Piccolo® Hepatic Function Panel

For In Vitro Diagnostic Use and For Professional Use Only
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1. Intended Use

The Piccolo® Hepatic Function Panel, used with the Piccolo Xpress® chemistry analyzer, is intended to be used for the *in vitro* quantitative determinations of alanine aminotransferase, albumin, alkaline phosphatase, aspartate aminotransferase, direct bilirubin, total bilirubin, and total protein in heparinized whole blood, heparinized plasma, or serum in a clinical laboratory setting or point-of-care location.

2. Summary and Explanation of Tests

The Piccolo Hepatic Function Panel reagent disc and the Piccolo Xpress chemistry analyzer comprise an *in vitro* diagnostic system that aids the physician in diagnosing the following disorders.

Alanine aminotransferase:	Liver diseases, including viral hepatitis and cirrhosis; heart diseases.
Albumin:	Liver and kidney diseases.
Alkaline phosphatase:	Liver, bone, parathyroid, and intestinal diseases.
Aspartate aminotransferase:	Liver disease including hepatitis and viral jaundice, shock.
Direct bilirubin:	Liver disorders, hemolytic hematological, and metabolic disorder, including hepatitis and gall bladder obstruction.
Total bililrubin:	Liver disorders, including hepatitis and gall bladder obstruction; jaundice.
Total protein:	Liver, kidney, bone marrow diseases; metabolic and nutritional disorders.

As with any diagnostic test procedure, all other test procedures including the clinical status of the patient should be considered prior to final diagnosis.

3. Principle of Procedure

Alanine Aminotransferase (ALT)
Alanine aminotransferase (ALT) has been measured by three methods. Two of these methods—the colorimetric dinitrophenylhydrazine coupling technique[1,2] and the fluorescent enzymatic assay—are rarely used.[3] An enzymatic method based on the work of Wróblewski and LaDue[4] is the most common technique for determining ALT concentrations in serum. A modified Wróblewski and LaDue procedure has been proposed as the recommended procedure of the International Federation of Clinical Chemistry (IFCC).[5]

The method developed for use on the Piccolo analyzer is a modification of the IFCC-recommended procedure. In this reaction, ALT catalyzes the transfer of an amino group from L-alanine to α-ketoglutarate to form L-glutamate and pyruvate. Lactate dehydrogenase catalyzes the conversion of pyruvate to lactate. Concomitantly, NADH is oxidized to NAD^+, as illustrated in the following reaction scheme.

$$\text{L-Alanine} + \alpha\text{-Ketoglutarate} \xrightarrow{\text{ALT}} \text{L-Glutamate} + \text{Pyruvate}$$

$$\text{Pyruvate} + \text{NADH} + \text{H+} \xrightarrow{\text{LDH}} \text{Lactate} + \text{NAD}^+$$

The rate of change of the absorbance difference between 340 nm and 405 nm is due to the conversion of NADH to NAD^+ and is directly proportional to the amount of ALT present in the sample.

Albumin (ALB)
Early methods used to measure albumin include fractionation techniques [6-8] and tryptophan content of globulins.[9,10] These methods are unwieldy to perform and do not have a high specificity. Two immunochemical techniques are considered as reference methods, but are expensive and time consuming.[11] Dye binding techniques are the most frequently used methods for measuring albumin. Bromcresol green (BCG) is the most commonly used of the dye binding methods but may over-estimate albumin concentration, especially at the low end of the normal range.[12] Bromcresol purple (BCP) is the most specific of the dyes in use.[13,14]

Bromcresol purple (BCP), when bound with albumin, changes color from a yellow to blue color. The absorbance maximum changes with the color shift.

$$\text{BCP} + \text{Albumin} \xrightarrow[\text{Acid pH}]{\text{Surfactants}} \text{BCP-Albumin Complex}$$

Bound albumin is proportional to the concentration of albumin in the sample. This is an endpoint reaction that is measured as the difference in absorbance between 600 nm and 550 nm.

