



POWER-PLANT STACK and connecting breeching usually have no facilities for proper sampling and testing of stack gases

Field Testing of Stack-Dust Emission Needs Simplifying

Determining just when a plant stack goes beyond allowable air-pollution ordinances is a tough job for enforcement as well as plant men. Here are some of the latest field aids employed around the country for combatting this problem

IN RECENT YEARS, air-pollution control has been getting unusual attention in a large percentage of our industrial areas. Along with it has come legislation frequently spelling out allowable limits for smoke emission, either in density to the eye or in actual stack-dust loading. But, unfortunately, the accepted methods of measuring these discharges do not lend themselves to simple, indisputable checks that plant operators or enforcement agents can run. As a direct, practical result of this measuring weakness, air-pollution control suffers. You'll find enforcement ordinances vary all over the lot in the way they identify a stack offense. Some employ the long used Ringelmann chart to decide density, and let it go at that; others refer to the ASME Power Test Code for dust loading.

The Ringelmann chart, for example, has been shot full of holes because there are so many outside influences that bear on its readings. For example, the background against which the stack is compared, the lighting variations, the observer's position, whether the day is

bright or dull, the more than likely differences in light intensity on the chart as contrasted with that at the stack—all contribute to the doubts about the value of the Ringelmann.

The ASME Power Test Code, designed primarily for performance and acceptability tests of dust collectors, proves a very trying method of field testing for allowable stack-dust loading.

Many directly involved in smoke-control work have been pushing to uncover suitable yet easily applied stack-measuring devices. Along with these individual

efforts there is a well-integrated test-code activity, sponsored by the ASTM Committee D-22 and numbering some 60 technical experts. Out of their efforts may very well come the truly scientific means of properly evaluating stack discharge. Possibly they may even be able to convince the public as well as the enforcement agent that visible stack emission is no true measure of an individual stack's contribution to a city's dust-fall problem.

Density Measurements. In the meantime, though, new developments in the

field of stack-dust measurement are being introduced. Fig. 1 pictures the operation of the Smokescope, as presented by J P Strange of the Mine Safety Appliances Co before the spring meeting of American Society of Mechanical Engineers in Columbus, Ohio. It is aimed at removing criticisms to the Ringelmann method of measuring stack density. A reference-standard film disk *H* is viewed against the background next to the stack. Both smoke and reference film get light from the same source.

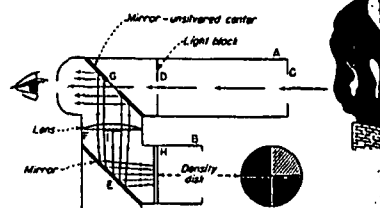
Then a lens in the instrument projects a virtual image of the reference standard to a focal distance equivalent to that of the stack. Then the eye can make of truly realistic comparison. This system limits the field of vision to the stack area and eliminates stray light.

Light from the area next to the stack passes through the reference film disk *H*, in the barrel *B*, to front-surface mirror *E*. This mirror, together with the lens *F*, places an image of the reference film on the image mirror, where you can compare it with the smoke as you see it through the apertures. The four densities corresponding to Ringelmann numbers 1-4 appear on the image mirror.

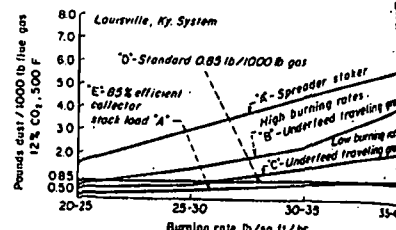
Stack-Dust Loading. Fig. 3 is a special testing arrangement developed by H C Ballman and his staff in the Smoke Regulation Dept of Columbus, Ohio. They estimate it takes a crew of two to three men two days to run a set of tests they can use in smoke-control work. The charts, Fig. 4, permit them to translate field data from the test setup directly to usable results right on the job.

The usable results Ballman seeks are whether an individual stack-emission rate lies within or without the ordinance allowance, namely 0.85 lb per 1000 lb of flue gas. In fact, a reasonable margin of 0.15 lb, or roughly 17.5%, is permitted so that if a stack tests out at 0.85 lb per 1000 lb of gas or under it's approved; between 0.85 and 1.0 lb per 1000 lb, it's approved based on duplicate tests; over 1.0 lb per 1000 lb, and it's disapproved. The only flaw Ballman finds is that few plants have reasonably long, straight runs of duct so vital to accurate dust-load sampling.

Down in Louisville, Ky., J C Marks, assistant chief, and R W Bourne, chief engineer of Jefferson County Air-Pollution Control District, have worked up the chart in Fig. 2, based on the table (facing page) from Bituminous Coal Research publication, *Aid to Industry*, 500-320. This chart's sole objective is to acquaint the plant-operating man with the amount of dust he is sending out his stack under various firing rates, and how these amounts compare with the ordinance recommendation. Fig. 2, line D. The rest is up to the operator.



1 Special instrument, a Smokescope, places stack discharge seen through apertures, in center of reference density disk



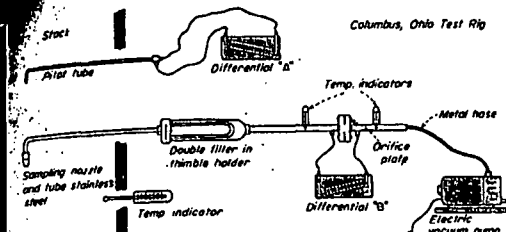
2 Stack-dust loadings, based on the Bituminous Coal Research table, below, is designed as a guide for boiler operators

Dust In Stack Gases by Stoker Type, Burning Rate

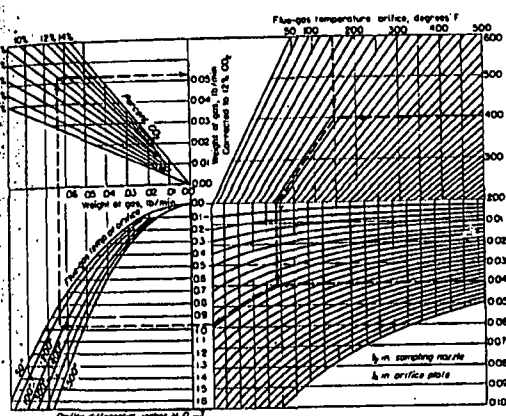
Grains of dust per cu ft gas, 500 F; 12% CO₂ leaving boiler

Burning rate lb/sq ft/hr	Underfeed, chain and traveling-grate stoker	Spreader stoker
20 to 25	0.15 to 0.2	
25 to 30	0.2 to 0.4	
30 to 35	0.4 to 0.7	0.5 to 1.0
35 to 40	0.7 to 1.3	
Over 40		1.8 to 3.0

Note: To convert the above values to pounds of dust per 1000 lb of gas adjusted to 12% CO₂, multiply by 3.30.



3 Stack samples, carried out by one Midwestern smoke-regulation department with this test equipment, are given a quick on-the-spot check with curves in 4, below



4 Chart permits a field appraisal of stack loading for smoke-control purposes and translates results as being within or either side of the allowable limits