

## **COLORZYME<sup>®</sup> ANA TEST SYSTEM**

***For in vitro Diagnostic Use***  
***For Professional Use***

*INTENDED USE: This is an indirect enzyme antibody test for the semi-quantitative detection of antinuclear antibody in human serum. This test system is to be used as an aid in the detection of antibodies associated with systemic rheumatic disease.*

### **SUMMARY AND EXPLANATION OF THE TEST**

Antinuclear antibody (ANA) is a general term used to describe autoantibodies against various cell nuclear proteins. Early studies of these autoantibodies, using immunofluorescent techniques, revealed a select few nuclear protein specificities (1). Because of the high correlation of positive ANA with systemic lupus erythematosus (SLE), a negative ANA essentially ruled out the disease (2).

Although antibodies specific to DNA continue to show a high disease correlation with SLE (3), a number of nuclear (4) and cytoplasmic (5-7) macromolecules have also been detected and associated with other connective tissue diseases (8-10). Some of these antibodies appear to have diagnostic and/or prognostic significance in progressive systemic sclerosis (11-12), mixed connective tissue disease (13-15), Sjögren's syndrome (16-17), polymyositis (18), and/or rheumatoid arthritis (19). Because of these disease associations, ANA testing is now recognized as a general screening tool for connective tissue disease (20).

Sensitivity of the ANA test varies with the type of substrate used, fixative procedure, and types of ANA present in sera. Cell culture substrates generally show greater sensitivity than tissue sections (21-24). The Immuno Concepts Colorzyme<sup>®</sup> ANA Test System with mitotic\* human epithelioid cells (HEp-2), represents one of the most advanced systems for detection of ANA. HEp-2 cells with mitotic figures have been shown to have greater sensitivity and yield sharper pattern recognition than classical mouse kidney substrate in detecting antibodies in progressive systemic sclerosis (PSS) (25). Mitotic figures aid in differential pattern recognition as well as in detecting previously unreported nuclear antigens present in higher concentrations in mitotically active cells (26-28).

### **PRINCIPLE OF THE TEST**

The Immuno Concepts Colorzyme<sup>®</sup> ANA Test System is an indirect enzyme antibody technique. Patient samples are incubated with antigen substrate to allow specific binding of autoantibodies to cell nuclei. If ANA's are present, a stable antigen-antibody complex is formed. After washing to remove non-specifically bound antibodies, the substrate is incubated with an anti-human antibody reagent conjugated to horseradish peroxidase. When results are positive, there is the formation of a stable three-part complex consisting of enzyme antibody bound to human antinuclear antibody, which is bound to nuclear antigen.

This complex can be visualized by incubating the slide in color reagent that contains an enzyme specific substrate.

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*\*Mitosis is a term used to describe the cell division process. It is generally divided into six phases including interphase, prophase, metaphase, anaphase, telophase, and cytokinesis.*

The reaction between the enzyme labeled antibody and enzyme specific substrate results in a color reaction on the slide visible by standard light microscopy. In positive samples, the cell nuclei will show dark blue-purple staining with a pattern characteristic of the particular nuclear antigen distribution within the cells. If the sample is negative for ANA, the nucleus will not show a clearly discernible pattern of nuclear staining. The cytoplasm may demonstrate weak staining while the nonchromosome region of the mitotic cells may demonstrate a darker staining.

## SYSTEM COMPONENTS - MATERIALS PROVIDED

**Use:** All components come ready to use with no aliquoting or reconstitution required (except the PBS buffer and color reagent which must be dissolved in deionized or distilled water before use).

**Storage:** All components can be stored under refrigeration at 2-10°C. After reconstitution, PBS buffer reagent should be stored in a closed container at 2-25°C. After reconstitution, Colorzyme® color reagent should be stored in a closed container at room temperature for up to 30 days. Depending on the rate of use, 150 ml of Colorzyme® color reagent can be used with up to twenty slides.

**Stability:** All components remain stable at least 12 months from date of manufacture. Do not use any component beyond its expiration date.

### REACTIVE REAGENTS

**Substrate Slides [SLIDE]:** ANA substrate slides using HEp-2 cells (with mitotic figures) grown and stabilized directly on the test wells. Unique moat slide design minimizes cross contamination of wells during testing. The slide pouch is filled with an inert non-toxic gas that contributes to the stability of the cells.

**Homogeneous Positive Control [CONTROL] +:** Catalog No. 2021. Ready-to-use dropper vial containing 1.0 ml positive human control serum with antibody specific to DNA and/or DNP nuclear antigens. This serum demonstrates a homogeneous staining reaction on Immuno Concepts' HEp-2 cell substrate. The chromosome region of mitotic cells demonstrates the same homogeneous staining reaction.

