

Multistix[®] PRO 10LS Reagent Strips

Tests for Protein–High, Protein–Low, Creatinine, Blood, Leukocytes, Nitrite, Glucose, Ketone (Acetoacetic Acid), pH, and Specific Gravity in Urine.

INTENDED USE:

Siemens Healthcare Diagnostics Multistix[®] PRO Reagent Strips for Urinalysis include test pads for protein–high, protein–low, creatinine, blood, leukocytes, nitrite, glucose, ketone (acetoacetic acid), pH, and specific gravity. Please refer to the carton or bottle label to see which tests are included on the product you are using.

Multistix PRO Reagent Strips are for professional *in vitro* diagnostic use in near patient (point-of-care) and centralized laboratory locations. The strips are intended for use in at-risk patient groups to assist diagnosis in the following areas¹⁻³:

- kidney function
- urinary tract infections
- carbohydrate metabolism (e.g., diabetes mellitus)

The strips also measure physical characteristics, including acid-base balance and urine concentration. Test results can be used along with other diagnostic information to rule out certain disease states.^{1,4}

SUMMARY AND EXPLANATION:

The Multistix PRO Reagent Strips are ready to use upon removal from the bottle, and the reagent strip is disposable. The strips may be read visually, requiring no additional laboratory equipment for testing. The strips can also be read instrumentally, using the CLINITEK[®] family of Urine Chemistry Analyzers and the appropriate software. The CLINITEK Status[®] systems and CLINITEK 50 instruments automatically identify the strip being tested, using the colored ID band near the handle of the strip. Contact your product representative for further information. Siemens Reagent Strips have been determined to be nonhazardous under the guidelines issued by OSHA in 29 CFR 1910.1200(d).

INFORMATION REGARDING CLIA WAIVER:

- The CLINITEK Status systems and CLINITEK 50 Analyzers are CLIA waived only when used with Siemens Reagent Strips, manufactured by Siemens.
- These tests are CLIA waived when read visually and when run on the CLINITEK Status systems and CLINITEK 50 Analyzers. A certificate of CLIA waiver is required to perform these tests in a waived setting. To obtain a Certificate of Waiver, contact your state department of health or visit the CMS web site for an application, Form CMS-116.
- Failure to adhere to the instructions for use, including instructions for limitations, intended use, and performing quality control testing, is off-label use, resulting in these tests being categorized as high complexity and subject to all CLIA regulations.

SPECIMEN COLLECTION AND PREPARATION:

Collect freshly-voided urine in a clean container and test it as soon as possible. The container should allow for complete dipping of all reagent strip areas. A first-morning specimen is preferred but random collections are acceptable. Test the urine within two hours after voiding. If unable to test within the recommended time, refrigerate the specimen immediately and let it return to room temperature, between 15–30°C (59–86°F), before testing. The use of urine preservatives is not recommended.



CAUTION: Ensure that work areas and specimen containers are always free of detergents and other contaminants. Some substances can interfere with patient results. Contamination of the urine specimen with skin cleansers containing chlorhexidine may affect protein test results. The user should determine whether the use of such cleansers is warranted.

PROCEDURE:

1. Collect a fresh urine specimen in a clean, dry container.
2. Mix well just before testing, but do not centrifuge.
3. Check the expiration date on the Reagent Strip bottle. If the date has passed, discard and get a new bottle. Record the opening date on the label.

Use of Reagent Strips beyond the expiration date may yield inaccurate results.

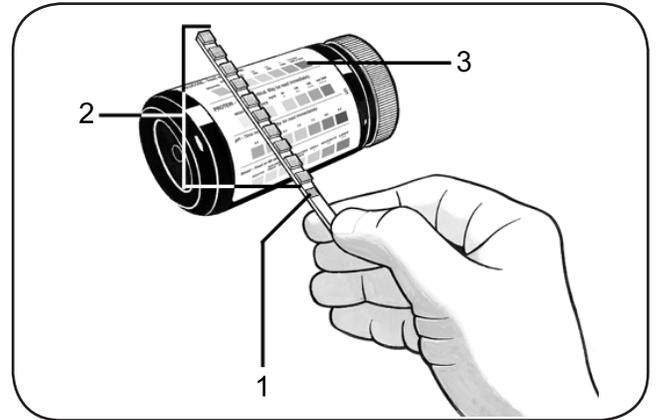
4. Remove a strip from the bottle and replace the cap.
 - NOTE:** Do not touch the test pads on the strip.
5. Dip all the test pads of the strip into the urine and immediately remove the strip. If reading the strip visually, start timing.

