The additional benefit obtained by 10 hours wetting down as opposed to 4 hours is almost negligible and hence the period of wetting down before re-entry does not appear to be particularly significant. However, wetting down for less than 4 hours would not be sufficient, since the duration of wetting down must be such as to permit cooling penetration for some distance (say 6 to 12 inches) into the rock. This cooled rock skin serves as a coolth storage reservoir during the succeeding hours.

The depth of rock cooled tends to an asymptotic limit as the duration of wetting down increases, the most favourable duration probably being about 4 to 6 hours for typical stope conditions. The advantage to be gained by wetting down for much longer periods is unlikely to be large.

3.5 <u>The effect of different starting times for a fixed period of wetting down</u>

The model was given a wetness factor of $f = 1$ for times 0 - 2, 2 - 6 and 6 - 10 hours after blast respectively, with the remaining part of the cycle at $f = 0.2$.

The results (Fig. (3.5)) confirm those of Fig. (3.4) in that they show that where a fixed period of wetting down is involved, the greatest advantage will be obtained if wetting down is carried out immediately prior to the entry of the next shift.

3.6 <u>Conclusions</u>

The basic principles which should be considered when planning a wetting down procedure are as follows :-

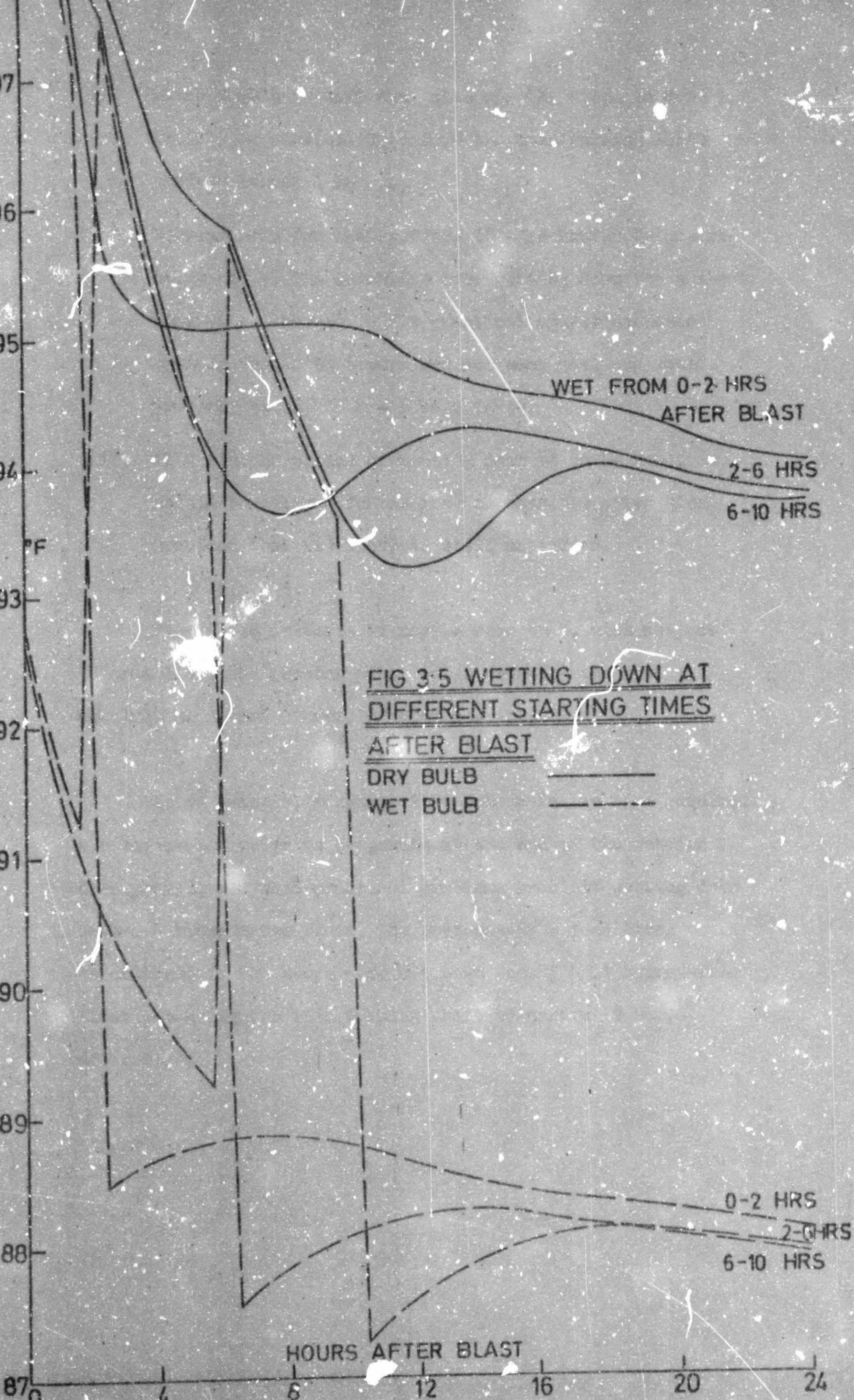


FIG 3·5 WETTING DOWN AT DIFFERENT STARTING TIMES AFTER BLAST

(i) There should be time available for the stope to dry (wholly or partially), before the main working shift arrives (about 1 hour).

