MAYO CLINIC LABORATORIES

# Test Definition: GAL1B

Galactose-1-Phosphate, Blood Spot

## Overview

### Useful For

Monitoring dietary therapy of individuals with galactosemia due to deficiency of galactose-1-phosphate uridyltransferase (GALT) or uridine diphosphate galactose-4-epimerase (GALE) in blood spots

### Genetics Test Information

Galactose-1-phosphate uridyltransferase (GALT) deficiency is the most common cause of galactosemia and requires lifelong restriction of dietary galactose.

Galactose-1-phosphate is elevated in patients with galactosemia due to GALT deficiency or uridine diphosphate galactose-4-epimerase (GALE) deficiency, therefore is a suitable analyte for monitoring dietary compliance.

### Testing Algorithm

For more information see Galactosemia Testing Algorithm.

### Special Instructions

- Galactosemia Testing Algorithm
- Biochemical Genetics Patient Information
- Blood Spot Collection Card-Spanish Instructions
- Blood Spot Collection Card-Chinese Instructions
- Galactosemia-Related Test List
- Blood Spot Collection Instructions

### Method Name

Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)

### NY State Available

Yes

## Specimen

### Specimen Type

Whole blood

### Ordering Guidance

This test is used to monitor dietary therapy of patients with galactosemia due to deficiency of galactose-1-phosphate uridyltransferase or uridine diphosphate galactose-4-epimerase.

This test is **not appropriate** for the diagnosis of galactosemia. The preferred test to evaluate for possible diagnosis of galactosemia, routine carrier screening, and follow-up of abnormal newborn screening results is GCT / Galactosemia Reflex, Blood.

This test is **not appropriate** for the diagnosis of epimerase deficiency, the preferred test to evaluate this deficiency is GALE / Uridine Diphosphate-Galactose 4' Epimerase, Blood.

For more information see Galactosemia-Related Test List.

## Necessary Information

Biochemical Genetics Patient Information (T602) is recommended, but not required, to be filled out and sent with the specimen to aid in the interpretation of test results.

## Specimen Required

**Submit only 1 of the following specimen types:**

**Preferred:**
**Specimen Type:** Blood spot
**Supplies:** Card-Blood Spot Collection (Filter Paper) (T493)
**Container/Tube:**
**Preferred:** Blood Spot Collection Card
**Acceptable:** Whatman Protein Saver 903 Paper, Revvity 226 filter paper, or blood collected in tubes containing EDTA and dried on filter paper
**Specimen Volume:** 2 Blood spots
**Collection Instructions:**
1. An alternative blood collection option for a patient older than 1 year is a fingerstick. For detailed instructions, see How to Collect Dried Blood Spot Sample.
2. At least 2 spots should be complete (ie, unpunched).
3. Let blood dry on filter paper at ambient temperature in a horizontal position for a minimum of 3 hours.
4. Do not expose specimen to heat or direct sunlight.
5. Do not stack wet specimens.
6. Keep specimen dry.
**Specimen Stability Information:** Ambient (preferred) 91 days/Refrigerate 91 days/Frozen 91 days
**Additional Information:**
1. For collection instructions, see Blood Spot Collection Instructions
2. For collection instructions in Spanish, see Blood Spot Collection Card-Spanish Instructions (T777)
3. For collection instructions in Chinese, see Blood Spot Collection Card-Chinese Instructions (T800)

**Acceptable:**
**Specimen Type:** Whole Blood
**Container/Tube:**
**Preferred:** Lavender top (EDTA)
**Acceptable:** Green top (sodium heparin) or yellow top (ACD)
**Specimen Volume:** 2 mL
**Collection Instructions:** Send specimen in original tube**. Do not aliquot.**
**Specimen Stability Information:** Refrigerate (preferred) 48 hours/Frozen 14 days

## Forms

Biochemical Genetics Patient Information (T602) is recommended.

### Specimen Minimum Volume

Blood Spots: 1; Whole blood: 0.5 mL

### Reject Due To

| | |
|---|---|
| Blood spot specimen that shows serum rings or has multiple layers | Reject |
| Insufficient specimen | Reject |
| Unapproved filter papers | Reject |
| Capitainer (microsampling devices) | Reject |

### Specimen Stability Information

| Specimen Type | Temperature | Time | Special Container |
|---|---|---|---|
| Whole blood | Varies | | |

## Clinical & Interpretive

### Clinical Information

Galactosemia is an autosomal recessive disorder that results from a deficiency of any 1 of the 4 enzymes catalyzing the conversion of galactose to glucose: galactose-1-phosphate uridyltransferase (GALT), galactokinase (GALK), uridine diphosphate galactose-4-epimerase (GALE), and galactose mutarotase (GALM). Galactose-1-phosphate (Gal-1-P) accumulates in the erythrocytes of patients with galactosemia due to GALT or GALE deficiency or in neonates with GALM deficiency. The quantitative measurement of Gal-1-P is useful for monitoring compliance with dietary therapy for either GALT or GALE deficiency. Gal-1-P is thought to be the causative factor for development of liver disease in these patients and, therefore, patients should maintain low levels and be monitored on a regular basis. The concentration of Gal-1-P in erythrocytes is the most sensitive index of dietary control.

Galactose-1-phosphate uridyltransferase deficiency is the most common cause of galactosemia and is often referred to as classic galactosemia. The complete or near-complete deficiency of GALT enzyme is life-threatening if left untreated. Complications in the neonatal period include failure to thrive, liver failure, sepsis, and death.

