Reichert TS 400

Catalog No. 13740000
Total Solids Refractometer
Serum Protein 6.54

INSTRUCTION MANUAL

Reichert®

REICHERT TS-METER

Total Solids Refractometer
Serum Protein 6.54
Model TS400

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1.0 Introduction

The Reichert TS Meter Model TS400 (Part Number 13740000) Total Solids Refractometer has been designed for simple, rapid microanalysis in biomedical, chemistry and classroom laboratories. The determination of concentrations of solutions is one of the oldest uses of refractometry. The TS METER Refractometer offers unprecedented simplicity of application, lending itself to checks and controls of many laboratory reagents, preparations, pharmaceuticals, and specimens.

Scales are calibrated for protein concentration of plasma or serum (Grams/100ml) and specific gravity of urine and refractive index.

Determinations are precise and rapid and require only a few drops of fluid sample. The value on the appropriate scale seen through the eyepiece is read where the sharp boundary between the dark and light fields crosses the scale. The instruments are temperature compensated for temperatures between 60°F (16°C) and 90°F (32.5°C). The reading does not need to be adjusted for the sample or ambient temperature.

The accuracy of the determination of total solids-or water-in plasma and urine from measurement of refractive index, and for the measurement of specific gravity of urine from refractive index, has been well documented.[1]-2,3,20 The estimation of plasma or serum protein concentration by refractometry has also been advocated for many years.[4]-[9]

2.0 Operating Instructions

Hold the instrument in a horizontal position (Figure 2). To minimize evaporation, place the cover plate over the measuring prism, then place the sample liquid on the exposed end of the measuring prism. The liquid will be drawn

into the space between the prism and the cover plate by capillary action. Take care to avoid lifting the cover plate before the reading is made. A dropper may be used to transfer the sample to the measuring prism. The dropper should be plastic to minimize the possibility of scratching the prism surface.

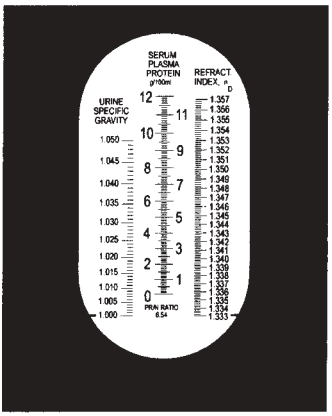
To obtain a reading, hold the instrument underneath a light source so the light is shining down into the sample prism. To obtain the optimum contrast between the light and dark boundary, the instrument must be properly tilted under the light source. The eyeguard may be extended to reduce reflections. To lock in place, gently turn the eyeguard clockwise.

Focus the scale (Figure 1) seen in the eyepiece by rotating the eyepiece. This setting does not need to be changed as long as the same individual continues to use the instrument. Read the appropriate scale at the point where the dividing line between bright and dark fields cross. Use the conversion tables in this manual, if required.

Use a soft cloth or tissue moistened with water to wipe the prism and dry thoroughly. If the prism surface or cover plate is not cleaned before the next sample is loaded, an erroneous or fuzzy reading may result. Do not immerse the eyepiece in water. Never use gritty cleaning compounds or extremely hot water to clean the prism. WARNING: Never expose the instrument to temperatures above 150°F(60°C).

3.0 Calibration

The zero setting of the TS METER Refractometer rarely needs adjustment. In order to check adjustment, make sure the temperature of the instrument is between 60°F (15°C) and 77°F (25°C) and take a reading with distilled water. If a reading departs from 1.000 on the Urine Specific Gravity scale by more than 1 /2 division or 0.05% , gently remove the black rubber plug on the underside of the instrument and turn the adjustment screw with the supplied 1.5mm alien wrench tool clockwise to increase the reading, counterclockwise to decrease it. Make sure that final motion is clockwise. Seal the hole with the plug after the correct reading has been obtained.



