SIEMENS Healthineers

Ferritin (Fer)

Current Revision and Date[a]	Rev. 03, 2019-07	
Product Name	Atellica IM Ferritin (Fer)	REF 10995569 (90 tests) REF 10995568 (450 tests)
Abbreviated Product Name	Atellica IM Fer	
Test Name/ID	Fer	
Systems	Atellica IM Analyzer	
Materials Required but Not Provided	Atellica IM CAL C	REF 10995506 (2-pack) REF 10995507 (6-pack)
Optional Materials	Atellica IM Multi-Diluent 1	REF 10995637 (2-pack) REF 10995638 (6-pack) REF 10995639 (vial)
	Atellica IM Fer MCM	REF 10995570
Specimen Types	Serum, EDTA plasma, heparinized plasma	
Sample Volume	10 µL	
Measuring Interval	0.5–1650.0 ng/mL (1.1–3630.0 pmol/L)	

[a] A vertical bar in the page margin indicates technical content that differs from the previous version.

CE

Intended Use

The Atellica® IM Ferritin (Fer) assay is for *in vitro* diagnostic use in the quantitative determination of ferritin in human serum and plasma (EDTA and heparin) using the Atellica® IM Analyzer.

This assay can be used as an aid in the diagnosis of iron deficiency anemia and iron overload.

Summary and Explanation

Ferritin is a compound composed of iron molecules bound to apoferritin, a protein shell. Stored iron represents about 25% of total iron in the body, and most of this iron is stored as ferritin.[1] Ferritin is found in many body cells, but especially those in the liver, spleen, bone marrow, and in reticuloendothelial cells.[2]

Ferritin plays a significant role in the absorption, storage, and release of iron. As the storage form of iron, ferritin remains in the body tissues until it is needed for erythropoiesis. When needed, the iron molecules are released from the apoferritin shell and bind to transferrin, the circulating plasma protein that transports iron to the erythropoietic cells.[3]

Although dietary iron is poorly absorbed, the body conserves its iron stores carefully, reabsorbing most of the iron released from the breakdown of red blood cells. As a result, the body normally loses only 1–2 mg of iron per day, which is generally restored by the iron absorbed in the small intestine from dietary sources.[1]

Ferritin is found in serum in low concentrations and is directly proportional to the body's iron stores.[1] Serum ferritin concentration, when analyzed with other factors such as serum iron, iron-binding capacity, and tissue iron stores, is valuable in the diagnosis of iron-deficiency anemias, anemias of chronic infection, and conditions such as thalassemia and hemochromatosis that are associated with iron overload. Measurement of serum ferritin is particularly valuable in distinguishing iron-deficiency anemias caused by low iron stores from those resulting from inadequate iron utilization.[1]

Principles of the Procedure

The Atellica IM Fer assay is a 2-site sandwich immunoassay using direct chemiluminometric technology, which uses constant amounts of 2 anti-ferritin antibodies. The first antibody, in the Lite Reagent, is a goat polyclonal anti-ferritin antibody labeled with acridinium ester. The second antibody, in the Solid Phase, is a mouse monoclonal anti-ferritin antibody, which is covalently coupled to paramagnetic particles.

A direct relationship exists between the amount of ferritin present in the patient sample and the amount of relative light units (RLUs) detected by the system.

Reagents

Material Description	Storage	Stability[a]
Atellica IM Fer ReadyPack® primary reagent pack **Lite Reagent** 3.6 mL/reagent pack Goat polyclonal anti-ferritin antibody (~0.64 µg/mL) labeled with acridinium ester in HEPES buffer; protein stabilizers; sodium azide (< 0.1%); preservatives **Solid Phase** 16.2 mL/reagent pack Mouse monoclonal anti-ferritin antibody (~32.2 µg/mL) covalently coupled to paramagnetic particles in sodium barbital buffer; protein stabilizers; sodium azide (< 0.1%); preservatives	Unopened at 2–8°C Onboard	Until expiration date on product 28 days

Material Description	Storage	Stability[a]
Atellica IM Multi-Diluent 1 ReadyPack ancillary reagent pack[b] 25.0 mL/pack Equine serum; sodium azide (0.1%); preservatives	Unopened at 2–8°C Onboard	Until expiration date on product 28 days
Atellica IM Multi-Diluent 1[b] 50.0 mL/vial Equine serum; sodium azide (0.1%); preservatives	At 2–8°C	Until expiration date on product

[a] Refer to *Storage and Stability*.

[b] Refer to *Optional Materials*.

Warnings and Precautions

For *in vitro* diagnostic use.

For Professional Use.

CAUTION

Federal (USA) law restricts this device to sale by or on the order of a licensed healthcare professional.

