 84.7 | 84.9 | 85.4 | 85.4 | 85.4 | 85.4 | 85.1 | 83.4 | 83.8 | 84.9 | 129.8 |
| TL | 68.2 | 72.1 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 | 75.9 |
| HT | 1.22 | 1.46 | 2.12 | 2.19 | 2.08 | 2.12 | 2.08 | 1.98 | 1.98 | 1.98 | 1.98 | 2.03 | 2.51 | 2.36 | 2.08 | 0.35 |

# APPENDIX D

## SAMPLE CALCULATIONS

D-1 Single Phase Closed Loop Thermosiphon Studies

D-2 Thermosiphon Reboiler Studies

## D-1 SINGLE PHASE CLOSED LOOP THERMOSIPHON STUDIES

### D-1.1 General

#### D-1.1.1 Heat transfer area

$d = 0.01905$ m

$L = 0.94$ m

$\therefore \quad A = \pi x 0.01905 x 0.94 = 0.05625 \ m^2$

#### D-1.1.2 Area of cross section

$a = \frac{\pi}{4} \times (0.01905)^2 = 2.85 \times 10^{-4} \ m^2$

#### D-1.1.3 Heat flux

$q = \frac{Q}{A} = \frac{Q}{0.05625} = 17.78 \ Q \ W/m^2$

### D-1.2 Standardization Calculations

Run No. = 4, Table A-6 (set up-I)

Mean wall temperature $= 61.27^{o}C$

Mean liquid temperature $= \frac{24.43+33.17}{2} = 28.8^{o}C$

At these temperatures,

$\rho_L = 995.98 \ kg/m^3$

$C_L = 4176.33 \ J/kg \ ^{o}C$

$k_L = 0.61537 \ W/m \ ^{o}C$

$\mu_L = 8.3059 \times 10^{-4} \ Ns/m^2$

$\beta = 2.8965 \times 10^{-4} \ ^{o}C^{-1}$

$\mu_w = 4.5333 \times 10^{-4} \ Ns/m^2$

#### D-1.2.1 Temperature drop across the wall of the test section

The temperature drop across the wall of a cylindrical test surface with conductive heat transfer may be computed by the equation,

$$\Delta T_w = \frac{q \ d_o}{2k_w} \ ln \ \frac{d_o}{d}$$

where $d_o = d + 2$ (wall thickness between inner surface and thermocouple bead)

$= 0.02063$ m

$$\Delta T_w = \frac{19.55\times10^3\times0.02063}{2\times377.9} \ln \frac{0.02063}{0.01905}$$

$= 0.0425\ ^oC$

where $k_w$ for copper $= 377.9$ W/m $^oC$

D-1.2.2 Heat balance

Heat input $= 19.55\times10^3\times0.05625$

$= 1099.7$ W

$$\text{Heat output} = \frac{1.80\times0.99598\times4176.33\times(33.17-24.43)}{60}$$

$= 1090.63$ W

$$\therefore \text{Heat loss} = \frac{1099.7-1090.63}{1090.63}\times 100$$

$= 0.83\%$

D-1.2.3 Forced convective Nusselt numbers

$$h_{exptl} = \frac{19.55\times10^3}{(61.27-28.8)}$$

$= 602.094$ W/m$^2$ $^oC$

$$Nu_{exptl} = \frac{602.094\times0.01905}{0.61537}$$

$= 18.64$

$$Nu_{pred} = 1.86(Re\ Pr\ \frac{d}{L})^{1/3} (\frac{\mu_L}{\mu_w})^{0.14} \chi \qquad \text{... Eq.(5.2)}$$

where

$$\chi = \frac{2.25[1+0.01(Gr)^{1/3}]}{\log Re}$$

$$Re = \frac{0.01905\times1.8\times60\times995.98\times1000\times2.7778\times10^{-4}}{8.3059\times10^{-4}\times10^6\times2.85\times10^{-4}}$$