TS400 image as seen through eyepiece
Figure 1

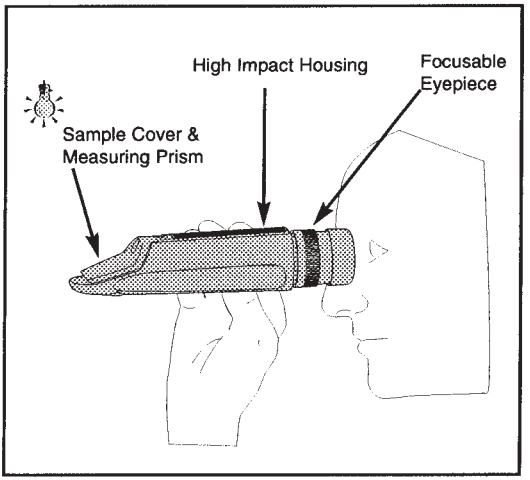


Figure 2

4.0 Temperature Compensation

The actual physical quantity measured by the TS METER is refractive index. The TS METER's scales show this value as specific gravity, protein concentration and refractive index. The relationship between refractive index and the quantity used is derived from an analysis of published and unpublished experimental data. Since refractive index changes appreciably with temperature, the conversion formulas are valid at a standard temperature only.

The TS METER Refractometer is temperature compensated to give correct readings directly on aqueous solutions at all temperatures ranging from 60°F (16°C) to 90°F (32.5°C). The maximum error occurs at the extremes of the scale but never by more than 0.1%.

If the refractometer is used as a dipping instrument, three to five minutes should be allowed if the temperature of the solution differs substantially from that of the instrument.

5.0 Non-Aqueous Solutions

The TS METER is temperature compensated for aqueous solutions. The refractive index temperature coefficient of oils, hydrocarbons or other liquid products is generally larger than that of water. Precautions should thus be taken if materials other than aqueous solutions are measured.

At temperatures between 65°F (18°C) and 70°F (21°C), the reading will generally be correct for all products.

6.0 Use of TS Meter Refractometer Conversion Tables

If using the direct reading scales in the instrument and the conversion tables in this manual remember that these measurements are specific for two types: plasma/serum and urine. These scales are NOT a valid measure of other samples without conversion.

7.0 Serum Total Solids and Water Measurement: Serum and Urine Solute Concentrations Based Upon Water

The convenience of estimating serum total solids with the TS METER Refractometer makes it useful not merely as an absolute and comparative measure of solids, but also as a measure of serum water. The concentration of water in serum (g/100 ml) and percent water in serum are given in the conversion table. Individual solute concentrations are readily converted from a serum to a serum water base: e.g., serum sodium,146mEq/L of serum; TS METER reading, 9.0%; water concentration (from conversion table), 93.3 gm/100 ml or 0.933 kg/ml; and 146/0.933 = 156 mEq of sodium/kg of serum water. If desired, the concentration of sodium in extra-cellular fluid, corrected for Donnan ratio, can be found from 156 x 0.95 = 148 mEq of sodium/kg of water of extracellular fluid.

Similarly, the conversion tables shown at the end of this manual can help you determine urinary water as a percent or as a concentration; e.g., urine reading on the specific gravity scale, 1.035; actual urine solids.

8.0 Estimation of Protein by Refractometry

Although it is practical for many purposes to estimate total serum protein by refractometric methods, certain points should be kept in mind. Measurements of serum protein depends on high correlation between refraction and total solids. In the computation of the table, the two non-protein solids fractions are considered: ultrafiltrates proportional to water concentration, and lipids (and other high molecular weight compounds proportional to the protein concentration). Total non-protein solids is the sum of these two fractions. While the accuracy of estimate of total solids is approximately Al gm%, that of protein may be somewhat less.[7] This follows from the variability of concentration of such serum solutes as glucose, urea, salts and lipids, especially in certain disease states.[8]

The TS METER Refractometer reticle and conversion tables (pages 6-11) are scaled primarily for the measurement of serum or plasma protein and must not be applied indiscriminately to other protein-containing solutions. Pure water set and read at scale zero is sufficient to check the TS METER since the instrument is itself standardized optically. If further testing is desired, it is advisable to use an aqueous solution whose refractive index is well known from concentrative conversion tables.[15,16]

Total protein in urine and certain other fluids can be measured refractometrically from the determination of total solids in the fluid before and after protein has been removed by heat.[9,18]