**Speckled Positive Control [CONTROL] +:** Catalog No. 2022. Ready-to-use dropper vial containing 1.0 ml positive human control serum with antibody specific to Sm and/or RNP nuclear antigens. This serum demonstrates one of the most common speckled staining reactions seen on Immuno Concepts' HEp-2 cell substrate. The chromosome region of mitotic cells demonstrates a negative staining reaction.

**Nucleolar Positive Control [CONTROL] +:** Catalog No. 2023. Ready-to-use dropper vial containing 1.0 ml positive human control serum with antibody specific to nucleolar antigens. This serum demonstrates a nucleolar staining reaction on Immuno Concepts' HEp-2 cell substrate.

**Centromere Positive Control [CONTROL] +:** Catalog No. 2025. Ready-to-use dropper vial containing 1.0 ml positive human control serum with antibody specific to chromosomal centromeres (kinetochore). This serum demonstrates a discrete speckled staining reaction on Immuno Concepts' HEp-2 cell substrate. The chromosome region of mitotic cells demonstrates the same discrete speckled staining reaction.

**Titrateable Control Serum [TC]:** Catalog No. 2026. Ready-to-use vial containing 0.5 ml positive human control serum to be treated as an undiluted patient sample. See vial label for titer value.

**Negative Control Serum [CONTROL] -:** Catalog No. 2031. Ready-to-use dropper vial containing 1.0 ml negative human control serum. Although the negative control serum may demonstrate weak staining of the cytoplasm with brighter staining of the nonchromosome region of the mitotic cell, it demonstrates no discernible pattern of nuclear staining.

**Enzyme Antibody Reagent [CONJ|HRP]:** Catalog No. 4009 (9.0 ml), 4075 (23 ml). Anti-human IgG conjugated to horseradish peroxidase (HRP). Reagent comes ready-to-use in precision dropper bottles with 9.0 ml for every 10 slides in complete test kits.

**Color Reagent [PWDR|CRP]:** Catalog No. 4066. HRP specific enzyme substrate powder, containing 4-chloro-1-naphthol. Each package contains powder to make 150 ml of self-activating Colorzyme® color reagent.

**Preparation:** Dissolve contents of one pouch in 150 ml of deionized or distilled water. Mix well until completely dissolved. This color reagent is stable for 30 days at room temperature in a closed container. This color reagent may be reused for up to 30 days or until any color change or precipitate is visible. Cloudiness or opalescence, with no visible precipitate upon reuse is normal. Depending on the rate of use, 150 ml of Colorzyme® color reagent can be used with up to twenty slides.

#### **NON-REACTIVE COMPONENTS**

**PBS Buffer Powder** **PWDR|PBS**: Catalog No. 1011. Phosphate-buffered saline powder (0.01 M, pH 7.4 ± 0.2). Each pouch contains sufficient buffer powder to make 1 liter. (One pouch of buffer powder is supplied for every five slides in complete test kits.)

**Preparation:** Dissolve one pouch of buffer powder in 1 liter of deionized or distilled water, cover, and store between 2-25°C for up to four weeks or until signs of contamination or other visible changes occur.

**Semi-Permanent Mounting Medium** **SOLN|MM**: Catalog No. 1111. Ready-to-use dropper vial containing 5.0 ml glycerol-based mounting medium.

**Coverslips** **CVSLP**: Catalog No. 1042. Each packet contains ten 24 x 64 mm No. 1 glass coverslips.

## **ADDITIONAL MATERIALS REQUIRED - BUT NOT PROVIDED**

Three Coplin jars or staining dishes  
Squeeze bottle or Pasteur pipettes  
Serological pipettes  
One-liter screw cap containers (for PBS buffer)  
Closed container for storing Colorzyme® color reagent  
Deionized or distilled water  
Test tubes to prepare serum dilutions  
Bibulous paper or paper towels  
Chamber for incubation  
Disposable gloves  
Lab timer  
Standard light microscope capable of 200X and 400X magnification

## **PRECAUTIONS**

1. All human source materials used for this product have been tested and found to be negative (not repeatedly reactive) for antibodies to Human Immunodeficiency Virus-1 (HIV-1), Human Immunodeficiency Virus-2 (HIV-2), hepatitis C virus (HCV), and for hepatitis B surface antigen (HBsAg) by FDA approved methods. However, no test method can offer complete assurance that HIV-1, HIV-2, hepatitis C, hepatitis B, or other infectious agents are absent. Thus, all kit materials should be handled in the same manner as potentially infectious materials.
2. All patient samples should be handled at the Biosafety Level 2 as recommended for any potentially infectious human serum or blood specimen in the Centers for Disease Control/National Institutes of Health Manual: *Biosafety in Microbiological and Biomedical Laboratories, 1999 Edition*.
3. Dilution of the components or substitution of components other than those provided in this system may yield inconsistent results.
4. Sodium azide (0.09%) is used as a preservative. Sodium azide may react with lead or copper plumbing and form explosive metal azide salts. When disposing of reagents, flush with ample volumes of tap water to prevent potential residues in plumbing. Sodium azide is a poison and may be toxic if ingested.
5. This kit is for *in vitro* diagnostic use.
6. In the event hemolyzed or lipemic sera must be used, heat inactivate sera 30 minutes at 56°C for optimal results. Microbially contaminated sera should not be used.
7. The titratable control serum is intended for use in monitoring lot-to-lot and run-to-run reproducibility. It is not intended as a measurement of overall sensitivity or specificity of the assay.
8. Do not smoke, eat, or drink in areas where specimens or kit reagents are handled.
9. Avoid splashing or generation of aerosols at all times.
10. Incubation times and temperatures other than those specified may give erroneous results.
11. Cross contamination of reagents or samples may give false results.

