Effect of Screens on Spatial Velocity Variation

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Recent studies (*1, 2, 3*) of liquid phase mass transfer in the turbulent wake of a cylinder yielded, as a by-product, some additional information on the effect of screens on spatial velocity variations in the controlled flow field in the working section of a water tunnel. Only a few papers have reported such data in the past. The primary publications resulting from the doctoral dissertation of R. E. Sparks did not report these data; it seems desirable to record them for interested parties in the following paragraphs.

The recent work of Schubauer, Spangenberg, and Klebanoff (*4*) appears to support the equation of Taylor and Batchelor for the phenomenon. This equation is

$$f = \frac{\left(\frac{\Delta v}{V_o}\right)_2}{\left(\frac{\Delta v}{V_o}\right)} = \frac{1 + \alpha_s - \alpha_s K}{1 + \alpha_s + K}$$

where f is the fraction by which the variations of velocity are reduced by passing through a screen. The data necessary for the calculation of α_s from screen characteristics are presented in Pankhurst and Holder (*5*). A simplified procedure for making the calculation is presented by Sparks (*1*). K represents the pressure drop coefficient (*5*).

Data showing the effect of various screen combinations on the mean velocity variation in the tunnel are presented in Table 1. The velocity was measured at 1-in. intervals across the tunnel over the middle 7 in. of the working section, and the profiles were found not to vary significantly with distance from the screens in the 44 in. working section. The results are not of sufficient scope or accuracy to verify the correlation of Taylor and Batchelor, but the general trend of the effect of the screens in water is seen to be similar to observed results in air. For the screen combination shown last in Table 1 the average deviation from the center-line velocity was approximately 0.5% with a maximum deviation at ane point of 1.2%.

For combinations of four or more screens the only differences in effect appear to be random, and these are thought to be caused by lack of precision in the screen geometry. Evidence for this is the fact that the shape of the profiles can be changed by rotation of some of the screens, but the average spatial deviation remains approximately the same.

From the investigations of Baines and Peterson (*6*) and Schubauer, Spangenberg, and Klebanoff (*4*), it appears that there is less chance of abnormal behavior if screens having more than 50% open area are selected to damp velocity variations. Screens used in this study had open areas from 30.3 to 56%.

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TABLE 1. EFFECTS OF SCREENS ON VELOCITY VARIATIONS

Screen mesh (horizontal or vertical transverse)	Average deviation (7 points) from mean velocity (%)	(Measured) of last screen added	Calculated from equation
None (H)	16.1		
None (H)	11.5		
16 (H)	4.8	0.30	0.28
16 (V)	6.0	0.53	0.28
13 (V)	5.2	0.45	0.38
16, 16 (H)	2.3	0.48	0.28
16, 16 (V)	3.0	0.50	0.28
20, 16, 16 (H)	2.8	1.04	0.14
16, 16, 16 (V)	2.0	0.67	0.28
13, 16, 16, 8 (H)	0.86	0.36	0.28
13, 60, 8, 8 (V)	0.97	0.48	
13, 250, 8, 8 (V)	0.60	0.30	
13, 16, 16, 16 (H)	0.73	0.30	0.38
13 16, 8, 8 (V)	0.90	0.45	0.38
13, 16, 16, 8, 8 (H)	0.64		
13, 30, 30, 8, 8(V)	0.69		
13, 16, 16, 16, 8 (H)	0.69		
13, 16, 16, 16, 8 (8)	0.64		
13, 16, 30, 60, 16, 8 (H)	0.83		
13, 30, 16, 16, 8, 8 (V)	0.69		
13, 250, 250, 16, 16, 16 (H)	1.03		
13, 16, 16, 16, 8, 8 (H)	0.97		
13, 16, 16, 16, 30, 30, 8, 8 (H)	1.14		
13, 4, 30, 16, 105, 100, 100, 100 (H)	0.36		
13, 60, 30, 16, 105, 100, 100, 100 (V)	0.41		
13, 60, 30, 16, 105, 100, 100, 100 (H)	0.40		

LITERATURE CITED

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