Safety data sheets (SDS) available on siemens.com/healthineers.

CAUTION

This device contains material of animal origin and should be handled as a potential carrier and transmitter of disease.

Contains sodium azide as a preservative. Sodium azide can react with copper or lead plumbing to form explosive metal azides. On disposal, flush reagents with a large volume of water to prevent buildup of azides. Disposal into drain systems must be in compliance with prevailing regulatory requirements.

Dispose of hazardous or biologically contaminated materials according to the practices of your institution. Discard all materials in a safe and acceptable manner and in compliance with prevailing regulatory requirements.

Note For information about reagent preparation, refer to *Preparing the Reagents* in the *Procedure* section.

Storage and Stability

Store reagents in an upright position. Protect the product from heat and light sources. Unopened reagents are stable until the expiration date on the product when stored at 2–8°C.

Store Atellica IM Multi-Diluent 1 in an upright position. Atellica IM Multi-Diluent 1 is stable until the expiration date on the product when stored at 2–8°C.

Do not use products beyond the expiration date printed on the product labeling.

Onboard Stability

Reagents are stable onboard the system for 28 days. Discard reagents at the end of the onboard stability interval.

Atellica IM Multi-Diluent 1 is stable onboard the system for 28 days.

Do not use products beyond the expiration date printed on the product labeling.

Specimen Collection and Handling

Serum and plasma (EDTA and heparin) are the recommended sample types for this assay.

Collecting the Specimen

- Observe universal precautions when collecting specimens. Handle all specimens as if they are capable of transmitting disease.[4]
- Follow recommended procedures for collection of diagnostic blood specimens by venipuncture.[5]
- Follow the instructions provided with your specimen collection device for use and processing.[6]
- Allow blood specimens to clot completely before centrifugation.[7]
- Keep tubes capped at all times.[7]

Storing the Specimen

- Do not use samples that have been stored at room temperature for longer than 8 hours.
- Tightly cap and refrigerate specimens at 2–8°C if the assay is not completed within 8 hours.
- Freeze samples at ≤ -20°C if the sample is not assayed within 48 hours.
- Freeze samples only 1 time and mix thoroughly after thawing.

The handling and storage information provided here is based on data or references maintained by the manufacturer. It is the responsibility of the individual laboratory to use all available references and/or its own studies when establishing alternate stability criteria to meet specific needs.

Transporting the Specimen

Package and label specimens for shipment in compliance with applicable federal and international regulations covering the transport of clinical specimens and etiological agents.

Preparing the Samples

This assay requires 10 µL of sample for a single determination. This volume does not include the unusable volume in the sample container or the additional volume required when performing duplicates or other tests on the same sample. For information about determining the minimum required volume, refer to the online help.

The sample volume required to perform onboard dilution differs from the sample volume required to perform a single determination. Refer to *Dilutions*.

Note Avoid assaying grossly hemolyzed samples because the release of intracellular ferritin can cause elevated results.

Note Do not use specimens with apparent contamination.

Before placing samples on the system, ensure that samples are free of:

- Bubbles or foam.
- Fibrin or other particulate matter.

Note Remove particulates by centrifugation according to CLSI guidance and the collection device manufacturer's recommendations.[7]

Note For a complete list of appropriate sample containers, refer to the online help.

Procedure

Materials Provided

The following materials are provided:

REF	Contents	Number of Tests
10995569	1 ReadyPack primary reagent pack containing Atellica IM Fer Lite Reagent and Solid Phase Atellica IM FER master curve and test definition MC TDEF	90
10995568	5 ReadyPack primary reagent packs containing Atellica IM Fer Lite Reagent and Solid Phase Atellica IM FER master curve and test definition MC TDEF	450

Materials Required but Not Provided

The following materials are required to perform this assay, but are not provided:

REF	Description	
	Atellica IM Analyzer[a]	
10995506	Atellica IM CAL C (calibrator)	2 x 5.0 mL low calibrator CAL L 2 x 5.0 mL high calibrator CAL H Calibrator lot-specific value sheet CAL LOT VAL
10995507	Atellica IM CAL C (calibrator)	6 x 5.0 mL low calibrator CAL L 6 x 5.0 mL high calibrator CAL H Calibrator lot-specific value sheet CAL LOT VAL

[a] Additional system fluids are required to operate the system: Atellica IM Wash, Atellica IM Acid, Atellica IM Base, and Atellica IM Cleaner. For system fluid instructions for use, refer to the Document Library.