12. Reusable glassware must be washed and thoroughly rinsed free of detergents prior to use. All glassware must be clean and dry before use.
13. Bring all reagents, slides, and specimens to room temperature (18-25°C) prior to use.
14. Wear disposable gloves when handling specimens and reagents, and wash hands thoroughly afterwards.
15. Microbial contamination of reagents or samples may give false results.
16. Never pipette by mouth and avoid contact of reagents and specimens with skin and mucous membranes. If contact occurs, wash with a germicidal soap and copious amounts of water.
17. Color reagent may be reused for up to 30 days or until any color change or precipitate is visible. Cloudiness or opalescence, with no visible precipitate upon reuse is normal. Depending on the rate of use, 150 ml of Colorzyme® color reagent can be used with up to twenty slides.

## SPECIMEN COLLECTION

**Collection:** Serum is the preferred specimen. Approximately 5 ml of whole blood should be collected aseptically by venipuncture using a sterile vacuum collection tube or other suitable collection system. Allow blood to clot at room temperature (18-25°C). Serum should be separated from the clot by centrifugation as soon as possible to minimize hemolysis.

**Interfering Substances:** Sera exhibiting a high degree of hemolysis, icterus, lipemia, or microbial growth should not be used because these conditions may cause aberrant results. Specimens containing visible particulate matter should be clarified by centrifugation before testing.

**Storage:** Sera may be stored at 2-10°C up to one week. If testing is further delayed, sera should be stored frozen at 20°C or lower. Serum should not be stored in a self-defrosting refrigerator or freezer.

**CAUTION:** Repeated freeze/thawing of patient samples may yield false positive or false negative results.

## INTERPRETATION OF RESULTS

### QUALITY CONTROL

Positive, negative, and PBS controls should be tested one time per run. The positive control should show dark blue-purple staining of the nuclei of the cells, with a clearly discernible pattern characteristic of the control serum that was used. The cytoplasm may stain light blue-purple in the positive control well. The negative control should show light blue-purple staining of both the cytoplasm and nucleus, but with no clearly discernible pattern of nuclear staining. The PBS control is used to observe non-specific staining of the enzyme antibody reagent, and should not exhibit blue staining. If the controls do not appear as described, the test is invalid and should be repeated.

### OPTIONAL TITRATABLE CONTROL

When reading titers, many laboratories begin reading with the well that contains the most dilute sample and read “backwards” to the 1:40 dilution. The first well in which a clearly discernible nuclear staining pattern is visible is the titer end-point. We recommend this technique for determining titer end-points.

The mean titer and titer range ( $\pm$  one dilution on either side of the mean) determined were established in our laboratory and are stated as a guide. This control is provided to allow each laboratory to assess the reproducibility (precision) of its ANA testing. Since this control is not intended to be an indicator of titer accuracy, each laboratory should establish its own mean titer end-point for this sample, and should use this information to assess run-to-run reproducibility (precision).

Through multiple testing of this titratable control, using the Immuno Concepts Colorzyme® ANA Test System, a mean titer value has been established for each lot number. The lot number, mean titer and titer range ( $\pm$  one twofold dilution on either side of the mean) are stated on the vial label and should be used as a guide for the test system performance.

It is important that the intensity of staining not be confused with the presence or absence of antinuclear antibodies. The key factor to consider in determining whether a given dilution of serum is positive is the appearance of a clearly discernible pattern, irrespective of the intensity of the staining.

This titratable control will show the typical speckled pattern associated with the RNP antibody. Also present may be a second pattern of NSp I (several discrete speckles in the nucleus of interphase cells), however, it is the typical RNP speckled pattern that is to be used for the purpose of reading end-point.

The values obtained in our laboratory may differ from your values. Some of the many factors that can affect your results may include, but are not limited to:

1. Proper alignment of the microscope light path. Refer to your microscope manual for instructions.
2. The numerical aperture of the objective. The numerical aperture is related to the light gathering capability and the resolution of the objective. This number is printed on the side of the objective.
3. Precision and accuracy of dilution technique, equipment, and performance of the test procedures.

### INTERPRETATION OF PATIENT RESULTS

200X total magnification is recommended for screening positive/negative, while 400X total magnification is recommended for pattern recognition and viewing mitotic cells.