$= 2404.6$

$$Pr = \frac{4176.33 \times 8.3059 \times 10^{-4}}{0.61537}$$

$$= 5.637$$

$$Gr = \frac{9.81 \times (0.01905)^3 \times 2.8965 \times 10^{-4} \times (61.27-28.8) \times (995.98)^2}{(8.3059 \times 10^{-4})^2}$$

$$= 9.17144 \times 10^5$$

$$\phi = \frac{2.25\left[1+0.01(9.17144 \times 10^5)^{1/3}\right]}{\log 2404.6}$$

$$= 1.318$$

$$\therefore Nu_{pred} = 1.86\left(2404.6 \times 5.637 \times \frac{0.01905}{0.94}\right)^{1/3} \times \left[\frac{8.3059 \times 10^{-4}}{4.533 \times 10^{-4}}\right]^{0.14} \times 1.318$$

$$= 17.41$$

$$\text{Deviation} = \frac{18.64 - 17.41}{17.41} \times 100$$

$$= 7.065\%$$

D-1.3 Thermosiphon Calculations

Run No. = 6, Table C-1, system-water

$$\text{Mean liquid temperature} = \frac{25.20+97.10}{2}$$

$$= 61.15^\circ C$$

At this temperature,

$C_L = 4179.6$ J/kg$^\circ$C

D-1.3.1 Temperature drop across the wall

$$\Delta T_w = \frac{10.66 \times 10^3 \times 0.02063}{2 \times 377.9} \ln \frac{0.02063}{0.01905}$$

$$= 0.023^\circ C$$

D-1.3.2 Circulation rate

$$m = \frac{\pi\, d\, L\, q}{C_L(T_{out}-T_{in})} \quad \frac{10.66 \times 10^3 \times 0.05625}{4179.6 \times (97.10-25.20)} \quad \ldots \text{Eq.}(5.4)$$

$$= 1.99533 \times 10^{-3} \text{ kg/sec.}$$

D-1.3.3 Liquid temperatures

$$(T_L)_z = \frac{0.1 x \pi dq}{m\ C_L} + (T_L)_{z'}$$

where

$z' = z-0.1$

$0.9 \geq z \geq 0.1$

Using this expression, $T_L$ values at different z are as under

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| z | 0.0 | 0.1 | .2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| $T_w$ | 33.8 | 49.4 | 57.3 | 64.2 | 74.3 | 79.6 | 87.7 | 95.6 | 104.2 | 105.6 |
| $T_L$ | 25.2 | 32.8 | 40.5 | 48.2 | 55.8 | 63.4 | 71.1 | 78.7 | 86.4 | 94.1 |

D-1.3.4 Local Nusselt numbers

At z = 0.4 m

Mean film temperature $= \frac{74.30+55.80}{2}$

$= 65.05\ ^oC$

At this temperature,

$\rho_L = 980.5\ kg/m^3$

$C_L = 4182.25\ J/kg^oC$

$k_L = 0.6637\ W/m^oC$

$\mu_L = 4.3135x10^{-4}\ Ns/m^2$

$\beta = 5.446x10^{-4}\ {}^oC^{-1}$

(a) Experimental Nusselt number

$$h_{exptl} = \frac{10.66x10^3}{(74.30-55.80)}$$

$$= 576\ W/m^2\ {}^oC$$

$$Nu_{exptl} = \frac{576x0.01905}{0.6637}$$

$$= 16.53$$

(b) Predicted Nusselt number

$$Nu_{pred} = 1.14(Gr\ Pr)^{0.388}\ (Re/Gr^{0.66})^{0.863} \qquad \text{... Eq.(6.9)}$$

$$Re = \frac{0.01905 \times 1.99533 \times 10^{-3}}{4.3135 \times 10^{-4} \times 2.85 \times 10^{-4}}$$

$$= 309.2$$

$$Pr = \frac{4182.25 \times 4.3135 \times 10^{-4}}{0.6637}$$

$$= 2.72$$

$$Gr = \frac{9.81 \times (0.01905)^3 \times 5.446 \times 10^{-4} (74.30-55.80) \times (980.50)^2}{(4.3135 \times 10^{-4})^2}$$