NOTE: The ID band can be dipped into urine and controls solutions.

6. Drag the edge of the strip against the container rim to remove excess urine and blot the edge on a paper towel or tissue if using the CLINITEK 50 or CLINITEK Status Analyzers. It is not necessary to blot if reading visually or using the CLINITEK Advantus[®] Analyzer.

7. If reading visually:

- **Compare** each test pad to the corresponding row of color blocks on the bottle label.
- **Read** each pad at the time shown on the label, starting with the shortest time.
- **Hold** the strip close to the color blocks and match carefully.
- **Read** the pads in good light.



1. ID Band 2. Test Pads 3. Color Block

If using an analyzer, place the test strip on the analyzer according to the analyzer operating manual. The analyzer automatically reads each test pad at a specified time.

HELPFUL HINTS: Discoloration or darkening of the test pads may indicate deterioration. If this is evident, or if test results are inconsistent with expected findings, the following steps are recommended:

1. Confirm that the product is within the expiration date shown on the label.
2. Check performance against known negative and positive control materials.
3. Retest with fresh product.

RESULTS: With visual use, results are obtained in clinically meaningful units directly from the Color Chart comparison. A single protein result should be reported, based on the protein–low and protein–high readings; a protein-to-creatinine ratio can also be determined.

Reporting Visual Protein Result and Ratio (see examples below):

1. Report the higher reading of the two pads (Protein–Low and Protein–High) as the protein result. Report “Negative” if both readings are negative.
2. You can determine the protein-to-creatinine ratio using the table below. Locate the square that corresponds to **both** the reported protein result, from Step 1 above, and the creatinine result.

Reported Protein Result (mg/dL)	Creatinine Result (mg/dL)				
	10	50	100	200	300
Negative	Recollect*			Normal	
15	Abnormal				
30					
100, 300, or 2000					

*Specimen is too dilute to accurately determine ratio result. Repeat test on new specimen, preferably a first-morning collection.

Examples:

Protein Readings	Reported Protein Result	Creatinine Result	Protein-to-Creatinine Ratio
Protein–High = Negative Protein–Low = 15 mg/dL	15 mg/dL	200 mg/dL	Normal
Protein–High = 30 mg/dL Protein–Low = 15 mg/dL	30 mg/dL	200 mg/dL	Abnormal

With **CLINITEK** instruments, the test pads are “read” by the instrument and the results are displayed or printed as soon as they are available. The instrument reports a single protein result, based on the protein–low and protein–high readings, and calculates the protein-to-creatinine ratio.

QUALITY CONTROL: Test negative and positive controls when you first open a new bottle. Water should NOT be used as a negative control. Each laboratory should establish its own goals for adequate standards of performance. For information about control manufacturers, contact the Siemens Customer Service Department.

CLIA-WAIVED LABORATORIES:

Test positive and negative quality controls with new lots, new shipments of reagents, and when you open a new bottle of reagent strips. Test reagents monthly that are stored for more than 30 days.

Run QC tests to ensure reagent strips integrity; train new users; confirm test performance; and when patients’ clinical conditions or symptoms do not match. Also, run QC tests per your laboratory procedures. Liquid ready-to-use controls are available. Do not use water as a negative control. For recommendations and technical questions, call Technical Support at 877-229-3711 or visit www.siemens.com/diagnostics.

Compare QC results to the QC manufacturer’s acceptable results list. If the QC results are not acceptable, do not test the patient samples until you solve the problem. Repeat QC tests until you have acceptable results.

STORAGE: All unused strips must remain in the original bottle. Transfer to any other container may cause reagent strips to deteriorate and become unreactive. Store at temperatures between 15–30°C (59–86°F). Do not use the strips after their expiration date. Do not store the bottle in direct sunlight and do not remove the desiccant from the bottle.

IMPORTANT NOTE: PROTECTION AGAINST EXPOSURE TO LIGHT, HEAT AND AMBIENT MOISTURE IS MANDATORY TO GUARD AGAINST ALTERED REAGENT REACTIVITY.

REAGENT PERFORMANCE:

Expected values for the “normal” healthy population and the abnormal population are listed below for each reagent.

Sensitivities listed for each reagent are the generally detectable levels of the analytes in contrived urines; however, because of the inherent variability of clinical urines, lesser concentrations may be detected under certain conditions. The percentage of clinical specimens correctly detected as positive increases with analyte concentration.