9.0 Estimation of Specific Gravity and Total Solids of Urine by Refractometry

In part because the TS METER Refractometer measures total solids in urine to an accuracy of $\pm$.1 gm%, and since it requires a change of ea 0.25 gm % in total solids to change specific gravity by ca. 0.001 units, optical urinometry is excellent for clinical measurement of specific gravity. The reticle of the TS METER Refractometer and conversion tables are scaled for human urine. Few normal human urines exceed 1.035. Much higher values suggest the presence of unusual solutes in the specimen which have high specific gravity increments per osmol (e.g. glucose, sucrose, protein, radiopaque iodine compounds, sodium sulfate, etc.). Because refraction correlates relatively poorly with specific gravity, in contrast to total solids in solutions of variable composition, especially at high concentrations, refractometric readings will not provide reliable extrapolation of urine specific gravity to values in excess of 1.035. Such extrapolation is particularly not advised in animals which may produce exceedingly hypergravic and hypersteric urines. Urinary total solids or the refractive index difference as a measure of absolute and relative concentration is a preferred method.

10.0 Estimation of Concentration of Other Body Fluids and of Pure Solutions

Fluids such as pancreatic juice, saliva and prostatic fluid may also be analyzed refractometrically. However, interpretation of such refractions should not be made without reference to suitable standardization. It may be inappropriate to use the TS METER scale of serum directly for this purpose.[20]

11.0 Refraction Scale

The refractive index scale (1.333-1.357) allows a check of a single solute concentration to be made in seconds. The results obtained can then be confirmed against published tables for known aqueous solutions. In addition, graphs for other solutions can be prepared by plotting points for several known concentrations against refraction.

12.0 Information Obtainable with the Leica TS Meter

URINE, 68°F (20°C)

1. Specific Gravity, 68°F (20°C), $D_{20/20}$ sp.g). Direct scale reading, TS METER.
2. Total Solids % Composition by Weight, (TS %). Read instrument scale and use Conversion Table.
3. Total Solids Concentration, grams/100 ml, 68°F (20°C), (C_{TS} g/100 ml). Read instrument scale and use Conversion Table.
4. Water % Composition by Weight (Water %). Subtract total solids % composition above from 100%.
5. Water Concentration, grams/100mL, 68°F (20°C), (C_W, g/100 ml). Read instrument scale and use Conversion Table.
6. Concentration Total Solids relative to water (CTS / C_W x 10^2 = grams/100 g water).

REFRACTIVE INDEX, 20°c.

1. Refractive Index (n) of aqueous or other solutions, 68°F (20°C). Direct scale reading with TS METER.

PLASMA OR SERUM, 68°F (20°C)

1. Specific Gravity, 68°F (20°C), $^{D}20/20$ sp.g). Read instrument scale and use Conversion Table.
2. Total Solids % Composition by Weight (TS%). Read instrument scale of protein and use Conversion Table.
3. Water % Composition by Weight, (Water %). Subtract total solids % composition above from 100%.
4. Total Solids Concentration, grams 100mL., 68°F (20°C), (C_W, g/100 ml). Read instrument scale and use Conversion Table.
5. Water Concentration, grams/100mL, 68°F (20°C), (C_W, g/100 ml). Read instrument scale and use Conversion Table.
6. Protein Concentration, grams/100mL, 68°F (20°C),(C_{PR}, g/100 ml). Direct scale reading with TS Meter.
7. Concentration Total Solids relative to water (C_{TS} / C_W x 10^2 = grams/100g water).

Notes: C=Concentration, TS=Total Solids, W=Water, Pr=Protein, NPr=Non-Protein Solids
Protein concentrations have been determined as differences between non-protein solids and total solids.
These protein concentrations are consistent with a Pr/N ratio of 6.54.

