

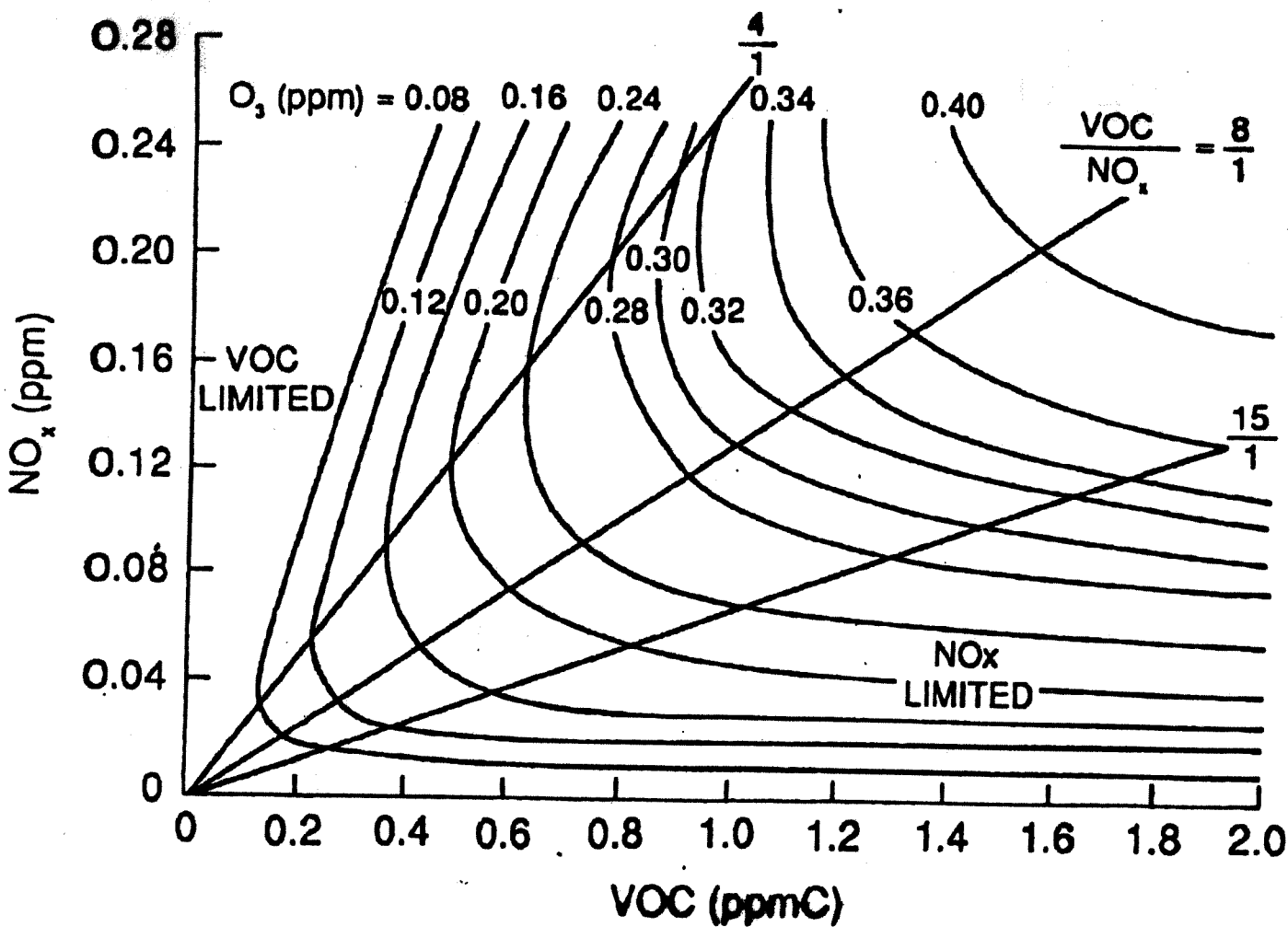
Due Oct. 18, 2007 Reduction in NMHC to Achieve Old 1-Hr Ozone NAAQS of 0.12 ppm

Given: Suppose a certain city is characterized by a nonmethane hydrocarbon/NO<sub>x</sub> ratio of about 12 to 1 and a measured maximum 1 hour average ozone conc. of 0.24 ppm (this is the peak hourly O<sub>3</sub> concentration). If no change in the 1 hr average ambient conc. of 0.08 ppm NO<sub>x</sub> is expected (ie NO<sub>x</sub> concentration remains constant at 0.08 ppm NO<sub>x</sub>), use the EKMA ("Empirical Kinetic Modeling Approach") to find out the % reduction in nonmethane hydrocarbons (NMHC) needed to achieve the "old" 1996 EPA Federal NAAQS std for ozone conc in the ambient air of 0.12ppm O<sub>3</sub> 1 hr average.. Note that the EKMA graph such as in Fig. 9.5 p. 481 WW&D use hourly averages of the NO<sub>x</sub>, NMHC, and O<sub>3</sub> concentrations.

