

SYNCHRON[®] System(s) Chemistry Information Sheet

CHOL
Cholesterol
REF 467825

For *In Vitro* Diagnostic Use

ANNUAL REVIEW

Reviewed by:		Reviewed by:	Date
Refer to coversheet in front of method			

PRINCIPLE

INTENDED USE

CHOL reagent, when used in conjunction with SYNCHRON LX[®] System(s), UniCel[®] Dx_C 600/800 System(s) and Synchron[®] Systems Multi Calibrator, is intended for quantitative determination of cholesterol concentration in human serum or plasma.

CLINICAL SIGNIFICANCE

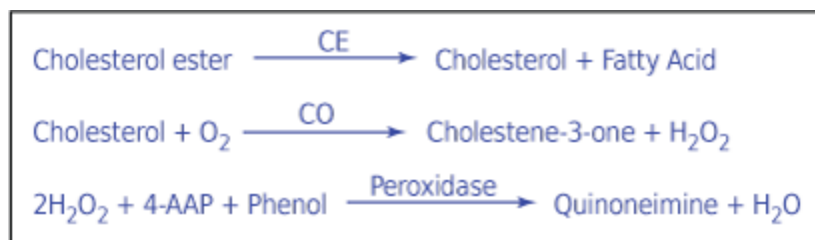
Cholesterol measurements are used in the diagnosis and treatment of atherosclerotic coronary artery disease. Cholesterol measurements are also used in the diagnosis of metabolic disorders involving lipids and lipoproteins. Total serum cholesterol concentrations depend on many factors including age, gender, diet, physical activity, liver disease, and other metabolic disorders.

METHODOLOGY

CHOL reagent is used to measure cholesterol concentration by a timed-endpoint method.^{1,2,3} In the reaction, cholesterol esterase (CE) hydrolyzes cholesterol esters to free cholesterol and fatty acids. Free cholesterol is oxidized to cholestene-3-one and hydrogen peroxide by cholesterol oxidase (CO). Peroxidase catalyzes the reaction of hydrogen peroxide with 4-aminoantipyrine (4-AAP) and phenol to produce a colored quinoneimine product.

The SYNCHRON[®] System(s) automatically proportions the appropriate sample and reagent volumes into the cuvette. The ratio used is one part sample to 100 parts reagent. The system monitors the change in absorbance at 520 nanometers. This change in absorbance is directly proportional to the concentration of CHOL in the sample and is used by the System to calculate and express CHOL concentration.

CHEMICAL REACTION SCHEME



E015196L.EPS

SPECIMEN

TYPE OF SPECIMEN

Biological fluid samples should be collected in the same manner routinely used for any laboratory test.⁴ Freshly drawn serum or plasma are the preferred specimens. Acceptable anticoagulants are listed in the PROCEDURAL NOTES section of this chemistry information sheet. Whole blood or urine are not recommended for use as a sample.

SPECIMEN STORAGE AND STABILITY

1. Tubes of blood are to be kept closed at all times and in a vertical position. It is recommended that the serum or plasma be physically separated from contact with cells within two hours from the time of collection.⁵
2. Separated serum or plasma should not remain at room temperature longer than 8 hours. If assays are not completed within 8 hours, serum or plasma should be stored at +2°C to +8°C. If assays are not completed within 48 hours, or the separated sample is to be stored beyond 48 hours, samples should be frozen at -15°C to -20°C. Frozen samples should be thawed only once. Analyte deterioration may occur in samples that are repeatedly frozen and thawed.⁵ Sample that are visually lipemic and contain high Triglycerides, when frozen and thawed may exhibit a low Total Cholesterol result.

ADDITIONAL SPECIMEN STORAGE AND STABILITY CONDITIONS AS DESIGNATED BY THIS LABORATORY:

[Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual](#)

SAMPLE VOLUME

The optimum volume, when using a 0.5 mL sample cup, is 0.3 mL of sample. For optimum primary sample tube volumes and minimum volumes, refer to the Primary Tube Sample Template for your system.

CRITERIA FOR UNACCEPTABLE SPECIMENS

Refer to the PROCEDURAL NOTES section of this chemistry information sheet for information on unacceptable specimens.