Alkaline Phosphatase (ALP)
Techniques to measure alkaline phosphatase were first developed over 60 years ago. Several of these endpoint or two-point spectrophotometric methods[15,16] are now considered obsolete or too cumbersome. The use of *p*-nitrophenyl phosphate (*p*-NPP) increased the speed of the reaction.[17,18] The reliability of this technique was greatly increased by the use of a metal-ion buffer to maintain the concentration of magnesium and zinc ions in the reaction.[19] The American Association for Clinical Chemistry (AACC) reference method[20] uses *p*-NPP as a substrate and a metal-ion buffer.

The Piccolo procedure is modified from the AACC and IFCC[21] methods. Alkaline phosphatase hydrolyzes *p*-NPP in a metal-ion buffer and forms *p*-nitrophenol and phosphate.

$$\textit{p}\text{-Nitrophenyl Phosphate} \xrightarrow[Zn^{2+},\ Mg^{2+}]{\text{ALP}} \textit{p}\text{-Nitrophenol} + \text{Phosphate}$$

The amount of ALP in the sample is proportional to the rate of increase in absorbance difference between 405 nm and 500 nm.

Aspartate Aminotransferase (AST)
The aspartate aminotransferase (AST) test is based on the Karmen rate method[22] as modified by Bergmeyer.[23] The current International Federation of Clinical Chemistry (IFCC) reference method utilizes the Karmen / Bergmeyer technique of coupling malate dehydrogenase (MDH) and reduced nicotinamide dinucleotide (NADH) in the detection of AST in serum.[23,24] Lactate dehydrogenase (LDH) is added to the reaction to decrease interference caused by endogenous pyruvate.

AST catalyzes the reaction of L-aspartate and α-ketoglutarate into oxaloacetate and L-glutamate. Oxaloacetate is converted to malate and NADH is oxidized to NAD^+ by the catalyst MDH.

$$\text{L-aspartate} + \alpha\text{-ketoglutarate} \xrightarrow{\text{AST}} \text{Oxaloacetate} + \text{L-glutamate}$$

$$\text{Oxaloacetate} + \text{NADH} \xrightarrow{\text{MDH}} \text{Malate} + \text{NAD}^+$$

The rate of absorbance change at 340 nm / 405 nm caused by the conversion of NADH to NAD^+ is directly proportional to the amount of AST present in the sample.

Direct Bilirubin (DBIL)
Direct Bilirubin was first detected in human serum by Van Den Bergh and Müller when they observed that the pigment in human bile reacted with diazotized sulfanilic acid in the absence of alcohol.[25] Today, commonly used techniques to measure direct bilirubin are modifications of a method developed by Malloy and Evelyn[26] which relies on diazotized sulfanilic acid combining with bilirubin to form the chromophore azobilirubin. Some diazo methods produce unreliable results because unconjugated may be quantitated as direct bilirubin.[27] A more specific assay for total bilirubin was developed after the enzyme bilirubin oxidase was isolated from *Myrothecium verrucaria* MT-1.[28-30] This method is also specific for direct bilirubin when the reaction is run at a lower pH.[31,32]

In the enzymatic procedure, the soluble bilirubin complex (direct bilirubin) is oxidized by bilirubin oxidase into biliverdin.

$$\text{Soluble Bilirubin} + O_2 \xrightarrow[\text{Complex}]{\text{Bilirubin Oxidase}} \text{Biliverdin} + H_2O$$

Direct Bilirubin is quantitated as the difference in absorbance between 467nm and 550nm. The initial absorbance of this end point reaction is determined from the direct bilirubin blank cuvette and the final absorbance is obtained from the direct bilirubin test cuvette. The amount of direct bilirubin in the sample is proportional to the difference between the initial and final absorbance measurements.

Total Bilirubin (TBIL)
Total bilirubin levels have been typically measured by tests that employ diazotized sulfanilic acid.[26,33] A newer, more specific method has been developed using the enzyme bilirubin oxidase.[28-30] In addition to using the more specific total bilirubin test method, photodegradation of the analyte is minimized on the Piccolo Analyzer because the sample can be tested immediately after collection.

