

Heat Treatment of Metals

MSE-S305

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Invariant reactions present in Fe-Fe₃C Phase Diagram

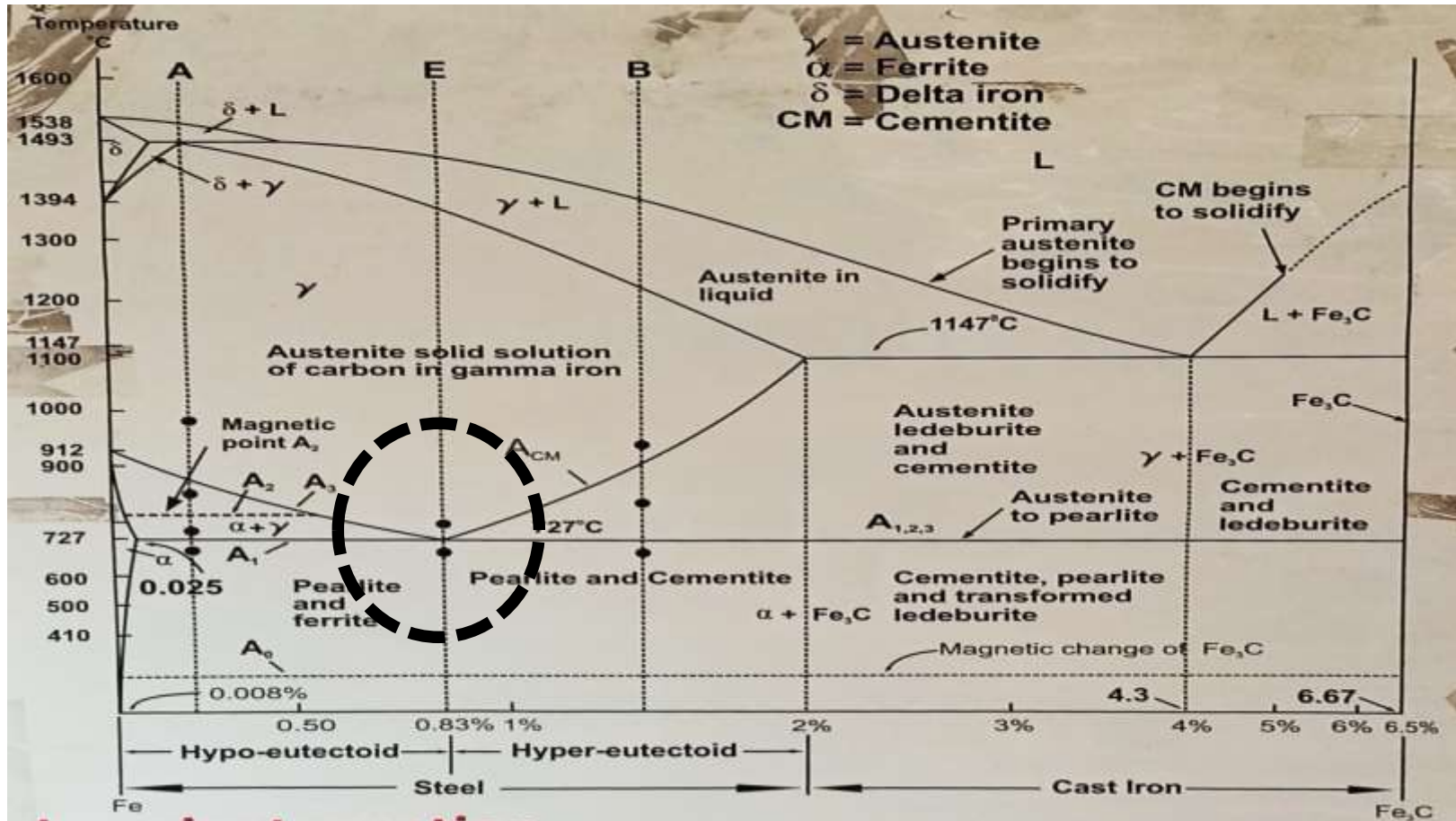
Eutectoid Reaction

➤ **During cooling of austenite (γ -ferrite) having 0.8% C at constant eutectoid temperature (727°C) undergoes eutectoid transformation to form a mixture of alternate lamellae of ferrite (0.02% C) and cementite (Fe_3C).**



➤ **Phase changes that occur upon passing from the γ region into the $\alpha + Fe_3C$ phase field.**

Invariant reactions present in Fe- Fe₃C Phase Diagram *Eutectoid Reaction*



A portion of the Fe-C diagram – (from pure Fe to 6.67 wt.% C.)

