

Elecsys Active B12

REF			SYSTEM
08717028190	08717028500	300	cobas e 402 cobas e 801

English

System information

Short name	ACN (application code number)
ACTB12	10152

Intended use

Immunoassay for the in vitro quantitative determination of active vitamin B12 (holotranscobalamin) in human serum. The assay is used as an aid in the diagnosis and treatment of vitamin B12 deficiency.

The electrochemiluminescence immunoassay "ECLIA" is intended for use on **cobas e** immunoassay analyzers.

Summary

Vitamin B12 is an essential water-soluble micronutrient that cannot be produced by the human body.^{1,2,3} Three carrier proteins are involved in the transport and absorption of vitamin B12 (cobalamin): intrinsic factor, transcobalamin (TC) and haptocorrin (HC).¹ The majority (70-90 %) of total serum vitamin B12 circulating in the blood is bound to HC.^{4,5} Approximately 20-30 % of total circulating vitamin B12 is bound to TC (known as holoTC).⁴ Cellular uptake from the circulation requires the biologically active holoTC fraction.^{4,5} This form is able to enter cells to exert the biological effects of vitamin B12 and is therefore referred to as "active vitamin B12".^{4,6}

Vitamin B12 is essential for carbohydrate, fat and protein metabolism as well as nucleic acid synthesis.² It serves as a cofactor for enzymes central to 2 important metabolic reactions: the production of methionine from homocysteine and the production of succinyl-coenzyme A from methylmalonyl coenzyme A.⁷ Therefore, vitamin B12 is vital for processes such as cell division, maintenance of the central nervous system, as well as the formation and regeneration of red blood cells.^{2,8}

Deficiency in vitamin B12 can have major clinical implications and cause irreversible damage if left untreated.^{1,7,9} The most common manifestations of vitamin B12 deficiency are hematologic disorders, particularly affecting the formation of erythrocytes (e.g. megaloblastic anemia),^{7,9} and neurological disorders, such as demyelination of the spinal cord and cognitive decline.⁷ Vitamin B12 deficiency has also been associated with bone disorders¹⁰ and optic neuropathy, though these are less frequent.⁹

The most common causes of vitamin B12 deficiency are malabsorption due to pernicious anemia (autoimmune gastritis) or due to aging, insufficient dietary intake and other acquired defects in vitamin B12 metabolism.^{7,3,11}

Given that holoTC is the active fraction of vitamin B12⁶ and has a shorter circulating half-life than holoHC,⁵ a number of publications suggest measurement of holoTC as a more diagnostically accurate and clinically relevant indicator of vitamin B12 deficiency than total serum vitamin B12.^{3,6,11,12,13} Unlike total serum vitamin B12, holoTC is believed to be stable in pregnancy.^{8,11} Furthermore, HoloTC was shown to be the best-performing indicator of vitamin B12 status in the elderly population, suggesting active vitamin B12 for first-line assessment of vitamin B12 deficiency.¹²

Test principle

Sandwich principle. Total duration of assay: 18 minutes.

- 1st incubation: 18 µL of sample, a biotinylated monoclonal anti-holotranscobalamin antibody and a monoclonal anti-transcobalamin antibody labeled with a ruthenium complex⁹ react to form a sandwich complex.
- 2nd incubation: After addition of streptavidin-coated microparticles, the complex becomes bound to the solid phase via interaction of biotin and streptavidin.
- The reaction mixture is aspirated into the measuring cell where the microparticles are magnetically captured onto the surface of the electrode. Unbound substances are then removed with ProCell II M. Application of a voltage to the electrode then induces chemiluminescent emission which is measured by a photomultiplier.

- Results are determined via a calibration curve which is instrument-specifically generated by 2-point calibration and a master curve provided via the **cobas link**.

a) Tris(2,2'-bipyridyl)ruthenium(II)-complex (Ru(bpy)₃²⁺)

Reagents - working solutions

The **cobas e** pack is labeled as ACTB12.

- M Streptavidin-coated microparticles, 1 bottle, 14.1 mL:
Streptavidin-coated microparticles 0.72 mg/mL; preservative.
- R1 Anti-holotranscobalamin antibody~biotin, 1 bottle, 16.7 mL:
Biotinylated monoclonal anti-holotranscobalamin antibody (mouse) 2 mg/L; HEPES^{b)} buffer 50 mmol/L, pH 6.8; preservative.
- R2 Anti-transcobalamin antibody~Ru(bpy)₃²⁺, 1 bottle, 16.7 mL:
Monoclonal anti-transcobalamin antibody (mouse) labeled with ruthenium complex 0.5 mg/L; HEPES buffer 50 mmol/L, pH 6.8; preservative.

b) HEPES = [4-(2-hydroxyethyl)-piperazine]-ethane sulfonic acid

Precautions and warnings

For in vitro diagnostic use for health care professionals. Exercise the normal precautions required for handling all laboratory reagents.