CRITERIA FOR SAMPLE REJECTION AS DESIGNATED BY THIS LABORATORY:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

PATIENT PREPARATION

SPECIAL INSTRUCTIONS FOR PATIENT PREPARATION AS DESIGNATED BY THIS LABORATORY:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

SPECIMEN HANDLING

SPECIAL INSTRUCTIONS FOR SPECIMEN HANDLING AS DESIGNATED BY THIS LABORATORY:

Refer to "Sample Integrity in Chemistry" write up in "Policies and Procedures" manual

REAGENTS

CONTENTS

Each kit contains the following items:

Two CHOL Reagent Cartridges (2 x 300 tests)

VOLUMES PER TEST

Sample Volume	3 µL
ORDAC Sample Volume	2 µL
Total Reagent Volume	300 µL
Cartridge Volumes	
A	290 µL
B	--
C	10 µL

REACTIVE INGREDIENTS

REAGENT CONSTITUENTS

4-Aminoantipyrine	0.28 mmol/L
Phenol	8.06 mmol/L
Cholesterol esterase (Candida Cylindracea)	211 IU/L
Cholesterol oxidase (Brevibacterium Maris)	216 IU/L
Peroxidase (horseradish)	6667 IU/L

Also non-reactive chemicals necessary for optimal system performance.

MATERIALS NEEDED BUT NOT SUPPLIED WITH REAGENT KIT

Synchron[®] Systems Multi Calibrator
At least two levels of control material
Saline

REAGENT PREPARATION

No preparation is required.

ACCEPTABLE REAGENT PERFORMANCE

The acceptability of a reagent is determined by successful calibration and by ensuring that quality control results are within your facility's acceptance criteria.

REAGENT STORAGE AND STABILITY

CHOL reagent when stored unopened at +2°C to +8°C will obtain the shelf-life indicated on the cartridge label. Once opened, the reagent is stable for 30 days at +2°C to +8°C unless the expiration date is exceeded. DO NOT FREEZE.

REAGENT STORAGE LOCATION:

[Chemistry section, room L568. Refer to reagent "map" on Chemistry refrigerator #6.](#)

CALIBRATION

CALIBRATOR REQUIRED

Synchron[®] Systems Multi Calibrator

CALIBRATOR PREPARATION

No preparation is required.

CALIBRATOR STORAGE AND STABILITY

If unopened, the Synchron[®] Systems Multi Calibrator should be stored at -15°C to -20°C until the expiration date printed on the calibrator bottle. Opened calibrators that are resealed and stored at +2°C to +8°C are stable for 20 days unless the expiration date is exceeded.

 **CAUTION**

Because this product is of human origin, it should be handled as though capable of transmitting infectious diseases. Each serum or plasma donor unit used in the preparation of this material was tested by United States Food and Drug Administration (FDA) approved methods and found to be negative for antibodies to HIV and HCV and nonreactive for HbsAg. Because no test method can offer complete assurance that HIV, hepatitis B virus, and hepatitis C virus or other infectious agents are absent, this material should be handled as though capable of transmitting infectious diseases. This product may also contain other human source material for which there is no approved test. The FDA recommends such samples to be handled as specified in Centers for Disease Control's Biosafety Level 2 guidelines.⁶

CALIBRATOR STORAGE LOCATION:

Thawed Multical vial in-use kept refrigerated in Calibrator tray. Unopened Multical kept frozen, Chemistry freezer 8.

Refer to "DXC800 Calibrator Quick Reference" write up in DXC800 Procedures manual

CALIBRATION INFORMATION

1. The system must have valid calibration factors in memory before controls or patient samples can be run.
2. Under typical operating conditions the CHOL reagent cartridge must be calibrated every 14 days and also with certain parts replacements or maintenance procedures, as defined in the SYNCHRON LX *Maintenance Manual and Instrument Log*, or the UniCel DxC 600/800 System *Instructions For Use* (IFU) manual. This assay has within-lot calibration available. Refer to the SYNCHRON LX *Operations Manual*, or the UniCel DxC 600/800 System *Instructions For Use* (IFU) manual for information on this feature.
3. For detailed calibration instructions, refer to the SYNCHRON LX *Operations Manual*, or the UniCel DxC 600/800 System *Instructions For Use* (IFU) manual.
4. The system will automatically perform checks on the calibration and produce data at the end of calibration. In the event of a failed calibration, the data will be printed with error codes and the system will alert the operator of the failure. For information on error codes, refer to the SYNCHRON LX *Diagnostics and Troubleshooting Manual*, or the UniCel DxC 600/800 System *Instructions For Use* (IFU) manual.

TRACEABILITY

For Traceability information refer to the Calibrator instructions for use.

