

Technical Specifications

FoundationOne Heme is a laboratory developed test (LDT) that combines DNA and RNA sequencing for patients with hematologic malignancies, sarcomas, or solid tumors where RNA sequencing is desired.



Methods

- Uses hybrid capture-based next-generation sequencing.
- Identifies the four main classes of genomic alterations (base substitutions, insertions and deletions, copy number alterations, and rearrangements).
- Sequences RNA of 265 genes commonly rearranged in cancer to better identify known and novel gene fusions.
- Sequences DNA to a median depth of ~500X unique coverage and RNA to an average of ~6.9 million unique pairs.
- All specimens are reviewed by a hematopathologist or pathologist to ensure specimen viability and tumor content.

ACCURACY		
Sensitivity: Base Substitutions	At \geq Minor Allele Frequency	>99.0%
Sensitivity: Insertions/Deletions (1-40bp)	At \geq 10 Mutant Allele Frequency	98.0%
Sensitivity: Focal Copy Number Alterations (Homozygous Deletions or Amplifications)	At \geq 8 copies	>95.0%
Sensitivity: Microsatellite status	At \geq 20% tumor nuclei	97.0%
Sensitivity: Known Gene Fusions	>95.0%	
Specificity: Base Substitutions, Insertions/Deletions, and Focal Copy Number Alterations	Positive Predictive Value (PPV)	>99.0%
Specificity: Known Gene Fusions	Positive Predictive Value (PPV)	>95.0%
Specificity: Microsatellite status	Positive Predictive Value (PPV)	>95.0%
Accuracy: Tumor Mutation Burden	At \geq 20% tumor nuclei	>90.0%
Reproducibility (average concordance between replicates)	97.0% Inter-batch precision 97.0% Intra-batch precision 95.0% microsatellite status precision 96.0% tumor mutation burden precision	

Assay specifications were determined for typical median exon coverage of approximately 500X. For more information regarding the validation of FoundationOne Heme, please refer to the article, He, J. et al. Integrated genomic DNA/RNA profiling of hematologic malignancies in the clinical setting. *Blood*. (2016 June 16).



Reporting

- Test results are provided in an interpretive report, curated by biomedical informatics scientists, and approved by on-site board-certified and licensed pathologists and hematopathologists.
- Genomic findings are listed with clinically relevant targeted therapies, immunotherapies, and clinical trial options.
- Reported alterations may indicate response or lack of response to therapy (FDA-approved or in clinical trials), or may be unambiguous drivers of oncogenesis based on reported scientific literature.
- Reports include tumor mutational burden (TMB) status and microsatellite instability (MSI) status, biomarkers that may help predict response to checkpoint inhibitors.

