

Improved Cab Air Inlet Location Reduces Dust Levels and Air Filter Loading Rates

Objective

To improve operational effectiveness of enclosed cab filtration systems.

Background

Enclosed operator cabs are widely used on mobile excavation equipment in the mining and construction industries. They protect the operator from bad weather, noise, and airborne dusts. The inside cab environment usually must be kept at very low dust concentrations because of quartz dust generated from the excavation of silica-bearing rock. Most cab designs achieve heating and air conditioning effectiveness by recirculating most of the interior cabin airflow, with a smaller portion of the outside air added to the cab as makeup air. Both the recirculated cab airflow and exterior makeup air added to the cabin should be efficiently filtered, with the makeup air positively pressurizing the cab interior. Ideally, operator cab air filters should provide at least 99% capture efficiency for dust particles as small as 0.3- μm aerodynamic diameters. These higher efficiency air filters provide good dust control for the equipment operator, but tend to accumulate dust more quickly than lower efficiency air filters.

Approach

The location of the cab air inlet is a key design factor that could affect the overall performance of air filtration systems. Locating the cab air inlet near the equipment's source of dust generation can subject the air filtration system to high dust-loading rates. High dust-loading rates tax air filtration systems and reduce their effectiveness. The higher pressure drop across a loaded filter decreases air system quantity and increases the possibility of dust leakage around the filter. Reduced air system quantity

decreases cab pressurization. Thus, air filters need to be changed or cleaned often to optimize air system performance. Finally, air filter performance is usually a relative dust capture efficiency (on a percentage basis), so filtration of higher outside cab dust levels can result in higher inside cab dust levels.

The cab air inlet should be strategically located away from the equipment's dust sources to reduce dust loading of the air filtration system. This usually means placing the cab air inlet at higher distances from ground level.

How It Works

Field studies were conducted at several surface coal mines to measure dust levels at several locations around the cabs of Caterpillar (CAT) D11N and D10N bulldozers during their overburden removal operation. The cab air inlets on these bulldozers are located both beneath and between the rear part of the cab and fuel tank. Personal respirable dust samplers were placed on the back side of the elevated drive axle (under the fuel tank and cab air inlet) and on each side of the rollover protection frame of the cab (above the fuel and hydraulic tanks). Figure 1 shows the dust sampling locations on a CAT D11N bulldozer. The axle sampling location is about 6 ft above ground level; the cab sampling locations are about 11 ft above ground level.

Figure 2 shows the dust level relationship measured between the field sampling locations on the bulldozers. This relationship shows that the dust levels at the bulldozer axle location (under the fuel tank) are between two and three times higher than those along the sides of the cab (above the fuel and hydraulic tanks). These findings suggest that the bulldozers' dust levels and cab air filter loading rates can be reduced by increasing the air inlet distance away from the ground level dust sources. Other air inlet location considerations should include which side of the equipment provides the best location, accessibility of the inlet filter, and the location of the engine exhaust. Placing the cab inlet air location on



the back or rear side of the cab may expose it to the dust plume trailing behind the equipment when it is traveling forward. Although many front-end loaders, drills, and agricultural tractors place their air inlets on top of the cabs, this may not be practical for some off-road haul trucks where the dump bed is located over the cab. However, if the air inlet is placed in a location where dust levels are typically lower, the filter-loading rates and maintenance requirements should be lowered.

For More Information

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Figure 1.—Surface mine excavation with a CAT D11N bulldozer.

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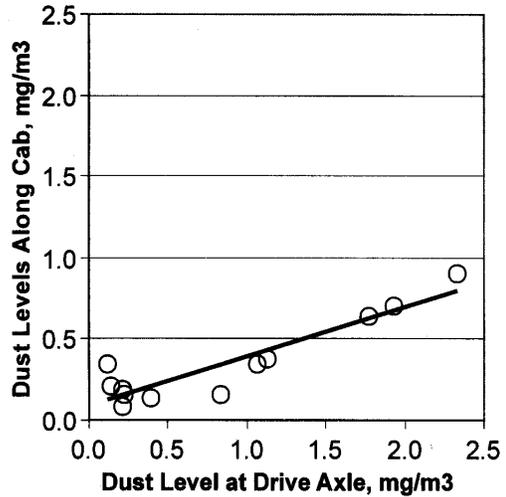


Figure 2.—Relationship between dust sampling locations on bulldozers.