QUALITY CONTROL

At least two levels of control material should be analyzed daily. In addition, these controls should be run with each new calibration, with each new reagent cartridge and after specific maintenance or troubleshooting procedures as detailed in the appropriate system manual. More frequent use of controls or the use of additional controls is left to the discretion of the user based on good laboratory practices or laboratory accreditation requirements and applicable laws.

The following controls should be prepared and used in accordance with the package inserts. Discrepant quality control results should be evaluated by your facility.

TABLE 1 QUALITY CONTROL MATERIAL

CONTROL NAME	SAMPLE TYPE	STORAGE
<p>Monitrol levels 1 and 2 vials in use kept refrigerated after thawing. Unopened Monitrol kept frozen until just before use. Refer to "DXC 800 Control Analysis" in DXC 800 procedure manual for other control material used and storage. Control preparations and acceptance of QC results are in "Policies and Procedures" manual</p>		

TESTING PROCEDURE(S)

1. If necessary, load the reagent onto the system.
2. After reagent load is completed, calibration may be required.
3. Program samples and controls for analysis.
4. After loading samples and controls onto the system, follow the protocols for system operations.

For detailed testing procedures, refer to the SYNCHRON LX *Operations Manual*, or the UniCel DxC 600/800 System *Instructions For Use (IFU)* manual.

CALCULATIONS

The SYNCHRON® System(s) performs all calculations internally to produce the final reported result. The system will calculate the final result for sample dilutions made by the operator when the dilution factor is entered into the system during sample programming.

REPORTING RESULTS

Equivalency between the SYNCHRON LX and UniCel DxC 600/800 Systems has been established. Chemistry results between these systems are in agreement and data from representative systems may be shown.

REFERENCE INTERVALS

The National Cholesterol Education Program has published reference cholesterol values for cardiovascular risk to be:

TABLE 2 REFERENCE INTERVALS

Less than 200 mg/dL	low risk
201 – 239 mg/dL	borderline risk
240 mg/dL and greater	high risk

Refer to Reference (7) for additional reference intervals according to age and sex. Each laboratory should establish its own reference intervals based upon its patient population.

LABORATORY**CONVENTIONAL UNITS**

Children and Adolescents (< 20 y/o):	< 170 mg/dL	Acceptable
	170-199 mg/dL	Borderline
	> 199 mg/dL	High
Adults (≥ 20 y/o):	< 200 mg/dL	Desirable
	200-239 mg/dL	Borderline
	> 239 mg/dL	High

Refer to References (8,9,10) for guidelines on establishing laboratory-specific reference intervals.

Note: Risk classification based on National Cholesterol Education Program (NCEP-ATPIII) guidelines.

ADDITIONAL REPORTING INFORMATION AS DESIGNATED BY THIS LABORATORY:

Refer to "DXC 800 Linearity and Reportable Range" chart in Technical Notes section of DXC 800 Procedure manual.

PROCEDURAL NOTES**ANTICOAGULANT TEST RESULTS**

1. If plasma is the sample of choice, the following anticoagulants were found to be compatible with this method based on a study of 20 healthy volunteers:

Table 3 Acceptable Anticoagulants^a

ANTICOAGULANT	LEVEL TESTED FOR IN VITRO INTERFERENCE	PLASMA-SERUM BIAS
Ammonium Heparin	29 Units/mL	NSI ^b
Lithium Heparin	29 Units/mL	NSI
Sodium Heparin	29 Units/mL	NSI

2. The following anticoagulants were found to be incompatible with this method:

Table 4 Incompatible Anticoagulants^c

ANTICOAGULANT	LEVEL TESTED FOR IN VITRO INTERFERENCE	PLASMA-SERUM BIAS ^d
EDTA	3.0 mg/mL	≤-24.0
Sodium Citrate	6.6 mg/mL	≤-79.0
Potassium Oxalate/Sodium Fluoride	4.0 / 5.0 mg/mL	≤-60.0

LIMITATIONS

None identified.

