

# **RPE FIT TEST RESULTS: WHAT DO THEY MEAN?**

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# WHAT IS FACEPIECE FIT TESTING?

*“Fit tests are used to help select a specific respirator for a person. If a person passes the test, they are assumed to have a respirator that “fits”. It is assumed that subsequent respirator use will provide a level of protection equal or greater than the assigned protection factor.”*

*Nelson & Mullins, JSIRP, 2004*

# WHAT IS FACEPIECE FIT TESTING?

*“Where tight fitting facepieces are used with RPE, there is a requirement for facepiece fit testing to ensure that the facepiece provided to an individual fits the person correctly.”*

*Loomis (2003)*

# WHAT IS FACEPIECE FIT TESTING?

*“It is a method for checking that a tight fitting facepiece matches the person’s facial features and seals adequately to the wearer’s face.*

*It will also help to ensure that incorrectly fitting facepieces are not selected for use.”*

*ID 282/28, HSE (2003)*

# WHAT IS FACEPIECE FIT TESTING?

*“Fitting tests only identify gross misfits and do not guarantee adequacy of fit.”*

*BS 4275:1997*

# WHAT IS FACEPIECE FIT TESTING?

*Fit testing identifies good fit.*

*Fit testing only identifies gross misfits.*

*Which is correct?*

# WHAT IS FACEPIECE FIT TESTING?

*Fit testing identifies good fit.*

*Fit testing only identifies gross misfits.*

*Which is correct?*

*Is either correct?*

# METHODOLOGY

*The Workplace Protection Factor (WPF) literature was searched for papers which enabled the relationship between Quantitative Fit Factors (QnFF) and WPF to be determined or in which the author(s) comment on such.*

# COMMENTS IN THE LITERATURE

*Some representative comments  
are given below.*

# COMMENTS IN THE LITERATURE

*“Quantitative fit testing cannot be used to quantitatively predict workplace performance of respirators for an individual.”*

*Dixon & Nelson (1984)*

# COMMENTS IN THE LITERATURE

*“The lack of a demonstrated association between quantitative fit factors obtained by these PAPRs and the level of protection they provide in the workplace brings into question the appropriateness of using quantitative fit factors as presently determined as the original basis for the PAPER classification of 1000.”*

*Myers et al (1984)*

**AH3****QnFF****WPF**

31500  
21700  
21500  
20000  
17000  
15400  
14200  
13500  
13500  
10700  
10500  
8300  
7700  
6300  
3100  
3000  
2800  
2200  
2200  
2000  
2000

**W-344****QnFF****WPF**

24600  
23500  
12200  
11000  
10900  
10300  
8600  
8500  
6700  
6700  
6500  
5300  
4000  
3900  
2800  
2600  
2500  
2000  
2000  
1900  
1400

**AH3**

<b>QnFF</b>	<b>WPF</b>
31500	292
21700	<u>42</u>
21500	143
20000	119
17000	<u>2323</u>
15400	341
14200	206
13500	137
13500	95
10700	100
10500	1016
8300	139
7700	211
6300	867
3100	293
3000	99
2800	571
2200	83
2200	48
2000	559
2000	87

**W-344**

<b>QnFF</b>	<b>WPF</b>
24600	235
23500	619
12200	123
11000	136
10900	78
10300	65
8600	245
8500	<u>28</u>
6700	153
6700	85
6500	<u>5500</u>
5300	34
4000	170
3900	714
2800	267
2600	209
2500	41
2000	46
2000	33
1900	291
1400	255