Optional Materials

The following materials may be used to perform this assay, but are not provided:

REF	Description	
10995637	Atellica IM Multi-Diluent 1 (diluent)	2 ReadyPack ancillary reagent packs containing 25.0 mL/pack DIL
10995638	Atellica IM Multi-Diluent 1 (diluent)	6 ReadyPack ancillary reagent packs containing 25.0 mL/pack DIL
10995639	Atellica IM Multi-Diluent 1 (diluent)	50.0 mL/vial DIL
10995570	Atellica IM Fer MCM (master curve material)	8 x 1.0 mL levels of master curve material MCM

Assay Procedure

The system automatically performs the following steps:

1. Dispenses 10 µL of sample into a cuvette.
2. Dispenses 40 µL of Lite Reagent and 180 µL of Solid Phase, then incubates for 12 minutes at 37°C.
3. Separates, aspirates, then washes the cuvette with special reagent water.

   Note For information about special reagent water requirements, refer to the online help.
4. Dispenses 400 µL each of Atellica IM Acid and Atellica IM Base to initiate the chemiluminescent reaction.
5. Reports results.

Preparing the Reagents

All reagents are liquid and ready to use. Before loading primary reagent packs onto the system, mix them by hand and visually inspect the bottom of the reagent pack to ensure that all particles are resuspended. For information about preparing the reagents for use, refer to the online help.

Preparing the System

Ensure that the system has sufficient reagent packs loaded in the reagent compartment. The system automatically mixes reagent packs to maintain homogeneous suspension of the reagents. For information about loading reagent packs, refer to the online help.

For automated dilutions, ensure that Atellica IM Multi-Diluent 1 is loaded in the reagent compartment.

Master Curve Definition

Before initiating calibration on each new lot of reagent, load the assay master curve and test definition values by scanning the MC TDEF 2D barcodes. For loading instructions, refer to the online help.

Performing Calibration

For calibration of the Atellica IM Fer assay, use Atellica IM CAL C. Use the calibrators in accordance with the calibrator instructions for use.

Calibration Frequency

Perform a calibration if one or more of the following conditions exist:

- When changing lot numbers of primary reagent packs.
- At the end of the lot calibration interval, for a specified lot of calibrated reagent on the system.
- At the end of the pack calibration interval, for calibrated reagent packs on the system.
- When indicated by quality control results.
- After major maintenance or service, if indicated by quality control results.

At the end of the onboard stability interval, replace the reagent pack on the system with a new reagent pack. Recalibration is not required, unless the lot calibration interval is exceeded.

Stability Interval	Days
Lot Calibration	50
Pack Calibration	28
Reagent Onboard Stability	28

For information about lot calibration and pack calibration intervals, refer to the online help.

Follow government regulations or accreditation requirements for calibration frequency. Individual laboratory quality control programs and procedures may require more frequent calibration.

Performing Quality Control

For quality control of the Atellica IM Fer assay, use an appropriate quality control material of known analyte concentration with at least 2 levels (low and high) at least once during each day that samples are analyzed. Use the quality control material in accordance with the quality control instructions for use.

A satisfactory level of performance is achieved when the analyte values obtained are within the expected control interval for the system or within your interval, as determined by an appropriate internal laboratory quality control scheme. Follow your laboratory's quality control procedures if the results obtained do not fall within the acceptable limits. For information about entering quality control definitions, refer to the online help.

Follow government regulations or accreditation requirements for quality control frequency. Individual laboratory quality control programs and procedures may require more frequent quality control testing.

Test quality control samples after a successful calibration.

Taking Corrective Action

If the quality control results do not fall within the assigned values, do not report results. Perform corrective actions in accordance with established laboratory protocol. For suggested protocol, refer to the online help.

Results

Calculation of Results

The system determines the result using the calculation scheme described in the online help. The system reports results in ng/mL (common units) or nmol/L (SI units), depending on the units defined when setting up the assay.

Conversion formula: 1.0 ng/mL (common units) = 2.2 pmol/L (SI units)

For information about results outside the specified measuring interval, refer to *Measuring Interval*.

Dilutions

The measuring interval for serum and plasma is 0.5–1650.0 ng/mL (1.1–3630.0 pmol/L). For information about dilution options, refer to the online help.

Dilute and retest serum and plasma samples with ferritin levels > 1650 ng/mL (3630 pmol/L) to obtain accurate results.

For automated dilutions, ensure that Atellica IM Multi-Diluent 1 is loaded in the reagent compartment. Ensure that sufficient sample volume is available to perform the dilution and that the appropriate dilution factor is selected when scheduling the test, as indicated in the table below.

For automatic dilutions, enter a dilution setpoint ≤ 1650 ng/mL (3630 pmol/L).

Sample	Dilution	Sample Volume (µL)
Serum and plasma	1:2	100
Serum and plasma	1:5	40
Serum and plasma	1:10	20

If patient results exceed the measuring interval of the assay when using automated dilution, or if laboratory protocol requires manual dilution, manually dilute the patient sample.