Performance characteristics are based on clinical and analytical studies and depend upon several factors: the variability of color perception; the presence or absence of inhibitory and matrix factors typically found in urine; and the laboratory conditions in which the product is used (e.g., lighting, temperature, and humidity). The strips should be read in good light, such as fluorescent; do not read in direct sunlight.

Each color block or instrumental result represents a range of values. Because of specimen and reading variability, specimens with analyte concentrations that fall between nominal levels may give results at either level. Results will usually be within one level of the true concentration. Exact agreement between visual results and instrumental results might not be found because of the inherent differences between the perception of the human eye and the optical systems of the instruments.

Limitations given for the reagents include specific substances and conditions that may affect the test results. **As with all laboratory tests, definitive diagnostic or therapeutic decisions should not be based on any single result or method.**

Substances that cause abnormal urine color may affect the readability of test pads on urinalysis reagent strips. These substances include visible levels of blood or bilirubin and drugs containing dyes (e.g., Pyridium®, Azo Gantrisin®, Azo Ganfanol®, nitrofurantoin (Macrochantin®, Furadantin®), or riboflavin. Levels of ascorbic acid normally found in urine do not interfere with these tests.

PROTEIN:

Expected values: Protein in urine can be the result of urological and nephrological disorders. Albumin has been established as an appropriate marker of glomerular damage. Albumin is normally present in urine at concentrations of 0.5–2.0 mg/dL. Increased albumin excretion (2.0–30 mg/dL) is indicative of nephropathy in high-risk groups.^{2,6,7}

In normal urine, less than 150 mg of total protein is excreted per day (< 15 mg/dL), while clinical proteinuria is indicated at greater than 500 mg of protein per day (strip result of ≥ 30 mg/dL). Positive results may also indicate tubular or overflow proteinuria in the absence of any glomerular abnormality or proteins of renal origin that may be excreted during infection. Urinary protein excretions can be temporarily elevated in the absence of renal abnormality by strenuous exercise, orthostatic proteinuria, dehydration, urinary tract infections, and acute illness with fever.^{1,6,8}

Sensitivity: 8–15 mg/dL albumin (Protein–Low) **PRO_LO**
30–65 mg/dL protein (Protein–High) **PRO_HI**

Performance characteristics: The Protein–Low test can accurately and specifically determine albumin. A strip result of 15 mg/dL is indicative of clinical albuminuria. The test is not affected by other proteins at concentrations at least nine times greater than the excretion rate considered to be abnormal.^{9,10}

The Protein–High test pad is not specific for a particular protein, and proteins other than albumin can cause a positive response. The test is less sensitive

to mucoproteins and globulins, which are generally detected at levels of 60 mg/dL or higher.¹⁰

Limitations: A visibly bloody urine (≥ 5 mg/dL) may cause falsely elevated results.¹⁰

CREATININE **CRE** :

Expected values: The normal creatinine concentration in adults is 0.6–2.0 g of creatinine per day (strip results of approximately 50–200 mg/dL). Random urines may have strip results that vary from 10–300 mg/dL. Concentrated urines from dehydrated individuals or first morning specimens will typically have elevated concentrations (strip results of ≥ 200 mg/dL); diuresis will typically result in lower concentrations (strip results of ≤ 50 mg/dL).^{1,11}

Performance characteristics: The test will detect creatinine in concentrations as low as 10 mg/dL or as high as 300 mg/dL. The absence of creatinine in a specimen cannot be determined.

Limitations: A visibly bloody urine (≥ 5 mg/dL) or the presence of cimetidine (Tagamet®) may cause falsely elevated results.¹²

PROTEIN-TO-CREATININE RATIO **PRO:CRE** :

Expected values: Clinical proteinuria is usually indicated at a ratio result of 300 mg protein/g creatinine.² “Normal” strip ratio results may occur in urines containing less than 80 mg albumin/g creatinine or less than 300 mg protein/g creatinine.

Performance characteristics: Use of the protein-to-creatinine ratio can assist in the diagnosis of kidney function by minimizing the impact of changes in the protein result due to exercise, diuresis and urine concentration.^{8,11} The ratio improves the results for single-void specimens compared to timed specimens in the discrimination of normal and abnormal levels of protein.

