

MEASUREMENT OF PARTICULATES

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The size distributions of particles in the exhaust plumes from the Titan rockets launched in August and September 1977 were determined from in situ measurements made from a small sampling aircraft that flew through the plumes. Two different sampling instruments were employed, a quartz crystal microbalance (QCM) cascade impactor and a forward scattering spectrometer probe (FSSP).

The QCM was flown inside the forward baggage compartment of the aircraft. The particles were directed to the sensor through an inlet probe that was designed for isokinetic flow. These particles passed through a heated tube, where most of the liquid component was evaporated, before entering the QCM. The QCM, therefore, measured only the nonvolatile component of the aerosols in the plume covering an aerodynamic size ranging from 0.05 to 25 micrometers in diameter.

The FSSP was flown outside the aircraft under the nose section. This probe measures both the liquid droplets and the solid particles over a size range from 0.5 to 7.5 micrometers in diameter. The particles are counted and classified into 15 size intervals.

Figures 1 to 3 show the data for passes 2, 3, and 18, respectively, through the cloud from the August 1977 Titan launch. In each figure, curve A represents the size distribution (mass concentration as a function of particle diameter) obtained with the QCM; curve B represents the number concentrations (number of particles per cubic centimeter as a function of particle diameter) derived from curve A; and curve C represents the number concentrations as measured with the FSSP. The comparatively high concentrations measured by the FSSP indicate the presence of a large number of liquid droplets in the cloud. Figure 4 shows a similar set of plots for pass 1 from the September 1977 Titan plume. Finally, figure 5 compares May, August, and September 1977 in situ measurements of launch vehicle effluents (HCl, NO_x, and particles) with measurements from 1974 and 1975.

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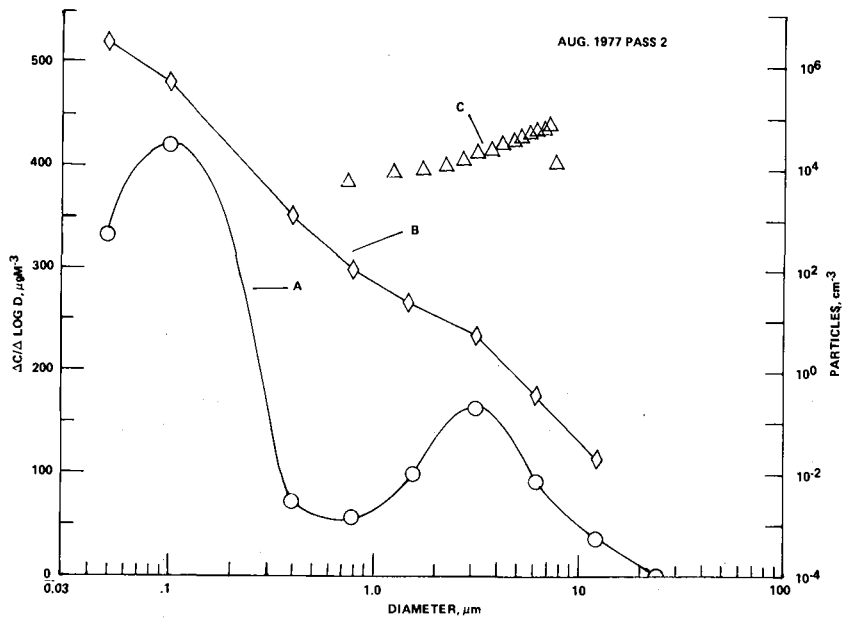


Figure 1.- Data for pass 2 from the August 1977 Titan launch.