PLASMA OR SERUM, 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20	C_{TS}	C_W	C_{TS}/C_W x10²	C_{NPr}	TS%	* C_{Pr}	* (n-no) x10⁴	n	* D20/20	TS%	C_{TS}	C_W	C_{TS}/C_W x10²
sp.gr.	g/100 ml.	g/100 ml.	g/100 g	g/100 ml.	by wt.	g/100 ml.			sp.gr.	by wt.	g/100 ml	g/100 ml.	g/100 g
							0	1.3330	1.000	0.0	0.0	99.8	0.00
							2	1.3332	1.001	0.1	0.1	99.8	0.1
							4	1.3334	1.001	0.2	0.2	99.7	0.2
							6	1.3336	1.002	0.4	0.4	99.6	0.4
							8	1.3338	1.002	0.5	0.5	99.6	0.5
							10	1.3340	1.003	0.6	0.6	99.5	0.6
							12	1.3342	1.004	0.7	0.7	99.4	0.7
							14	1.3344	1.004	0.9	0.9	99.4	0.9
							16	1.3346	1.005	1.0	1.0	99.3	1.0
1.0072	1.0	99.5	1.0	1.00	1.0		18	1.3348	1.005	1.1	1.1	99.2	1.1
1.0075	1.1	99.5	1.1	1.01	1.1		20	1.3350	1.006	1.2	1.2	99.2	1.3
1.0078	1.2	99.4	1.2	1.02	1.2		22	1.3352	1.006	1.4	1.4	99.1	1.4
1.0080	1.3	99.3	1.3	1.02	1.3		24	1.3354	1.007	1.5	1.5	99.0	1.5
1.0083	1.4	99.2	1.5	1.03	1.4		26	1.3356	1.008	1.6	1.6	99.0	1.6
1.0086	1.6	99.1	1.6	1.04	1.5		28	1.3358	1.008	1.7	1.8	98.9	1.8
1.0088	1.7	99.0	1.7	1.05	1.6		30	1.3360	1.009	1.9	1.9	98.8	1.9
1.0091	1.8	99.0	1.8	1.06	1.8		32	1.3362	1.009	2.0	2.0	98.7	2.0
1.0094	1.9	98.9	1.9	1.06	1.9		34	1.3364	1.010	2.1	2.2	98.7	2.2
1.0096	2.0	98.8	2.0	1.07	2.0		36	1.3366	1.010	2.3	2.3	98.6	2.3
1.0099	2.1	98.7	2.1	1.08	2.1		38	1.3368	1.011	2.4	2.4	98.5	2.4
1.0102	2.2	98.6	2.2	1.09	2.2		40	1.3370	1.012	2.5	2.5	98.4	2.6
1.0104	2.3	98.5	2.4	1.09	2.3		42	1.3372	1.012	2.7	2.7	98.4	2.7
1.0107	2.4	98.5	2.5	1.10	2.4		44	1.3374	1.013	2.8	2.8	98.3	2.9
1.0110	2.5	98.4	2.6	1.11	2.5		46	1.3376	1.013	2.9	2.9	98.2	3.0
1.0112	2.7	98.3	2.7	1.12	2.6		48	1.3378	1.014	3.0	3.1	98.1	3.1