Invariant reactions present in Fe-Fe₃C Phase Diagram

Eutectoid Reaction

➤ Consider an alloy of *eutectoid composition* (0.8%C), as it is *cooled* from a temperature within the γ phase region (around 800°C), Initially the alloy is composed entirely of the *austenite* (γ -ferrite) phase having composition 0.8 wt.%C and then transformed to Pearlite ($\alpha + Fe_3C$).

Thus Ferrite, wt% is $\alpha = \frac{6.67 - 0.8}{6.67 - 0.02} \times 100 = 88\%$

Thus cementite, wt % is $Fe_3C = \frac{0.8 - 0.02}{6.67 - 0.02} \times 100 = 12\%$

Invariant reactions present in Fe-Fe₃C Phase Diagram

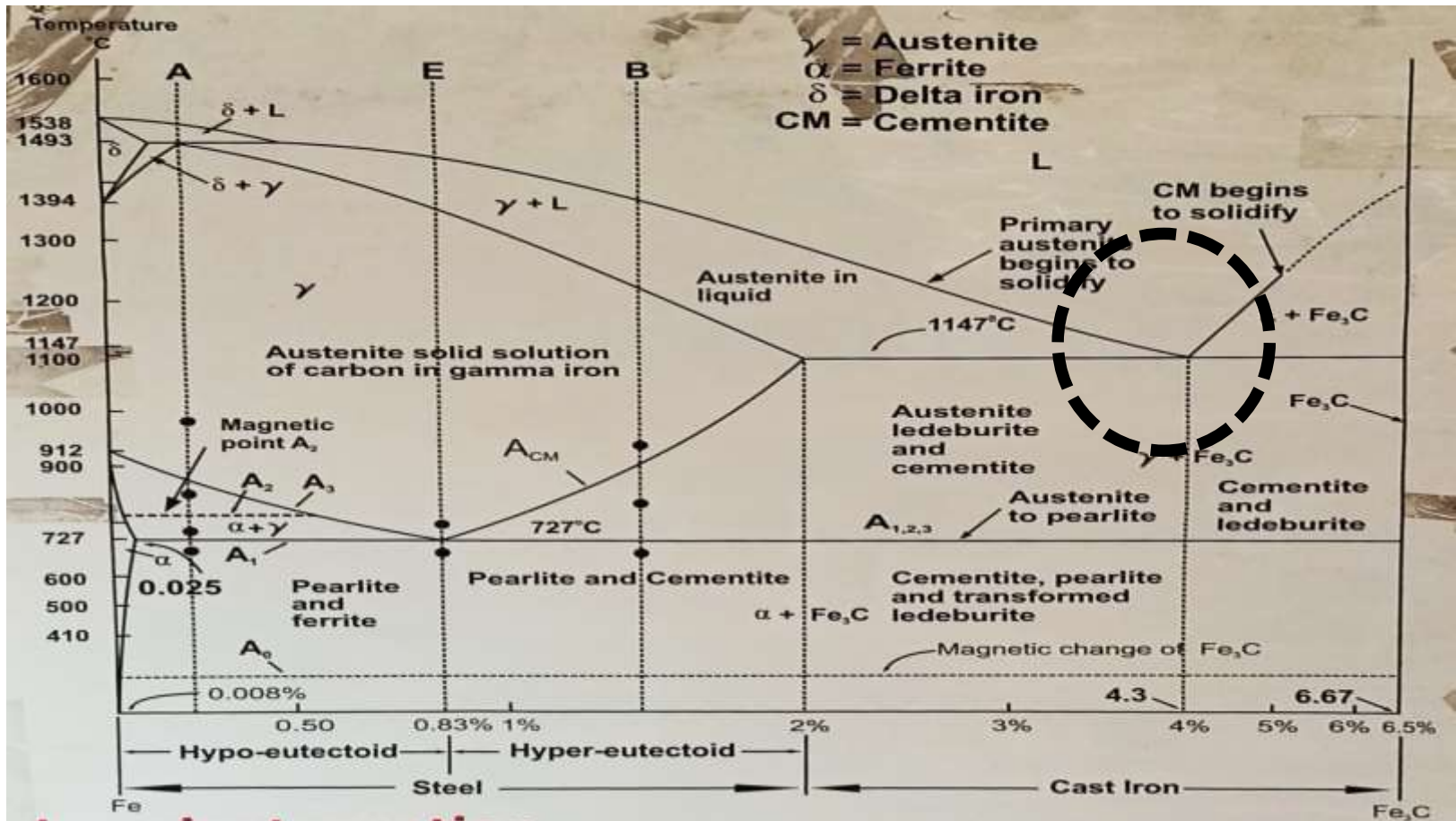
Eutectic Reaction

➤ Eutectic reaction undergoes at *eutectic temperature* (1147°C) to give mixture of two different solids, namely *austenite* (γ -ferrite) and *cementite* (Fe_3C), solidifying simultaneously. The eutectic mixture called *Ledeburite* ($\gamma + Fe_3C$).