$$= 3.53 \times 10^6$$

$$\therefore Nu_{pred} = 1.14(3.53 \times 10^6 \times 2.72)^{0.388} \left[309.2/(3.53 \times 10^6)^{0.66}\right]^{0.863}$$

$$= 15.33$$

(c) Percent deviation

$$\text{Deviation} = \frac{16.53-15.33}{15.33} \times 100$$

$$= 7.83\%$$

D-1.3.5 Average Nusselt numbers

At $\ell/d = 42.0$ between $z = 0.0$ to $0.8$

$$\text{Mean film temperature} = \frac{33.8+25.2+104.2+86.4}{4}$$

$$= 62.4^{\circ}C$$

At this temperature,

$\rho_L = 981.92\ kg/m^3$

$C_L = 4180.4\ J/kg\ ^{\circ}C$

$k_L = 0.6613\ W/m^{\circ}C$

$\mu_L = 4.465 \times 10^{-4}\ Ns/m^2$

$\beta = 5.3 \times 10^{-4}\ {}^{\circ}C^{-1}$

(a) Experimental Nusselt number

$$(\Delta T)_{avg} = \frac{(33.8-25.2)+(104.2-86.4)}{2}$$
$$= 13.2^{o}C$$

$$\therefore (h_{exptl})_{avg} = \frac{10.66\times10^{3}}{13.2}$$
$$= 807.58\ W/m^{2}\ ^{o}C$$

and

$$(Nu_{exptl})_{avg} = \frac{807.58\times0.01905}{0.6613}$$
$$= 23.264$$

(b) Predicted Nusselt number

$$(Nu_{pred})_{avg} = 0.049(Gr\ Pr)_{avg}^{0.584}(Re)_{avg}^{-0.1312}(\ell/d)^{-0.622} \quad Eq.(6.10)$$

$$(Gr)_{avg} = \frac{9.81\times(0.01905)^{3}\times5.3\times10^{-4}\times13.2\times(981.92)^{2}}{(4.465\times10^{-4})^{2}}$$
$$= 2.295\times10^{6}$$

$$(Pr)_{avg} = \frac{4180.4\times4.465\times10^{-4}}{0.6613} = 2.8225$$

$$(Re)_{avg} = \frac{0.01905\times1.99533\times10^{-3}}{4.465\times10^{-4}\times2.85\times10^{-4}}$$
$$= 298.7$$

$$\therefore (Nu_{pred})_{avg} = 0.049(2.295\times10^{6}\times2.8225)^{0.584}\ (298.7)^{-0.1312} \times (42.0)^{-0.622}$$
$$= 21.56$$

(c) Percent deviation

$$\text{Deviation} = \frac{23.264-21.56}{21.56}\times100$$
$$= 7.9\%$$

## D-2 THERMOSIPHON REBOILER STUDIES

### D-2.1 General

#### D-2.1.1 Heat transfer area

$d = 0.02144$ m

$L = 1.44$ m

$A = \pi \times 0.02144 \times 1.44 = 0.097 \ m^2$

#### D-2.1.2 Area of cross section

$a = \frac{\pi}{4} \times (0.02144)^2$

$= 3.61 \times 10^{-4} m^2$

#### D-2.1.3 Heat flux

$$q = \frac{Q}{A} = \frac{V \times I}{0.097} = 10.31 \ V \times I \quad W/m^2$$

### D-2.2 Standardisation Calculations

Run No. = 5, Table A-6 (Setup-II)