**Negative:** A serum is considered negative for antinuclear antibodies if nuclear staining is less than or equal to the negative control well with no clearly discernible pattern. The cytoplasm may demonstrate weak staining, with brighter staining of the nonchromosome region of mitotic cells, but with no clearly discernible nuclear pattern.

**Positive:** A serum is considered positive if the nucleus shows a clearly discernible pattern of staining in a majority of the interphase cells.

**Titers:** When reading titers, many laboratories begin reading with the well that contains the most dilute sample and read “backwards” to the 1:40 dilution. The first well in which a clearly discernible pattern is visible is the titer end-point. We recommend this technique for determining titer end-points. It is important that the intensity of staining not be confused with the presence or absence of antinuclear antibodies. The key factor to consider in determining whether a given dilution of serum is positive is the appearance of a clearly discernible nuclear pattern, irrespective of the staining intensity.

**CAUTION:** Some sera may demonstrate nuclear and cytoplasmic staining with no apparent nuclear pattern. This phenomenon is generally due to heterophile antibodies and should be reported as negative (29).

## ENZYME STAINING

The degree of staining has no proven clinical value and only limited value as an indicator of titer (30). To simplify interpretation, record screening results as strongly positive or positive, and titer accordingly.

**Strongly Positive Reaction:** Dark to very dark blue-purple staining, clear-cut cell outline, sharply defined nuclear pattern.

**Positive Reaction:** Dim or subdued blue-purple staining with greater variability of staining between cells; cell outline may be less well defined in some cells with a majority of cells still demonstrating a clearly discernible pattern of staining.

**NOTE:** Because the cells are grown directly on the slide surface, all cells are not in the same phase of the cell cycle. It is not unusual to see differential staining intensities from cell to cell due to the differences in the concentration and location of different antigens during the cell cycle.

## REPORTING OF RESULTS

**Screening:** Results should be reported as strongly positive or positive at the 1:40 dilution, and the nuclear staining pattern should be reported.

**Titering:** Results should be reported as the last serial dilution in which clearly discernible staining is seen. Results with a strong reaction at the highest dilution should be reported as greater than that dilution. Titers of 1:40 to 1:80 are considered low titers; 1:160 to 1:320 are considered medium titers; and 1:640 and greater are considered high titers. It is not necessary to determine the titer endpoint. Any ANA titer greater than or equal to 1:640 is considered a high titer, and will alert the clinician to do additional testing. Each laboratory should establish its own titering scheme, based on the antibodies that are detected in the patient population.

### PATTERN DETECTION

**Homogeneous:** A solid staining of the nucleus with or without apparent masking of the nucleoli. The chromosome region of metaphase mitotic cells is clearly positive with a smooth or peripheral staining intensity greater than, or equal to, interphase nuclei.

*Synonyms:* Diffuse; solid.



*Nuclear antigens:* dsDNA; nDNA; DNP; histone.

*Disease association:* High titers are suggestive of SLE. Lower titers are suggestive of SLE or other connective tissue diseases (31).

**Peripheral:** A solid staining, primarily around the outer region of the nucleus, with weaker staining toward the center of the nucleus. The chromosome region of metaphase mitotic cells is clearly positive with a smooth or peripheral staining intensity greater than, or equal to, interphase nuclei.

*Synonyms:* Rim, shaggy, membranous.

*Nuclear antigens:* dsDNA, ssDNA, nDNA, DNP, histone.

*Disease association:* High titers suggestive of SLE; lower titers suggestive of SLE or other connective tissue diseases (31).

**Speckled:** A coarse or fine granular staining of the nucleus generally without staining of the nucleoli. The nonchromosome region of metaphase mitotic cells demonstrates staining, while the chromosome region is negative for stain.

*Nuclear antigens:* Sm; RNP; Scl-70; SSA/Ro; SSB/La; and other antigen/antibody systems not yet characterized.

*Disease association:* High titers are suggestive of SLE (Sm antigen), mixed connective tissue disease (RNP antigen), scleroderma (Scl-70 antigen), or Sjögren's syndrome-sicca complex (SSA/Ro or SSB/La antigen). Lower titers may be suggestive of other connective tissue disease (32).

**Nucleolar:** Large coarse speckled staining within the nucleus, generally less than 6 in number per cell, with or without occasional fine speckles, 5-10 in number. The nonchromosome region of metaphase mitotic cells demonstrates strong staining, while the chromosome region may demonstrate faint staining. Anaphase and telophase cells may demonstrate similar staining to interphase nuclei.

*Nuclear antigens:* Generally referred to as 4-6s RNA's and other nuclear antigens such as fibrillarin, RNA Polymerase I, NOR 90, and PM/Scl.

*Disease association:* High titers prevalent in scleroderma and Sjögren's syndrome (33).