(ii) Wetting down for long periods (8 - 12 hours) before re-entry has little advantage over wetting down for a short time (4 - 6 hours). The practical and/or economic optimum should be determined for each case and would probably be in the 4 - 6 hour range.

(iii) If a limited period of wetting down is to be used, it should be delayed for as long as possible after blast provided that (i) above is still satisfied.

From these criteria it may be seen that, with respect to heat flow, the present practice is probably the most detrimental method of wetting down possible.

As an example, assuming that 1 hour is the time required for the excess water to evaporate at the end of the wetting down period, and that practical problems prohibit wetting down before 4 hours after blast, the best possible conditions would be obtained if the stope were wet down from 5 - 11 hours after blast, assuming the main working shift to arrive 12 hours after blast.

CHAPTER 4

An analysis of stope conditions in deep level mines

As mines increase in depth, so the VRT increases, which means that in future it will be important to utilise cooling facilities to their best possible advantage if stopes are to remain tolerable without greatly increasing ventilation costs.

Using Starfield's model, various stopes were examined in order to determine trends which may occur at a VRT of 140°F.

4.1 Significance of wetting down

Similar cases to those examined in Chapter 3 were treated and the same trends appeared, except that, as expected the benefits obtained by judicious wetting down at 140°F greatly exceeded those where the VRT was only 115°F. The input parameters were as follows :

(i) VRT : 140°F

(ii) Rate of advance : 2 ft every 24 hours

(iii) Air velocity : 110 ft/min

(iv) Inlet air temperature : 85/82°F

(v) Face to scatterwall : 12 ft

(vi) Stoping width : 42 inches

(vii) Heat source : decreasing from 280 to 90 BTU/ft hr over the first 12 hours after blast.

Wet and dry bulb temperatures were calculated at a point 500 ft along the stope face.

With a VRT of 140°F, the calculated points tend to oscillate slightly about a mean curve. This is due to the fact that the calculation is based on a method requiring certain specified space and time intervals; where sudden large changes occur (e.g. wetting down), these intervals may be decreased in size until the oscillation has been sufficiently dampened. Once again instantaneous wetting and drying was assumed, necessitating some interpolation.

Fig. (4.1) is a typical example of the results obtained for a VRT of 140°F, where wetting down was assumed to take place.

(i) from 2 to 6 hours after blast,

(ii) from 6 to 10 hours after blast,

(iii) from 2 to 10 hours after blast.

Comparing Fig. (4.1) with the figures in Chapter 3, it may be seen that as the VRT increases, the method of wetting down becomes increasingly critical. In comparing, it should be noted that the curves in Chapter 3 were plotted for a point 300 ft along the face, whereas the present graphs give results at a point 500 ft along the face. The additional distance was used in an attempt to smooth out oscillations as far as possible.

At a VRT of 140°F, the wet bulb increase per 100 ft of stope face under the given conditions is about 2°F[18].