In the enzyme procedure, bilirubin is oxidized by bilirubin oxidase into biliverdin.

$$\text{Bilirubin} + O_2 \xrightarrow{\text{Bilirubin Oxidase}} \text{Biliverdin} + H_2O$$

Bilirubin is quantitated as the difference in absorbance between 467 nm and 550 nm. The initial absorbance of this endpoint reaction is determined from the bilirubin blank cuvette and the final absorbance is obtained from the bilirubin test cuvette. The amount of bilirubin in the sample is proportional to the difference between the initial and final absorbance measurements.

Total Protein (TP)
The total protein method is a modification of the biuret reaction, noted for its precision, accuracy, and specificity.[34] Originally developed by Riegler[35] and modified by Weichselbaum[36], Doumas, et al.[37] proposed a biuret reaction as a candidate total protein reference method.

In the biuret reaction, the protein solution is treated with cupric [Cu(II)] ions in a strong alkaline medium. Sodium potassium tartrate and potassium iodide are added to prevent the precipitation of copper hydroxide and the auto-reduction of copper, respectively.[36] The Cu(II) ions react with peptide bonds between the carbonyl oxygen and amide nitrogen atoms to form a colored Cu-protein complex.

$$\text{Total Protein} + \text{Cu(II)} \xrightarrow{OH^-} \text{Cu-Protein Complex}$$

The amount of total protein present in the sample is directly proportional to the absorbance of the Cu-protein complex. The total protein test is an endpoint reaction and the absorbance is measured as the difference in absorbance between 550 nm and 850 nm.

4. Principle of Operation

See the Piccolo Xpress chemistry analyzer Operator's Manual, for the Principles and Limitations of the Procedure.

5. Description of Reagents

Reagents
Each Piccolo Hepatic Function Panel reagent disc contains dry test-specific reagent beads (described below). A dry sample blank reagent (comprised of buffer, surfactants, excipients, and preservatives) is included in each disc for use in calculating

concentrations of alanine aminotransferase (ALT), albumin (ALB), alkaline phosphatase (ALP), aspartate aminotransferase (AST). Dedicated sample blanks are included in the disc for total bilirubin (TBIL), direct bilirubin (DBIL), and total protein (TP). Each reagent disc also contains a diluent consisting of surfactants, excipients, and preservatives.

Table 1: Reagents

Component	Quantity/Disc
L-Alanine	874 µg
L-Aspartic acid	426 µg
Bilirubin oxidase	0.2 U
Bromcresol purple	2 µg
Cupric sulfate	134 µg
α-Ketoglutaric acid	82 µg
Lactate dehydrogenase	0.13 U
Magnesium chloride	3 µg
Malate dehydrogenase (MDH) (porcine heart)	0.01 U
β-Nicotinamide adenine dinucleotide, reduced (NADH)	12 µg
p-NPP	56 µg
Potassium iodide	28 µg
Sodium potassium tartrate	343 µg
Zinc sulfate	3 µg
Buffers, Surfactants, excipients, and preservatives	

Warnings & Precautions

- For *in vitro* Diagnostic Use
- The diluent container in the reagent disc is automatically opened when the analyzer drawer closes. A disc with an opened diluent container cannot be re-used. Ensure that the sample or control has been placed into the disc before closing the drawer
- Used reagent discs contain human body fluids. Follow good laboratory safety practices when handling and disposing used discs.[38] See the Piccolo Xpress chemistry analyzer Operator's Manual for instructions on cleaning biohazardous spills.
- The reagent discs are plastic and may crack or chip if dropped. **Never** use a dropped disc as it may spray biohazardous material throughout the interior of the analyzer.
- Reagent beads may contain acids or caustic substances. The operator does not come into contact with the reagent beads when following the recommended procedures. In the event that the beads are handled (e.g., cleaning up after dropping and cracking a reagent disc), avoid ingestion, skin contact, or inhalation of the reagent beads.