INTERFERENCES

1. The following substances were tested for interference with this methodology:

Table 5 Interferences^e

SUBSTANCE	SOURCE	LEVEL TESTED	OBSERVED EFFECT ^f
Hemoglobin	RBC hemolysate	(4+) 500 mg/dL	NSI ^g
Bilirubin	Bovine (unconjugated)	30 mg/dL	≤ - 25 mg/dL
			@ 400 mg/dL

SUBSTANCE	SOURCE	LEVEL TESTED	OBSERVED EFFECT ^f
Lipemia	Intralipid ^h	(4+) 400 mg/dL	NSI
Ascorbic Acid	NA ⁱ	3 mg/dL	NSI
Albumin	Human	7.7 g/dL	≤ - 12 mg/dL @ 240 mg/dL
Urea	NA	500 mg/dL	NSI

1. Samples or control materials which contain acetic acid, detergents, or surfactants may inhibit the enzymes in the reagent and should not be used.
2. Refer to References (11,12,13) for other interferences caused by drugs, disease and preanalytical variables.

PERFORMANCE CHARACTERISTICS

Analytic Range

The SYNCHRON[®] System(s) method for the determination of this analyte provides the following analytical ranges:

TABLE 6 ANALYTICAL RANGE

SAMPLE TYPE	CONVENTIONAL UNITS	S.I. UNITS
Serum or Plasma	5 – 750 mg/dL	0.13 – 19.43 mmol/L
Serum or Plasma (ORDAC)	600 – 1000 mg/dL	15.54 – 25.90 mmol/L

Samples with concentrations exceeding the high end of the analytical range should be rerun with ORDAC enabled or diluted with saline and reanalyzed.

REPORTABLE RANGE (as determined on site):

TABLE 7 REPORTABLE RANGE

SAMPLE TYPE	CONVENTIONAL UNITS	S.I. UNITS
Serum or Plasma	5 – 1000 mg/dL	n/a

SENSITIVITY

Sensitivity is defined as the lowest measurable concentration which can be distinguished from zero with 95% confidence. Sensitivity for CHOL determination is 5 mg/dL (0.13 mmol/L).

EQUIVALENCY

Equivalency was assessed by Deming regression analysis of patient samples to accepted clinical methods.

Serum or Plasma (in the range of 39 to 723 mg/dL):

Y (SYNCHRON LX Systems)	= 0.975X + 3.94
N	= 77
MEAN (SYNCHRON LX Systems)	= 241.9
MEAN (SYNCHRON CX7 DELTA)	= 244.0
CORRELATION COEFFICIENT (r)	= 0.9997

Equivalency to the Abell-Kendall procedure was assessed by Deming regression of Abell-Kendall values to those obtained with the SYNCHRON LX Systems using patient samples.

Serum or Plasma (in the range of 134 to 316 mg/dL):

Y (SYNCHRON LX Systems)	= 1.000X – 2.1
N	= 39
MEAN (SYNCHRON LX Systems)	= 212.0
MEAN (Abell-Kendall)	= 213.9
CORRELATION COEFFICIENT (r)	= 0.9961

The calibrator for Total Cholesterol is value-assigned by CDC-certified Lipid Laboratories using the Abell-Kendall procedure. The Total Cholesterol test on SYNCHRON Systems has been certified by the National Cholesterol Education Program (NCEP).

Refer to References (14) for guidelines on performing equivalency testing.

PRECISION

A properly operating SYNCHRON[®] System(s) should exhibit precision values less than or equal to the following:

TABLE 8 PRECISION VALUES

TYPE OF PRECISION	SAMPLE TYPE	1 SD		CHANGEOVER VALUE ^j		% CV
		mg/dL	mmol/L	mg/dL	mmol/L	
Within-run	Serum/Plasma	5.0	0.13	166.7	4.3	3.0
	Serum/Plasma (ORDAC)	NA ^k	NA	NA	NA	10.0
Total	Serum/Plasma	7.5	0.20	166.7	4.3	4.5
	Serum/Plasma (ORDAC)	NA	NA	NA	NA	15.0

Refer to References (15) for guidelines on performing precision testing.

Comparative performance data for a SYNCHRON LX[®] System evaluated using the NCCLS Proposed Guideline EP5-T2 appears in the table below.¹⁵ Each laboratory should characterize their own instrument performance for comparison purposes.

TABLE 9 NCCLS EP5-T2 PRECISION ESTIMATE METHOD

TYPE OF IMPRECISION	SAMPLE TYPE		No. Systems	No. Data Points ⁱ	Test Mean Value (mg/dL)	EP5-T2 Calculated Point Estimates	
						SD	% CV
Within-run	Serum	Control 1	1	80	98.7	1.08	1.09
	Serum	Control 2	1	80	155.4	1.65	1.06
	Serum	Control 3	1	80	213.2	20.8	0.98
Total	Serum	Control 1	1	80	98.7	1.46	1.48
	Serum	Control 2	1	80	155.4	2.44	1.57
	Serum	Control 3	1	80	213.2	2.99	1.40

Samples with mean values in the ORDAC range were also evaluated on one system using twenty replicates. Samples with a mean value of 716.2 mg/dL showed a standard deviation of 12.5 mg/dL and a coefficient variation of 1.75%. Samples with a mean value of 876.3 mg/dL showed a standard deviation of 19.9 mg/dL and a coefficient of variation of 2.28%.