4.2 <u>The effect of air velocity in a wet stope</u>

The stope parameters of paragraph 4.1 were again used,

/with

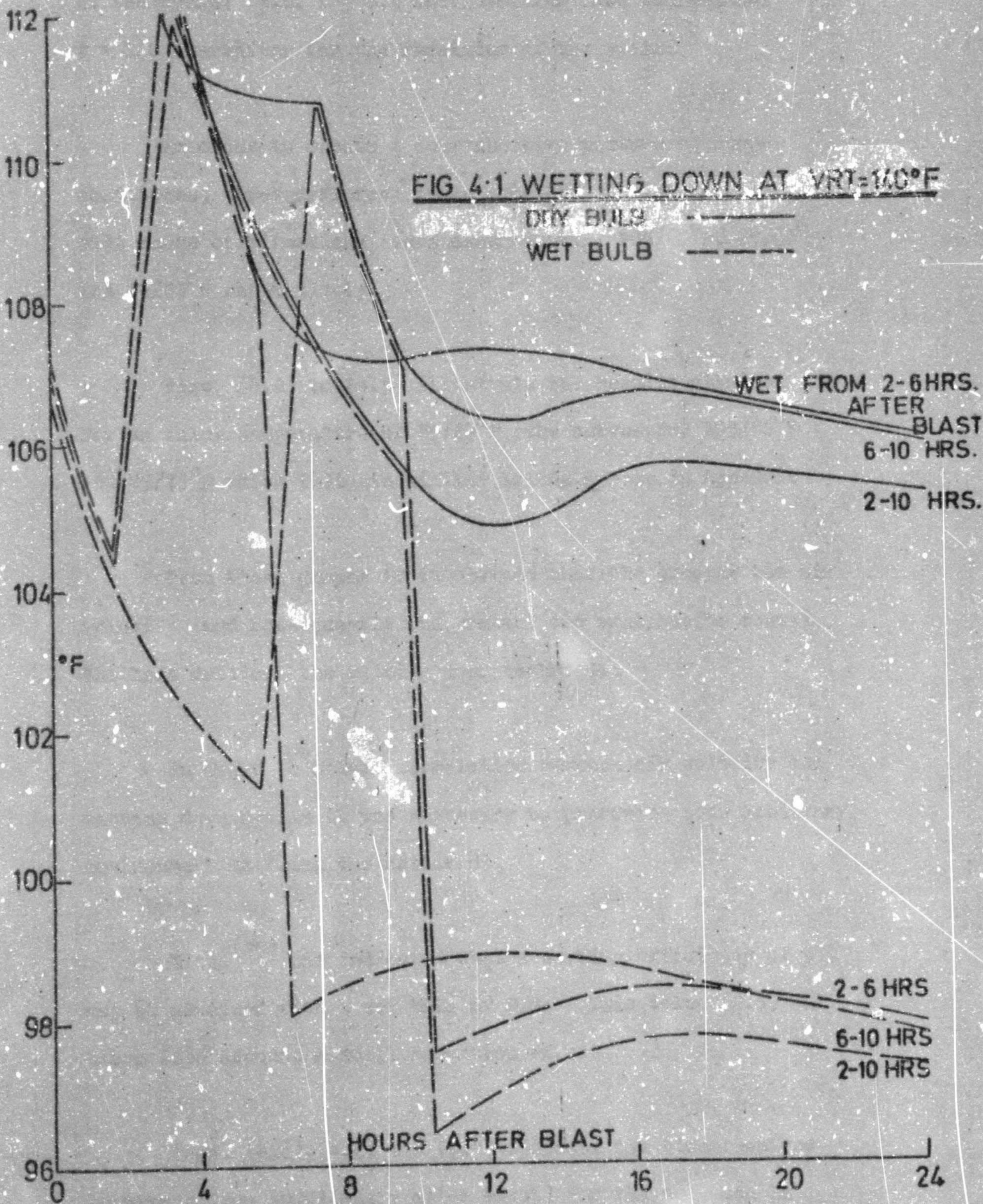


FIG 4·1 WETTING DOWN AT VRT=140°F
DRY BULB
WET BULB
112
110
108
106
104
102
100
98
96
°F
WET FROM 2-6HRS. AFTER BLAST
6-10 HRS.
2-10 HRS.
2-6 HRS
6-10 HRS
2-10 HRS
HOURS AFTER BLAST
0
4
8
12
16
20
24

with air velocities of 110, 220, 440 and 880 ft/min. It was assumed that the stope was wet down 2, 6 and 10 hours after blast respectively, and was kept wet throughout the remainder of the cycle; i.e. f = 0.2 until wetting down started and f = 1.0 thereafter for the remainder of the cycle.

In order to obtain a comprehensive picture of stope conditions, three different inlet conditions which covered a wide range of situations were assumed, viz. 105/80°F, 85/82°F and 75/75°F respectively.

Figs. (4.2) to (4.5) illustrate the results obtained for an inlet temperature of 85/82°F (the curves for 105/80°F and 75/75°F which indicate similar trends appear in Appendix A).

From these graphs it is obvious that the greater the air velocity (and consequently the greater the ventilation costs), the less critical the wetting down technique.

In order to obtain correlation between air velocity and wetting down cycles it was necessary to prescribe some arbitrary environment as being the criterion.

Kitto[25] has indicated that a working efficiency of 95% may be obtained with a wet kata of 9.5. This value (9.5) takes into account a small radiation effect.

Figs. (4.6), (4.7) and (4.8) indicate the time required (measured from immediately after blast) for the wet kata in the stope to rise to a value of 9.5, depending on the air