Instructions for Reagent Handling

Reagent discs may be used directly from the refrigerator without warming. Do not allow discs sealed in foil pouches to remain at room temperature longer than 48 hours prior to use. Open the sealed foil pouch, remove the disc, and use according to the instructions provided in the Piccolo Xpress chemistry analyzer Operator's Manual. A disc not used within 20 minutes of opening the pouch should be discarded.

Storage

Store reagent discs in their sealed pouches at 2-8°C (36-46°F). Do not expose opened or unopened discs to direct sunlight or temperatures above 32°C (90°F). Reagent discs may be used until the expiration date included on the package. The expiration date is also encoded in the bar code printed on the bar code ring. An error message will appear on the Piccolo Xpress chemistry analyzer display if the reagents have expired.

Indications of Reagent Disc Instability/Deterioration

A torn or otherwise damaged pouch may allow moisture to reach the unused disc and adversely effect reagent performance. Do not use a rotor from a damage pouch.

6. Instrument

See the Piccolo Xpress chemistry analyzer Operator's Manual for complete information on using the analyzer.

7. Sample Collection and Preparation

Sample collection techniques are described in the Piccolo Xpress chemistry analyzer Operator's Manual.

- The minimum required sample size is ~100 µL of heparinized whole blood, heparinized plasma, serum, or serum control. The reagent disc sample chamber can contain up to 120 µL of sample.

- Whole blood samples obtained by venipuncture must be homogeneous before transferring a sample to the reagent disc. Gently invert the collection tube several times just prior to sample transfer. Do **not** shake the collection tube; shaking can caused hemolysis.

- Whole blood venipuncture samples should be run within 60 minutes of collection.[39] Refrigerating whole blood samples can cause significant changes in concentrations of **aspartate aminotransferase.**[40] The sample may be separated into plasma or serum and stored in capped sample tubes at 2-8°C (36-46°F) if the sample can not be run within 60 minutes.

- **Total and direct bilirubin** results may be adversely affected by photodegradation.[41] Whole blood samples not run immediately should be stored in the dark for no longer than 60 minutes. If the sample can not be analyzed within that period, it should be separated into plasma or serum and stored in a capped sample tube in the dark at low temperatures.[42]

- Use only lithium heparin evacuated specimen collection tubes for whole blood or plasma samples. Use no-additive evacuated specimen collection tubes or serum separator tubes for serum samples.

8. Procedure

Materials Required

- One Piccolo Hepatic Function Panel

Materials Required but Not Provided

- Piccolo Xpress chemistry analyzer

- Commercially available control reagents recommended by Abaxis (refer to the Piccolo Xpress chemistry analyzer Operator's Manual).

Test Parameters

- The Piccolo Xpress chemistry analyzer operates at ambient temperatures between 15°C and 32°C (59-90°F). The analysis time for each Piccolo Hepatic Function Panel is less than 14 minutes. The analyzer maintains the reagent disc at a temperature of 37°C (98.6°F) over the measurement interval.

Test Procedure

The complete sample collection and step-by-step operating procedures are detailed in the Piccolo Xpress chemistry analyzer Operator's Manual.

Calibration

The Piccolo Xpress chemistry analyzer is calibrated by the manufacturer before shipment. The bar code printed on the reagent disc bar code ring provides the analyzer with disc-specific calibration data. See the Piccolo Xpress chemistry analyzer Operator's Manual.

Quality Control

Performance of the Piccolo Xpress chemistry analyzer can be verified by running controls. Controls recommended by Abaxis are listed in the Piccolo Xpress chemistry analyzer Operator's Manual. Other human serum or plasma-based controls may not be compatible.

See the Piccolo Xpress chemistry analyzer Operator's Manual, for a detailed discussion on running, recording, interpreting, and plotting control results.

9. Results

The Piccolo Xpress chemistry analyzer automatically calculates and prints the analyte concentrations in the sample. Details of the endpoint and rate reaction calculations are found in the Piccolo Xpress chemistry analyzer Operator's Manual.