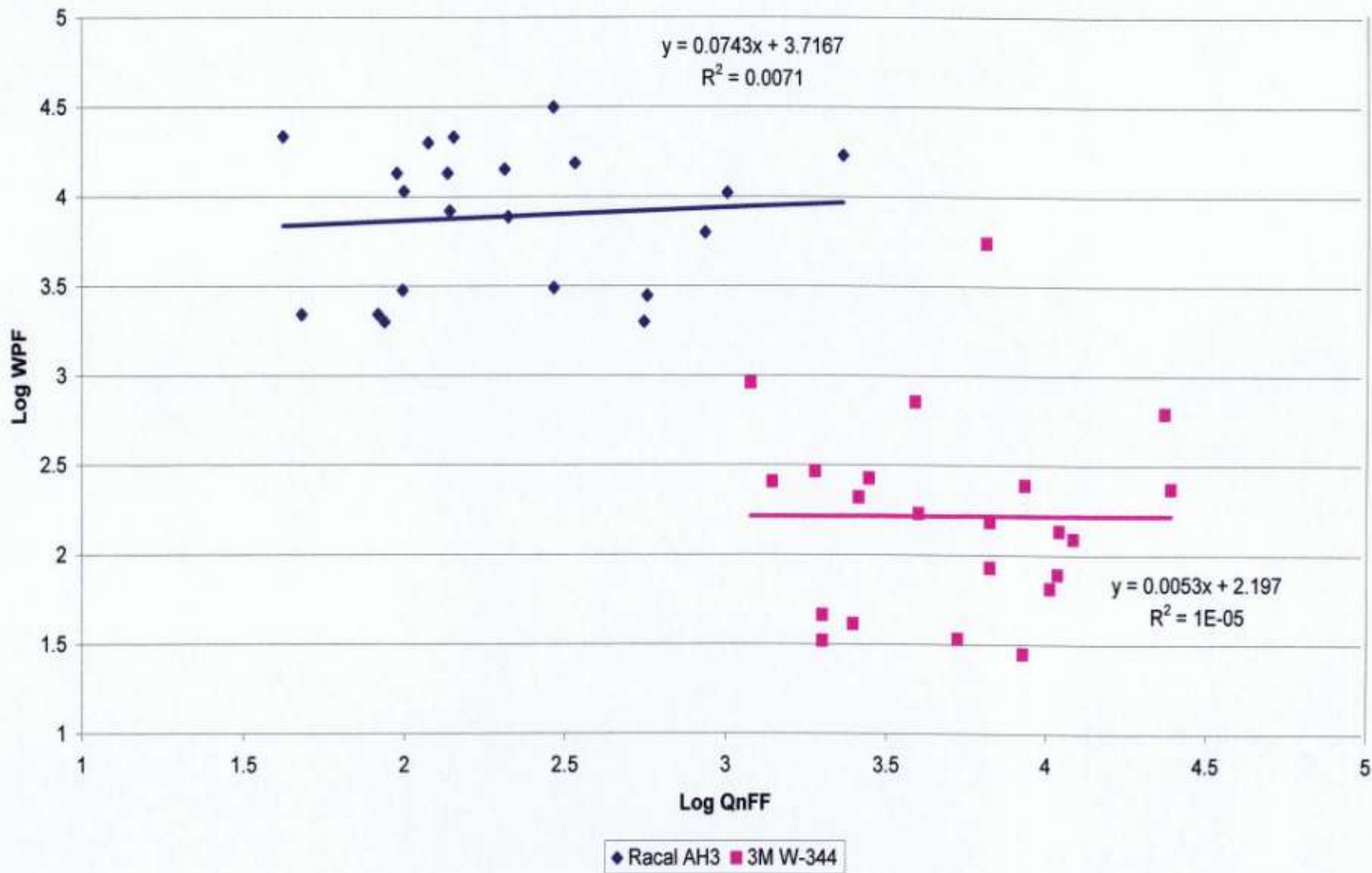
**AH3**

<b>QnFF</b>	<b>WPF</b>
31500	292
21700	<u>42</u>
21500	143
20000	119
17000	<u>2323</u>
15400	341
2000	87