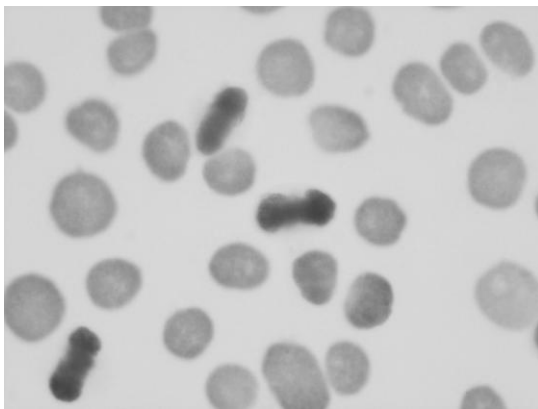
**Centromere:** A discrete speckled staining pattern highly suggestive of the CREST<sup>§</sup> syndrome variant of progressive systemic sclerosis (25). The nuclear speckles are very discrete and usually some multiple of 46 (usually 23-46 speckles per nucleus). Because centromeres are constrictions where spindle fibers attach on chromosomes, mitotic cells will show the same speckling reaction in the chromosome region (12).

*Synonyms:* ACA; discrete speckled.

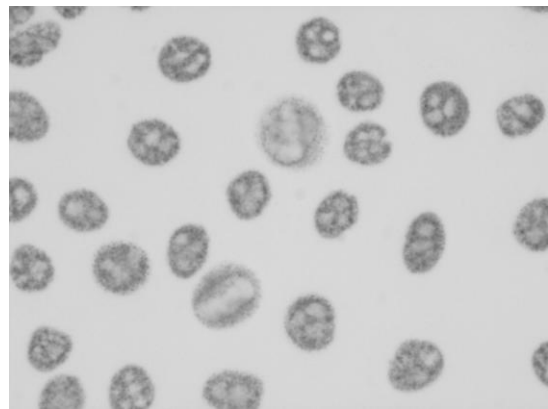
*Nuclear antigens:* Chromosomal centromere (Kinetochores).

*Disease association:* Highly suggestive of the CREST syndrome variant of progressive systemic sclerosis (25).

## BASIC STAINING PATTERNS

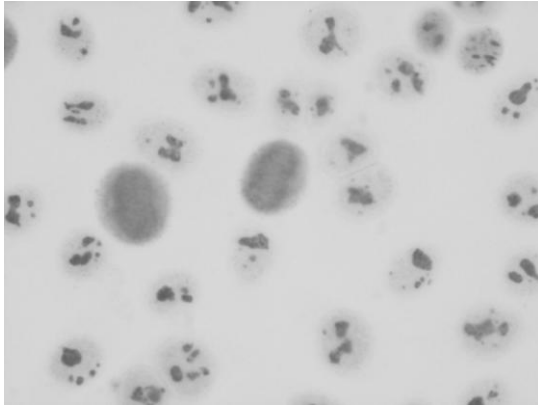


**Homogeneous**

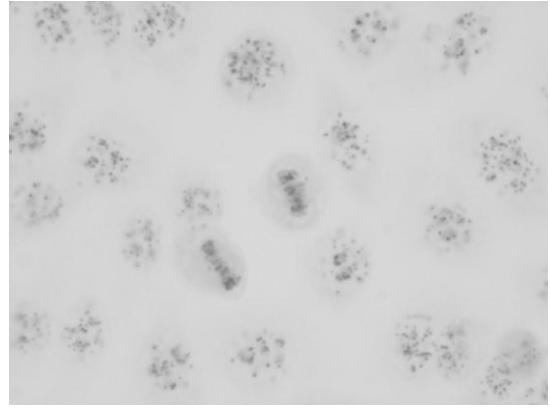


**Speckled**

<sup>§</sup>CREST is a form of PSS with prominent calcinosis, Raynaud's phenomenon, esophageal dysfunction, sclerodactyly, and telangiectasia.



Nucleolar



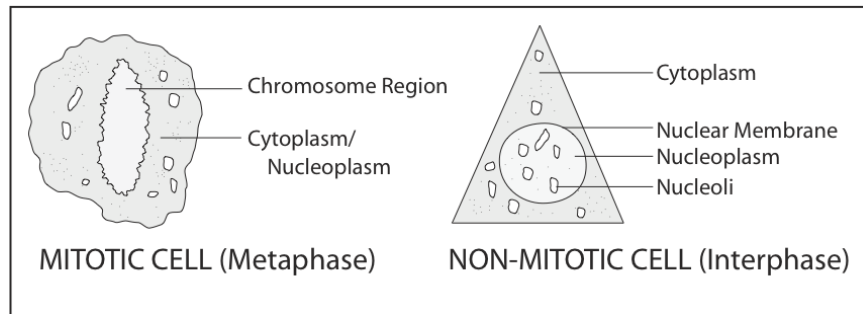
Centromere

## MITOTIC CELLS

### DETECTION

Mitotic cells should be visible on every field when viewed at 200X magnification or lower. To verify whether a cell is in mitosis, view at 400X magnification. Mitotic cells show a characteristic round cell shape with no detectable nuclear membrane. The chromosome region of mitotic cells will generally show an irregular shape within the cell, due to the lack of nuclear membrane, and extreme constriction of the chromosomes.