For manual dilutions, perform the following actions:

- Use Atellica IM Multi-Diluent 1 (vial) to prepare a manual dilution.
- For information about ordering tests for manually diluted samples, refer to the online help.
- Ensure that results are mathematically corrected for dilution. If a dilution factor is entered when scheduling the test, the system automatically calculates the result.

Interpretation of Results

Results of this assay should always be interpreted in conjunction with the patient's medical history, clinical presentation, and other findings.

Limitations

The following information pertains to limitations of the assay:

- Serum ferritin values are elevated in the presence of the following conditions and do not reflect actual body iron stores[1,8]:
  - inflammation
  - significant tissue destruction
  - liver disease
  - malignancies such as acute leukemia and Hodgkin's disease
  - therapy with iron supplements
- Patient samples may contain heterophilic antibodies that could react in immunoassays to give falsely elevated or depressed results. This assay is designed to minimize interference from heterophilic antibodies.[9,10] Additional information may be required for diagnosis.

Expected Values

The following values for apparently healthy male and female subjects with normal liver function enzyme tests, bilirubin, and serum iron tests, were determined using the ACS:180 system.

		Mean		95th Percentile Range	
Category	N	(ng/mL)	(pmol/L)	(ng/mL)	(pmol/L)
Normal Males	142	94	207	22–322	48–708
Normal Females	134	46	101	10–291	22–640

As with all *in vitro* diagnostic assays, each laboratory should determine its own reference interval for the diagnostic evaluation of patient results.[11] Consider these values as guidance only.

Performance Characteristics

Measuring Interval

The Atellica IM Fer assay provides results from 0.5–1650.0 ng/mL (1.1–3630.0 pmol/L). The lower end of the measuring interval is defined by the design requirement for the analytical sensitivity. Report results below the measuring interval as < 0.5 ng/mL (1.1 pmol/L). When sample results exceed the measuring interval, refer to *Dilutions*.

Specificity

Specificity was determined using the Atellica IM Analyzer in accordance with CLSI Document EP07-A2.[12]

Substance	Substance Test Concentration (ng/mL)	Analyte Concentration (ng/mL)	Substance Test Concentration (pmol/L)	Analyte Concentration (pmol/L)	Cross-Reactivity (%)
Liver Ferritin	285	52.1	627	114.6	115
	285	120.5	627	265.1	99
	285	433.8	627	954.4	95
	285	741.2	627	1630.6	94
Spleen Ferritin	225	51.5	495	113.3	103
	225	121.0	495	266.2	98
	225	421.4	495	927.1	94
	225	739.2	495	1626.2	91

Assay results obtained at individual laboratories may vary from the data presented.

Detection Capability

Detection capability was determined in accordance with CLSI Document EP17-A2.[13] The assay is designed to have an analytical sensitivity of ≤ 0.5 ng/mL (1.1 pmol/L), limit of blank (LoB) ≤ 0.5 ng/mL (1.1 pmol/L), a limit of detection (LoD) ≤ 1.0 ng/mL (2.2 pmol/L), and a limit of quantitation (LoQ) ≤ 5.0 ng/mL (11.0 pmol/L).

Representative detection capability data are shown below. Assay results obtained at individual laboratories may vary from the data presented.

Analytical sensitivity is defined as the concentration of ferritin that corresponds to the RLUs that are 2 standard deviations more than the mean RLUs of 20 replicate determinations of the ferritin zero standard. This response is an estimate of the minimum detectable concentration with 95% confidence. The analytical sensitivity for the Atellica IM Fer assay is 0.0 ng/mL (0.0 pmol/L).

The LoB corresponds to the highest measurement result that is likely to be observed for a blank sample. The LoB of the Atellica IM Fer assay is 0.3 ng/mL (0.7 pmol/L).

The LoD corresponds to the lowest concentration of ferritin that can be detected with a probability of 95%. The LoD for the Atellica IM Fer assay is 0.7 ng/mL (1.5 pmol/L), and was determined using 536 determinations, with 456 blank and 80 low-level replicates, and an LoB of 0.3 ng/mL (0.7 pmol/L).

The LoQ corresponds to the lowest amount of Ferritin in a sample at which the within laboratory CV is ≤ 20%. The LoQ of the Atellica IM Fer assay is 0.9 ng/mL (2.0 pmol/L), and was determined using multiple patient samples in the interval 0.4–4.6 ng/mL (0.9–10.1 pmol/L). All samples were assayed in replicates of 8, in 1 run per day using 2 reagent lots, over a period of 5 days.