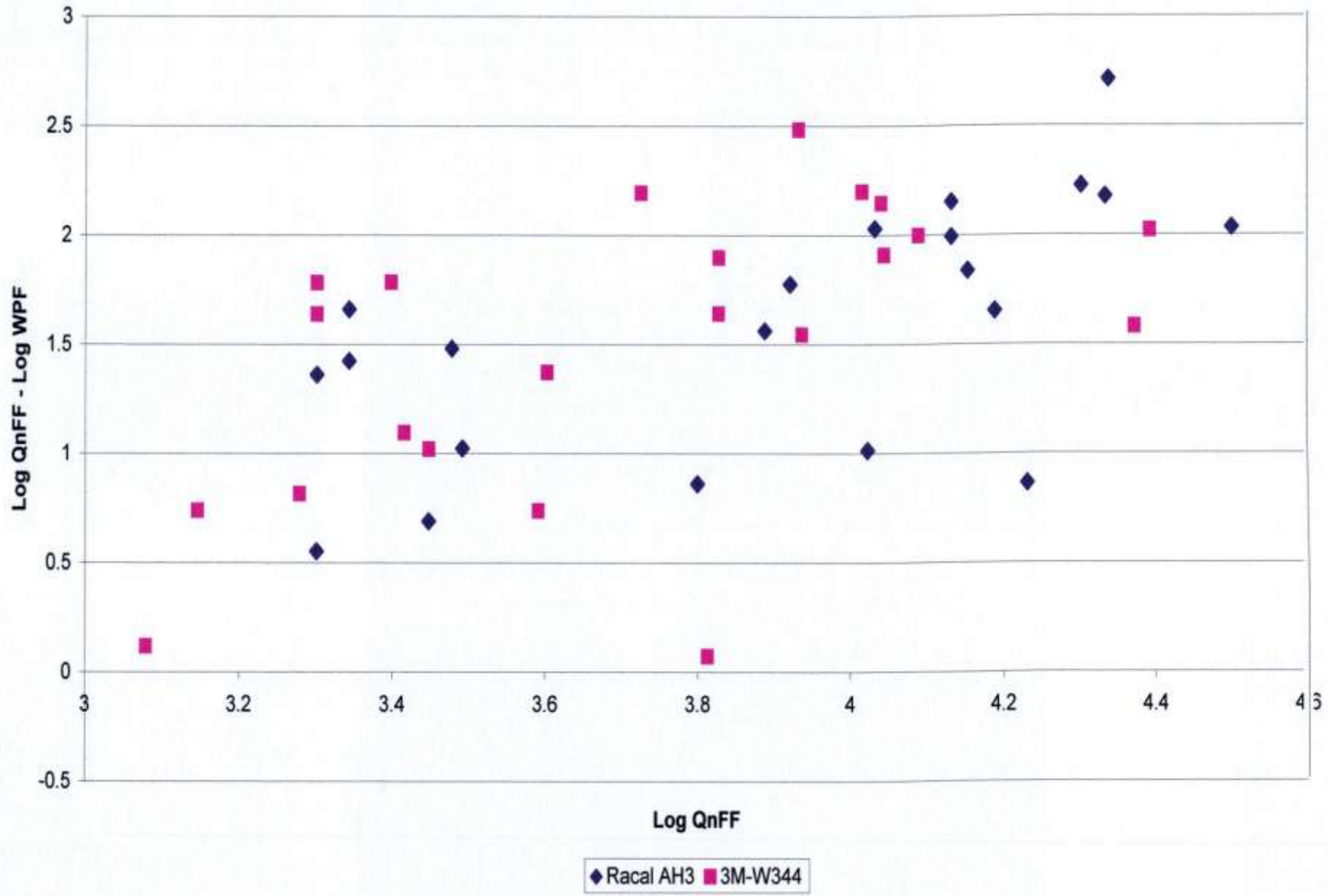
**W-344**

<b>QnFF</b>	<b>WPF</b>
24600	235
8500	<u>28</u>
6700	153
6700	85
6500	<u>5500</u>
5300	34
1400	255

Log WPF v Log QnFF ( Myers et al (1984))



Log QnFF-Log WPF v Log QnFF (Myers (1984))



# MYERS et al (1984)

*There was neither a useful correlation nor a useful ranking relationship between QnFF and WPF.*

*In addition, QnFT failed to correctly rank the two devices.*

# COMMENTS IN THE LITERATURE

*“No relationship was found between the Quantitative Fit Factors measured by the Portacount and the WPF obtained for dual cartridge half-mask negative pressure respirators.”*

*Gaboury and Burd (1989)*

# COMMENTS IN THE LITERATURE

*“The quantitative fit factors that were obtained did not predict which workers would have the highest or lowest WPF. Although the data were limited, it appears there was no correlation between WPF and the quantitative fit factor.”*