Sera positive for DNA and/or DNP and/or histone (such as the Immuno Concepts homogeneous positive control) will show bright staining of the chromosome region of these cells. In samples negative for DNA and/or DNP and/or histone (such as the Immuno Concepts speckled positive control), the mitotic cells will not show chromosome staining and may be difficult to see.



## USE OF MITOTIC CELLS

**Discerning Speckled vs. Homogeneous Antibody:** A fine speckled pattern of staining is sometimes difficult to differentiate from homogeneous staining. If the pattern is homogeneous, there will be solid staining of the chromosomes of the mitotic cells. If the pattern is strictly speckled, the region outside of the chromosomes will show a fine speckled reaction.

**NOTE:** If fine speckling of the entire mitotic cell occurs along with solid staining of the chromosome region, it is highly probable that two or more antibodies are present. Report the screening dilution as speckled/homogeneous and titer each antibody to endpoint.

**Peripheral vs. Nuclear Membrane Antibody:** Antibody that shows a peripheral pattern is generally associated with DNA/DNP nuclear antigens. High titers of these antibodies are suggestive of SLE. In substrates that do not include mitotic cells, the peripheral pattern can be difficult to distinguish from nuclear membrane antibody. By using Immuno Concepts' mitotic cells, these patterns can be differentiated, because the chromosome region of the mitotic cells will be stained intensely in a peripheral pattern, but will not be stained by nuclear membrane antibody. This distinction is clinically important because nuclear membrane antibody does not have DNA/DNP specificity and is not associated with SLE (34).

**Anti-Centromere Antibody (ACA) vs. Atypical speckled antibody resembling Centromere:** In order to verify anti-centromere antibody, the chromosome region of the mitotic cells should stain brightly with discrete speckles. If the chromosome region does not stain, the antibody has neither kinetochore specificity nor association with the CREST variant of scleroderma (35). If the chromosome region does not stain, the antibody is not anti-centromere, and should be reported as “atypical speckled.”

## CYTOPLASMIC STAINING

Although autoantibodies to cytoplasmic antigens are not commonly associated with connective tissue disease, these antibodies may be detected using epithelial cell culture substrates (36). Mitochondrial and smooth muscle antibodies are the two most commonly detected antibodies and are generally associated with mononucleosis, chronic active hepatitis, and liver disease (37-38). Using the HEp-2 cell substrate, smooth muscle antibody has also been demonstrated in patients with warts (39).

**Anti-Mitochondrial Antibody (AMA):** Discrete speckles concentrated in the perinuclear region of the cell and extended in lower density to the outer regions of the cytoplasm. This should be distinguished from anti-Golgi antibody, which generally stains only one side of the perinuclear region, and from anti-ribosomal antibody, which demonstrates finer speckles with a strand like appearance consistent with the location of the endoplasmic reticulum within the cell.

**NOTE:** Perinuclear speckles can most easily be distinguished from peripheral nuclear staining by noting that the mitochondrial speckles form an interrupted speckled staining around the outside of the nuclear membrane, while peripheral sera form a solid smooth staining inside the nuclear membrane.

REPORT SERA AS NEGATIVE FOR ANTINUCLEAR ANTIBODIES AND VERIFY POSITIVE FOR ANTIMITOCHONDRIAL ANTIBODY ON AMA SPECIFIC SUBSTRATE.

**Anti-Smooth Muscle Antibody (ASMA):** Very fine fibrous staining over the entire cytoplasm of cells with a “spiderweb” appearance. Unlike mitochondrial antibody, smooth muscle antibody staining is uniform over the entire cytoplasm and may also extend over the nucleus. Mitotic cells generally show large discrete speckles outside the chromosome region. Smooth muscle antibody has been shown to have a high specificity to actin (40-41).

REPORT SERA AS NEGATIVE FOR ANTINUCLEAR ANTIBODY AND VERIFY POSITIVE FOR ANTI-SMOOTH MUSCLE ANTIBODY ON ASMA SPECIFIC SUBSTRATE.