Interpretation of results is detailed in the Piccolo Xpress chemistry analyzer Operator's Manual. Results are printed onto results cards or paper rolls supplied by Abaxis. The result cards or paper rolls have an adhesive backing for easy placement in the patient's files.

10. Limitations of Procedure

General procedural limitations are discussed in the Piccolo Xpress chemistry analyzer Operator's Manual.

- The only anticoagulant **recommended for use** with the Piccolo blood chemistry analyzer is **lithium heparin**. Abaxis has performed studies demonstrating that EDTA, fluoride, oxalate, and any anticoagulant containing ammonium ions will interfere with at least one chemistry contained in the Piccolo Hepatic Function Panel.

- Samples with hematocrits in excess of 62% packed red cell volume may give inaccurate results. Samples with high hematocrits may be reported as hemolyzed. These samples may be spun down to get plasma then re-run in a new reagent disc.

- **Any result for a particular test that exceeds the assay range should be analyzed by another approved test method or sent to a referral laboratory. Do not dilute the sample and run it again on the Piccolo blood chemistry analyzer.**
  Warning: Extensive testing of the Piccolo Xpress chemistry anylzer has shown that in very rare instances, sample dispensed into the reagent disc may not flow smoothly into the sample chamber. Due to uneven flow, an inadequate quantity of sample may be analyzed and several results may fall outside the reference ranges. The sample may be re-run using a new reagent disc.

Interference

Substances were tested as interferents with the analytes. Human serum pools were prepared. The concentration at which each potential interferent was tested was based on testing levels in CLSI EP7-A.[45]

Effects of Endogenous Substances

- Physiological interferents (hemolysis, lipemia, and icterus) cause changes in the reported concentrations of some analytes. The sample indices are printed on the bottom of each test printout to inform the operator about the levels of interferents present in each sample. The Piccolo blood chemistry analyzer suppresses any results that are affected by > 10 % interference from hemolysis, icterus, and lipemia. "HEM", "LIP", "ICT" respectively, is printed on the results printout in place of the result.

Effects of Therapeutic Substances

- Significant interference is defined as a >10% shift in the results for a normal range specimen. Human pools were supplemented with a known concentration of the drugs or chemicals and then analyzed.

Table 2: Therapeutic Substances Evaluated

	Physiologic or Therapeutic Range[43-48] (mg/dL)	Highest Concentration Tested (mg/dL)
Endogenous Substances		
Acetaminophen	1-2	100
Acetylsalicylic acid	2-10	50
Chloramphenicol	1-2.5	100
Cimetidine	0.1-1	16
Erythromycin	0.2-2	10
Isoniazide	0.1-0.7	4
Ketoprofen	—	50
Methicillin	—	100
Methotrexate	0.1	0.5
Metronidazole	0.1	5
Nafcillin	—	1
Oxacillin	—	1
Phenytoin	1-2	3

Table 3: Substances With Significant Interference > 10%

	Physiologic or Therapeutic Range[43-48] (mg/dL)	Concentration with Significant Interference (mg/dL)	Interference[A]
Alanine Aminotransferase (ALT)			
Ascorbic acid	0.8-1.2	20	11% inc
Oxaloacetate	—	132	843% inc
Albumin (ALB)			
Acetoacetate	0.05-3.60	102	18% dec
Ampicillin	0.5	30	12% dec
Caffeine	0.3-1.5	10	14% dec
Calcium chloride	—	20	17% dec
Cephalothin (Keflin)	10	400	13% inc
Ibuprofen	0.5-4.2	50	28% inc
α-Ketoglutarate	—	5	11% dec
Nitrofurantoin	0.2	20	13% dec
Proline	—	4	12% inc
Sulfalazine	2-4	10	14% dec
Sulfanilamide	10-15	50	12% dec
Theophylline	1-2	20	11% dec
Alkaline Phosphatase (ALP)			
Theophylline	1-2	20	42% dec
Aspartate Aminotransferase (AST)	None	None	None
Direct Total Bilirubin (DBIL)			
Ascorbic acid	0.8-1.2	2.5	30% dec
Dopamine	0.3-1.5	15	50% dec
Total Bilirubin (TBIL)			
Dopamine	—	19	55% dec
L-dopa	—	5	17% dec
Total Protein (TP)	None	None	None

[A] Dec.= decreased concentration of the specified analyte; Inc. = increased concentration of the specified analyte

For additional information on potential chemical interferents, see the Bibliography.