A ratio result of “Normal Dilute” is reported instrumentally when the protein result is below the sensitivity limits and the creatinine result is 10 mg/dL. In this case, consider testing a new specimen, preferably a first morning collection, for greater confidence in the result. Very low creatinine results can be caused by adulteration of the urine specimen or by severe renal failure.^{13,14}

Limitations: The ratio cannot be accurately determined if the creatinine result is 10 mg/dL and the protein–low result is Negative, when the strip is read visually. A new specimen, preferably a first-morning collection, should be tested. Both the protein and P:C ratio results should be considered when making a decision about the clinical diagnosis or need for confirmatory testing.

BLOOD **BLO** :

Expected values: Normally, no hemoglobin is detectable in urine (< 0.010 mg/dL or 3 RBC/μL). Occult blood occurs in urine as intact erythrocytes and hemoglobin, which can occur during urological, nephrological and bleeding disorders. Small amounts of blood (0.030–0.065 mg/dL or a strip result of Small) are sufficiently abnormal to require further investigation. The significance of the Trace reaction may vary among patients, and clinical judgment is required for assessment in an individual case. Blood is often, but not always, found in the urine of menstruating females.^{1,15}

Sensitivity: 0.015–0.062 mg/dL hemoglobin

Performance characteristics: The appearance of green spots on the reacted test pad indicates the presence of intact erythrocytes, while green color across the entire test pad indicates free hemoglobin. The test is equally sensitive to myoglobin as to hemoglobin. This test complements the microscopic examination; a hemoglobin concentration of 0.015–0.062 mg/dL is approximately equivalent to 5–20 intact red blood cells per microliter.

Limitations: Capoten® (captopril) may reduce the sensitivity. Certain oxidizing contaminants, such as hypochlorite, may produce false positive results. Microbial peroxidase associated with urinary tract infection may cause a false positive reaction.

LEUKOCYTES **LEU** :

Expected values: Normal urine specimens generally yield negative results. An increase in leukocytes (≥ 10 leukocytes/μL) is an indication of pyuria and is found in nearly all diseases of the kidney and urinary tract; however, pyuria may often be present in non-infective conditions.¹ A strip result of Small or greater is a useful indicator of infection. Trace results may be of questionable clinical significance; however, Trace results observed repeatedly may be clinically significant.

Sensitivity: 5–15 white blood cells/hpf in clinical urine.

Performance characteristics: Leukocyte esterase is a reliable indicator of leukocytes in urine. A positive reaction (Small or greater) at less than the 2 minute reading time may be regarded as a positive indication of leukocytes in urine.

Limitations: Elevated glucose concentrations (≥ 3 g/dL) may cause decreased test results. The presence of cephalixin (Keflex®), cephalothin, or high concentrations of oxalic acid may also cause decreased test results. Tetracycline may cause decreased reactivity, and high levels of the drug may cause a false negative reaction. Positive results may occasionally be due to contamination of the specimen by vaginal discharge.

NITRITE **NIT** :

Expected values: Normally no nitrite is detectable in urine. Many enteric gram-negative organisms give positive results when their number is greater than 10⁵/mL (0.075 mg/dL nitrite ion or greater).²

Sensitivity: 0.06–0.1 mg/dL nitrite ion.

Performance characteristics: The test is specific for nitrite and will not react with any other substance normally excreted in urine. Nitrite concentration during

infection increases with the length of time the urine specimen is retained in the bladder prior to collection. A minimum of four hours of bladder incubation significantly increases the likelihood of obtaining a positive result.

Limitations: Pink spots or pink edges should not be interpreted as a positive result. A negative result does not rule out significant bacteriuria. False negative results may occur with shortened bladder incubation of the urine, absence of dietary nitrate, or the presence of nonreductive pathological microbes.

GLUCOSE **GLU** :

Expected values: Small amounts of glucose (< 30 mg/dL) are normally excreted by the kidney. These amounts are usually below the sensitivity level of this test but on occasion may produce a result between Negative and 100 mg/dL that is interpreted as a positive result. Results at the first positive level may be significantly abnormal if found consistently.²

Sensitivity: 75–125 mg/dL glucose

Performance characteristics: The test is specific for glucose; no substance excreted in urine other than glucose is known to give a positive result. This test may be used to determine whether the reducing substance found in urine is glucose. If the color appears somewhat mottled at the higher glucose concentrations, match the darkest color to the color blocks.

