Good decisions come from good information.

A urinary protein or albumin (nonquantitative) test system is a device intended to identify proteins or albumin in urine. Identification of urinary protein or albumin (nonquantitative) is used in the diagnosis and treatment of disease conditions such as renal or heart diseases or thyroid disorders, which are characterized by proteinuria or albuminuria. The FDA classifies urine protein test strips (Product Code JIR) as Class I medical devices. The device is exempt from the premarket notification as outlined in 21CFR862.1645.

This document presents analytical and clinical studies performed to assess the accuracy and performance characteristics of the urine test strips by Diagnox. The data presented in this document is based on FDA submission K111999 for the multiparameter urinalysis strips. For simplicity, this document reports the performance characteristics of the protein analyte only, collected using the URS10 test strips.

Device Description

Diagnox Reagent strips for urinalysis are *in vitro* diagnostic test devices that use reagents for qualitative and semi-quantitative urinalysis. The urine protein test strip comprises a reagent pad aligned on a strip. The pad is employed for testing one assay (urinary protein) by visually reading the color change of the pad and comparing it with the corresponding blocks on a color chart.

The test is based on the protein-error-of-indicators principle. An ion in the specific pH indicator attracted by a cation on the protein molecule makes the indicator further ionized, which changes its color.

Performance Characteristics

Analytical Performance

a. Precision/Reproducibility:

The cut-off evaluation for the strips was evaluated using 20 replicates from each of 3 levels of urine controls (N=60). Control levels 1 and 2 represented the low and high samples. Level 3 control was spiked sample with analyte concentration adjusted to around the cutoff value. The samples were blinded. Within-run precision was evaluated by testing 20 replicates on each of the three levels of urine controls using strips from each of the 3 lots of strips. Within-day prevision was evaluated by testing three levels of urine controls in duplicate, one a day, for 10 days using strips from 3 lots. Both reading methods (qualitative or semi-quantitative) were evaluated. Instrumental readings were performed on the Healgen 500 and Healgen 800. Testing was completed at three different point-of-care (POC) sites by six technicians at the POC sites. The technicians were provided with no other instructions other than the instrument manual and the test strip labeling. The results from the precision evaluation are summarized below:

Analyte Levels Tested

Analyte	Level 1	Level 2	Level 3
Protein	Negative	30 - 300 mg/dL (1+ - 3+)	10 - 80 mg/dL (± - 1+)

Within-Run Study

Agreement of Visual Reading

Analyte	Exact match			Match within ±1 color block		
	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Protein	60/60 (100%)	57/60 (95%)	58/60 (96.7%)	60/60 (100%)	60/60 (100%)	60/60 (100%)

Within-Day Study

Agreement of Visual Reading

Analyte	Exact match			Match within ±1 color block		
	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Protein	60/60 (100%)	58/60 (96.7%)	58/60 (96.7%)	60/60 (100%)	60/60 (100%)	60/60 (100%)

b. Linearity/assay reportable range:

Linearity for the device was evaluated by visual reading and instrumental reading on the Healgen 500 and 800 by repeated testing of urine specimen containing known concentrations of analyte. Negative samples were obtained by testing clinical samples with the predicate device. Those samples confirmed to be negative or expected were selected for the study.

Positive samples were obtained by adding known amounts of analyte to negative control and confirming the expected value using the predicate device.

Blind and random testing of samples was completed by two experimenters. Ten replicates for each strip from 3 manufacturing lots (n = 30) were tested with each sample. The percentages of exact match and ±1 color block match of reported result to the expected result were calculated and recorded as shown below:

Analyte	Levels	Exact Match			±1 Color Block Match		
		Visual Read	Healgen 500 Read	Healgen 800 Read	Visual Read	Healgen 500 Read	Healgen 800 Read
Protein (mg / dL)	Negative	30	30	30			
	10	27	28	29	30	30	30
	30	28	27	27	30	30	30
	100	30	29	29	30	30	30
	300	29	27	27	30	30	30
	2000	30	30	29	30	30	30

The reportable ranges of strips for the protein analyte are listed in the table below.

Analyte	Unit	Lab Assay Range	Reportable Range
Protein	mg/dL	0.3 - 5000	Negative – 2000

The specified reportable values of the protein analyte are labeled above the block of the color chart on the strips inner labeling as shown below:

Analyte	Unit	Levels (color Blocks)					
		Negative	Positive				
Protein	(mg / dL)	Negative	10	30	100	300	2000

c. Traceability, Stability, Expected values:

Real-time stability data support the following claim: "The strips can be stored in room temperature and closed package to 24 months from the manufacture date. If exposed to air with a temperature of 15-30°C and relative humidity of 65-85%, the strips can be stored at least 12 hours."