*Colton, Johnston, Mullins et al (1989)*

# COMMENTS IN THE LITERATURE

*“This finding is consistent with  
that of other investigators.”*

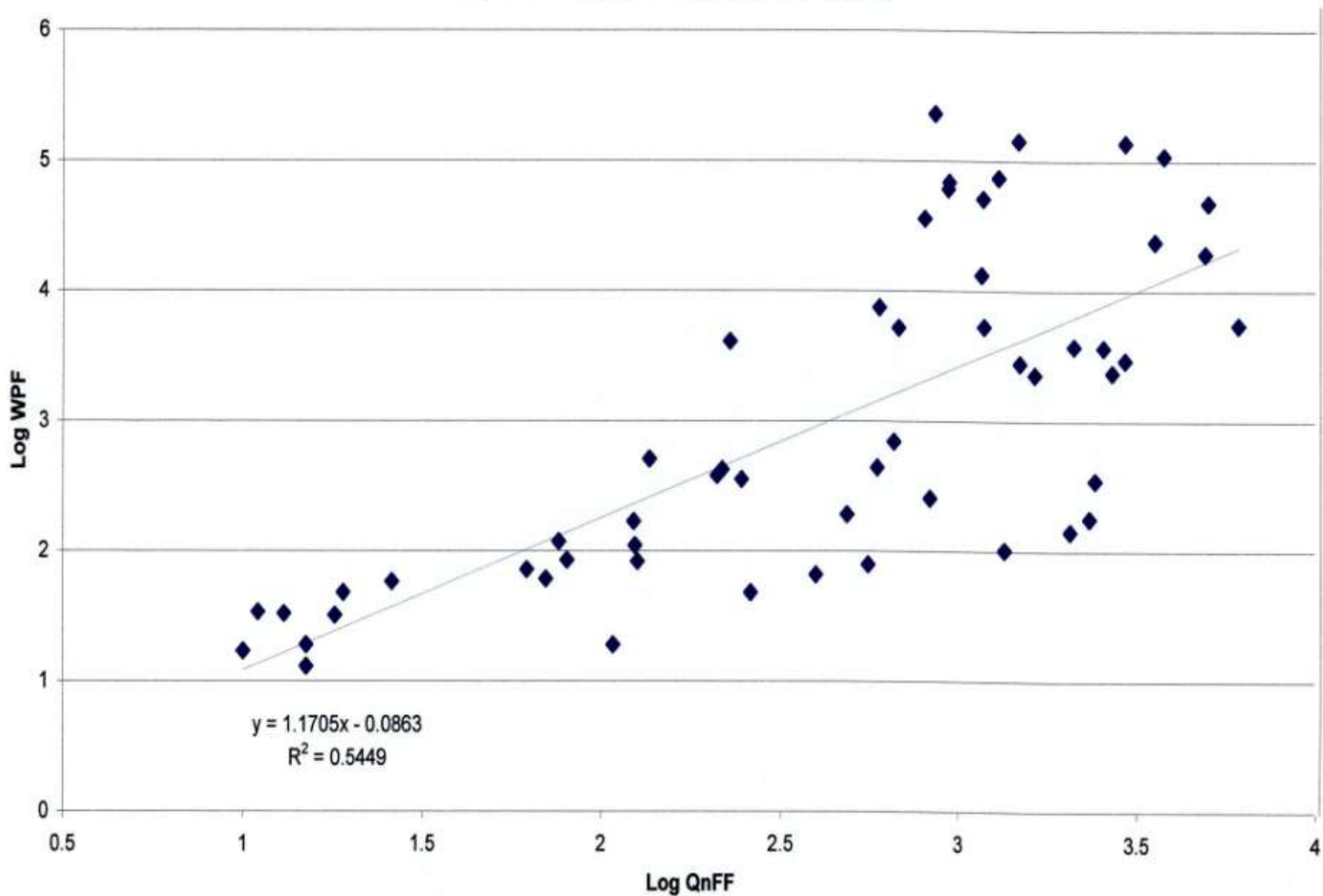
*Colton, Johnston, Mullins et al (1989)*