PLASMA OR SERUM. 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20	C_{TS}	C_W	C_{TS}/C_W x10²	C_{NPr}	TS%	* C_{Pr}	* (n-no) x10⁴	n	* D20/20	TS%	C_{TS}	C_W	C_{TS}/C_W x10²
sp.gr.	g/100 ml.	g/100 ml.	g/100 g	g/100 ml.	by wt.	g/100 ml			sp.gr.	by wt.	g/100 ml.	g/100 ml.	g/100 g
1.0112	2.7	98.3	2.7	1.12	2.6		48	1.3378	1.014	3.0	3.1	98.1	3.1
1.0115	2.8	98.2	2.8	1.13	2.7		50	1.3380	1.014	3.2	3.2	98.0	3.3
1.0117	2.9	98.1	2.9	1.13	2.8		52	1.3382	1.015	3.3	3.3	98.0	3.4
1.0120	3.0	98.0	3.0	1.14	3.0		54	1.3384	1.015	3.4	3.5	97.9	3.6
1.0123	3.1	97.9	3.2	1.15	3.1		56	1.3386	1.016	3.6	3.6	97.8	3.7
1.0125	3.2	97.9	3.3	1.16	3.2		58	1.3388	1.017	3.7	3.8	97.7	3.8
1.0128	3.3	97.8	3.4	1.17	3.3		60	1.3390	1.017	3.8	3.9	97.6	4.0
1.0131	3.4	97.7	3.5	1.17	3.4		62	1.3392	1.018	4.0	4.0	97.6	4.1
1.0133	3.5	97.6	3.6	1.18	3.5		64	1.3394	1.018	4.1	4.2	97.5	4.3
1.0136	3.7	97.5	3.7	1.19	3.6	2.5	66	1.3396	1.019	4.2	4.3	97.4	4.4
1.0139	3.8	97.4	3.9	1.20	3.7	2.6	68	1.3398	1.019	4.4	4.4	97.3	4.6
1.0141	3.9	97.4	4.0	1.21	3.8	2.7	70	1.3400	1.020	4.5	4.6	97.2	4.7
1.0144	4.0	97.3	4.1	1.21	3.9	2.8	72	1.3402	1.020	4.6	4.7	97.1	4.8
1.0147	4.1	97.2	4.2	1.22	4.0	2.9	74	1.3404	1.021	4.8	4.8	97.1	5.0
1.0149	4.2	97.1	4.3	1.23	4.2	3.0	76	1.3406	1.021	4.9	5.0	97.0	5.1
1.0152	4.3	97	4.5	1.24	4.3	3.1	78	1.3408	1.022	5	5.1	96.9	5.3
1.0155	4.4	96.9	4.6	1.25	4.4	3.5	80	1.3410	1.022	5.1	5.3	96.8	5.4
1.0157	4.5	96.8	4.7	1.25	4.5	3.3	82	1.3412	1.023	5.3	5.4	96.7	5.6
1.0160	4.7	96.8	4.8	1.26	4.6	3.4	84	1.3414	1.023	5.4	5.5	96.6	5.7
1.0163	4.8	96.7	4.9	1.27	4.7	3.5	86	1.3416	1.024	5.5	5.7	96.5	5.9
1.0165	4.9	96.8	5.1	1.28	4.8	3.6	88	1.3418	1.024	5.7	5.8	96.4	6.0
1.0168	5.0	96.5	5.2	1.29	4.9	3.7	90	1.3420	1.025	5.8	5.9	96.4	6.2
1.0171	5.1	96.4	5.3	1.29	5.0	3.8	92	1.3422	1.025	5.9	6.1	96.3	6.3
1.0173	5.2	96.3	5.4	1.30	5.1	3.9	94	1.3424	1.026	6.1	6.2	96.2	6.5
1.0176	5.3	96.3	5.6	1.31	5.2	4.0	96	1.3426	1.026	6.2	6.4	96.1	6.6
1.0179	5.4	96.2	5.7	1.32	5.4	4.1	98	1.3428	1.027	6.3	6.5	96.0	6.8
1.0181	5.6	96.1	5.8	1.33	5.5	4.2	100	1.3430	1.027	6.5	6.6	95.9	6.9