FoundationOne Heme Gene List

I Genes With Complete Exonic (Coding) Coverage¹

<i>ABL1</i>	<i>ACTB</i>	<i>AKT1</i>	<i>AKT2</i>	<i>AKT3</i>	<i>ALK</i>	<i>AMER1</i> (<i>FAM123B</i> or <i>WTX</i>)	<i>APC</i>	
<i>APH1A</i>	<i>AR</i>	<i>ARAF</i>	<i>ARFRP1</i>	<i>ARHGAP26</i> (<i>GRAF</i>)	<i>ARID1A</i>	<i>ARID2</i>	<i>ASMTL</i>	<i>ASXL1</i>
<i>ATM</i>	<i>ATR</i>	<i>ATRX</i>	<i>AURKA</i>	<i>AURKB</i>	<i>AXIN1</i>	<i>AXL</i>	<i>B2M</i>	<i>BAP1</i>
<i>BARD1</i>	<i>BCL10</i>	<i>BCL11B</i>	<i>BCL2</i>	<i>BCL2L2</i>	<i>BCL6</i>	<i>BCL7A</i>	<i>BCOR</i>	<i>BCORL1</i>
<i>BIRC3</i>	<i>BLM</i>	<i>BRAF</i>	<i>BRCA1</i>	<i>BRCA2</i>	<i>BRD4</i>	<i>BRIP1</i> (<i>BACH1</i>)	<i>BRSK1</i>	<i>BTG2</i>
<i>BTK</i>	<i>BTLA</i>	<i>C11orf30</i> (<i>EMSY</i>)	<i>CAD</i>	<i>CALR</i>	<i>CARD11</i>	<i>CBFB</i>	<i>CBL</i>	<i>CCND1</i>
<i>CCND2</i>	<i>CCND3</i>	<i>CCNE1</i>	<i>CCT6B</i>	<i>CD22</i>	<i>CD274</i> (<i>PD-L1</i>)	<i>CD36</i>	<i>CD58</i>	<i>CD70</i>
<i>CD79A</i>	<i>CD79B</i>	<i>CDC73</i>	<i>CDH1</i>	<i>CDK12</i>	<i>CDK4</i>	<i>CDK6</i>	<i>CDK8</i>	<i>CDKN1B</i>
<i>CDKN2A</i>	<i>CDKN2B</i>	<i>CDKN2C</i>	<i>CEBPA</i>	<i>CHD2</i>	<i>CHEK1</i>	<i>CHEK2</i>	<i>CIC</i>	<i>CIITA</i>
<i>CKS1B</i>	<i>CPS1</i>	<i>CREBBP</i>	<i>CRKL</i>	<i>CRLF2</i>	<i>CSF1R</i>	<i>CSF3R</i>	<i>CTCF</i>	<i>CTNNA1</i>
<i>CTNNB1</i>	<i>CUX1</i>	<i>CXCR4</i>	<i>DAXX</i>	<i>DDR2</i>	<i>DDX3X</i>	<i>DNM2</i>	<i>DNMT3A</i>	<i>DOT1L</i>
<i>DTX1</i>	<i>DUSP2</i>	<i>DUSP9</i>	<i>EBF1</i>	<i>ECT2L</i>	<i>EED</i>	<i>EGFR</i>	<i>ELP2</i>	<i>EP300</i>
<i>EPHA3</i>	<i>EPHA5</i>	<i>EPHA7</i>	<i>EPHB1</i>	<i>ERBB2</i>	<i>ERBB3</i>	<i>ERBB4</i>	<i>ERG</i>	<i>ESR1</i>
<i>ETS1</i>	<i>ETV6</i>	<i>EXOSC6</i>	<i>EZH2</i>	<i>FAF1</i>	<i>FAM46C</i>	<i>FANCA</i>	<i>FANCC</i>	<i>FANCD2</i>
<i>FANCE</i>	<i>FANCF</i>	<i>FANCG</i>	<i>FANCL</i>	<i>FAS</i> (<i>TNFRSF6</i>)	<i>FBXO11</i>	<i>FBXO31</i>	<i>FBXW7</i>	<i>FGF10</i>