Infectious or microbial waste:

Warning: handle waste as potentially biohazardous material. Dispose of waste according to accepted laboratory instructions and procedures.

Environmental hazards:

Apply all relevant local disposal regulations to determine the safe disposal.

Safety data sheet available for professional user on request.

This kit contains components classified as follows in accordance with the Regulation (EC) No. 1272/2008:



Warning

H317 May cause an allergic skin reaction.

Prevention:

P261 Avoid breathing dust/fume/gas/mist/vapours/spray.

P272 Contaminated work clothing should not be allowed out of the workplace.

P280 Wear protective gloves.

Response:

P333 + P313 If skin irritation or rash occurs: Get medical advice/attention.

P362 + P364 Take off contaminated clothing and wash it before reuse.

Disposal:

P501 Dispose of contents/container to an approved waste disposal plant.

Product safety labeling follows EU GHS guidance.

Contact phone: all countries: +49-621-7590

Avoid foam formation in all reagents and sample types (specimens, calibrators and controls).

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Reagent handling

The reagents in the kit have been assembled into a ready-for-use unit that cannot be separated.

All information required for correct operation is available via the **cobas** link.

Storage and stability

Store at 2-8 °C.

Do not freeze.

Store the **cobas e** pack **upright** in order to ensure complete availability of the microparticles during automatic mixing prior to use.

Stability:	
unopened at 2-8 °C	up to the stated expiration date
on the cobas e analyzers	16 weeks

Specimen collection and preparation

Only the specimens listed below were tested and found acceptable.

Serum collected using standard sampling tubes or tubes containing separating gel.

Stable for 5 days at 15-25 °C, 14 days at 2-8 °C, 6 months at -20 °C (± 5 °C). The samples may be frozen 5 times.

The sample types listed were tested with a selection of sample collection tubes that were commercially available at the time of testing, i.e. not all available tubes of all manufacturers were tested. Sample collection systems from various manufacturers may contain differing materials which could affect the test results in some cases. When processing samples in primary tubes (sample collection systems), follow the instructions of the tube manufacturer.

Centrifuge samples containing precipitates before performing the assay.

Do not use heat-inactivated samples.

Do not use samples and controls stabilized with azide.

Ensure the samples and calibrators are at 20-25 °C prior to measurement.

Due to possible evaporation effects, samples and calibrators on the analyzers should be analyzed/measured within 2 hours.

Materials provided

See "Reagents – working solutions" section for reagents.

Materials required (but not provided)

- [REF] 07726350190, CalSet Active B12, for 4 x 1.0 mL
- [REF] 07713223190, PreciControl Active B12, for 4 x 3.0 mL
- [REF] 07299001190, Diluent Universal, 36 mL sample diluent
- General laboratory equipment
- **cobas e** analyzer

Additional materials for **cobas e** 402 and **cobas e** 801 analyzers:

- [REF] 06908799190, ProCell II M, 2 x 2 L system solution
- [REF] 04880293190, CleanCell M, 2 x 2 L measuring cell cleaning solution
- [REF] 07485409001, Reservoir Cup, 8 cups to supply ProCell II M and CleanCell M
- [REF] 06908853190, PreClean II M, 2 x 2 L wash solution
- [REF] 05694302001, Assay Tip/Assay Cup tray, 6 magazines x 6 magazine stacks x 105 assay tips and 105 assay cups, 3 wasteliners
- [REF] 07485425001, Liquid Flow Cleaning Cup, 2 adaptor cups to supply ISE Cleaning Solution/Elecsys SysClean for Liquid Flow Cleaning Detection Unit
- [REF] 07485433001, PreWash Liquid Flow Cleaning Cup, 1 adaptor cup to supply ISE Cleaning Solution/Elecsys SysClean for Liquid Flow Cleaning PreWash Unit
- [REF] 11298500316, ISE Cleaning Solution/Elecsys SysClean, 5 x 100 mL system cleaning solution

Assay

For optimum performance of the assay follow the directions given in this document for the analyzer concerned. Refer to the appropriate operator's manual for analyzer-specific assay instructions.

Resuspension of the microparticles takes place automatically prior to use.