➤ The invariant *Eutectic reaction* in Fe-Fe₃C diagram is given by –



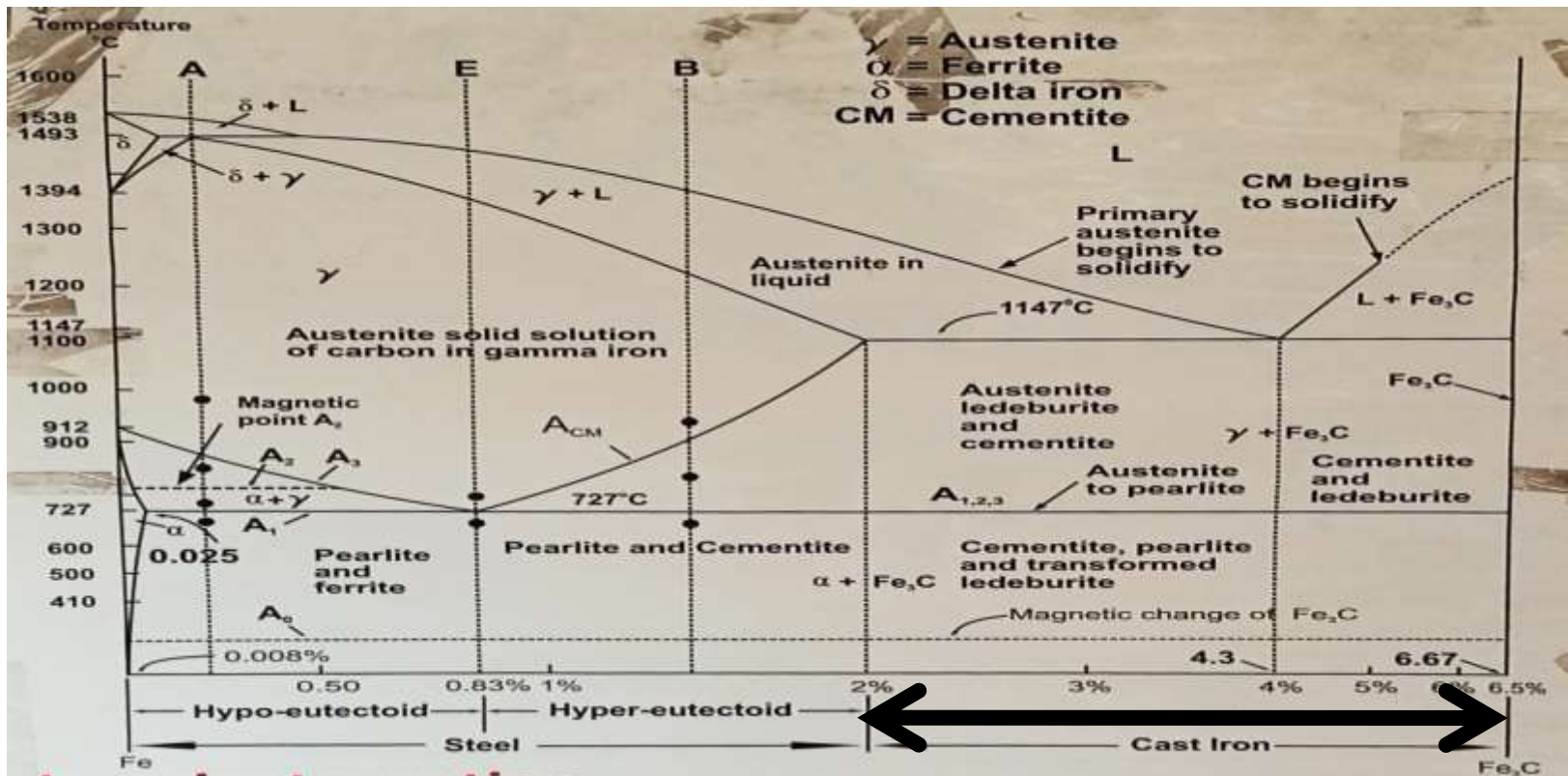
Invariant reactions present in Fe- Fe₃C Phase Diagram *Eutectic Reaction*



A portion of the Fe-C diagram – (from pure Fe to 6.67 wt.% C.)

Invariant reactions present in Fe- Fe₃C Phase Diagram *Eutectic Reaction*

➤ Ferrous alloys contain *more than 2.1 wt% C* are called *Cast Irons*.