# COMMENTS IN THE LITERATURE

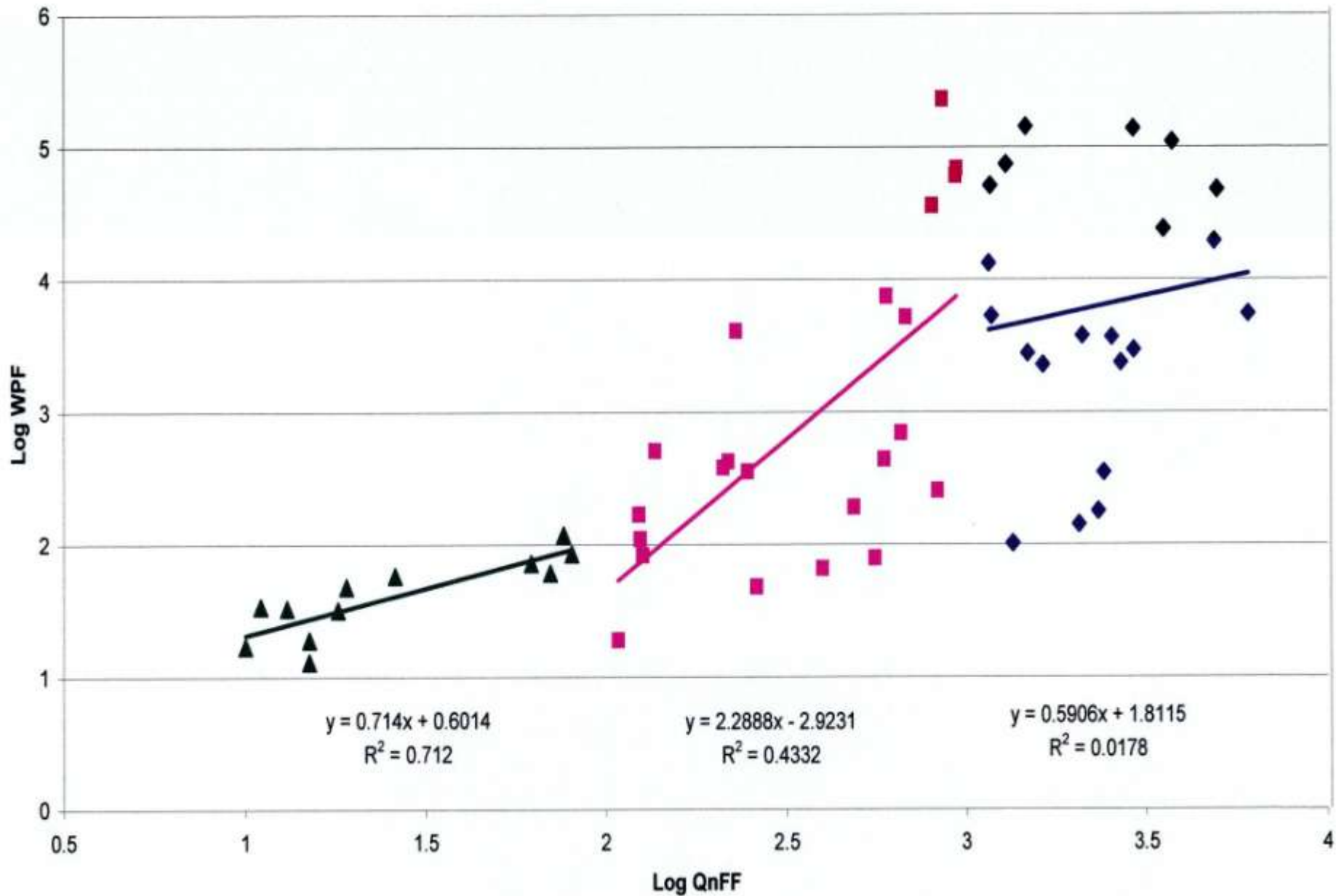
*“... FF was shown to be a meaningful indicator of respirator performance in actual workplace environments.”*