Place the cooled (stored at 2-8 °C) **cobas e** pack on the reagent manager. Avoid foam formation. The system automatically regulates the temperature of the reagents and the opening/closing of the **cobas e** pack.

Calibration

Traceability: This method has been standardized against the WHO International Standard NIBSC (National Institute for Biological Standards and Control) code 03/178.

The predefined master curve is adapted to the analyzer using the relevant CalSet.

Calibration frequency: Calibration must be performed once per reagent lot using fresh reagent (i.e. not more than 24 hours since the **cobas e** pack was registered on the analyzer).

Calibration interval may be extended based on acceptable verification of calibration by the laboratory.

Renewed calibration is recommended as follows:

- after 12 weeks when using the same reagent lot
- after 28 days when using the same **cobas e** pack on the analyzer
- as required: e.g. quality control findings outside the defined limits

Quality control

For quality control, use PreciControl Active B12.

In addition, other suitable control material can be used.

Controls for the various concentration ranges should be run individually at least once every 24 hours when the test is in use, once per **cobas e** pack, and following each calibration.

The control intervals and limits should be adapted to each laboratory's individual requirements. Values obtained should fall within the defined limits. Each laboratory should establish corrective measures to be taken if values fall outside the defined limits.

If necessary, repeat the measurement of the samples concerned.

Follow the applicable government regulations and local guidelines for quality control.

Calculation

The analyzer automatically calculates the analyte concentration of each sample in pmol/L.

Limitations - interference

The effect of the following endogenous substances and pharmaceutical compounds on assay performance was tested. Interferences were tested up to the listed concentrations and no impact on results was observed.

Endogenous substances

Compound	Concentration tested
Bilirubin	≤ 1129 µmol/L or ≤ 66 mg/dL
Hemoglobin	≤ 0.621 mmol/L or ≤ 1000 mg/dL
Intralipid	≤ 2000 mg/dL
Biotin	≤ 4912 nmol/L or ≤ 1200 ng/mL
Rheumatoid factors	≤ 1200 IU/mL
Human serum albumin	≤ 7 g/dL

Criterion: For concentrations of 3-20 pmol/L the deviation is ≤ 2.0 pmol/L. For concentrations > 20-100 pmol/L the deviation is ≤ 10 %. For concentrations > 100 pmol/L the deviation is ≤ 15 %.

There is no high-dose hook effect at holotranscobalamin concentrations up to 1000 pmol/L.

Pharmaceutical substances

In vitro tests were performed on 17 commonly used pharmaceuticals. No interference with the assay was found.

In rare cases, interference due to extremely high titers of antibodies to analyte-specific antibodies, streptavidin or ruthenium can occur. These effects are minimized by suitable test design.

For diagnostic purposes, the results should always be assessed in conjunction with the patient's medical history, clinical examination and other findings.

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Mutations or polymorphisms in genes related, peripheral to, or even unrelated to the vitamin B12 metabolic pathway, can affect the results of the vitamin B12 tests.¹⁰ In particular, recent case reports have shown that genetic variations in the transcobalamin gene (TCN2) can affect HoloTC test results and indicate falsely low levels of HoloTC.^{14,15}

Limits and ranges

Measuring range

3.0-150 pmol/L (defined by the Limit of Detection and the maximum of the master curve). Values below the Limit of Detection are reported as < 3.0 pmol/L. Values above the measuring range are reported as > 150 pmol/L.

Lower limits of measurement

Limit of Blank, Limit of Detection and Limit of Quantitation

Limit of Blank = 2.0 pmol/L

Limit of Detection = 3.0 pmol/L

Limit of Quantitation = 5.0 pmol/L

The Limit of Blank, Limit of Detection and Limit of Quantitation were determined in accordance with the CLSI (Clinical and Laboratory Standards Institute) EP17-A2 requirements.

The Limit of Blank is the 95th percentile value from $n \geq 60$ measurements of analyte-free samples over several independent series. The Limit of Blank corresponds to the concentration below which analyte-free samples are found with a probability of 95 %.

The Limit of Detection is determined based on the Limit of Blank and the standard deviation of low concentration samples. The Limit of Detection corresponds to the lowest analyte concentration which can be detected (value above the Limit of Blank with a probability of 95 %).

The Limit of Quantitation is defined as the lowest amount of analyte in a sample that can be accurately quantitated with an intermediate precision CV of ≤ 10 %.

Dilution

Samples with holotranscobalamin concentrations above the measuring range can be diluted with Diluent Universal. The recommended dilution is 1:2 (either automatically by the analyzers or manually). The concentration of the diluted sample must be ≥ 65 pmol/L.