Galactosemia due to GALT deficiency is treated by a galactose-restricted diet, which allows for rapid recovery from the acute symptoms and a generally good prognosis. Despite adequate treatment from an early age, individuals with galactosemia remain at increased risk for developmental delays, speech problems, and abnormalities of motor function. Female patients with galactosemia are at increased risk for premature ovarian failure. Based upon reports by newborn

screening programs, the frequency of classic galactosemia in the United States is approximately 1 in 30,000, although literature reports range from 1 in 10,000 to 1 in 60,000 live births.

Epimerase deficiency galactosemia can be categorized into 3 types: generalized, peripheral, and intermediate. Generalized epimerase deficiency galactosemia results in profoundly decreased enzyme activity in all tissues, whereas peripheral epimerase deficiency galactosemia results in decreased enzyme activity in red and white blood cells but normal enzyme activity in all other tissues. Intermediate epimerase deficiency galactosemia results in decreased enzyme activity in red and white blood cells and less than 50% of normal enzyme levels in other tissues.

Clinically, infants with generalized epimerase deficiency galactosemia develop symptoms such as liver and kidney dysfunction and mild cataracts when lactose is not restricted, while infants with peripheral or intermediate epimerase deficiency galactosemia do not develop any symptoms. Generalized epimerase deficiency galactosemia is treated by a galactose- and lactose-restricted diet, which can improve or prevent the symptoms of kidney and liver dysfunction and mild cataracts. Despite adequate treatment from an early age, individuals with generalized epimerase deficiency galactosemia remain at increased risk for developmental delay and intellectual disability. Unlike patients with classic galactosemia resulting from GALT deficiency, female patients with generalized epimerase deficiency galactosemia experience normal puberty and are not at increased risk for premature ovarian failure. Based upon reports by newborn screening programs, the frequency of epimerase deficiency galactosemia in the United States ranges from approximately 1 in 6700 African American infants to 1 in 70,000 infants of European ancestry.

Galactose mutarotase deficiency is a rare form of galactosemia that is due to a deficiency of galactose mutarotase, which may manifest clinically with bilateral cataracts. Infants with GALM deficiency have increased blood galactose concentrations with levels of galactose 1-phosphate ranging from 0.3 to 10.8 mg/dL. Neonates with GALM deficiency have elevated galactose-1-phosphate, but Gal-1-P decreases rapidly in early infancy. To date, only pediatric patients have been described in the literature, therefore long-term effects of GALM deficiency are unknown.

The incidence of GALM deficiency has been reported as 1 in 10,000 in African populations and close to 1 in 80,000 in the Japanese population, with an overall estimation of about 1:228,411 in all populations.

For more information see Galactosemia Testing Algorithm.

### Reference Values

< or =1.0 mg/dL

### Interpretation

The concentration of galactose-1-phosphate (Gal-1-P) is provided along with reference values for patients with galactosemia and normal controls.

### Cautions

Patients should wait 3 to 4 months after blood transfusion before a blood collection for galactose-1-phosphate testing.

### Clinical Reference

1. Wada Y, Kikuchi A, Arai-Ichinoi N, et al. Biallelic GALM pathogenic variants cause a novel type of galactosemia. Genet Med. 2019;21(6):1286-1294. doi:10.1038/s41436-018-0340-x
2. Iwasawa S, Kikuchi A, Wada Y, et al. The prevalence of GALM mutations that cause galactosemia: A database of functionally evaluated variants. Mol Genet Metab. 2019;126(4):362-367. doi:10.1016/j.ymgme.2019.01.018

3. Welling L, Bernstein LE, Berry GT, et al. Galactosemia Network (GalNet). International clinical guideline for the management of classical galactosemia: diagnosis, treatment, and follow-up. J Inherit Metab Dis. 2017;40(2):171-176. doi:10.1007/s10545-016-9990-5
4. Berry GT. Classic galactosemia and clinical variant galactosemia. In: Adam MP, Feldman J, Mirzaa GM, et al. eds. GeneReviews [Internet]. University of Washington, Seattle; 2000. Updated March 11, 2021. Accessed March 12, 2025. Available at www.ncbi.nlm.nih.gov/books/NBK1518/
5. Walter JH, Fridovich-Keil JL. Galactosemia. In: Valle D, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA, eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; 2019. Accessed March 12, 2025. Available at https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=%20225081023
6. Timson DJ. Type IV galactosemia. Genet Med. 2019;21(6):1283-1285. doi:10.1038/s41436-018-0359-z
7. Fridovich-Keil J, Bean L, He M, et al. Epimerase deficiency galactosemia. In: Adam MP, Feldman J, Mirzaa GM, et al. eds. GeneReviews [Internet]. University of Washington, Seattle; 1993-2024. Updated March 4, 2021. Accessed March 12, 2025. Available at www.ncbi.nlm.nih.gov/books/NBK51671/

## Performance

### Method Description
Dried blood spots are extracted with water and an organic solvent mixture of acetonitrile and methanol containing (13)Carbon2-Gal-1-P internal standard. The extract is then filtered prior to injection on a liquid chromatography tandem mass spectrometry (LC-MS/MS) system. The ratio of the extracted peak area of Gal-1-P to its internal standard as determined by LC-MS/MS is used to calculate the concentration of Gal-1-P in mg/dL in each sample.(Unpublished Mayo Method)

### PDF Report
No

### Day(s) Performed
Thursday

### Report Available
4 to 10 days

### Specimen Retention Time
3 months

### Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Main Campus

## Fees & Codes

### Fees
- Authorized users can sign in to Test Prices for detailed fee information.

- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

## Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

## CPT Code Information

84378

## LOINC® Information

| Test ID | Test Order Name | Order LOINC® Value |
|---|---|---|
| GAL1B | Galactose-1-Phosphate, BS | 40842-7 |

| Result ID | Test Result Name | Result LOINC® Value |
|---|---|---|
| 622838 | Galactose-1-Phosphate, BS | 40842-7 |