## LIMITATIONS OF THE TEST

1. Diagnosis cannot be made on the basis of antinuclear antibody detection alone. The physician must interpret these results in conjunction with the patient's history and symptoms, the physical findings, and other diagnostic procedures.
2. Treatment should not be initiated on the sole basis of a positive test for antinuclear antibodies. Clinical indications, other laboratory findings, and the physician's clinical impression must be considered before any treatment is initiated.
3. Certain drugs, including procainamide and hydralazine, may induce a lupus erythematosus-like disease (42). Patients with drug-induced LE may demonstrate positive homogeneous or homogeneous/peripheral ANAs commonly directed against nuclear histones (43).
4. A small percentage of patients with SLE may not demonstrate ANAs by indirect immunoenzyme but may have ANAs by other techniques (44).
5. It is not necessary to determine the titer endpoint. Any ANA titer greater than or equal to 1:640 is considered a high titer, and will alert the clinician to do additional testing. Each laboratory should establish its own titration scheme, based on the antibodies that are detected in the patient population. Although a high-titered ANA may be highly suggestive of connective tissue disease, it should not be considered diagnostic but rather viewed as a part of the overall clinical history of a patient.
6. Staining patterns often change with progressive titration of sera. This phenomenon is generally due to the presence of more than one nuclear antibody.
7. Positive ANAs are also seen in a small percentage of patients with infectious and/or neoplastic diseases (9).



## EXPECTED VALUES

In a large university medical center, using HEP-2 cell ANA substrate, the following data were generated over a two-year period (45). Table 1.

**TABLE 1**

Diagnosis	Pattern Segregation	% Positive
Abnormal Population (Over 4,500 Sera Tested):		
Systemic lupus erythematosus	S, P+H, H, P	93
Rheumatoid arthritis	S, H	40
Mixed connective tissue disease	S	99
Progressive systemic sclerosis-diffuse	S, N	85
Progressive systemic sclerosis-CREST	ACA	93
Juvenile rheumatoid arthritis		
Systemic	S	14
Polyarticular	S	13
Pauciarticular-B27+	-	0
DM/PM	S	25
Vasculitis	S	20
Normal Population (Over 9,000 Sera Tested):		
20-60 Years	S	2
70-80 Years	S	3.5

Abbreviations: S=Speckled, H=Homogeneous, P=Peripheral, N=Nucleolar, ACA=anti-Centromere

## PERFORMANCE CHARACTERISTICS

A comparative study has shown the Immuno Concepts Colorzyme<sup>®</sup> ANA Test System to be equivalent to the Immuno Concepts indirect immunofluorescent ANA test. Fifty serum samples were screened and titered on both systems. These samples included autoantibodies commonly detected with the HEP-2 substrate, uncommon and atypical patterns, and borderline negative sera. The enzyme results correlated 98% with the Immuno Concepts immunofluorescent ANA for positive, negative, and mixed pattern sera tested (45).

The Immuno Concepts Fluorescent ANA test system was previously evaluated in comparison with two other fluorescent antibody tests in commercial distribution (45). The study employed 97 serum samples from normal individuals as well as from diagnoses including systemic lupus erythematosus (SLE), mixed connective tissue disease (MCTD), Raynaud's-progressive systemic sclerosis-CREST variant (PSS-CREST), rheumatoid arthritis (RA), juvenile rheumatoid arthritis (JRA), as well as other connective tissue disease. Sera were tested at the recommended screening dilutions for each manufacturer. Study results are summarized in Table 2.

**TABLE 2**

Diagnosis	Number of Patients	Immuno Concepts Positives 1:40	KB Cells Positives 1:20	Mouse Kidney Positives 1:20
SLE	23	23	22	21
MCTD/overlap	7	7	6	4
Raynaud's PSS-CREST	17	17	16	7
RA	2	2	2	0
JRA	4	4	4	3
Other connective tissue disease	9	9	9	6
Hospitalized controls	11	7	3	2
Normal controls	24	1	1	0









The patients positive in the "other connective tissue disease" categories on IC's substrate had temporal arthritis (1), undifferentiated connective tissue disease (1), polymyositis (2), monoarthritis (2), polyarthritis (3), and not further classifiable.

The hospitalized controls with positive ANAs on IC's substrate had diabetes (2), unclassifiable arthritis (3), hypothyroidism (1), and immune complex renal disease (1), which did not meet criteria for diagnosis of SLE.

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# COLORZYME® ANA TEST PROCEDURE

**NOTE: If the laboratory is using an automated sample processing system, the procedure and recommendations of the manufacturer of the processor should be followed. The slide processing system should be programmed for the appropriate sample dilutions, dispense volumes, and incubation times as outlined below.**