Precision

Precision was determined in accordance with CLSI Document EP05-A3.[14] Samples were assayed on an Atellica IM Analyzer in duplicate in 2 runs per day for 20 days. The assay was designed to have within-laboratory precision of ≤ 0.42 SD for samples < 6.0 ng/mL (pmol/L), ≤ 7% CV for samples from 6.0–200.0 ng/mL (pmol/L), and ≤ 12% CV for samples from 201.0–1650.0 ng/mL (pmol/L). The following results were obtained:

		Mean		Repeatability			Within-Laboratory Precision		
				SD[b]		CV[c]	SD		CV
Sample Type	N[a]	(ng/mL)	(pmol/L)	(ng/mL)	(pmol/L)	(%)	(ng/mL)	(pmol/L)	(%)
Serum A	80	4.2	9.2	0.15	0.33	N/A[d]	0.31	0.68	N/A
Serum B	80	8.2	18.0	0.14	0.31	1.8	0.44	0.97	5.4
Serum C	80	41.9	92.2	0.57	1.25	1.4	1.78	3.92	4.2
Serum D	80	65.4	143.9	0.82	1.80	1.3	2.89	6.36	4.4
Serum E	80	118.3	260.3	1.44	3.17	1.2	4.79	10.54	4.0
Serum F	80	487.1	1071.6	8.00	17.60	1.6	20.39	44.86	4.2
Serum G	80	779.9	1715.8	20.69	45.52	2.7	44.48	97.86	5.7
Serum H	80	1453.6	3197.9	49.51	108.92	3.4	91.40	201.08	6.3
Control 1	80	51.8	114.0	0.84	1.85	1.6	2.49	5.48	4.8
Control 2	80	132.7	291.9	1.61	3.54	1.2	6.01	13.22	4.5
Control 3	80	374.0	822.8	4.97	10.93	1.3	20.69	45.52	5.5

[a] Number of samples tested.
[b] Standard deviation.
[c] Coefficient of variation.
[d] Not applicable

Assay results obtained at individual laboratories may vary from the data presented.

Assay Comparison

The Atellica IM Fer assay is designed to have a correlation coefficient of ≥ 0.95 and a slope of 1.0 ± 0.1 compared to the ADVIA Centaur FER assay. Assay comparison was determined using the weighted Deming linear regression model in accordance with CLSI Document EP09-A3.[15] The following results were obtained:

Specimen	Comparative Assay (x)	Regression Equation	Sample Interval	N[a]	r[b]
Serum	ADVIA Centaur FER	y = 1.03x - 0.6 ng/mL (y = 1.03x - 1.3 pmol/L)	3.6–1479.5 ng/mL (7.9–3254.9 pmol/L)	106	1.00

[a] Number of samples tested.
[b] Correlation coefficient.

The relationship between the ADVIA Centaur and ACS:180 Ferritin assays is described by this equation:

Specimen	Comparative Assay (x)	Regression Equation	Sample Interval	N[a]	r[b]
Serum	ACS:180 FER	y = 0.96x - 2.6 ng/mL (y = 0.96x - 5.7 pmol/L)	2.6–1602 ng/mL (5.7–3524.4 pmol/L)	277	0.99

[a] Number of samples tested.
[b] Correlation coefficient.

Agreement of the assays may vary depending on the study design, comparative assay, and sample population used. Assay results obtained at individual laboratories may vary from the data presented.

Specimen Equivalency

Specimen equivalency was determined using the Deming linear regression model on the Atellica IM Analyzer in accordance with CLSI Document EP09-A3.[15] The following results were obtained:

Specimen (y)	Reference Specimen (x)	Regression Equation	Sample Interval	N[a]	r[b]
EDTA plasma	Serum	y = 0.96x + 1.6 ng/mL (y = 0.96x + 3.5 pmol/L)	2.5–1440.7 ng/mL (6.25–3169.5 pmol/L)	56	1.00
Lithium heparin	Serum	y = 0.95x + 0.1 ng/mL (y = 0.95x + 0.2 pmol/L)	2.5–1440.7 ng/mL (6.25–3169.5 pmol/L)	56	1.00

[a] Number of samples tested.
[b] Correlation coefficient.

Agreement of the specimen types may vary depending on the study design and sample population used. Assay results obtained at individual laboratories may vary from the data presented.