/velocity

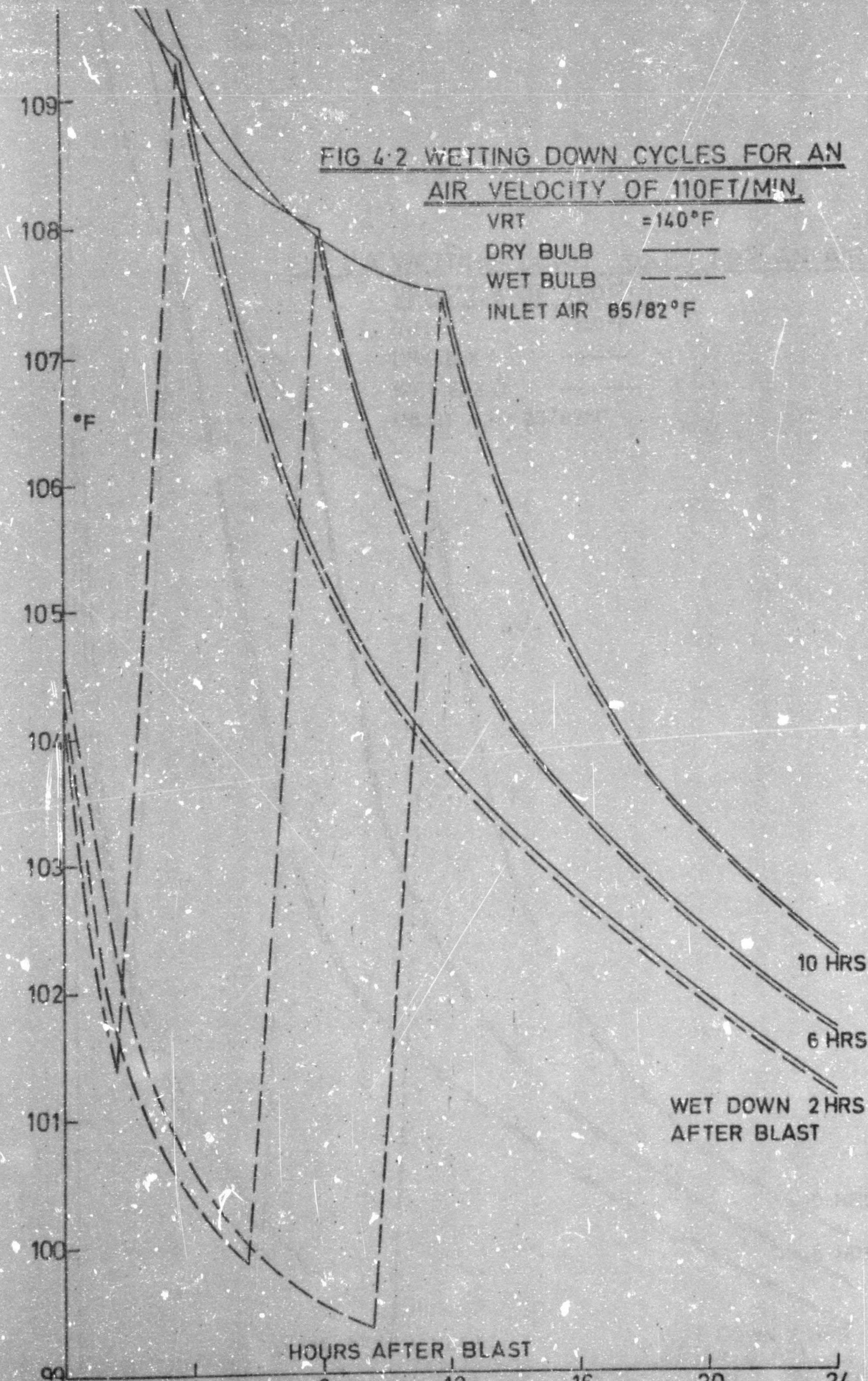


FIG 4·2 WETTING DOWN CYCLES FOR AN AIR VELOCITY OF 110FT/MIN.
VRT =140°F
DRY BULB
WET BULB
INLET AIR 85/82°F
°F
109
108
107
106
105
104
103
102
101
100
99
HOURS AFTER BLAST
0
4
8
12
16
20
24
10 HRS
6 HRS
WET DOWN 2 HRS AFTER BLAST