11. Expected Values

Samples from a total of 125 adult males and females analyzed on the Piccolo blood chemistry analyzer, were used to determine the reference intervals. These ranges are provided as a guideline only. ALP levels in growing children are highly variable.[47] It is recommended that your office or institution establish normal ranges for your particular patient population.

Table 4: Piccolo References Intervals

Analyte	Reference Interval	
	Common Units	**SI Units**
Alanine Amino-transferase (ALT)	10-47 U/L	10-47 U/L
Albumin (ALB)	3.3-5.5 g/dL	33-55 g/L
Alkaline Phosphatase (ALP), Male	53-128 U/L	53-128 U/L
Alkaline Phosphatase (ALP), Female	42-141 U/L	42-141 U/L
Aspartate Amino-transferase (AST)	11-38 U/L	11-38 U/L
Direct Bilirubin (DBIL)	0-0.3 mg/dL	0-5.1 µmol/L
Total Bilirubin (TBIL)	0.2-1.6 mg/dL	3.4-27.4 µmol/L
Total Protein (TP)	6.4-8.1 g/dL	64-81 g/L

12. Performance Characteristics

Linearity
The chemistry for each analyte is linear over the dynamic range listed below when the Piccolo blood chemistry analyzer is operated according to the recommended procedure (refer to the Piccolo blood chemistry analyzer Manual).

Table 5: Piccolo Dynamic Ranges

Analyte	Dynamic Range	
	Common Units	**SI Units**
Alanine Aminotransferase (ALT)	5-2000 U/L	5-2000 U/L
Albumin (ALB)	1-6.5 g/dL	10-65 g/L
Alkaline Phosphatase (ALP)	5-2400 U/L	5-2400 U/L
Aspartate Amino-transferase (AST)	5-2000 U/L	5-2000 U/L
Direct Bilirubin (DBIL)	0.1-15 mg/dL	1.7-257 µmol/L
Total Bilirubin (TBIL)	0.1-30 mg/dL	1.7-513 µmol/L
Total Protein (TP)	2-14 g/dL	20-140 g/L

Sensitivity (Limits of Detection)
The lower limit of detection for each analyte is: alanine aminotransferase 5 U/L; albumin 1 g/dL (10 g/L); alkaline phosphatase 5 U/L; aspartate aminotransferase 5 U/L; direct bilirubin 0.1mg/dL (1.7 µmol/L); total bilirubin 0.1 mg/dL (1.7 µmol/L); and total protein 2 g/dL (20 g/L).

Precision
For all assays precision studies were conducted using CLSI EP5-A guidelines.[49] Results for within-run and total precision were determined by testing two levels of control material. Controls were run in duplicate twice each day for 20 days over a four-week period. Results of the precision studies are shown in Table 6.

Table 6: Precision (N=80)

Analyte	Within-Run	Total
Alanine Aminotransferase (U/L)		
Control Level 1	21	21
Mean	2.76	2.79
SD	13.4	13.5
%CV		
Control Level 2		
Mean	52	52
SD	2.70	3.25
%CV	5.2	6.2
Albumin (g/dL)		
Control Level 1		
Mean	5.6	5.6

Table 6: Precision (N=80) (contined)