<i>FGF14</i>	<i>FGF19</i>	<i>FGF23</i>	<i>FGF3</i>	<i>FGF4</i>	<i>FGF6</i>	<i>FGFR1</i>	<i>FGFR2</i>	<i>FGFR3</i>
<i>FGFR4</i>	<i>FHIT</i>	<i>FLCN</i>	<i>FLT1</i>	<i>FLT3</i>	<i>FLT4</i>	<i>FLYWCH1</i>	<i>FOXL2</i>	<i>FOXO1</i>
<i>FOXO3</i>	<i>FOXP1</i>	<i>FRS2</i>	<i>GADD45B</i>	<i>GATA1</i>	<i>GATA2</i>	<i>GATA3</i>	<i>GID4</i> (<i>C17orf39</i>)	<i>GNA11</i>
<i>GNA12</i>	<i>GNA13</i>	<i>GNAQ</i>	<i>GNAS</i>	<i>GPR124</i>	<i>GRIN2A</i>	<i>GSK3B</i>	<i>GTSE1</i>	<i>HDAC1</i>
<i>HDAC4</i>	<i>HDAC7</i>	<i>HGF</i>	<i>HIST1H1C</i>	<i>HIST1H1D</i>	<i>HIST1H1E</i>	<i>HIST1H2AC</i>	<i>HIST1H2AG</i>	<i>HIST1H2AL</i>
<i>HIST1H2AM</i>	<i>HIST1H2BC</i>	<i>HIST1H2BJ</i>	<i>HIST1H2BK</i>	<i>HIST1H2BO</i>	<i>HIST1H3B</i>	<i>HNFI1A</i>	<i>HRAS</i>	<i>HSP90AA1</i>
<i>ICK</i>	<i>ID3</i>	<i>IDH1</i>	<i>IDH2</i>	<i>IGF1R</i>	<i>IKBKE</i>	<i>IKZF1</i>	<i>IKZF2</i>	<i>IKZF3</i>
<i>IL7R</i>	<i>INHBA</i>	<i>INPP4B</i>	<i>INPP5D</i> (<i>SHIP</i>)	<i>IRF1</i>	<i>IRF4</i>	<i>IRF8</i>	<i>IRS2</i>	<i>JAK1</i>
<i>JAK2</i>	<i>JAK3</i>	<i>JARID2</i>	<i>JUN</i>	<i>KAT6A</i> (<i>MYST3</i>)	<i>KDM2B</i>	<i>KDM4C</i>	<i>KDM5A</i>	<i>KDM5C</i>
<i>KDM6A</i>	<i>KDR</i>	<i>KEAP1</i>	<i>KIT</i>	<i>KLHL6</i>	<i>KMT2A</i> (<i>MLL</i>)	<i>KMT2C</i> (<i>MLL3</i>)	<i>KMT2D</i> (<i>MLL2</i>)	<i>KRAS</i>
<i>LEF1</i>	<i>LRP1B</i>	<i>LRRK2</i>	<i>MAF</i>	<i>MAFB</i>	<i>MAGED1</i>	<i>MALT1</i>	<i>MAP2K1</i> (<i>MEK1</i>)	<i>MAP2K2</i> (<i>MEK2</i>)
<i>MAP2K4</i>	<i>MAP3K1</i>	<i>MAP3K14</i>	<i>MAP3K6</i>	<i>MAP3K7</i>	<i>MAPK1</i>	<i>MCL1</i>	<i>MDM2</i>	<i>MDM4</i>
<i>MED12</i>	<i>MEF2B</i>	<i>MEF2C</i>	<i>MEN1</i>	<i>MET</i>	<i>MIB1</i>	<i>MITF</i>	<i>MKI67</i>	<i>MLH1</i>
<i>MPL</i>	<i>MRE11A</i>	<i>MSH2</i>	<i>MSH3</i>	<i>MSH6</i>	<i>MTOR</i>	<i>MUTYH</i>	<i>MYC</i>	<i>MYCL</i> (<i>MYCL1</i>)
<i>MYCN</i>	<i>MYD88</i>	<i>MYO18A</i>	<i>NCOR2</i>	<i>NCSTN</i>	<i>NF1</i>	<i>NF2</i>	<i>NFE2L2</i>	<i>NFKBIA</i>