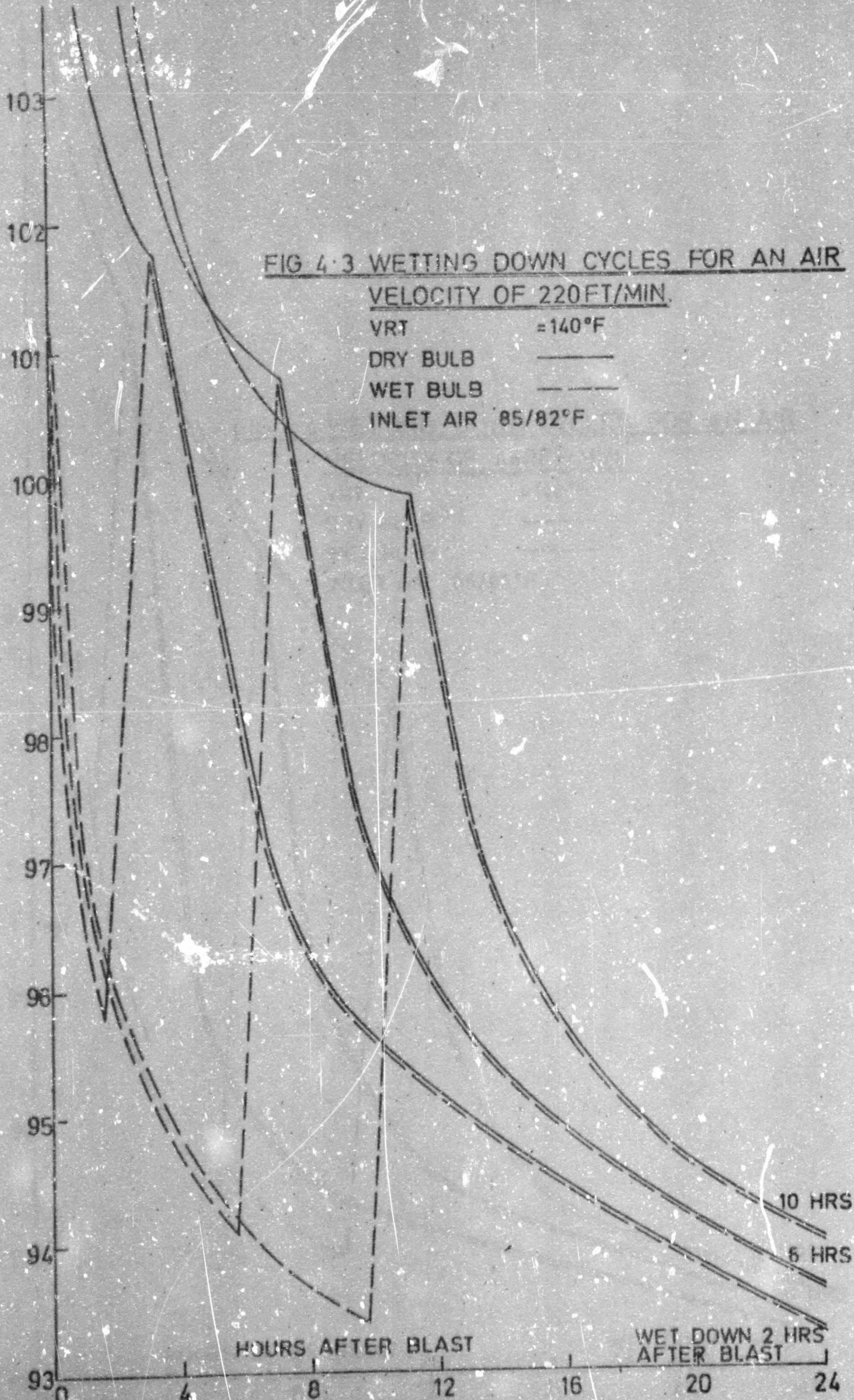


FIG 4·3 WETTING DOWN CYCLES FOR AN AIR VELOCITY OF 220FT/MIN.

