

## Overview

### Useful For

Aiding in the distinction between a reactive blood cytosis and a chronic myeloproliferative disorder in extracted DNA specimens

### Special Instructions

- [Hematopathology Patient Information](#)

### Method Name

Point Mutation Detection in DNA Using Quantitative Polymerase Chain Reaction (PCR)

### NY State Available

Yes

## Specimen

### Specimen Type

Varies

### Specimen Required

**Specimen Type:** Extracted DNA from blood or bone marrow

**Container/Tube:** 1.5- to 2-mL tube with indication of volume and concentration of the DNA

**Specimen Volume:** Entire specimen

**Collection Instructions:** Label specimen as extracted DNA from blood or bone marrow and indicate volume and concentration of the DNA.

**Specimen Stability Information:** Refrigerated/Ambient

### Forms

1. [Hematopathology Patient Information](#) (T676) in Special Instructions
2. If not ordering electronically, complete, print, and send a [Hematopathology/Cytogenetics Test Request](#) (T726) with the specimen.

### Specimen Minimum Volume

Extracted DNA from blood or bone marrow: 50 microliter at 20 ng/microliter

### Reject Due To

Other	Bone marrow biopsies, slides, paraffin shavings Frozen tissues and paraffin-embedded tissues Paraffin-embedded bone marrow aspirates Moderately to severely clotted
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### Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Varies	Varies		

## Clinical and Interpretive

### Clinical Information

The Janus kinase 2 gene (*JAK2*) codes for a tyrosine kinase (JAK2) that is associated with the cytoplasmic portion of a variety of transmembrane cytokine and growth factor receptors important for signal transduction in hematopoietic cells. Signaling via JAK2 activation causes phosphorylation of downstream signal transducers and activators of transcription (STAT) proteins (eg, STAT5) ultimately leading to cell growth and differentiation. BCR-ABL1-negative myeloproliferative neoplasms (MPN) frequently harbor an acquired single nucleotide mutation in *JAK2* characterized as c.G1849T; p. Val617Phe (V617F). This mutation is identified overall in approximately two-thirds of all MPN,<sup>(1-3)</sup> but the prevalence varies by MPN subtype. The *JAK2* V617F is present in 95% to 98% of polycythemia vera, 50% to 60% of primary myelofibrosis (PMF), and 50% to 60% of essential thrombocythemia (ET). It has also been described infrequently in other myeloid neoplasms, including chronic myelomonocytic leukemia and myelodysplastic syndrome.<sup>(4)</sup> This mutation is not seen in chronic myelogenous leukemia (CML) or in reactive conditions with elevated blood counts. Detection of the *JAK2* V617F is useful to help establish the diagnosis of MPN. However, a negative *JAK2* V617F result does not indicate absence of a MPN. Other important molecular markers in BCR-ABL1-negative MPN include *CALR* exon 9 mutation (20%-30% of PMF and ET) and *MPL* exon 10 mutation (5%-10% of PMF and 3%-5% of ET). Mutations in *JAK2*, *CALR*, and *MPL* are essentially mutually exclusive.

### Reference Values

An interpretive report will be provided.

### Interpretation

The results will be reported as 1 of the 2 states:

-Negative for *JAK2* V617F mutation

-Positive for *JAK2* V617F mutation

Positive mutation status is highly suggestive of a myeloid neoplasm, but must be correlated with clinical and other laboratory features for a definitive diagnosis.

Negative mutation status does not exclude the presence of a myeloproliferative neoplasm or other neoplasm.

Results below the laboratory cutoff for positivity are of unclear clinical significance at this time.

### Cautions

A positive result is not specific for a particular subtype of myeloproliferative neoplasm and clinicopathologic correlation is necessary in all cases. If this test is ordered in the setting of erythrocytosis and suspicion of polycythemia vera, interpretation requires correlation with a concurrent or recent prior bone marrow evaluation.

A negative result does not exclude the presence of a myeloproliferative neoplasm or other neoplastic process.

In rare cases, a mutation other than the V617F may be present in an area that interferes with primer or probe binding and cause a false-negative result.

### Supportive Data

Analytical sensitivity is determined at 0.06% (by dilution of a *JAK2* V617F-positive cell line DNA into a negative cell line DNA).

### Clinical Reference

1. Baxter EJ, Scott LM, Campbell PJ, et al: Acquired mutation of the tyrosine kinase *JAK2* in human myeloproliferative disorders. *Lancet* 2005 March 16;365(9464):1054-1061
2. James C, Ugo V, Le Couedic JP, et al: A unique clonal *JAK2* mutation leading to constitutive signaling causes polycythaemia vera. *Nature* 2005 April 28;434(7037):1144-1148
3. Kralovics R, Passamonti F, Buser AS, et al: A gain-of-function mutation of *JAK2* in myeloproliferative disorders. *N Engl J Med* 2005;352:1779-1790
4. Steensma DP, Dewald GW, Lasho TL, et al: The *JAK2* V617F activating tyrosine kinase mutation is an infrequent event in both "atypical" myeloproliferative disorders and the myelodysplastic syndrome. *Blood* 2005;106:1207-1209

### Performance

### Method Description

Genomic DNA is extracted and 2 PCR reactions are used for each sample. In each reaction, a short fragment of genomic DNA, including the mutation site, is amplified using quantitative PCR in a real-time PCR instrument (LightCycler 480, Roche). In the first reaction, the 5' terminal base of the reverse primer matches the mutated sequence and the PCR conditions are such that it will only bind mutated DNA. In the second reaction, the 5' terminal base of the reverse primer matches the wild-type sequence and the PCR conditions are such that it will only bind the wild-type sequence. In both reactions, the PCR is monitored using TaqMan probe chemistry. The amount of mutated DNA and the amount of wild-type DNA is measured for each sample. In each run, the amount of mutated and wild-type DNA in a calibrator DNA sample is also measured. The calibrator is a mixture of DNA from a positive cell line (HEL) and a negative cell line (HL60) that is frozen in aliquots and expected to give an identical result in each run. Deviations in the calibrator result are assumed to be due to deviations in the run conditions and the sample results are corrected accordingly. Following each reaction, LightCycler 480 Relative Quantification Software is used to calculate the normalized mutated:wild-type ratio, which is expressed as a unitless ratio following correction with the calibrator data.

The formula for the normalized ratio is as follows:

Normalized ratio =	mutated/wild-type (sample)
	mutated/wild-type (calibrator)

The final result is reported as percent *JAK2* V617F of total *JAK2*, ie  $[\text{mutated}/\text{mutated} + \text{wild-type}] \times 100\%$ , calculated from the normalized mutated:wild-type ratio. (Instruction manual: Roche Applied Science Technical Note No. LC 13/2001. Relative Quantification; LightCycler 480, 2006)

### PDF Report

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No

**Day(s) and Time(s) Test Performed**

Monday through Friday; 12 p.m.

**Analytic Time**

2 days

**Maximum Laboratory Time**

5 days

**Specimen Retention Time**

DNA stored for 3 months

**Performing Laboratory Location**

Rochester

**Fees and 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 Regional Manager. 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. This test has not been cleared or approved by the U.S. Food and Drug Administration.

**CPT Code Information**

81270-JAK2 (Janus kinase 2) (eg, myeloproliferative disorder) gene analysis, p.Val617Phe (V617F) variant

**LOINC® Information**

Test ID	Test Order Name	Order LOINC Value
JAK2V	JAK2 V617F Mutation Detection, V	43399-5

Result ID	Test Result Name	Result LOINC Value
39724	JAK2 Result	53761-3
31160	JAK2 V617F Mutation Detection, V	43399-5