Interferences

Interference testing was performed in accordance with CLSI Document EP07-A2.[12]

Substance	Substance Test Concentration	Analyte Concentration (ng/mL)	Analyte Concentration (pmol/L)	Bias (%)
Heparin	3000 IU/L	27.2	59.8	-2
	3000 IU/L	188.0	413.6	-2
N-acetylcysteine	17.6 mM	29.2	64.2	1
	17.6 mM	193.1	424.8	1
Acetylsalicylic acid	2.78 mM	23.2	51.0	1
	2.78 mM	226.8	499.0	-1
Ampicillin	152 µM	22.9	50.4	1
	152 µM	228.9	503.6	0
Dobesilate	33.3 µg/mL	29.9	65.8	-1
	33.3 µg/mL	200.6	441.3	-1

Substance	Substance Test Concentration	Analyte Concentration (ng/mL)	Analyte Concentration (pmol/L)	Bias (%)
Ibuprofen	2425 µM	22.7	49.9	0
	2425 µM	223.9	492.6	0
Levodopa	1.3 mM	30.0	66.0	1
	1.3 mM	200.4	440.9	-1
Metronidazole	701 µM	21.8	48.0	3
	701 µM	222.0	488.4	-1
Rifampicin	78.1 µM	21.5	47.3	2
	78.1 µM	213.1	468.8	0
Theophylline	222 µM	29.9	65.8	-2
	222 µM	197.1	433.6	2
Phenylbutazone	650 µM	31.9	70.2	-1
	650 µM	212.1	466.6	-1
Valproic acid	3.5 mM	30.9	68.0	1
	3.5 mM	206.5	454.3	4
Methotrexate	2.0 mM	29.3	64.5	0
	2.0 mM	196.1	431.4	2
Prednisone	0.5 mM	30.7	67.5	-2
	0.5 mM	208.2	458.0	2
Ferrous sulphate	1.0 mM	30.1	66.2	-3
	1.0 mM	198.6	436.9	0
Ascorbic acid	176 mg/dL	28.7	63.1	0
	176 mg/dL	202.1	444.6	0

Results were established using the Atellica IM Analyzer. Assay results obtained at individual laboratories may vary from the data presented.

Hemolysis, Icterus, and Lipemia (HIL)

The Atellica IM Fer assay is designed to have ≤ 10% interference from hemoglobin, bilirubin, and lipemia. Interfering substances at the levels indicated in the table below were tested in accordance with CLSI Document EP07-A2 using the Atellica IM Analyzer.[12]

Bias is the difference in the results between the control sample (does not contain the interferent) and the test sample (contains the interferent) expressed in percent. Analyte results should not be corrected based on this bias.

Substance	Substance Test Concentration Common Units (SI Units)	Analyte Concentration (ng/mL)	Analyte Concentration (pmol/L)	Bias (%)
Hemoglobin	900 mg/dL (0.56 mmol/L)	22.8	50.2	0
	900 mg/dL (0.56 mmol/L)	214.6	472.1	-2
Bilirubin, conjugated	60 mg/dL (1021 µmol/L)	22.9	50.4	-2
	60 mg/dL (1021 µmol/L)	228.3	502.3	-4
Bilirubin, unconjugated	60 mg/dL (1021 µmol/L)	22.6	49.7	1
	60 mg/dL (1021 µmol/L)	222.4	489.3	0
Lipemia (Intralipid®)	2000 mg/dL (22.6 mmol/L)	21.0	46.2	7
	2000 mg/dL (22.6 mmol/L)	203.2	447.0	6

Assay results obtained at individual laboratories may vary from the data presented.

Dilution Recovery

Three human serum samples in the range of 1713.9–1750.6 ng/mL (3770.6–3851.3 pmol/L) of ferritin were diluted 1:2, 1:4, 1:8, and 1:16 with Multi-Diluent 1 and assayed for recovery and parallelism. The recoveries ranged from 89%–100% with a mean of 94%.

Sample	Dilution	Observed (ng/mL)	Expected (ng/mL)	Observed (pmol/L)	Expected (pmol/L)	Recovery (%)
1	—	1716.8	—	3777.0	—	—
	1:2	859.4	858.4	1890.7	1888.5	100
	1:4	412.1	429.2	906.6	944.2	96
	1:8	209.2	214.6	460.2	472.1	97
	1:16	106.1	107.3	233.4	236.1	99
	Mean					98
2	—	1750.6	—	3851.3	—	—
	1:2	838.8	875.3	1845.4	1925.7	96
	1:4	393.4	437.6	865.5	962.7	90
	1:8	199.6	218.8	439.1	481.4	91
	1:16	101.5	109.4	223.3	240.7	93
	Mean					92
3	—	1713.9	—	3770.6	—	—
	1:2	787.8	856.9	1733.2	1885.2	92
	1:4	382.7	428.5	841.9	942.7	89
	1:8	202.4	214.2	445.3	471.2	94
	1:16	95.5	107.1	210.1	235.6	89

Sample	Dilution	Observed (ng/mL)	Expected (ng/mL)	Observed (pmol/L)	Expected (pmol/L)	Recovery (%)
	Mean					91
Mean						94

Results were established using the Atellica IM Analyzer. Assay results obtained at individual laboratories may vary from the data presented.