PLASMA OR SERUM, 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20	C_{TS}	C_W	C_{TS}/C_W x10²	C_{NPr}	TS%	* C_{Pr}	* (n-no) x10⁴	n	* D20/20	TS%	C_{TS}	C_W	C_{TS}/C_W x10²
sp.gr.	g/100 ml.	g/100 ml.	g/100 g	g/100 ml.	by wt.	g/100 ml.			sp.gr.	by wt.	g/100 ml.	g/100 ml.	g/100 g
1.0181	5.6	96.1	5.8	1.33	5.5	4.2	100	1.3430	1.027	6.5	6.6	95.9	6.9
1.0184	5.7	96.0	5.9	1.34	5.6	4.3	102	1.3432	1.028	6.6	6.8	95.8	7.1
1.0187	5.8	95.9	6	1.34	5.7	4.4	104	1.3434	1.028	6.7	6.9	95.7	7.2
1.0189	5.9	95.8	6.1	1.35	5.8	4.5	106	1.3436	1.029	6.9	7.0	95.6	7.4
1.0192	6.0	95.7	6.3	1.36	5.9	4.6	108	1.3438	1.029	7.0	7.2	95.5	7.5
1.0195	6.1	95.7	6.4	1.37	6.0	4.7	110	1.3440	1.030	7.1	7.3	95.5	7.7
1.0197	6.2	95.6	6.5	1.38	6.1	4.8	112	1.3442	1.030	7.3	7.5	95.4	7.8
1.0200	6.3	95.5	6.6	1.38	6.2	5.0	114	1.3444	1.031	7.4	7.6	95.3	8.0
1.0203	6.4	95.4	6.8	1.39	6.3	5.1	116	1.3446	1.031	7.5	7.7	95.2	8.1
1.0205	6.5	95.3	6.9	1.40	6.4	5.2	118	1.3448	1.032	7.7	7.9	95.1	8.3
1.0208	6.7	95.2	7.0	1.41	6.5	5.3	120	1.3450	1.032	7.8	8.0	95.0	8.4
1.0211	6.8	95.1	7.1	1.42	6.7	5.4	122	1.3452	1.032	7.9	8.2	94.9	8.6
1.0213	6.9	95.1	7.3	1.42	6.8	5.5	124	1.3454	1.033	8.0	8.3	94.8	8.7
1.0216	7.0	95.0	7.4	1.43	6.9	5.6	126	1.3456	1.033	8.2	8.4	94.7	8.9
1.0219	7.1	94.9	7.5	1.44	7.0	5.7	128	1.3458	1.034	8.3	8.6	94.6	9.1
1.0221	7.2	94.8	7.6	1.45	7.1	5.8	130	1.3460	1.034	8.4	8.7	94.5	9.2
1.0224	7.3	94.7	7.8	1.46	7.2	5.9	132	1.3462	1.035	8.6	8.8	94.4	9.4
1.0227	7.5	94.6	7.9	1.46	7.3	6.0	134	1.3464	1.035	8.7	9.0	94.4	9.5
1.0229	7.6	94.5	8.0	1.47	7.4	6.1	136	1.3466	1.036	8.8	9.1	94.3	9.7
1.0232	7.7	94.5	8.1	1.48	7.5	6.2	138	1.3468	1.036	9.0	9.3	94.2	9.8
1.0235	7.8	94.4	8.3	1.49	7.6	6.3	140	1.3470	1.037	9.1	9.4	94.1	10.0
1.0237	7.9	94.3	8.4	1.50	7.7	6.4	142	1.3472	1.037	9.2	9.5	94.0	10.1
1.0240	8.0	94.2	8.5	1.50	7.8	6.5	144	1.3474	1.037	9.3	9.7	93.9	10.3
1.0243	8.1	94.1	8.6	1.51	8.0	6.6	146	1.3476	1.038	9.5	9.8	93.8	10.5
1.0245	8.2	94.0	8.8	1.52	8.1	6.7	148	1.3478	1.038	9.6	9.9	93.7	10.6
1.0248	8.4	93.9	8.9	1.53	8.2	6.8	150	1.3480	1.039	9.7	10.1	93.6	10.8