Mean wall temperature $= 40.22^\circ C$

Mean liquid temperature $= \frac{29.2+32.1}{2}$

$= 30.65^\circ C$

At these temperatures,

$\rho_L = 995.43 \ kg/m^3$

$C_L = 4175.54 \ J/kg^\circ C$

$k_L = 0.61877 \ W/m^\circ C$

$\mu_L = 7.963 \times 10^{-4} \ Ns/m^2$

$\beta = 3.065 \times 10^{-4} \ {}^\circ C^{-1}$

$\mu_W = 6.49 \times 10^{-4} \ Ns/m^2$

D-2.2.1 Temperature drop across the wall of the test section

The temperature drop across the wall of a cylindrical test surface with simultaneous heat generation and conduction may be computed by the equation,

$$\Delta T_w = \frac{Q}{2\pi L k_w (D^2 - d^2)} \left[ D^2 \ln \frac{D}{d} - \frac{(D^2 - d^2)}{2} \right]$$

$$= \frac{3445.3 \times 0.097}{2\pi \times 1.44 \times 16.262 \left[ (0.0255)^2 - (0.02144)^2 \right]} \times \left[ (0.0255)^2 \ln \frac{0.0255}{0.02144} - \frac{\left[ (0.0255)^2 - (0.02144)^2 \right]}{2} \right]$$

$$= 0.2^\circ C$$

where k for the tube = 16.262 W/m °C

D-2.2.2 Heat balance

$$\text{Heat input} = 3445.3 \times 0.097$$

$$= 334.2 \text{ W}$$

$$\text{Heat output} = \frac{1.65 \times 995.43 \times 4175.54 \times (32.1 - 29.2)}{1000 \times 60}$$

$$= 331.4775 \text{ W}$$

$$\text{Heat loss} = \frac{334.2 - 331.4775}{331.4775} \times 100$$

$$= 0.82\%.$$

D-2.2.3 Forced Convective Nusselt numbers

$$h_{exptl} = \frac{3445.3}{(40.22 - 30.65)}$$

$$= 360 \text{ W/m}^2 \, ^\circ C$$

$$Nu_{exptl} = \frac{360 \times 0.02144}{0.61877}$$

$$= 12.474$$

$$Nu_{pred} = 1.86(Re\ Pr\ \frac{d}{L})^{1/3}(\frac{\mu_L}{\mu_w})^{0.14}\ \chi \qquad \ldots\ Eq.(5.2)$$

where

$$\chi = \frac{2.25[1+0.01(Gr)^{1/3}]}{\log Re}$$

$$Re = \frac{0.02144x1.65x60x995.43x1000x2.7778x10^{-4}}{7.963x10^{-4}x10^{6}x3.61x10^{-4}}$$

$$= 2041.7$$

$$Pr = \frac{4175.54x7.963x10^{-4}}{0.61877}$$

$$= 5.3735$$

$$Gr = \frac{9.81x(0.02144)^3x3.065x10^{-4}x(40.22-30.65)x(995.43)^2}{(7.963x10^{-4})^2}$$

$$= 4.43x10^5$$

$$\chi = \frac{2.25[1+0.01(4.43x10^5)^{1/3}]}{\log 2041.7}$$

$$= 1.202$$

$$\therefore\ Nu_{pred} = 1.86(2041.7x5.3735x\frac{0.02144}{1.44})^{1/3}\ x\ (\frac{7.963x10^{-4}}{6.49x10^{-4}})^{0.14}\ x\ 1.202$$

$$= 12.62$$

$$\therefore\ Deviation = \frac{12.474-12.62}{12.62}\ x\ 100$$

$$= -1.157\%$$

D-2.3 Reboiler Calculations

Run no. = 6, Table C-2, System-Water

D-2.3.1 Temperature drop across the wall

$$\Delta T_w = \frac{3672x0.097}{2\pi x1.44x16.262[(0.0255)^2-(0.02144)^2]}\ x$$

$$\left[(0.0255)^2 \ln \frac{0.0255}{0.02144} - \frac{(0.0255)^2-(0.02144)^2}{2}\right]$$