- 1. RECONSTITUTE BUFFER (PBS)**  
Dissolve contents of one buffer pouch in one liter of deionized or distilled water. The PBS buffer may be covered and stored at 2-25°C up to four weeks.
- 2. RECONSTITUTE COLOR REAGENT**  
Dissolve contents of one pouch in 150 ml of deionized or distilled water. Mix well until completely dissolved. This color reagent is stable for 30 days at room temperature in a closed container. This color reagent may be reused for up to 30 days or until any color change or precipitate is visible. Cloudiness or opalescence, with no visible precipitate upon reuse is normal. Depending on the rate of use, 150 ml of Colorzyme® color reagent can be used with up to twenty slides.
- 3. DILUTE PATIENT SAMPLES**  
Screening: Dilute patient samples to 1:40 by adding 0.05 ml (50 µl) serum to 1.95 ml reconstituted PBS.  
Semi-Quantitative Titering: Make serial dilutions of screening sample(s) (e.g. 1:80, 1:160, 1:320...etc.) using PBS.
- 4. PREPARE SUBSTRATE SLIDES (20-25 µl/well)**  
Remove slide(s) from pouch(es) and place control sera on control wells as follows: Invert control dropper bottle and squeeze gently until drop is visible at the tip. Gently touch the drop to appropriate control well while avoiding direct contact of dropper tip with slide surface. Add 1 drop (20-25 µl) patient sample to the numbered wells.  
**NOTE:** For general screening, the homogeneous positive control is recommended. For semi-quantitative titering, select the positive control illustrating the most similar pattern of staining to the screening sample (e.g. for patient sample yielding a speckled pattern of staining in screening, use speckled positive control).  
**CAUTION: DIRECT CONTACT OF DROPPER TIP WITH SLIDE SURFACE MAY RESULT IN DAMAGE TO THE ANTIGEN SUBSTRATE.**
- 5. INCUBATE SLIDES (30 ± 5 minutes at room temperature, i.e. 18-25°C)**  
Place slide(s) into a moist covered chamber (a petri dish with moistened paper toweling will be adequate). Incubate, with lid in place, for 30 minutes (± 5 minutes) at room temperature (18-25°C).
- 6. PBS RINSE**  
Remove slide(s) from incubator tray and rinse briefly with PBS using a squirt bottle, Pasteur, or serological pipette. Do not squirt buffer directly on the wells.  
**NOTE:** To avoid cross contamination on the slides, direct PBS stream along midline of slide, tilting first toward the upper row of wells followed by tilting toward the lower row of wells.
- 7. PBS WASH (10 minutes)**  
Wash slide(s) 10 minutes with PBS in a slide staining dish or Coplin jar. This wash may be extended 10-30 minutes with no variability in final test results. Discard PBS wash solution after use.
- 8. ENZYME ANTIBODY REAGENT (Cover the wells with 12-14 drops)**  
Remove one slide at a time from PBS and dip 3-5 times in deionized or distilled water. Tap slide on its side against bibulous paper or paper toweling to remove excess water. Immediately return slide to the incubation chamber and cover the wells completely using enzyme antibody reagent; begin by placing a drop over each well. Repeat for each slide. Enzyme antibody reagent has been titered to compensate for residual deionized or distilled water remaining on the slide after rinsing.  
**NOTE:** It is important that slide wells do not dry during this procedure or damage to the substrate may occur.
- 9. INCUBATE SLIDES (30 ± 5 minutes at room temperature, i.e. 18-25°C)**  
Place lid on incubation chamber and allow slide(s) to incubate 30 minutes (± 5 minutes) at room temperature (18-25°C).
- 10. PBS RINSE**  
Remove slide(s) from incubator tray and rinse briefly with PBS. Do not squirt buffer directly on the wells.
- 11. PBS WASH (10 minutes)**  
Wash slide(s) 10 minutes with PBS in a slide staining dish or Coplin jar. This wash may be extended 10-30 minutes with no variability in final test results.
- 12. COLOR REAGENT INCUBATION (30 minutes at room temperature, i.e. 18-25°C)**  
Remove one slide at a time from PBS, dip 3-5 times in deionized or distilled water, and tap slide on its side against bibulous paper or paper toweling to remove excess water. Immediately place slide(s) into a Coplin jar containing activated color reagent and incubate for 30 minutes.
- 13. PBS RINSE**  
Remove one slide at a time from the Coplin jar and rinse each side of slide 4-5 seconds with PBS. Do not squirt buffer directly on the wells. Place each PBS rinsed slide into a Coplin jar filled with deionized or distilled water until all slides have been removed from the color reagent. Immediately proceed to step 14.
- 14. MOUNT COVERSLIP**  
Remove one slide at a time from the deionized or distilled water and tap slide on its side against bibulous paper or paper toweling to remove excess water.  
**DO NOT BLOT OR DRY THE SLIDE IN ANY MANNER OR ALLOW TO SIT WITHOUT COVERSLIP FOR LONGER THAN 15 SECONDS.** Add 4-5 drops of semi-permanent mounting medium along midline of each slide. Carefully place coverslip in position, avoiding air pockets, by gently lowering coverslip from one end of the slide to the other.  
**NOTE:** Excess mounting medium on slide may result in a lack of clear resolution of cells (blurred image). Excess mounting medium may be removed from slide by gently blotting coverslip with bibulous or lens paper while avoiding any direct movement of the coverslip. Slides may be read immediately or stored for an extended time at 2-10°C with no loss of reactivity.

#### FOR TECHNICAL ASSISTANCE:

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