*Zhuang et al (2003)*

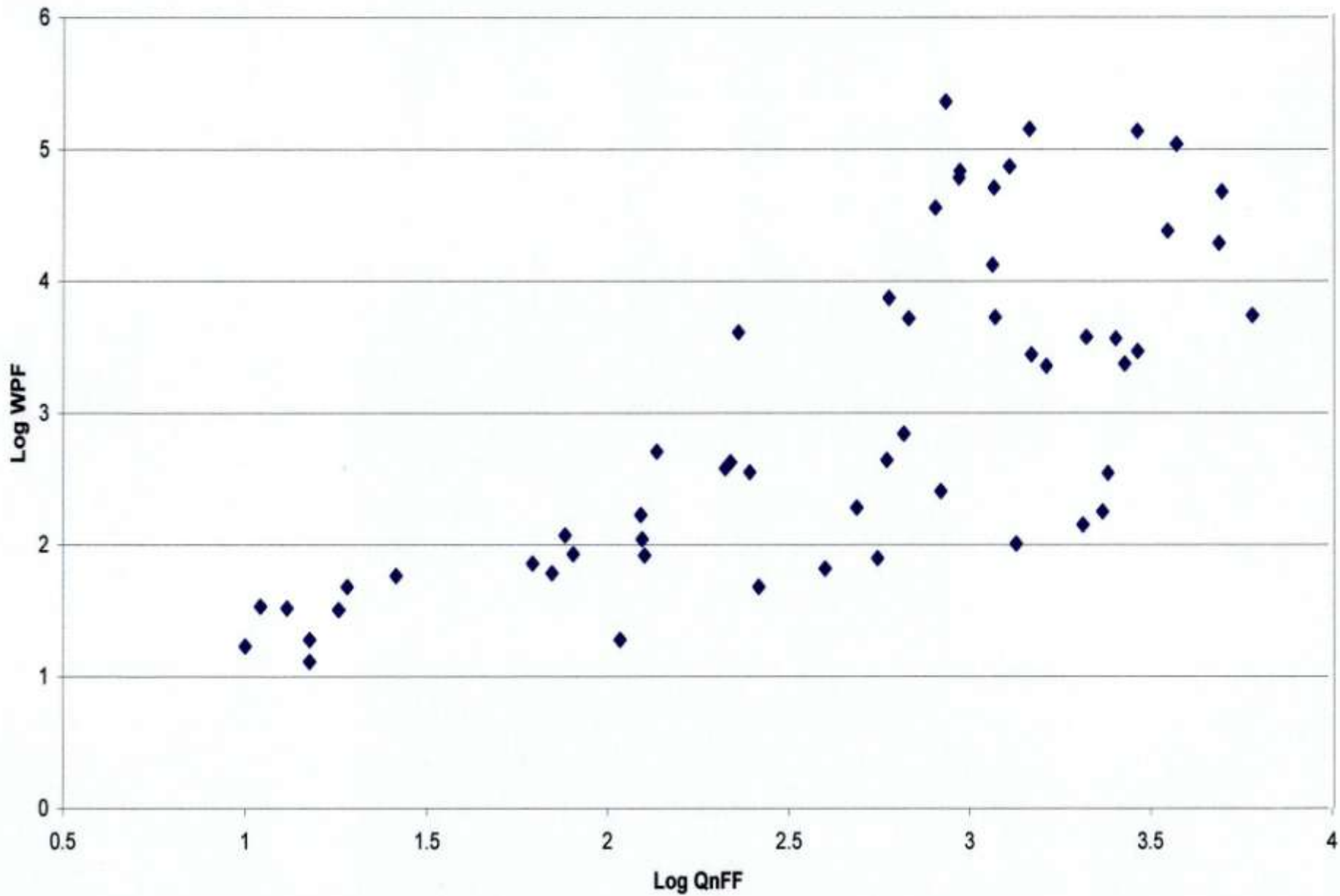
Log WPF v log QnFF (Zhuang et al (2003))