<i>NKX2-1</i>	<i>NOD1</i>	<i>NOTCH1</i>	<i>NOTCH2</i>	<i>NPM1</i>	<i>NRAS</i>	<i>NSD1</i>	<i>NT5C2</i>	<i>NTRK1</i>
<i>NTRK2</i>	<i>NTRK3</i>	<i>NUP93</i>	<i>NUP98</i>	<i>P2RY8</i>	<i>PAG1</i>	<i>PAK3</i>	<i>PALB2</i>	<i>PASK</i>
<i>PAX5</i>	<i>PBRM1</i>	<i>PC</i>	<i>PCBP1</i>	<i>PCLO</i>	<i>PDCD1</i> (<i>PD-1</i>)	<i>PDCD11</i>	<i>PDCD1LG2</i> (<i>PD-L2</i>)	<i>PDGFRA</i>
<i>PDGFRB</i>	<i>PDK1</i>	<i>PHF6</i>	<i>PIK3CA</i>	<i>PIK3CG</i>	<i>PIK3R1</i>	<i>PIK3R2</i>	<i>PIM1</i>	<i>PLCG2</i>
<i>POT1</i>	<i>PPP2R1A</i>	<i>PRDM1</i>	<i>PRKARIA</i>	<i>PRKDC</i>	<i>PRSS8</i>	<i>PTCH1</i>	<i>PTEN</i>	<i>PTPN11</i>
<i>PTPN2</i>	<i>PTPN6</i> (<i>SHP-1</i>)	<i>PTPRO</i>	<i>RAD21</i>	<i>RAD50</i>	<i>RAD51</i>	<i>RAF1</i>	<i>RARA</i>	<i>RASGEF1A</i>
<i>RB1</i>	<i>RELN</i>	<i>RET</i>	<i>RHOA</i>	<i>RICTOR</i>	<i>RNF43</i>	<i>ROS1</i>	<i>RPTOR</i>	<i>RUNX1</i>
<i>S1PR2</i>	<i>SDHA</i>	<i>SDHB</i>	<i>SDHC</i>	<i>SDHD</i>	<i>SERP2</i>	<i>SETBP1</i>	<i>SETD2</i>	<i>SF3B1</i>
<i>SGK1</i>	<i>SMAD2</i>	<i>SMAD4</i>	<i>SMARCA1</i>	<i>SMARCA4</i>	<i>SMARCB1</i>	<i>SMC1A</i>	<i>SMC3</i>	<i>SMO</i>
<i>SOCS1</i>	<i>SOCS2</i>	<i>SOCS3</i>	<i>SOX10</i>	<i>SOX2</i>	<i>SPEN</i>	<i>SPOP</i>	<i>SRC</i>	<i>SRSF2</i>
<i>STAG2</i>	<i>STAT3</i>	<i>STAT4</i>	<i>STAT5A</i>	<i>STAT5B</i>	<i>STAT6</i>	<i>STK11</i>	<i>SUFU</i>	<i>SUZ12</i>
<i>TAF1</i>	<i>TBL1XR1</i>	<i>TCF3</i> (<i>E2A</i>)	<i>TCL1A</i> (<i>TCL1</i>)	<i>TET2</i>	<i>TGFBR2</i>	<i>TLL2</i>	<i>TMEM30A</i>	<i>TMSB4XP8</i>
(<i>TMSL3</i>)	<i>TNFAIP3</i>	<i>TNFRSF11A</i>	<i>TNFRSF14</i>	<i>TNFRSF17</i>	<i>TOP1</i>	<i>TP53</i>	<i>TP63</i>	<i>TRAF2</i>
<i>TRAF3</i>	<i>TRAF5</i>	<i>TSC1</i>	<i>TSC2</i>	<i>TSHR</i>	<i>TUSC3</i>	<i>TYK2</i>	<i>U2AF1</i>	<i>U2AF2</i>
<i>VHL</i>	<i>WDR90</i>	<i>WHSC1</i> (<i>MMSET</i> or <i>NSD2</i>)	<i>WISP3</i>	<i>WTI</i>	<i>WT1</i>	<i>XBPI</i>	<i>XPO1</i>	<i>YY1AP1</i>
<i>ZMYM3</i>	<i>ZNF217</i>	<i>ZNF24</i> (<i>ZSCAN3</i>)	<i>ZNF703</i>	<i>ZRSR2</i>				