$$= 0.21\ ^oC$$

D-2.3.2 Boiling and Non-boiling Sections

$$\text{Mean liquid temperature} = \frac{98.35+99.8}{2} = 99.075\ ^{\circ}C$$

At this temperature,

$C_{L1} = 4219.24$ J/kg °C

At $T_s = 99.8$ °C,

$C_{L2} = 4220.2$ J/kg°C

$\lambda = 22.598 \times 10^5$ J/kg

Average bulk temperature of condenser water

$$= \frac{21.6+22.8}{2}$$

$$= 22.2^{\circ}C$$

at this temperature,

$C_{L_c} = 4180.16$ J/kg°C

Therefore, length of boiling section,

$$z_B = \left[\frac{F\, C_{L_c}(T_2-T_1)}{(\lambda+C_{L2}(T_s-T_{sc}))}\right] \Big/ \pi dq \qquad \text{... Eq.(5.7)}$$

$$= \left[\frac{0.0224 \times 4180.16 \times 1.2}{(22.598 \times 10^5 + 4220.2 \times 71)}\right] \Big/ \pi \times 0.02144 \times 3672$$

$$= 0.4 \text{ m}$$

$$\therefore \quad z_{NB} = 1.44-0.4$$

$$= 1.04 \text{ m}$$

D-2.3.3 Circulation rate

$$m = \frac{\pi\, d\, z_{NB}\, q}{C_{L1}(T_s-T_{in})} \qquad \text{... Eq.(5.9)}$$

$$= \frac{\pi \times 1.04 \times 3672 \times 0.02144}{4219.24(99.8-98.35)}$$

$$= 0.042 \text{ kg/sec}$$

D-2.3.4 Vapour fraction at exit of test section:

$$x = \frac{\dfrac{F \times C_{L_c} \times (T_2 - T_1)}{\lambda + C_{L2} \times (T_s - T_{sc})}}{m} \qquad \text{... Eq.(5.12)}$$

$$= \frac{\dfrac{0.0224 \times 4180.16 \times 1.2}{22.598 \times 10^5 + 4220.2 \times 71}}{0.042}$$

$$= 1.0453 \times 10^{-3}$$

D-2.3.5 Local liquid temperatures and heat transfer coefficients

$$T_L = \frac{(T_s - T_{in})}{z_{NB}} \times z + T_{in} \qquad \text{... Eq.(5.13)}$$

$$\Delta T_z = (T_w - T_L)_z$$

and

$$h_z = \frac{q}{\Delta T_z}$$

Using these expressions, say for $z = 0.2$ m

$$T_L = \frac{1.45}{1.04} \times 0.2 + 98.35$$

$$= 98.63^\circ C$$

$$\Delta T_z = 102.76 - 98.63$$

$$= 4.13^\circ C$$

$$h_z = 889 \ W/m^2 \ ^\circ C$$

(rest values are tabulated in Table C-2)

D-2.3.6 Onset of boiling:

(a) Determination of point of onset of boiling:

$$\left(\frac{z_{OB}}{L} \times 100\right)_{exptl} = 69.478$$

$$\left(\frac{z_{OB}}{L} \times 100\right)_{pred} = 544.899\times10^{-6}(Pe_B)^{0.00143}(K_{sub})^{0.1326} \times (S)^{2.405}$$ ... Eq.(6.14)

Physical properties at $T_s = 99.8^oC$

$\rho_L = 958.5\ kg/m^3$

$\rho_v = 0.588\ kg/m^3$

$C_L = 4220.2\ J/kg\ ^oC$

$k_L = 0.683\ W/m^oC$

$\sigma_L = 0.06\ N/m$

$\lambda = 22.598\times10^5\ J/kg$

Using these properties,

$$Pe_B = \frac{3672\times958.5\times4220.2}{0.588\times22.598\times10^5\times0.683}\sqrt{\frac{0.06}{9.8067(958.5-0.588)}}$$

$$= 41.363$$

$$K_{sub} = \left(1 + \frac{958.5}{0.588} \times \frac{1.45}{99.8}\right)$$

$$= 24.68$$

and $S = 96.874$

$$\therefore \left(\frac{z_{OB}}{L} \times 100\right)_{pred} = 544.899\times10^{-6}(41.363)^{0.00143}(24.68)^{0.1326} \times (96.874)^{2.405}$$