PLASMA OR SERUM, 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20	C_{TS}	C_W	C_{TS}/C_W x10²	C_{NPr}	TS%	* C_{Pr}	* (n-no) x10⁴	n	* D20/20	TS%	C_{TS}	C_W	C_{TS}/C_W x10²
sp.gr.	g/100 ml.	g/100 ml.	g/100 g	g/100 ml.	by wt.	g/100 ml.			sp.gr.	by wt.	g/100 ml.	g/100 ml.	g/100 g
1.0248	8.4	93.9	8.9	1.53	8.2	6.8	150	1.3480	1.039	9.7	10.1	93.6	10.8
1.0251	8.5	93.8	9.0	1.54	8.3	6.9	152	1.3482	1.039	9.8	10.2	93.5	10.9
1.0254	8.6	93.8	9.2	1.55	8.4	7.0	154	1.3484	1.04	10.0	10.3	93.4	11.1
1.0256	8.7	93.7	9.3	1.55	8.5	7.1	156	1.3486	1.04	10.1	10.5	93.3	11.2
1.0259	8.8	93.6	9.4	1.56	8.6	7.2	158	1.3488	1.04	10.2	10.6	93.2	11.4
1.0262	8.9	93.5	9.5	1.57	8.7	7.4	160	1.3490					
1.0264	9.0	93.4	9.7	1.58	8.8	7.5	162	1.3492					
1.0267	9.1	93.3	9.8	1.59	8.9	7.6	164	1.3494					
1.0270	9.3	93.3	9.9	1.59	9.0	7.7	166	1.3496					
1.0272	9.4	93.2	10.1	1.60	9.1	7.8	168	1.3498					
1.0275	9.5	93.1	10.2	1.61	9.2	7.9	170	1.3500					
1.0278	9.6	93.0	10.3	1.62	9.4	8.0	172	1.3502					
1.0281	9.7	92.9	10.4	1.63	9.5	8.1	174	1.3504					
1.0283	9.8	92.8	10.6	1.63	9.6	8.2	176	1.3506					
1.0286	9.9	92.7	10.7	1.64	9.7	8.3	178	1.3508					
1.0289	10.0	92.7	10.8	1.65	9.8	8.4	180	1.3510					
1.0291	10.2	92.6	11.0	1.66	9.9	8.5	182	1.3512					
1.0294	10.3	92.5	11.1	1.67	10.0	8.6	184	1.3514					
1.0297	10.4	92.4	11.5	1.67	10.1	8.7	186	1.3516					
1.0300	10.5	92.3	11.4	1.68	10.2	8.8	188	1.3518					
1.0302	10.6	92.2	11.5	1.69	10.3	8.9	190	1.3520					
1.0305	10.7	92.1	11.6	1.70	10.4	9.0	192	1.3522					
1.0308	10.8	92.1	11.8	1.71	10.5	9.1	194	1.3524					
1.0311	10.9	92.0	11.9	1.72	10.6	9.2	196	1.3526					
1.0313	11.1	91.9	12.0	1.72	10.7	9.3	198	1.3528					
1.0316	11.2	91.8	12.2	1.73	10.8	9.4	200	1.3530					

PLASMA OR SERUM, 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20 sp.gr.	C_{TS} g/100 ml.	C_W g/100 ml.	C_{TS}/C_W x10² g/100 g	C_{NPr} g/100 ml.	TS% by wt.	* C_{Pr} g/100 ml.	* (n-rio) x10⁴	n	* D20/20 sp.gr.	TS% by wt.	C_{TS} g/100 ml.	C_W g/100 ml.	C_{TS}/C_W x10² g/100 g
1.0316	11.2	91.8	12.2	1.73	10.8	9.4	200	1.3530					
1.0319	11.3	91.7	12.3	1.74	11.0	9.5	202	1.3532					
1.0322	11.4	91.6	12.4	1.75	11.1	9.6	204	1.3534					
1.0324	11.5	91.6	12.6	1.76	11.2	9.8	206	1.3536					
1.0327	11.6	91.5	12.7	1.76	11.3	9.9	208	1.3538					
1.0330	11.7	91.4	12.8	1.77	11.4	10.0	210	1.3540					
1.0333	11.8	91.3	13.0	1.78	11.5	10.1	212	1.3542					
1.0335	12.0	91.2	13.1	1.79	11.6	10.2	214	1.3544					
1.0338	12.1	91.1	13.2	1.80	11.7	10.3	216	1.3546					
1.0341	12.2	91.0	13.4	1.80	11.8	10.4	218	1.3548					
1.0344	12.3	91.0	13.5	1.81	11.9	10.5	220	1.3550					
1.0346	12.4	90.9	13.7	1.82	12.0	10.6	222	1.3552					
1.0349	12.5	90.8	13.8	1.83	12.1	10.7	224	1.3554					
1.0352	12.6	90.7	13.9	1.84	12.2	10.8	226	1.3556					
1.0355	12.7	90.6	14.1	1.84	12.3	10.9	228	1.3558					
1.0357	12.9	90.5	14.2	1.85	12.4	11.0	230	1.3560					
1.0360	13.0	90.4	14.3	1.86	12.5	11.1	232	1.3562					
1.0363	13.1	90.4	14.5	1.87	12.6	11.2	234	1.3564					
1.0366	13.2	90.3	14.6	1.88	12.8	11.3	236	1.3566					
1.0369	13.3	90.2	14.8	1.89	12.9	11.4	238	1.3568					
1.0371	13.4	90.1	14.9	1.89	13.0	11.5	240	1.3570					
1.0374	13.5	90.0	15.0	1.90	13.1	11.6	242	1.3572					
1.0377	13.6	89.9	15.2	1.91	13.2	11.7	244	1.3574					
1.0380	13.8	89.9	15.3	1.92	13.3	11.8	246	1.3576					
1.0383	13.9	89.8	15.4	1.93	13.4	11.9	248	1.3578					
1.0385	14.0	89.7	15.6	1.93	13.5	12.0	250	1.3580					