Limitations: Ketone bodies reduce the sensitivity of the test; moderately high ketone levels (40 mg/dL) may cause false negatives for specimens containing small amounts of glucose (75–125 mg/dL) but the combination of such ketone levels and low glucose levels is metabolically improbable in screening.

KETONE **KET** :

Expected values: Normally, no ketone is detectable in urine (up to 2 mg/dL acetoacetic acid). In ketoacidosis, starvation or with other abnormalities of carbohydrate or lipid metabolism, ketones may appear in urine at levels of 10 mg/dL or higher before serum ketone levels are elevated. Clinical judgment is needed to determine the significance of Trace results, which may occur during physiological stress conditions such as fasting, pregnancy and frequent strenuous exercise.¹

Sensitivity: 5–10 mg/dL acetoacetic acid

Performance characteristics: The test reacts with acetoacetic acid in urine. It does not react with acetone or β -hydroxybutyric acid.

Limitations: False Trace results may occur with highly pigmented urine specimens or those containing large amounts of levodopa metabolites. Compounds such as mesna (2-mercaptoethane sulfonic acid) that contain sulfhydryl groups may cause false positive results or an atypical color reaction.

pH **pH** :

Expected values: The normal pH of urine can range from 4.6–8.0. Certain dietary conditions can produce acid or alkaline urines, which can be useful in the treatment of some calculi.¹

Performance characteristics: The pH test area measures pH values from 5–8.5 visually and 5–9 instrumentally, generally to within one unit of the expected result. pH readings are not affected by variations in the urinary buffer concentration.

Limitations: Bacterial growth by certain organisms in a specimen may cause a marked alkaline shift (pH > 8.0), usually because of urea conversion to ammonia.

SPECIFIC GRAVITY **SG** :

Expected values: The normal SG of urine ranges from 1.001–1.035. If the specific gravity of a random urine is 1.023 or greater, the concentrating ability of the kidneys can be considered normal.¹

Performance characteristics: This test permits determination of urine specific gravity between 1.000–1.030. In general, it correlates within 0.005 with values obtained with the refractive index method. For increased accuracy, 0.005 may be added to readings from urines with pH \geq 6.5. Strips read instrumentally are automatically adjusted for pH by the instrument. The Siemens SG test is not affected by the presence of radiopaque dyes as are the refractive index, urinometer, and osmolality methods.

Limitations: The Siemens SG test is dependent on ions in urine and results may differ from those obtained with other specific gravity methods when certain non-ionic urine constituents, such as glucose, are present. Highly buffered alkaline urines may cause low readings, while the presence of moderate quantities of protein (100–750 mg/dL) may cause elevated readings.

HELPFUL HINTS:

- Do not remove the strip from the bottle until immediately before it is to be used for testing. Replace the cap immediately and tightly after removing the reagent strip. Do not touch the test areas of the strip.
- Do not read any test pad after 2 minutes; color changes that occur after this time are of no diagnostic value.
- Discoloration or darkening of the test pads may indicate deterioration. If this is evident, or if test results are questionable or inconsistent with expected findings, the following steps are recommended: (1) confirm that the product is within the expiration date shown on the label; (2) check performance against known negative and positive control materials; (3) retest with fresh product. If proper results are not obtained, consult your local Siemens representative, or contact the Customer Service Department for advice on testing technique and results.
- Contamination of the urine specimen with skin cleansers containing chlorhexidine may affect protein (and to a lesser extent specific gravity) test results. The user should determine whether the use of such skin cleansers is warranted.
- You may notice a “burst” of color on the protein–low pad that fades within several seconds after dipping. This does not indicate a positive result, unless the

color remains until the specified reading time.

CHEMICAL PRINCIPLES OF PROCEDURES AND INGREDIENTS: (based on dry weight at time of impregnation)

Protein–Low (Albumin): This test is based on dye binding using a high affinity sulfonephthalein dye. At a constant pH, the development of any blue color is due to the presence of albumin. The resulting color ranges from pale green to aqua blue. **Ingredients:** 1.9% w/w bis (3,3'-diiodo- 4,4'-dihydroxy-5,5'-dinitrophenyl)-3,4,5,6-tetrabromosulfonephthalein; 94.2% w/w buffer; 3.9% w/w nonreactive ingredients.

Protein–High: This test is based on the protein-error-of-indicators principle. At a constant pH, the development of any green color is due to the presence of protein. Colors range from yellow for “Negative” through yellow-green and green to green-blue for “Positive” reactions. **Ingredients:** 0.3% w/w tetrabromophenol blue; 97.3% w/w buffer; 2.4% w/w nonreactive ingredients.