$$= 50.13$$

$$\text{Deviation} = \frac{69.478-50.13}{50.13} \times 100$$

$$= 38.6\%$$

(b) Determination of $\delta^*/r_c$ at the point of onset of boiling

$$\left(\frac{\delta^*}{r_c}\right)_{exptl} = \sqrt{\frac{(T_w-T_s)^2 k_L\ \lambda\ \rho_v}{2q\ \sigma\ T_s}}$$ ... Eq.(6.11)

$(T_w - T_s)_{OB} = 7.6\ ^oC$

$$\therefore \quad \left(\frac{\delta^*}{r_c}\right)_{exptl} = \sqrt{\frac{(7.6)^2 x 0.683 x 22.598 x 10^5 x 0.588}{2 x 3672 x 0.06 x 372.96}}$$

$$= 17.86$$

and $$\left(\frac{\delta^*}{r_c}\right)_{pred} = 16.42 - \frac{0.10576\ q}{1000} \qquad \ldots \text{Eq.}(6.12)$$

$$= 16.42 - \frac{0.10576 x 3672}{1000}$$

$$= 16.032$$

$$\text{Deviation} = \frac{17.86 - 16.032}{16.032} x 100$$

$$= 11.4\%$$

D-2.3.7 Non-Boiling Region

$$\text{Mean average bulk temperature} = \frac{T_{in} + T_s}{2}$$

$$= \frac{98.35 + 99.8}{2}$$

$$= 99.075\ ^oC$$

At this temperature,

$\rho_L = 959.00\ kg/m^3$

$k_L = 0.6827\ W/m\ ^oC$

$C_L = 4220.3\ J/kg\ ^oC$

$\beta = 7.432 x 10^{-4}\ ^oC^{-1}$

$\mu_L = 2.797 x 10^{-4}\ \frac{Ns}{m^2}$

(a) Experimental Average Nusselt number

$(\Delta T_{NB})_{avg} = 5.75^oC$

$$(h_{NB})_{avg} = \frac{3672}{5.75}$$

$$= 638.6\ W/m^2\ ^oC$$

$$(Nu_{NB})_{avg} = \frac{638.6 \times 0.02144}{0.6827}$$

(b) Predicted Average Nusselt number

$$(Nu_{NB})_{avg} = 0.0126 (Gr\ Pr)_{avg}^{0.481} (Re)_{avg}^{0.0638} (z_{OB}/d)^{-0.23}$$

... Eq.(6.17)

$$(Gr)_{avg} = \frac{9.81 \times (0.02144)^3 \times 5.75 \times 7.432 \times 10^{-4} \times (959)^2}{(2.797 \times 10^{-4})^2}$$

$$= 4.857 \times 10^6$$

$$(Pr)_{avg} = \frac{4220.3 \times 2.797 \times 10^{-4}}{0.6827}$$

$$= 1.729$$

$$(Re)_{avg} = \frac{0.02144 \times 4 \times 0.042}{3.14 \times (0.02144)^2 \times 2.797 \times 10^{-4}}$$

$$= 8922$$

$$\frac{z_{OB}}{d} = \frac{0.9}{0.02144}$$

$$= 41.98$$

$$\therefore \quad (Nu_{NB})_{avg} = 0.0126 (4.857 \times 10^6 \times 1.729)^{0.481} (8922)^{0.0638} \times (41.98)^{-0.23}$$

$$= 20.4$$

(c) Percent deviation

$$\text{Deviation} = \frac{20.05 - 20.4}{20.4} \times 100$$

$$= -1.72\%$$

D-2.3.8 Boiling Region:

(a) Heat transfer coefficient

$$(h_B)_{exptl} = \frac{q}{\Delta T_B}$$

$$= \frac{3672}{(101.95 - 99.8)} = 1707.9 \text{ W/m}^2\ ^oC$$

$$(h_B)_{pred} = 17.509\ q^{0.556} \quad \text{... Eq.(6.15)}$$

$$= 17.509\ (3672)^{0.556}$$

$$= 1680.15\ W/m^2\ ^oC$$

$$\text{Deviation} = \frac{1707.9-1680.15}{1680.15} \times 100$$

$$= 1.65\%$$

(b) Nusselt numbers

$$(Nu_B)_{exptl} = \frac{h\ d}{k_L}$$

$$= \frac{1707.9 \times 0.02144}{0.683}$$

$$= 53.6$$

$$(Nu_B)_{pred} = 6.142(Pe_B)^{0.462} \left(\frac{1}{X_{tt}}\right)^{0.0134} (Pr)^{1.0143} \left(\frac{\nu_{H_2O}}{\nu_L}\right)^{1.743} \quad \text{... Eq.(6.19)}$$

at $T_s = 99.8\ ^oC$

$$\mu_L = 2.762 \times 10^{-4}\ Ns/m^2$$

$$\mu_v = 11.972 \times 10^{-6}\ Ns/m^2$$

and $Pe_B = 41.363$

$$\frac{\nu_{H_2O}}{\nu_L} = 1.00$$

$$Pr = \frac{C_L\ \mu_L}{k_L}$$

$$= \frac{4220.2 \times 2.762 \times 10^{-4}}{0.683}$$

$$= 1.7066$$

$$\frac{1}{X_{tt}} = \left[\left(\frac{1-x}{x}\right)^{0.9} \left(\frac{\rho_v}{\rho_L}\right)^{0.5} \left(\frac{\mu_L}{\mu_v}\right)^{0.1}\right]^{-1}$$

$$= \left[\left(\frac{1-1.0453 \times 10^{-3}}{1.0453 \times 10^{-3}}\right)^{0.9} \left(\frac{0.588}{958.5}\right)^{0.5} \left(\frac{2.762 \times 10^{-4}}{11.972 \times 10^{-6}}\right)^{0.1}\right]^{-1}$$

$$= 0.0613$$

$$\therefore \quad (Nu_B)_{pred} = 6.142(41.363)^{0.462}(0.0613)^{0.0134}(1.7066)^{1.01}$$

$$= 56.8$$

$$\text{Deviation} = \frac{53.6-56.8}{56.8} \times 100$$

$$= -5.63\%$$

D-2.3.9 Comparison of experimental $h_B$ with those predicted by earlier correlations:

(i) Gel'perin, et al [40]

$$(h_B)_{pred} = 3.38\left(\frac{L}{d}\right)^{0.2} q^{0.64}$$

$$= 3.38\left(\frac{1.44}{0.02144}\right)^{0.2}(3672)^{0.64}$$

$$= 1499.3 \ W/m^2 \ ^oC$$

$$\text{Deviation} = \frac{1707.9-1499.3}{1499.3} \times 100$$

$$= 13.9\%$$

(ii) Dengler and Addoms [27]

$$\left(\frac{h_{TP}}{h_L}\right)_{pred} = 3.5\left(\frac{1}{X_{tt}}\right)^{0.5}$$

where,

$$\frac{h_L d}{k_L} = 0.023(Re)^{0.8}(Pr)^{0.4}$$

$$Re = \frac{4dm}{\pi d^2 \mu_L} = \frac{4 \times 0.02144 \times 0.042}{3.14 \times (0.02144)^2 \times 2.762 \times 10^{-4}}$$

$$= 9035$$

$$Pr = 1.7066$$

$$\therefore (h_L)_{pred} = 0.023 \times (9035)^{0.8} \times (1.7066)^{0.4} \times \frac{0.683}{0.02144}$$

$$= 1325.9 \ W/m^2 \ ^oC$$

and

$$(h_{TP})_{pred} = 1325.9 \times 3.5(0.0613)^{0.5}$$

$$= 1149.0 \ W/m^2 \ ^oC$$

$$\text{Deviation} = \frac{1707.9-1149}{1149} \times 100$$
$$= 48.6\%$$

(iii) Guerrieri and Talty [44]