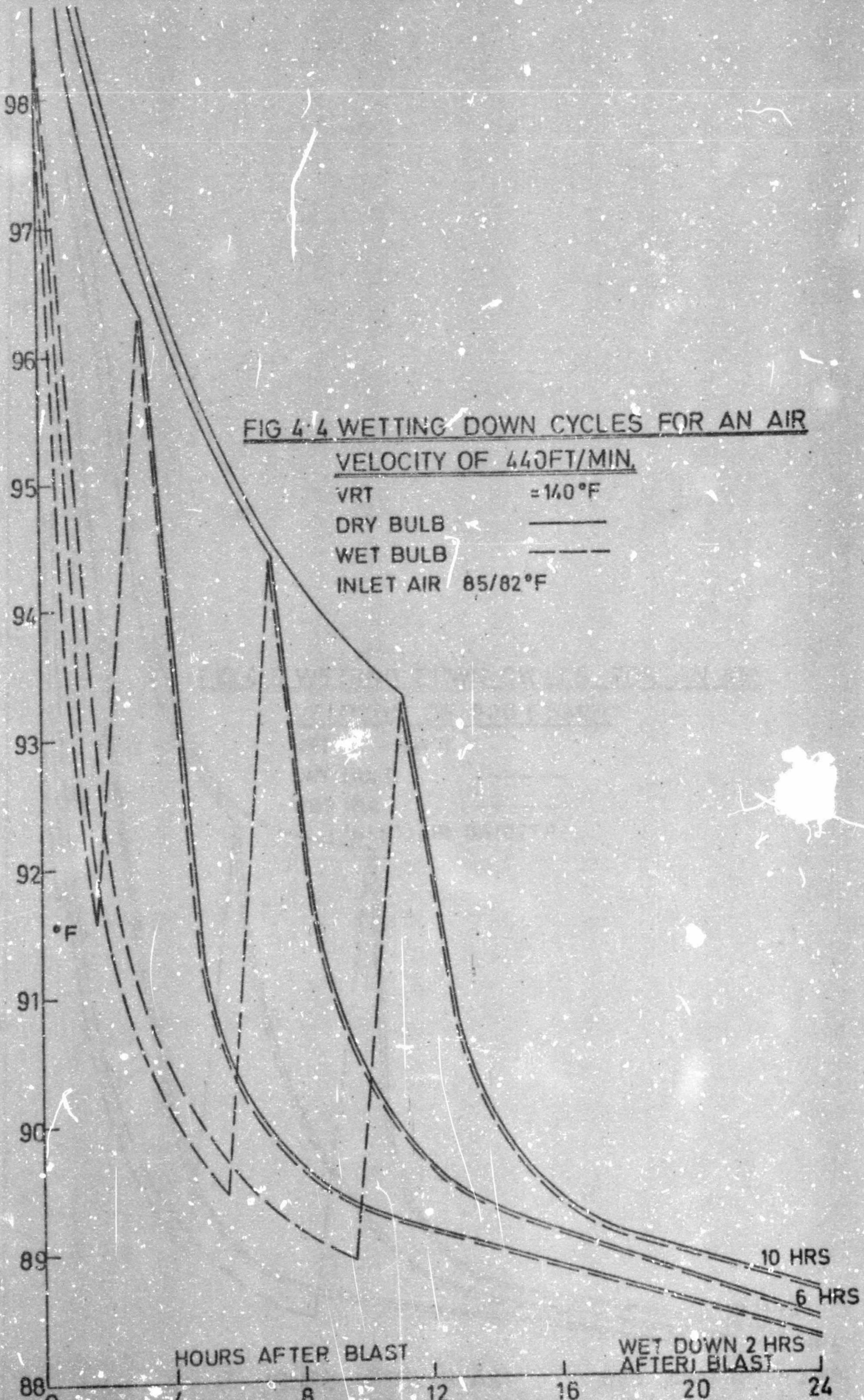


FIG 4·4 WETTING DOWN CYCLES FOR AN AIR VELOCITY OF 440FT/MIN.
VRT =140°F
DRY BULB
WET BULB
INLET AIR 85/82°F
°F
98
97
96
95
94
93
92
91
90
89
88
0
4
8
12
16
20
24
HOURS AFTER BLAST
10 HRS
6 HRS
WET DOWN 2 HRS AFTER BLAST