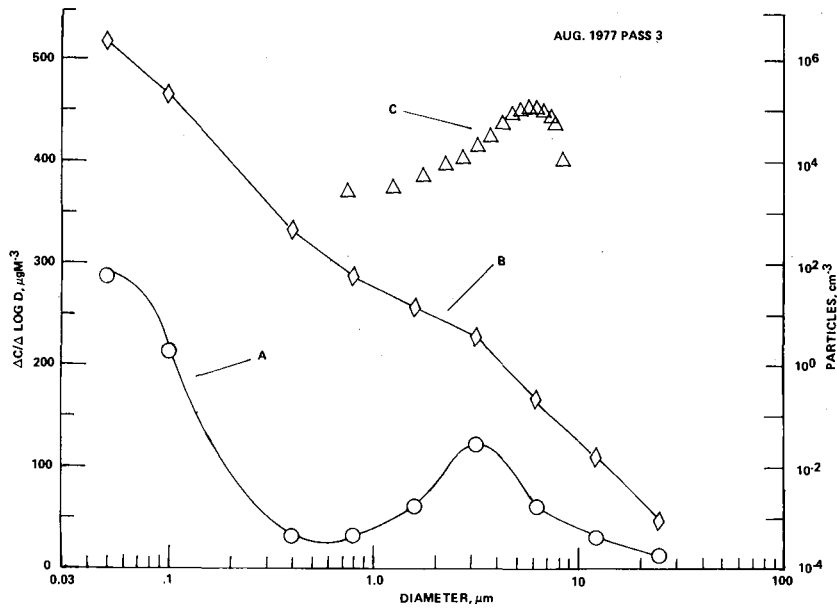


Figure 2.- Data for pass 3 from the August 1977 Titan launch.

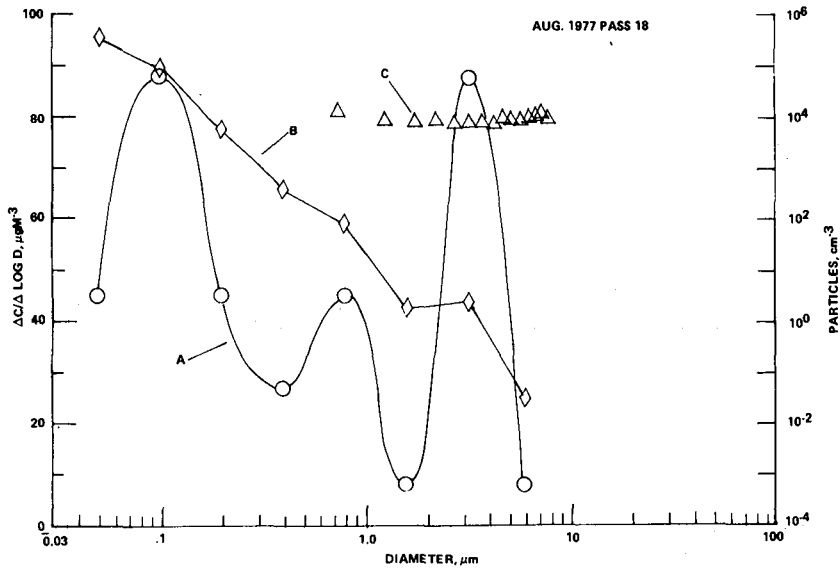


Figure 3.- Data for pass 18 from the August 1977 Titan launch.

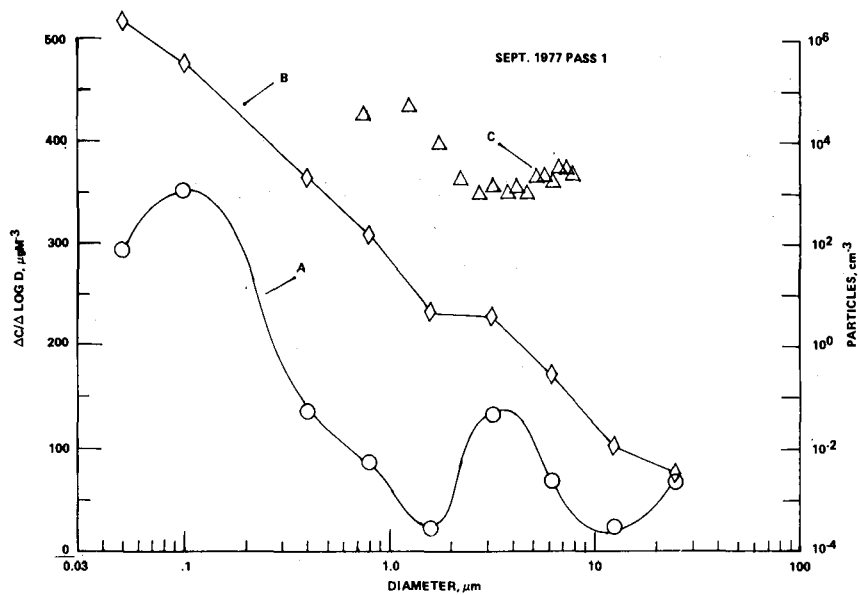


Figure 4.- Data for pass 1 from the September 1977 Titan launch.

