

# B-Fe-Yb (Boron-Iron-Ytterbium)

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## Introduction

[1992Rag] listed the structural data on two ternary compounds of this system. Recently, [2005Ver] determined an isothermal section at 797 °C, which depicts these two ternary compounds.

## Binary Systems

The Fe-B phase diagram depicts two intermediate phases: Fe<sub>2</sub>B (C16, CuAl<sub>2</sub>-type tetragonal) and FeB (B27-type orthorhombic). The B-Yb diagram [Massalski2] has the following intermediate phases: YbB<sub>2</sub> (C32, AlB<sub>2</sub>-type hexagonal), YbB<sub>4</sub> (D1<sub>e</sub>, ThB<sub>4</sub>-type tetragonal), YbB<sub>6</sub> (D2<sub>1</sub>, CaB<sub>6</sub>-type cubic), YbB<sub>12</sub> (D2<sub>f</sub>, UB<sub>12</sub>-type cubic) and YbB<sub>66</sub> (ThB<sub>66</sub>-type cubic). The Fe-Yb phase diagram depicts two compounds: Fe<sub>17</sub>Yb<sub>2</sub> (Th<sub>2</sub>Ni<sub>17</sub>-type hexagonal) and Fe<sub>23</sub>Yb<sub>6</sub> (D8<sub>a</sub>, Mn<sub>23</sub>Th<sub>6</sub>-type cubic).

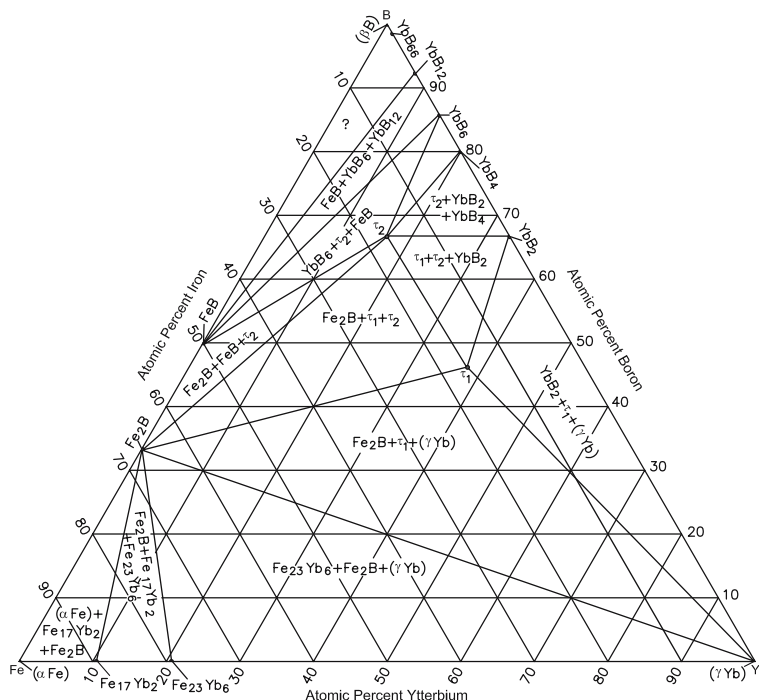
## Ternary Isothermal Section

With starting metals of 99.4% B, 99.96% Fe and 99.94% Yb, [2005Ver] arc-melted 75 alloy samples under Ar atm.

Compositions close to YbB<sub>66</sub> were not studied. The final anneal at 797 °C (1070 K) was for 500-1000 h, which was followed by water quenching. The phase equilibria were studied by single crystal and powder x-ray diffraction. The presence of two ternary compounds, Yb<sub>5-x</sub>Fe<sub>2+x</sub>B<sub>6</sub> (Pr<sub>5-x</sub>Co<sub>2+x</sub>B<sub>6</sub>-type rhombohedral, denoted τ<sub>1</sub> here) and YbFeB<sub>4</sub> (YCrB<sub>4</sub>-type orthorhombic, denoted τ<sub>2</sub> here) were confirmed. [2005Ver] refined the structural details of YbFeB<sub>4</sub>, determining the atomic coordinates and bond lengths. The isothermal section constructed by [2005Ver] at 797 °C (1070 K) is given in Fig. 1. The elements or the binary compounds show little solubility for the other components. [2005Ver] also made a comparison of the occurrence of ternary borides in the R-Fe-B systems (R = rare-earth metal from Gd through Lu).

## References

- 1992Rag:** V. Raghavan, The B-Fe-Yb (Boron-Iron-Ytterbium) System, *Phase Diagrams of Ternary Iron Alloys. Part 6A*, Ind. Inst. Metals, Calcutta, 1992, p 454
- 2005Ver:** I.V. Veremchuk, N.F. Chaban, V.S. Babizhetskyy, O.T. Pilyushchak, and Yu.B. Kuzma, The 1070 K Section of the Yb-Fe-B Phase Diagram, *Neorg. Mater.*, 2005 **41**(7), p 803-807 in Russian; *TR:Inorg. Mater.*, 2005, **41**(7), p 700-705



**Fig. 1** B-Fe-Yb isothermal section at 797 °C [2005Ver]. Narrow two-phase regions are omitted