Spiking Recovery

Varying amounts of ferritin were added to 5 samples with endogenous ferritin levels of 34.0–321.5 ng/mL (74.8–707.3 pmol/L). The recoveries ranged from 90%–116% with a mean of 104%.

Sample	Amount Added (ng/mL)	Observed Mean Test (ng/mL)	Observed Mean Control (ng/mL)	Expected Concen-tration (ng/mL)	Amount Added (pmol/L)	Observed Mean Test (pmol/L)	Observed Mean Control (pmol/L)	Expected Concen-tration (pmol/L)	Recovery (%)
1	—	34.0	—	—	—	74.8	—	—	—
	60.0	107.0	32.3	92.3	132.0	235.4	71.1	203.1	116
	200.0	253.3	31.4	231.4	440.0	557.3	69.1	509.1	109
	360.0	421.2	30.3	390.3	792.0	926.6	66.7	858.7	108
	800.0	810.7	27.3	827.3	1760.0	1783.5	60.1	1820.1	98
	Mean								108
2	—	95.9	—	—	—	211.0	—	—	—
	60.0	156.7	91.2	151.2	132.0	344.7	200.6	332.6	104
	200.0	326.2	91.7	291.7	440.0	717.6	201.7	641.7	112
	360.0	464.7	87.6	447.6	792.0	1022.3	192.7	984.7	104
	800.0	842.0	79.7	879.7	1760.0	1852.4	175.3	1935.3	96
	Mean								104
3	—	133.9	—	—	—	294.6	—	—	—
	60.0	200.4	133.4	193.4	132.0	440.9	293.5	425.5	104
	200.0	350.0	127.3	327.3	440.0	770.0	280.1	720.1	107
	360.0	519.3	124.5	484.5	792.0	1142.5	273.9	1065.9	107
	800.0	842.0	131.4	931.4	1760.0	1852.4	289.1	2049.1	90
	Mean								102
4	—	209.7	—	—	—	461.3	—	—	—
	60.0	277.3	200.0	260.0	132.0	610.1	440.0	572.0	107
	200.0	427.5	194.8	394.8	440.0	940.5	428.6	868.6	108
	360.0	600.6	189.6	549.6	792.0	1321.3	417.1	1209.1	109
	800.0	962.5	167.4	967.4	1760.0	2117.5	368.3	2128.3	99
	Mean								106

Sample	Amount Added (ng/mL)	Observed Mean Test (ng/mL)	Observed Mean Control (ng/mL)	Expected Concen-tration (ng/mL)	Amount Added (pmol/L)	Observed Mean Test (pmol/L)	Observed Mean Control (pmol/L)	Expected Concen-tration (pmol/L)	Recovery (%)
5	—	321.5	—	—	—	707.3	—	—	—
	60.0	379.2	322.8	382.8	132.0	834.2	710.2	842.2	99
	200.0	523.0	305.6	505.6	440.0	1150.6	672.3	1112.3	103
	360.0	682.6	294.9	654.9	792.0	1501.7	648.8	1440.8	104
	800.0	1037.8	268.0	1068.0	1760.0	2283.2	589.6	2349.6	97
	Mean								101
Mean									**104**

Results were established using the Atellica IM Analyzer. Assay results obtained at individual laboratories may vary from the data presented.

High-Dose Hook Effect

High ferritin concentrations can cause a paradoxical decrease in the RLUs (high-dose hook effect). In this assay, patient samples with ferritin concentrations as high as 80,000 ng/mL (176,000 pmol/L) will report > 1650.0 ng/mL (3630.0 pmol/L). Results were established using the Atellica IM Analyzer.

Standardization

The Atellica IM Fer assay standardization is traceable to World Health Organization 2nd International Standard (WHO 80/578). Assigned values for calibrators are traceable to this standardization.

Technical Assistance

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

siemens.com/healthineers

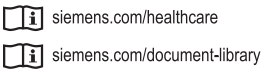
References

1. Miale JB. *Laboratory Medicine: Hematology*. St. Louis: CV Mosby; 1982:388–415.
2. Schreiber WE. Iron, porphyrin, and bilirubin metabolism. In: Kaplan LA, Pesce AJ, eds. *Clinical Chemistry: Theory, Analysis, Correlation*. 2nd ed. St. Louis: CV Mosby; 1989:496–511.
3. Vander AJ, Sherman JH, Luciano DS. *Human Physiology: The Mechanisms of Body Function.* New York: McGraw-Hill Inc.; 1985:475.
4. Clinical and Laboratory Standards Institute. *Protection of Laboratory Workers From Occupationally Acquired Infections; Approved Guideline—Fourth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2014. CLSI Document M29-A4.
5. Clinical and Laboratory Standards Institute. *Procedures for the Collection of Diagnostic Blood Specimens by Venipuncture; Approved Standard—Sixth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2007. CLSI Document GP41-A6.
6. Clinical and Laboratory Standards Institute. *Tubes and Additives for Venous and Capillary Blood Specimen Collection; Approved Standard—Sixth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2010. CLSI Document GP39-A6.