I Genes With Select Intronic (Non-Coding) Coverage²

<i>ALK</i>	<i>BCL2</i>	<i>BCL6</i>	<i>BCR</i>	<i>BRAF</i>	<i>CCND1</i>	<i>CRLF2</i>	<i>EGFR</i>	<i>EPOR</i>
<i>ETV1</i>	<i>ETV4</i>	<i>ETV5</i>	<i>ETV6</i>	<i>EWSR1</i>	<i>FGFR2</i>	<i>IGH</i>	<i>IGK</i>	<i>IGL</i>
<i>JAK1</i>	<i>JAK2</i>	<i>KMT2A</i> (<i>MLL</i>)	<i>MYC</i>	<i>NTRK1</i>	<i>PDGFRA</i>	<i>PDGFRB</i>	<i>RAF1</i>	<i>RARA</i>
<i>RET</i>	<i>ROS1</i>	<i>TMPRSS2</i>	<i>TRG</i>					

| Genes with RNA sequencing coverage

Please note, some VUS* rearrangements between targeted genes and unknown fusion partners may not be reported.

<i>ABI1</i>	<i>ABL1</i>	<i>ABL2</i>	<i>ACSL6</i>	<i>AFF1</i>	<i>AFF4</i>	<i>ALK</i>	<i>ARHGAP26 (GRAF)</i>	
<i>ARHGEF12</i>	<i>ARID1A</i>	<i>ARNT</i>	<i>ASXL1</i>	<i>ATF1</i>	<i>ATG5</i>	<i>ATIC</i>	<i>BCL10</i>	<i>BCL11A</i>
<i>BCL11B</i>	<i>BCL2</i>	<i>BCL3</i>	<i>BCL6</i>	<i>BCL7A</i>	<i>BCL9</i>	<i>BCOR</i>	<i>BCR</i>	<i>BIRC3</i>
<i>BRAF</i>	<i>BTG1</i>	<i>CAMTA1</i>	<i>CARS</i>	<i>CBFA2T3</i>	<i>CBFB</i>	<i>CBL</i>	<i>CCND1</i>	<i>CCND2</i>
<i>CCND3</i>	<i>CD274 (PD-L1)</i>	<i>CDK6</i>	<i>CDX2</i>	<i>CHIC2</i>	<i>CHN1</i>	<i>CIC</i>	<i>CIITA</i>	<i>CLP1</i>
<i>CLTC</i>	<i>CLTCL1</i>	<i>CNTRL (CEP110)</i>	<i>COL1A1</i>	<i>CREB3L1</i>	<i>CREB3L2</i>	<i>CREBBP</i>	<i>CRLF2</i>	<i>CSF1</i>
<i>CTNNB1</i>	<i>DDIT3</i>	<i>DDX10</i>	<i>DDX6</i>	<i>DEK</i>	<i>DUSP22</i>	<i>EGFR</i>	<i>EIF4A2</i>	<i>ELF4</i>
<i>ELL</i>	<i>ELN</i>	<i>EML4</i>	<i>EP300</i>	<i>EPOR</i>	<i>EPS15</i>	<i>ERBB2</i>	<i>ERG</i>	<i>ETS1</i>
<i>ETV1</i>	<i>ETV4</i>	<i>ETV5</i>	<i>ETV6</i>	<i>EWSR1</i>	<i>FCGR2B</i>	<i>FCRL4</i>	<i>FEV</i>	<i>FGFR1</i>
<i>FGFR1OP</i>	<i>FGFR2</i>	<i>FGFR3</i>	<i>FLI1</i>	<i>FNBP1</i>	<i>FOXO1</i>	<i>FOXO3</i>	<i>FOXO4</i>	<i>FOXP1</i>
<i>FSTL3</i>	<i>FUS</i>	<i>GAS7</i>	<i>GLI1</i>	<i>GMPS</i>	<i>GPHN</i>	<i>HERPUD1</i>	<i>HEY1</i>	<i>HIP1</i>
<i>HIST1H4I</i>	<i>HLF</i>	<i>HMGA1</i>	<i>HMGA2</i>	<i>HOXA11</i>	<i>HOXA13</i>	<i>HOXA3</i>	<i>HOXA9</i>	<i>HOXC11</i>
<i>HOXC13</i>	<i>HOXD11</i>	<i>HOXD13</i>	<i>HSP90AA1</i>	<i>HSP90AB1</i>	<i>IGH</i>	<i>IGK</i>	<i>IGL</i>	<i>IKZF1</i>
<i>IL21R</i>	<i>IL3</i>	<i>IRF4</i>	<i>ITK</i>	<i>JAK1</i>	<i>JAK2</i>	<i>JAK3</i>	<i>JAZF1</i>	<i>KAT6A (MYST3)</i>
<i>KDSR</i>	<i>KIF5B</i>	<i>KMT2A (MLL)</i>	<i>LASP1</i>	<i>LCPI</i>	<i>LMO1</i>	<i>LMO2</i>	<i>LPP</i>	<i>LYL1</i>