After manual dilution, multiply the result by the dilution factor.

After dilution by the analyzers, the software automatically takes the dilution into account when calculating the sample concentration.

Note: Sample-dependent non-linearity upon dilution is seen with samples having analyte levels beyond the measuring range. As Diluent Universal may contain low levels of endogenous vitamin B12, it is recommended that linearity studies be performed using a known low analyte-containing serum pool. Samples outside the measuring range can be diluted 1:2 with Diluent Universal; the effect of endogenous vitamin B12 concentration is insignificant at these levels.

Expected values

Because differences may exist with respect to population and dietary status, it is recommended that normal ranges be determined by each laboratory over a suitable period of time and in a statistically significant number of samples before clinical significance is attached to the results.

The values shown below were performed on samples from an apparently healthy population, using the Elecsys Active B12 assay. The calculation is based on 214 sera (99 men, 115 women). The age range was between 20 and 79 years. Pregnant women were excluded. The reference population was selected according to normal homocysteine values.

N	Median	Range (2.5 th -97.5 th percentile)
	pmol/L	pmol/L
214	77.0	37.5-188

These values should only be used as guidance.

Each laboratory should investigate the transferability of the expected values to its own patient population and if necessary determine its own reference ranges.

Specific performance data

Representative performance data on the analyzers are given below. Results obtained in individual laboratories may differ.

Precision

Precision was determined using Elecsys reagents, pooled human sera and controls in a protocol (EP05-A3) of the CLSI (Clinical and Laboratory Standards Institute): 2 runs per day in duplicate each for 21 days ($n = 84$). The following results were obtained:

cobas e 402 and cobas e 801 analyzers					
Sample	Mean pmol/L	Repeatability		Intermediate precision	
		SD pmol/L	CV %	SD pmol/L	CV %
Human serum 1	5.41	0.106	2.0	0.231	4.3
Human serum 2	24.8	0.469	1.9	0.605	2.4
Human serum 3	51.2	0.886	1.7	1.24	2.4
Human serum 4	67.5	1.20	1.8	1.69	2.5
Human serum 5	146	2.15	1.5	3.57	2.4
PC ^{c)} Active B12 1	25.5	0.455	1.8	0.579	2.3
PC Active B12 2	53.5	0.790	1.5	1.06	2.0

c) PC = PreciControl

Method comparison

a) A comparison of the Elecsys Active B12 assay, [REF] 08717028190 (cobas e 801 analyzer; y), with the Elecsys Active B12 assay, [REF] 07713258190 (cobas e 801 analyzer; x), gave the following correlations (pmol/L):

Number of samples measured: 168

Passing/Bablok¹⁶ Linear regression

$y = 0.996x - 3.05$ $y = 0.985x - 1.92$

$\tau = 0.904$ $r = 0.986$

The sample concentrations were between 7.8 and 149 pmol/L.

b) A comparison of the Elecsys Active B12 assay, [REF] 08717028190 (cobas e 402 analyzer; y), with the Elecsys Active B12 assay, [REF] 08717028190 (cobas e 801 analyzer; x), gave the following correlations (pmol/L):

Number of samples measured: 105

Passing/Bablok¹⁶ Linear regression

$y = 1.05x - 1.13$ $y = 1.05x - 1.29$

$\tau = 0.943$ $r = 0.995$

The sample concentrations were between 5.26 and 139 pmol/L.

Analytical specificity

The following cross-reactivities were found, tested with active B12 concentrations of approximately 7 pmol/L, 48 pmol/L and 124 pmol/L.

Cross-reactant	Concentration tested pmol/L	Cross-reactivity %
Apotranscobalamin	500	n. d. ^{d)}
Haptocorrin	5000	n.d.

d) n. d. = not detectable

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For further information, please refer to the appropriate operator's manual for the analyzer concerned, the respective application sheets and the Method Sheets of all necessary components (if available in your country).

A point (period/stop) is always used in this Method Sheet as the decimal separator to mark the border between the integral and the fractional parts of a decimal numeral. Separators for thousands are not used.

Any serious incident that has occurred in relation to the device shall be reported to the manufacturer and the competent authority of the Member State in which the user and/or the patient is established.

Symbols

Roche Diagnostics uses the following symbols and signs in addition to those listed in the ISO 15223-1 standard (for USA: see dialog.roche.com for definition of symbols used):

	Contents of kit
	Analyzers/Instruments on which reagents can be used
	Reagent
	Calibrator
	Volume for reconstitution
	Global Trade Item Number

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