No urinalysis controls are provided with the device. We recommend using commercially available positive and negative controls. Labeling also recommends the following:

- Test commercially available positive and negative quality controls with each new lot, each new shipment of strips, and when a new bottle of reagent strips is opened.
- Water should not be used as a negative control.

d. Detection Limit:

The cut-off evaluation was conducted using 20 replicates for the strip. Negative and positive samples at different levels were confirmed by testing clinical samples with the predicate device. Positive samples were prepared by adding known amounts of analyte to negative samples. The cut-off for each analyte is defined as the value at which 50% of the test results are positive. The cut-off values for each strip format on all reading modes are shown in the table below.

Analyte	Cut-off (at least 50% Positive results)
Protein (mg/dL)	7

e. Analytical Specificity

To evaluate interferences, known amounts of potential interfering substances were added to urine samples and tested. Five test strips from each of 3 lots were evaluated, in replicates of 15, for each interference test. Analyte levels (positive, negative) were confirmed with the predicate method. Two levels of analyte and 3 levels of interfering substance were evaluated in the study. Interference is defined as: a) For negative or lower level samples, with the presence of one potential interfering substance in a certain concentration, and no change of other conditions in the test system, if the reported results are ≥2 color blocks different from the expected results, it is interference. And if ±1 color block match with the expected values, it is non-interference. B) For positive or higher level samples, with the presence of one potential interfering substance in a certain concentration and no change of other conditions in the test system, if the reported results ≥2 color blocks different from the expected results (only negative for nitrite), it is an interference. And if ±1 color block match with the expected values, it is non-interference. Concentrations of the potentially interfering substances that will not have an influence on the test results are shown below:

Potential Interfering Substance	Concentration Not Affecting Test
Albumin	800 mg/dL
Ascorbic Acid	50 mg/dL
Hemoglobin	50 mg/dL
Citric Acid	50 mg/dL
Bilirubin	3.0 mg/dL
Creatine	8 mg/dL
Acetoacetate Acid	1 mmol/L
Ammonium Chloride	189 mg/dL
Calcium Chloride	50 mg/dL
Creatinine	800 mg/dL
Glucose	2000 mg/dL
Glycine	1000 mg/dL
KCL	550 mg/dL
NaCl	2800 mg/dL
Oxalic Acid	70 mg/dL
Sodium Acetate	1200 mg/dL
Sodium Bicarbonate	1500 mg/dL
Sodium Nitrate	0.26 mg/dL
Sodium Nitrite	0.3 mg/dL
Sodium Phosphate	16 mg/dL
Urobilinogen	3.0 mg/dL
Urea	3000 mg/dL
Riboflavin	100 mg/L
Theophylline	100 mg/L

Phenolphthalein	1200 mg/L
pH	9.0
Specific gravity	1.030
Glutathione	200 mg/dL
Hypochlorite	10 mg/L
Chlorine	1 mg/dL
Peroxide	1 mg/L
Atropine	300 mg/L
Fructose	5000 mg/dL
Lactose	5000 mg/dL
Leucocytes	800 cells/µL
Ketone	200 mg/dL
Blood	300 cells/µL
Mesna	50 mg/dL

Comparison Studies

Method Comparison with predicate device:

Comparison studies were performed at three different POC sites between the Diagnox strips and the predicate (URISTK H Series Reagent Strips) by visual and instrument readings. Urine samples were collected as indicated in the instructions for use and tested by 5 persons in each POC site (15 persons in total). The operators were blinded by masking the urine sample receptacles before being sent to them. The number of patient samples tested for the analyte was 100 (i.e., 33-34 patient samples tested at each of the 3 sites). The patient samples were collected so that at least 40 to 50% of the samples were positive across the measuring range of each analyte, and at least 10% of the samples were around the cutoff of each analyte. The results of the comparison study for the combined sites are shown in the table below. Visual Read, Combined Sites 1 - 3 (n=100)

Protein (mg/dL)		Predicate Device					
		NEG	10	30	100	300	2000
Proposed Device	NEG	42	0	0	0	0	0
	10	0	11	2	1	0	0
	30	0	1	11	1	0	0
	100	0	0	0	11	1	0
	300	0	0	0	0	11	0
	2000	0	0	0	0	0	8
Total		42	12	13	13	12	8
% exact match		100	91.7	84.6	84.6	91.7	100
% ±1 color block			100	100	92.3	100	100