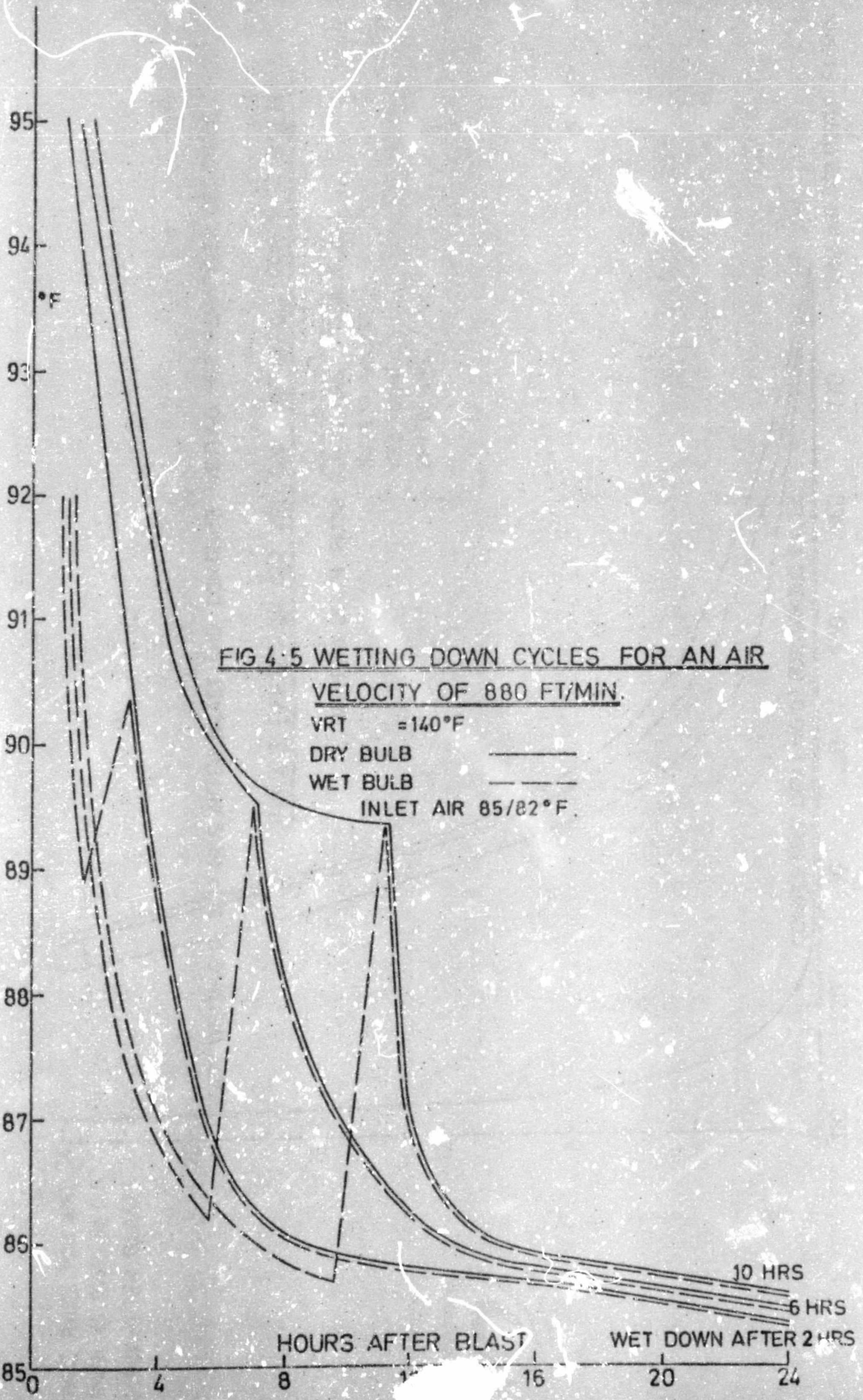


FIG 4·5 WETTING DOWN CYCLES FOR AN AIR VELOCITY OF 880 FT/MIN.