PLASMA OR SERUM, 20°C.							REFRACTIVE INDEX 20°C.		URINE SOLIDS, 20°C.				
D20/20	C_{TS}	C_W	C_{TS}/C_W x10³	C_{NPr}	TS%	* C_{Pr}	* (n-no) x10⁴	n	* D20/20	TS%	C_{TS}	C_W	C_{TS}/C_W x10²
sp.gr	g/100 ml.	g/100 ml.	g/100 g	g/100 ml.	by wt.	g/100 ml.			sp.gr	by wt.	g/100 ml.	g/100 ml.	g/100 g
1.0385	14.0	89.7	15.6	1.93	13.5	12.0	250	1.3580					
1.0388	14.1	89.6	15.7	1.94	13.6	12.2	252	1.3582					
1.0391	14.2	89.5	15.9	1.95	13.7	12.3	254	1.3584					
1.0394	14.3	89.4	16.0	1.96	13.8	12.4	256	1.3586					
1.0397	14.4	89.4	16.1	1.97	13.9	12.5	258	1.3588					
1.0399	14.5	89.3	16.3	1.97	14.0	12.6	260	1.3590					
1.0402	14.7	89.2	16.4	1.98	14.1	12.7	262	1.3592					
1.0405	14.8	89.1	16.6	1.99	14.2	12.8	264	1.3594					
1.0408	14.9	89.0	16.7	2.00	14.3	12.9	266	1.3596					
1.0411	15.0	88.9	16.9	2.01	14.4	13.0	268	1.3598					
1.0414	15.1	88.9	17.0	2.01	14.5	13.1	270	1.3600					
1.0416	15.2	88.8	17.1	2.02	14.6	13.2	272	1.3602					
1.0419	15.3	88.7	17.3	2.03	14.7	13.3	274	1.3604					
1.0422	15.4	88.6	17.4	2.04	14.8	13.4	276	1.3606					
1.0425	15.5	88.5	17.6	2.05	14.9	13.5	278	1.3608					
1.0428	15.7	88.4	17.7	2.05	15.0	13.6	280	1.3610					
1.0431	15.8	88.4	17.8	2.06	15.1	13.7	282	1.3612					
1.0433	15.9	88.3	18.0	2.07	15.2	13.8	284	1.3614					
1.0436	16.0	88.2	18.1	2.08	15.3	13.9	286	1.3616					
1.0439	16.1	88.1	18.3	2.09	15.5	14.0	288	1.3618					
1.0442	16.2	88.0	18.4	2.09	15.6	14.1	290	1.3620					
1.0445	16.3	87.9	18.6	2.10	15.7	14.2	292	1.3622					
1.0448	16.4	87.9	18.7	2.11	15.8	14.3	294	1.3624					
1.0451	16.5	87.8	18.9	2.12	15.9	14.4	296	1.3626					
1.0453	16.7	87.7	19.0	2.13	16.0	14.5	298	1.3628					
1.0456	16.8	87.6	19.1	2.13	16.1	14.6	300	1.3630					

Notes: C=Concentration, TS=Total Solids, W=Water, Pr=Protein, NPr=Non-Protein Solids
Protein concentrations have been determined as differences between non-protein solids and total solids.
These protein concentrations are consistent with a Pr/N ratio of 6.54.
*Denotes scales which appear on instrument

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