Creatinine: This test is based on the peroxidase-like activity of a copper creatinine complex that catalyzes the reaction of diisopropylbenzene dihydroperoxide and 3,3',5,5'-tetramethylbenzidine. The resulting color ranges from orange through green to blue. **Ingredients:** 2.5% w/w copper sulfate; 4.5% w/w diisopropylbenzene dihydroperoxide; 2.0% w/w 3,3',5,5'-tetramethylbenzidine; 56.4% w/w buffer; 34.6% w/w nonreactive ingredients.

Blood: This test is based on the peroxidase-like activity of hemoglobin, which catalyzes the reaction of diisopropylbenzene dihydroperoxide and 3,3',5,5'-tetramethylbenzidine. The resulting color ranges from orange through green; very high levels of blood may cause the color development to continue to blue. **Ingredients:** 6.8% w/w diisopropylbenzene dihydroperoxide; 4.0% w/w 3,3',5,5'-tetramethylbenzidine; 48.0% w/w buffer; 41.2% w/w nonreactive ingredients.

Leukocytes: Granulocytic leukocytes contain esterases that catalyze the hydrolysis of the derivatized pyrrole amino acid ester to liberate 3-hydroxy-5-phenyl pyrrole. This pyrrole then reacts with a diazonium salt to produce a purple product. **Ingredients:** 0.4% w/w derivatized pyrrole amino acid ester; 0.2% w/w diazonium salt; 40.9% w/w buffer; 58.5% w/w nonreactive ingredients.

Nitrite: This test depends upon the conversion of nitrate (derived from the diet) to nitrite by the action of Gram-negative bacteria in the urine. At the acid pH of the reagent area, nitrite in the urine reacts with p-arsanilic acid to form a diazonium compound. This diazonium compound in turn couples with 1,2,3,4-tetrahydrobenzo(h)quinolin-3-ol to produce a pink color. **Ingredients:** 1.4% w/w p-arsanilic acid; 1.3% w/w 1,2,3,4-tetrahydrobenzo(h)quinolin-3-ol; 10.8% w/w buffer; 86.5% w/w nonreactive ingredients.

Glucose: This test is based on a double sequential enzyme reaction. One enzyme, glucose oxidase, catalyzes the formation of gluconic acid and hydrogen peroxide from the oxidation of glucose. A second enzyme, peroxidase, catalyzes the reaction of hydrogen peroxide with a potassium iodide chromogen to oxidize the chromogen to colors ranging from green to brown. **Ingredients:** 2.2% w/w glucose oxidase (microbial, 1.3 IU); 1.0% w/w peroxidase (horseradish, 3300 IU); 8.1% w/w potassium iodide; 69.8% w/w buffer; 18.9% w/w nonreactive ingredients.

Ketone: This test is based on the development of colors ranging from buff-pink, for a negative reading, to maroon when acetoacetic acid reacts with nitroprusside. **Ingredients:** 7.1% w/w sodium nitroprusside; 92.9% w/w buffer.

pH: This test is based on a double indicator principle that gives a broad range of colors covering the entire urinary pH range. Colors range from orange through yellow and green to blue. **Ingredients:** 0.2% w/w methyl red; 2.8% w/w bromthymol blue; 97.0% w/w nonreactive ingredients.

Specific Gravity: This test is based on the apparent pKa change of certain pre-treated polyelectrolytes in relation to ionic concentration. In the presence of an indicator, colors range from deep blue-green in urine of low ionic concentration through green and yellow-green in urines of increasing ionic concentration. **Ingredients:** 2.8% w/w bromthymol blue; 68.8% w/w poly (methyl vinyl ether/maleic anhydride); 28.4% w/w sodium hydroxide.

AVAILABILITY: Multistix PRO Reagent Strips for Urinalysis are available as follows:

- Multistix PRO 10LS (#1554, 100 strips/bottle)
- Multistix PRO 10LS (#1566, 25 strips/bottle)

TRADEMARKS:

Multistix, CLINITEK, CLINITEK Status, and CLINITEK Advantus are trademarks of Siemens Healthcare Diagnostics.

All other trademarks are the property of their respective owners.

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TECHNICAL ASSISTANCE:

For technical support, contact your local technical support provider or distributor.

To receive a hardcopy of this document, please contact your local technical support provider or distributor.

In the US call 877-229-3711.

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