$$\left(\frac{h_{TP}}{h_L}\right)_{pred} = 3.4\left(\frac{1}{X_{tt}}\right)^{0.45}$$

where,

$$\frac{h_L d}{k_L} = 0.023\left(\frac{4d\ m\ (1-x)}{\pi\ d^2 \mu_L}\right)^{0.8} (Pr)^{0.4}$$

here

$$\frac{4dm(1-x)}{\pi d^2\ \mu_L} = 9035x(1-1.0453x10^{-3})$$
$$= 9025.56$$

$$\therefore \quad (h_L)_{pred} = 0.023x(9025.56)^{0.8} x(1.7066)^{0.4} x \frac{0.683}{0.02144}$$
$$= 1324.82\ W/m^2\ ^oC$$

and,
$$(h_{TP})_{pred} = 1324.82x3.4(0.0613)^{0.45}$$
$$= 1282.3\ W/m^2\ ^oC$$

$$\text{Deviation} = \frac{1707.9-1282.3}{1282.3} \times 100$$
$$= 33.2\%$$

(iv) Bennett, et al [6]

$$\frac{h_{TP}}{h_L} = 0.64(q')^{0.11}\left(\frac{1}{X_{tt}}\right)^{0.74}$$

where, $q'$ = heat flux, $BTU/hr\ ft^2$

and $h_L$ = all liquid heat transfer coefficient as calculated in (iii)

hence,
$$q' = \frac{0.86xq}{4.882}$$
$$= \frac{0.86x3672}{4.882}$$
$$= 646.85\ BTU/hr\ ft^2$$

and

$$h_{TP} = 0.64 x 1324.82 (646.85)^{0.11} (0.0613)^{0.74}$$
$$= 218.9 \ W/m^2 \ {}^oC$$

$$\text{Deviation} = \frac{1707.9 - 218.9}{218.9} \times 100$$
$$= 680\%.$$

(v) Calus et al [11]

Average heat transfer coefficient

$$\text{Experimental } (\Delta T_B)_{avg} = \frac{\sum_n \Delta T_n}{n}$$

$$= \frac{6.4 + 4.7 + 3.2 + 2.15 + 2.15}{5}$$

$$= 3.72^oC$$

$$\therefore \text{Experimental } (h_B)_{avg} = \frac{3672}{3.72} = 987.1 \ W/m^2 \ {}^oC$$

Average vapour fraction over two phase region,

$$(x)_{avg} = \frac{x}{2} = \frac{1.0453 x 10^{-3}}{2}$$

$$= 5.2265 x 10^{-4}$$

$$(X_{tt})_{avg} = \left(\frac{1 - 5.2265 x 10^{-4}}{5.2265 x 10^{-4}}\right)^{0.9} \left(\frac{0.588}{958.5}\right)^{0.5} \left(\frac{2.762 x 10^{-4}}{11.972 x 10^{-6}}\right)^{0.1}$$
$$= 30.46$$

$$\text{and, predicted } (h_L)_{avg} = 0.023 \left[\frac{0.042 x 0.02144 x (1 - 5.2265 x 10^{-4})}{2.762 x 10^{-4} x 3.61 x 10^{-4}}\right]^{0.8} x$$

$$(1.7066)^{0.4} x \frac{0.683}{0.02144}$$

$$= 1325.35 \ W/m^2 \ {}^oC$$

$$\therefore \text{Predicted } (h_{TP})_{avg} = 0.065 \times 1325.35 \left(\frac{1}{30.46}\right)\left(\frac{99.8}{3.72}\right)(1)^{0.9}$$

$$= 75.88 \text{ W/m}^2\ {}^{\circ}\text{C}$$

$$\text{Deviation} = \frac{987.1 - 75.88}{75.88} \times 100$$

$$= 1200\%.$$

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