Find:

- NMHC Conc. when O<sub>3</sub> is 0.24 ppm & NO<sub>x</sub> is 0.08 ppm. \_\_\_\_\_ ppm
- NMHC Conc. when O<sub>3</sub> is at 1996 NAAQS of 0.12 ppm 1 hr av. and NO<sub>x</sub> is 0.08 ppm \_\_\_\_\_ ppm
- % Reduction in 1-hr average Non Methane Hydrocarbon Concentration (NMHC)

$$\% \text{ Reduction in 1-hr NMHC Conc Needed to achieve 1996 NAAQS for 1-hr Ozone} = \frac{(\text{NMHC}@0.24 \text{ ppm O}_3) - (\text{NMHC}@0.12 \text{ ppm O}_3)}{(\text{NMHC}@0.24 \text{ ppm O}_3)}$$



Empirical Kinetic Modeling Approach (EKMA).

# EKMA = Empirical Kinetic Modeling Approach

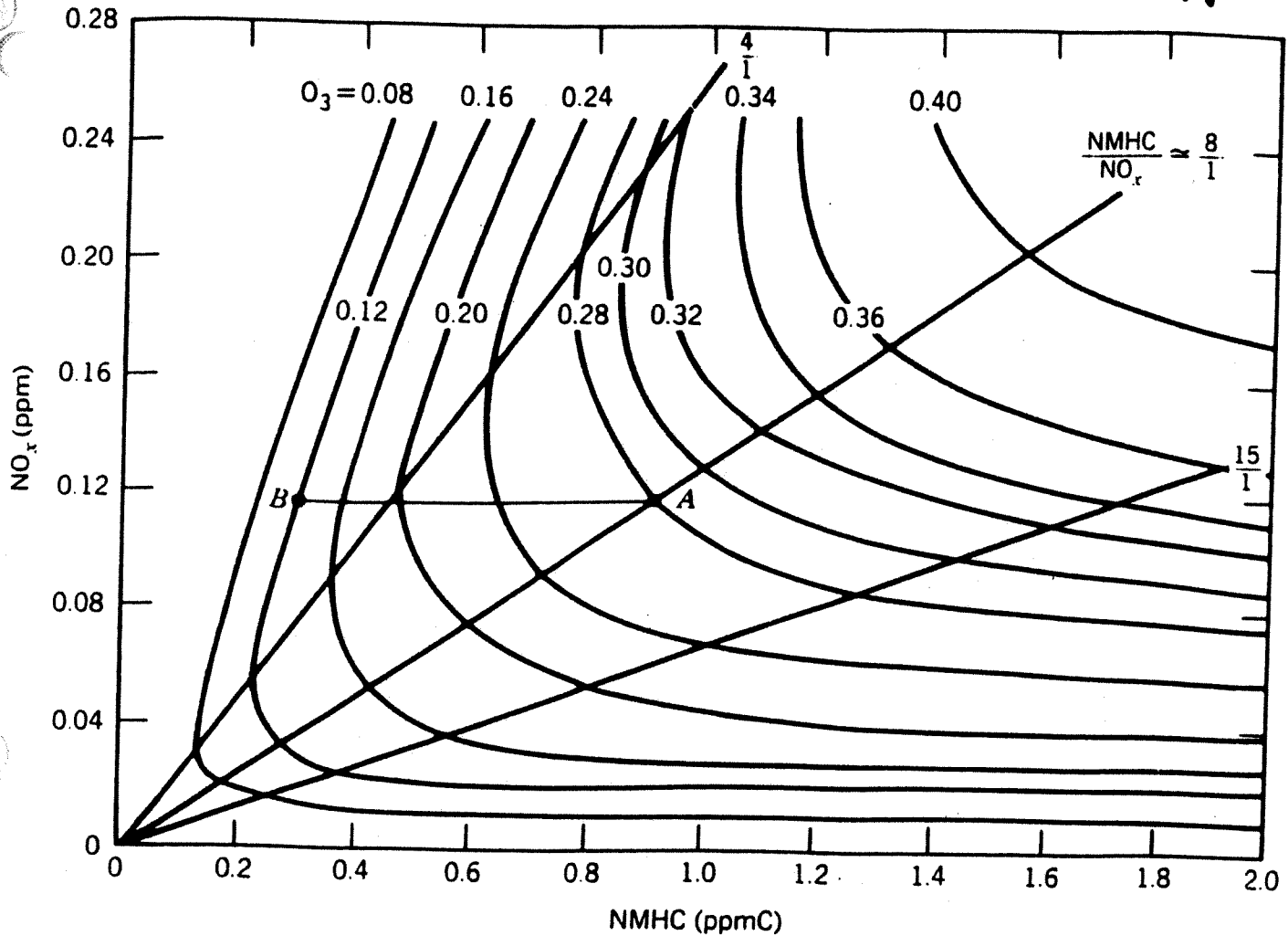


FIGURE 10.5. Ozone isopleths used in EKMA approach (from Dodge, 1977a).

Figure 10.5 can be used to predict the changes in NMHC and  $\text{NO}_x$  needed to produce a given change in the peak  $\text{O}_3$  concentration. For example, suppose a particular city is characterized by a NMHC/ $\text{NO}_x$  ratio of 8:1, and a *design value*<sup>2</sup> of  $\text{O}_3$  of 0.28 ppm (i.e., point A on Fig. 10.5). If no change in ambient  $\text{NO}_x$  is anticipated, and one wants to reduce the peak  $\text{O}_3$  from 0.28 to the federal air quality standard of 0.12 ppm, one must reduce NMHC to point B in Fig. 10.5 or by approximately 67%.

The term *empirical* in the title EKMA comes from the use of *observed*  $\text{O}_3$  peaks to examine various control strategy options. The *kinetics modeling* portion of the title reflects the use of a chemical submodel validated against smog chamber data to generate the isopleths of Fig. 10.5.