7. Clinical and Laboratory Standards Institute. *Procedures for the Handling and Processing of Blood Specimens for Common Laboratory Tests; Approved Guideline—Fourth Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2010. CLSI Document GP44-A4.
8. Franco CD. Ferritin. In: Kaplan LA, Pesce AJ, eds. *Methods in Clinical Chemistry*. 2nd ed. St. Louis: CV Mosby; 1987:1240–1242.
9. Kricka LJ. Human anti-animal antibody interferences in immunological assays. *Clin Chem*. 1999;45(7):942–956.
10. Vaidya HC, Beatty BG. Eliminating interference from heterophilic antibodies in a two-site immunoassay for creatine kinase MB by using F(ab')2 conjugate and polyclonal mouse IgG. *Clin Chem*. 1992;38(9):1737–1742.
11. Clinical and Laboratory Standards Institute. *Defining, Establishing, and Verifying Reference Intervals in the Clinical Laboratory; Approved Guideline—Third Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2010. CLSI Document EP28-A3c.
12. Clinical and Laboratory Standards Institute. *Interference Testing in Clinical Chemistry; Approved Guideline—Second Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2005. CLSI Document EP07-A2.
13. Clinical and Laboratory Standards Institute. *Evaluation of Detection Capability for Clinical Laboratory Measurement Procedures; Approved Guideline—Second Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2012. CLSI Document EP17-A2.
14. Clinical and Laboratory Standards Institute. *Evaluation of Precision of Quantitative Measurement Procedures; Approved Guideline—Third Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2014. CLSI Document EP05-A3.
15. Clinical and Laboratory Standards Institute. *Measurement Procedure Comparison and Bias Estimation Using Patient Samples; Approved Guideline—Third Edition*. Wayne, PA: Clinical and Laboratory Standards Institute; 2013. CLSI Document EP09-A3.

Definition of Symbols

The following symbols may appear on the product labeling:

Symbol	Symbol Title and Description
	Consult instructions for use
	Version of instructions for use
	Internet URL address to access the electronic instructions for use
	Revision
	Caution Consult instructions for use or accompanying documents for cautionary information such as warnings and precautions that cannot, for a variety of reasons, be presented on the medical device.
	Biological risks Potential biological risks are associated with the medical device.
	Corrosive

Symbol	Symbol Title and Description
	Dangerous to environment
	Irritant Oral, dermal, or inhalation hazard
	Inhalation hazard Respiratory or internal health
	Flammable Flammable to extremely flammable
	Oxidizing
	Explosive
	Toxic
	Compressed gas
	Keep away from sunlight Prevent exposure to sunlight and heat.
	Up Store in an upright position.
	Do not freeze
	Temperature limit Upper and lower limits of temperature indicators are adjacent to the upper and lower horizontal lines.
	Handheld barcode scanner
IVD	*In vitro* diagnostic medical device
Σ (n)	Contains sufficient for <n> tests Total number of IVD tests the system can perform with the IVD kit reagents appears adjacent to the symbol.
RxOnly	Prescription device (US only) Applies only to United States-registered IVD assays. CAUTION: Federal (USA) law restricts this device to sale by or on the order of a licensed healthcare professional.

Symbol	Symbol Title and Description
	Mixing of substances Mix product before use.
	Reconstitute and mix lyophilized product before use.
	Target
	Interval
	Legal Manufacturer
EC REP	Authorized Representative in the European Community
	Use-by date Use by the designated date.
LOT	Batch code
REF	Catalog number
	Recycle
	Printed with soy ink
	CE Mark
	CE Mark with notified body ID number Notified body ID number can vary.
YYYY-MM-DD	Date format (year-month-day)
CHECKSUM	Variable hexadecimal number that ensures the Master Curve and Calibrator definition values entered are valid.
UNITS C	Common Units
UNITS SI	International System of Units
MATERIAL	Material
MATERIAL ID	Unique material identification number
CONTROL NAME	Name of control
CONTROL TYPE	Type of control

Legal Information

Siemens Healthcare Diagnostics Inc.
511 Benedict Avenue
Tarrytown, NY 10591
USA
siemens.com/healthineers

Siemens Healthineers Headquarters
Siemens Healthcare GmbH
Henkestr. 127
91052 Erlangen
Germany
Phone: +49 9131 84-0
siemens.com/healthineers