<i>MAF</i>	<i>MAFB</i>	<i>MALT1</i>	<i>MDS2</i>	<i>MECOM</i>	<i>MKL1</i>	<i>MLF1</i>	<i>MLLT1 (ENL)</i>	<i>MLLT10 (AF10)</i>
<i>MLLT3</i>	<i>MLLT4 (AF6)</i>	<i>MLLT6</i>	<i>MN1</i>	<i>MNX1</i>	<i>MSI2</i>	<i>MSN</i>	<i>MUC1</i>	<i>MYB</i>
<i>MYC</i>	<i>MYH11</i>	<i>MYH9</i>	<i>NACA</i>	<i>NBEAP1 (BCL8)</i>	<i>NCOA2</i>	<i>NDRG1</i>	<i>NF1</i>	<i>NF2</i>
<i>NFKB2</i>	<i>NIN</i>	<i>NOTCH1</i>	<i>NPM1</i>	<i>NR4A3</i>	<i>NSD1</i>	<i>NTRK1</i>	<i>NTRK2</i>	<i>NTRK3</i>
<i>NUMA1</i>	<i>NUP214</i>	<i>NUP98</i>	<i>NUTM2A</i>	<i>OMD</i>	<i>P2RY8</i>	<i>PAFAH1B2</i>	<i>PAX3</i>	<i>PAX5</i>
<i>PAX7</i>	<i>PBX1</i>	<i>PCM1</i>	<i>PCSK7</i>	<i>PDCD1LG2 (PD-L2)</i>	<i>PDE4DIP</i>	<i>PDGFB</i>	<i>PDGFRA</i>	<i>PDGFRB</i>
<i>PER1</i>	<i>PHF1</i>	<i>PICALM</i>	<i>PIM1</i>	<i>PLAG1</i>	<i>PML</i>	<i>POU2AF1</i>	<i>PPP1CB</i>	<i>PRDM1</i>
<i>PRDM16</i>	<i>PRRX1</i>	<i>PSIP1</i>	<i>PTCH1</i>	<i>PTK7</i>	<i>RABEP1</i>	<i>RAF1</i>	<i>RALGDS</i>	<i>RAP1GDS1</i>
<i>RARA</i>	<i>RBM15</i>	<i>RET</i>	<i>RHOH</i>	<i>RNF213</i>	<i>ROS1</i>	<i>RPL22</i>	<i>RPN1</i>	<i>RUNX1</i>
<i>RUNX1T1 (ETO)</i>	<i>RUNX2</i>	<i>SEC31A</i>	<i>SEPT5</i>	<i>SEPT6</i>	<i>SEPT9</i>	<i>SET</i>	<i>SH3GL1</i>	<i>SLC1A2</i>
<i>SNX29 (RUNDC2A)</i>	<i>SRSF3</i>	<i>SS18</i>	<i>SSX1</i>	<i>SSX2</i>	<i>SSX4</i>	<i>STAT6</i>	<i>STL</i>	<i>SYK</i>
<i>TAF15</i>	<i>TAL1</i>	<i>TAL2</i>	<i>TBL1XR1</i>	<i>TCF3 (E2A)</i>	<i>TCL1A (TCL1)</i>	<i>TEC</i>	<i>TET1</i>	<i>TFE3</i>
<i>TFG</i>	<i>TFPT</i>	<i>TFRC</i>	<i>TLX1</i>	<i>TLX3</i>	<i>TMPRSS2</i>	<i>TNFRSF11A</i>	<i>TOP1</i>	<i>TP63</i>
<i>TPM3</i>	<i>TPM4</i>	<i>TRIM24</i>	<i>TRIP11</i>	<i>TTL</i>	<i>TYK2</i>	<i>USP6</i>	<i>WHSC1 (MMSET or NSD2)</i>	
<i>WHSC1L1</i>	<i>YPEL5</i>	<i>ZBTB16</i>	<i>ZMYM2</i>	<i>ZNF384</i>	<i>ZNF521</i>			

*VUS: Variants of Unknown Significance

FoundationOne Heme is a laboratory developed test that was developed and its performance characteristics determined by Foundation Medicine. FoundationOne Heme has not been cleared or approved by the U.S. Food and Drug Administration. For more information on FoundationOne Heme, please see its Technical Specifications at foundationmedicine.com/heme.

References

1. Current as of July 2021. Please visit foundationmedicine.com/heme for the most up to date gene list.
2. Select Introns only. Detailed list available upon request.