Analyte	Within-Run	Total
SD	0.09	0.11
%CV	1.7	2.1
Control Level 2		
Mean	3.7	3.7
SD	0.07	0.11
%CV	2.0	2.9
Alkaline Phosphatase (U/L)		
Control Level 1		
Mean	39	39
SD	1.81	2.29
%CV	4.6	5.8
Control Level 2		
Mean	281	281
SD	4.08	8.75
%CV	1.5	3.1
Aspartate Aminotransferase (U/L)		
Control Level 1		
Mean	47	49
SD	0.98	0.92
%CV	2.1	1.9
Control Level 2		
Mean	145	147
SD	1.83	1.70
%CV	1.3	1.2
Direct Bilirubin (mg/dL)		
Control Level 1		
Mean	0.4	0.4
SD	0.03	0.03
%CV	6.5	6.6
Control Level 2		
Mean	2.2	2.2
SD	0.10	0.12
%CV	4.8	5.6
Total Bilirubin (mg/dL)		
Control Level 1		
Mean	0.8	0.8
SD	0.06	0.07
%CV	8.0	9.3
Control Level 2		
Mean	5.2	5.2
SD	0.09	0.15
%CV	1.7	2.8
Total Protein (g/dL)		
Control Level 1		
Mean	6.8	6.8
SD	0.05	0.08
%CV	0.8	1.2
Control Level 2		
Mean	4.7	4.7
SD	0.09	0.09
%CV	2.0	2.0

Correlation

Heparinized whole blood and serum samples were collected from patients at two sites. The whole blood samples were analyzed by the Piccolo Xpress chemistry analyzer at the field sites and the serum samples were analyzed by the Piccolo Xpress chemistry analyzer and by comparative methods. In some cases, high and low supplemented samples were used to cover the dynamic range. All samples were run in singlicate on the same day. Representative correlation statistics are shown in Table 7.

Table 7: Correlation of Piccolo Blood Chemistry Analyzer with Comparative Method

Analyte	Correlation coefficient	Slope	Intercept	SEE	N	Sample Range	Comparative Method
Alanine Aminotransferase (U/L)	0.981	0.905	1.3	3.21	86	10-174	Paramax®
	0.985	0.946	-2.5	2.84	67	10-174	Technicon
Albumin (g/dL)	0.854	1.001	-0.3	0.22	261	1.1-5.3	Paramax®
	0.896	0.877	-0.1	0.21	100	1.5-5.0	Beckman
Alkaline Phosphatase (U/L)	0.988	0.970	-5.9	3.97	99	27-368	Paramax®
	0.929	1.136	-17.6	4.79	80	26-150	Technicon
AspartateAminotransferase (U/L)	0.93	0.87	5.3	2.76	159	13-111	Paramax®
	1.0	0.97	3.0	1.90	46	13-252	DAX™
Direct Bilirubin (mg/dL)	0.990	0.88	-0.1	0.08	263	0-12.8	Paramax®
Total Bilirubin (mg/dL)	0.974	0.901	0.0	0.07	250	0.2-3.7	Paramax®
	0.980	1.113	-0.4	0.09	91	0.1-6.4	Beckman
Total Protein (g/dL)	0.849	0.932	0.6	0.19	251	5.7-9.2	Paramax®
	0.873	0.935	0.3	0.16	92	6.5-9.2	Beckman

*Serum samples from hospitalized patients provided a broader, and possibly more useful, sample range than did venous whole blood samples from outpatients.

13. Symbols

Use By

Catalog Number

Batch Code

In Vitro Diagnostic Medical Device

Consult Instructions For Use

Manufacturer

Do Not Reuse

X Number of Test Devices in Kit

Manufacturing Sequence

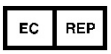
Serial Number

Caution

Temperature Limitation

Authorized Representative in Switzerland

PN:
Part Number



Authorized Representative In the European Community

Denotes conformity to specified European directives

UDI Barcode structure in Health Industry Bar Code (HIBC) standard format

Unique Device Identifier (UDI) in human and machine-readable form used to adequately identify medical devices through their distribution and use

Separate waste collection for this electronic item indicated; Equipment manufactured / placed on the market after 13 August 2005; Indicates compliance with Article 14(4) of Directive 2012/19/EU (WEEE) for the European Union (EU).

14. Bibliography

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