NOTICE

These degrees of precision and equivalency were obtained in typical testing procedures on a SYNCHRON LX[®] System and are not intended to represent the performance specifications for this reagent.

ADDITIONAL INFORMATION

For more detailed information on SYNCHRON LX Systems or UniCel DxC Systems, refer to the appropriate system manual.

SHIPPING DAMAGE

If damaged product is received, notify your Beckman Coulter Clinical Support Center.

REFERENCES

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4. Tietz, N. W., "Specimen Collection and Processing; Sources of Biological Variation", *Textbook of Clinical Chemistry*, 2nd Edition, W. B. Saunders, Philadelphia, PA (1994).
5. National Committee for Clinical Laboratory Standards, *Procedures for the Handling and Processing of Blood Specimens*, Approved Guideline, NCCLS publication H18-A, Villanova, PA (1990).
6. CDC-NIH manual, *Biosafety in Microbiological and Biomedical Laboratories*, U.S. Government Printing Office, Washington, D.C. (1984).
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8. National Committee for Clinical Laboratory Standards, *How to Define, Determine, and Utilize Reference Intervals in the Clinical Laboratory*, Approved Guideline, NCCLS publication C28-A, Villanova, PA (1995).
9. Tietz, N. W., ed., *Fundamentals of Clinical Chemistry*, 3rd Edition, W. B. Saunders, Philadelphia, PA (1987).
10. Henry, J. B., *Clinical Diagnosis and Management by Laboratory Methods*, 18th Edition, W. B. Saunders Company, Philadelphia, PA (1991).
11. Young, D. S., *Effects of Drugs on Clinical Laboratory Tests*, 4th Edition, AACC Press, Washington, D. C. (1995).
12. Friedman, R. B., Young, D. S., *Effects of Disease on Clinical Laboratory Tests*, 3rd Edition, AACC Press, Washington, D.C. (1997).
13. Young, D. S., *Effects of Preanalytical Variables on Clinical Laboratory Tests*, 2nd Edition, AACC Press, Washington, D. C. (1997).
14. National Committee for Clinical Laboratory Standards, *Method Comparison and Bias Estimation Using Patient Samples*, Approved Guideline, NCCLS publication EP9-A, Villanova, PA (1995).
15. National Committee for Clinical Laboratory Standards, *Precision Performance of Clinical Chemistry Devices*, Tentative Guideline, 2nd Edition, NCCLS publication EP5-T2, Villanova, PA (1992).



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ENDNOTES

- a Data shown was collected using SYNCHRON CX Systems. Equivalency between SYNCHRON LX Systems has been established by Deming regression analysis to SYNCHRON CX Systems.
- b NSI = No Significant Interference (within ± 10.0 mg/dL or 6%).
- c Data shown was collected using SYNCHRON CX Systems. Equivalency between SYNCHRON LX Systems has been established by Deming regression analysis to SYNCHRON CX Systems.
- d Bias is based on worst case instead of average. Plus (+) or minus (-) signs in this column signify positive or negative bias.
- e Data shown was collected using SYNCHRON CX Systems. Equivalency between SYNCHRON LX Systems has been established by Deming regression analysis to SYNCHRON CX Systems.
- f Plus (+) or minus (-) signs in this column signify positive or negative interference.
- g NSI = No significant interference (within ± 10.0 mg/dL or 6%).
- h Intralipid is a registered trademark of KabiVitrum, Inc., Clayton, NC 27250.
- i NA = Not applicable.
- j When the mean of the test precision data is less than or equal to the changeover value, compare the test SD to the SD guideline given above to determine the acceptability of the precision testing. When the mean of the test precision data is greater than the changeover value, compare the test % CV to the guideline given above to determine acceptability. Changeover value = (SD guideline/CV guideline) x 100.
- k NA = Not applicable.
- l The point estimate is based on the data from one system, run for twenty days, two runs per day, two observations per run on an instrument operated and maintained according to the manufacturer's instructions.