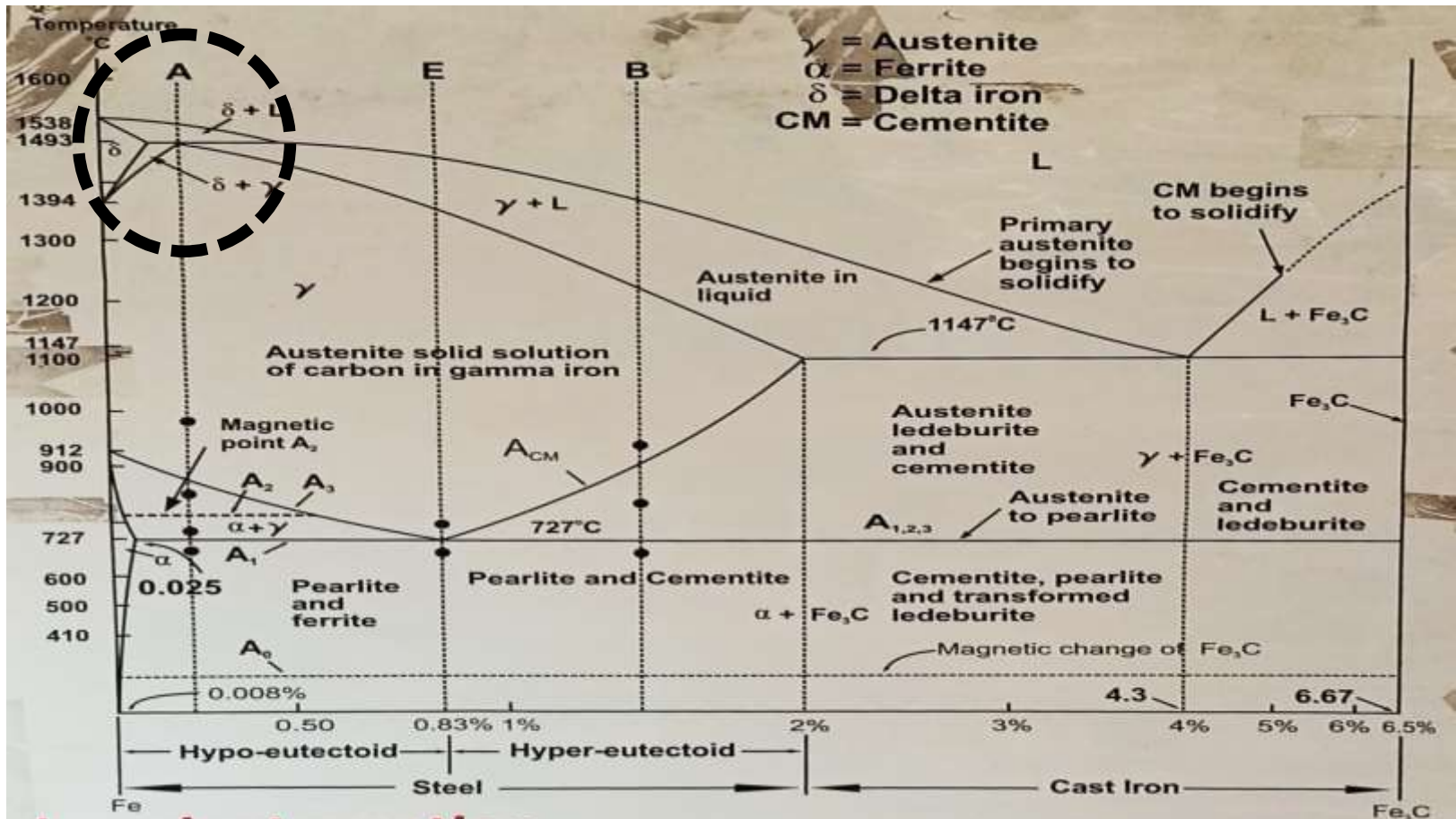


Invariant reactions present in Fe- Fe₃C Phase Diagram

- The Fe-C alloys having carbon between 2.11%C and 4.3%C are called *hypo eutectic cast irons*.
- Alloys having carbon between 4.3%C and 6.67%C are called *hypereutectic cast irons*.
- Alloys of Fe with 4.3%C carbon is called *eutectic cast iron*.

Invariant reactions present in Fe- Fe₃C Phase Diagram

Peritectic Reaction



A portion of the Fe-C diagram – (from pure Fe to 6.67 wt.% C.)

Invariant reactions present in Fe-Fe₃C Phase Diagram

Peritectic Reaction

➤ Consider an alloy of *peritectic composition* (0.16%C), Calculate weight fractions of *liquid phase* and *δ-ferrite phase*.

Thus Liquid, wt% is
$$L = \frac{0.16 - 0.1}{0.51 - 0.1} \times 100 = 14.63\%$$

Thus δ ferrite, wt % is
$$\delta(\text{ferrite}) = \frac{0.51 - 0.16}{0.51 - 0.1} \times 100 = 85.37\%$$