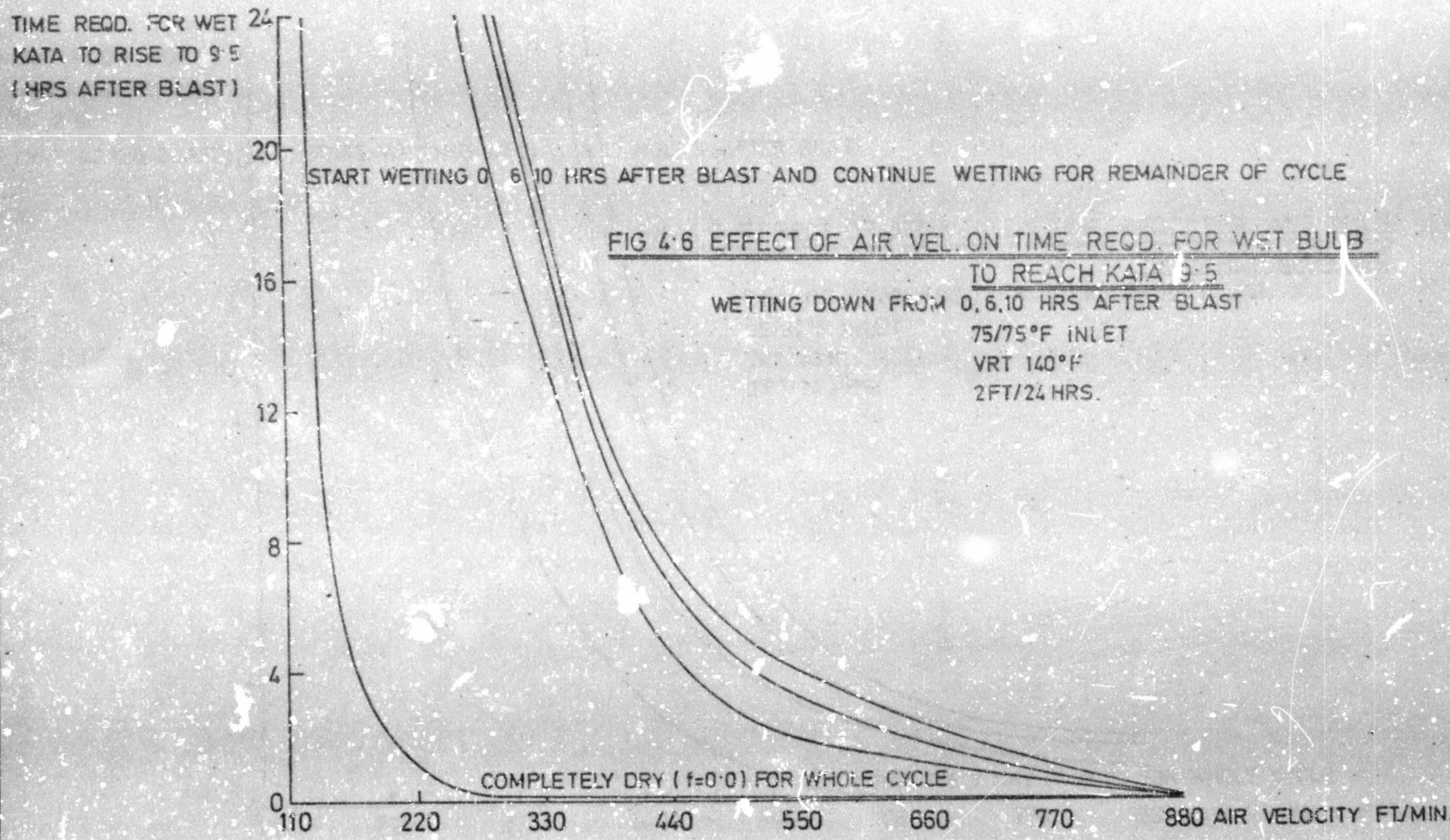
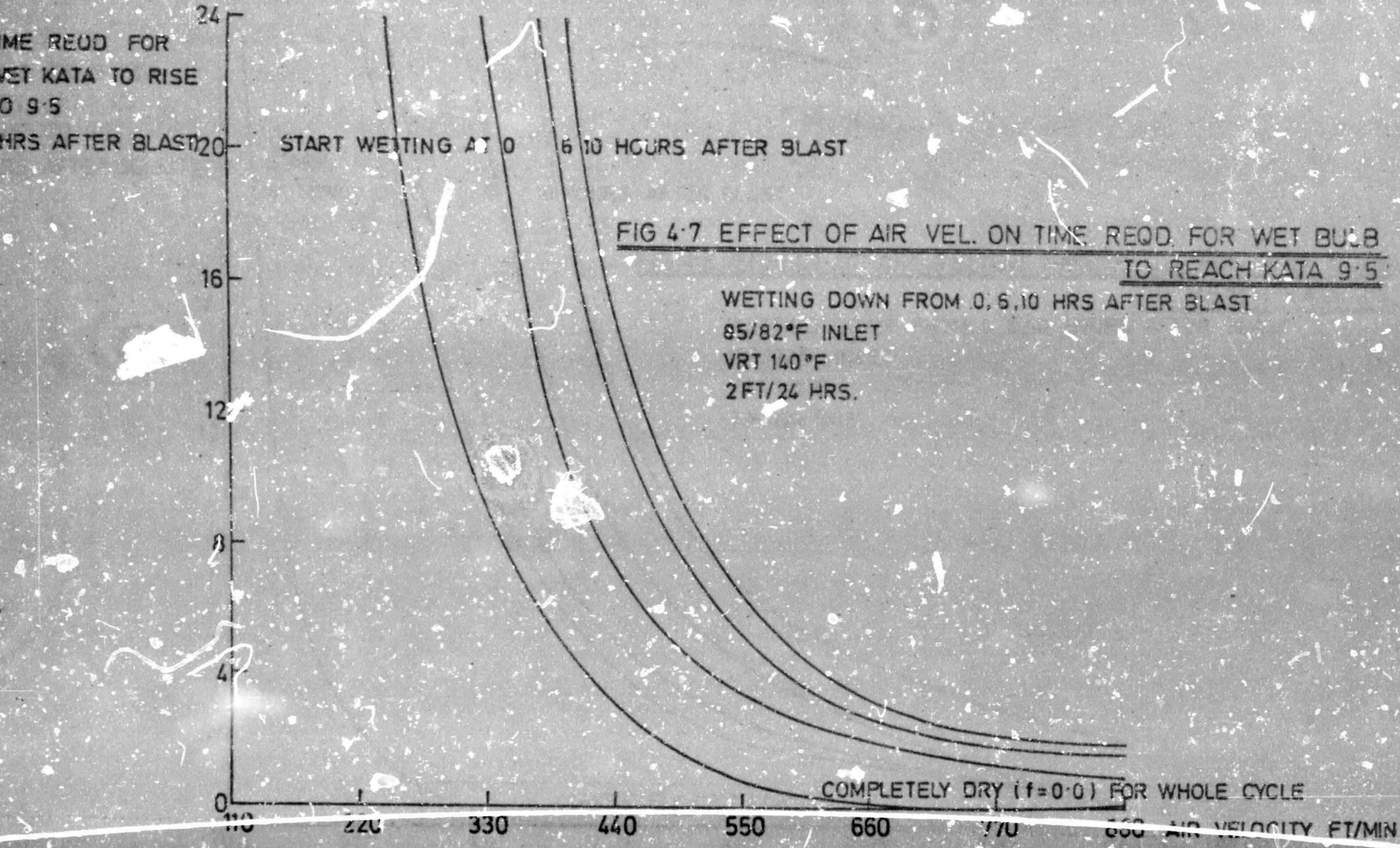


FIG 4·6 EFFECT OF AIR VEL. ON TIME REQD. FOR WET BULB TO REACH KATA 9·5


IME REQD FOR
WET KATA TO RISE
O 9·5
HRS AFTER BLAST
24
20
16
12
8
4
0
START WETTING AT 0 6 10 HOURS AFTER BLAST
FIG 4·7 EFFECT OF AIR VEL. ON TIME REQD. FOR WET BULB TO REACH KATA 9·5
WETTING DOWN FROM 0, 6, 10 HRS AFTER BLAST
85/82°F INLET
VRT 140°F
2 FT/24 HRS.
COMPLETELY DRY (f=0·0) FOR WHOLE CYCLE
110
220
330
440
550
660
770
AIR VELOCITY FT/MIN.