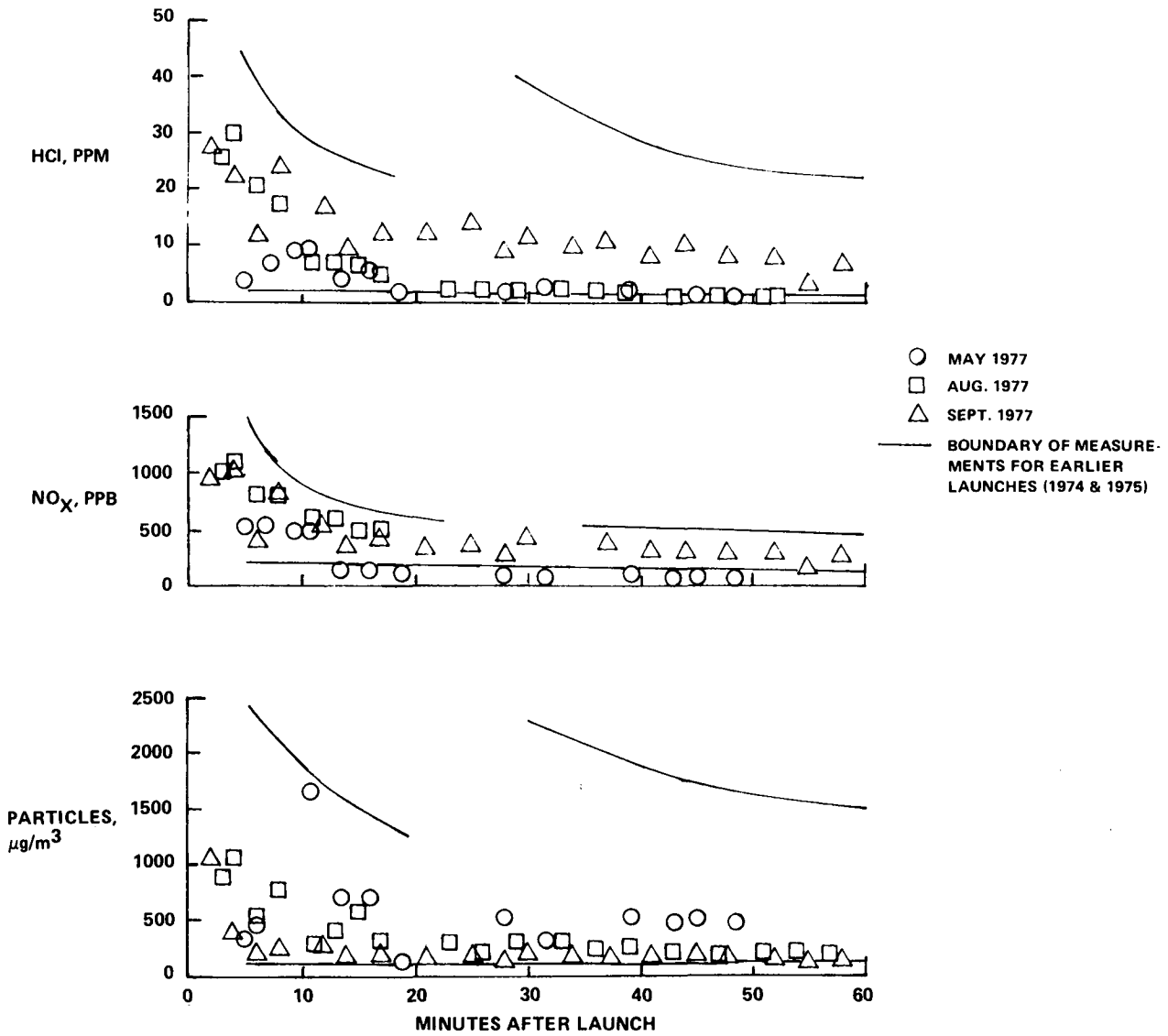


Figure 5.- Comparison of in situ measurements of launch vehicle effluents for 1974, 1975, and 1977 launches.