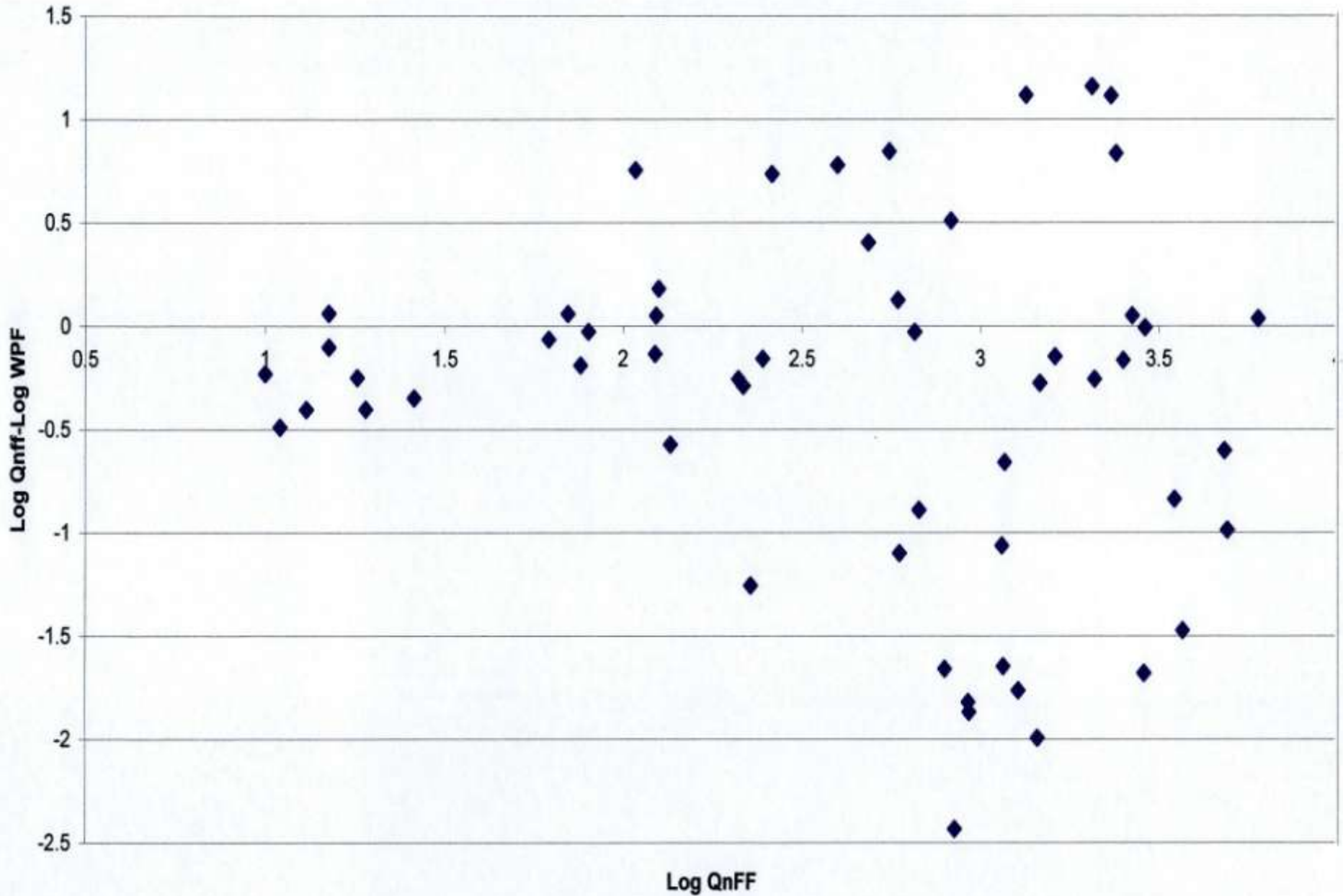
Log WPF v Log QnFF (Zhuang et al (2003))



Log WPF v log QnFF (Zhuang et al (2003))



Log QnFF-Log WPF v Log QnFF (Zhuang et al (2003))



# **ZHUANG et al (2003)**

*WPF obtained for Fit Factors  
of 1,000-3,000 ranged between  
about 100 and 100,000.*

*Zhuang et al (2003)*

# ZHUANG et al (2003)

*Analysis of the raw data demonstrate that  $QnFF < 100$  and WPF were highly correlated.*

*For  $QnFF > 100$  the the data were poorly correlated.*

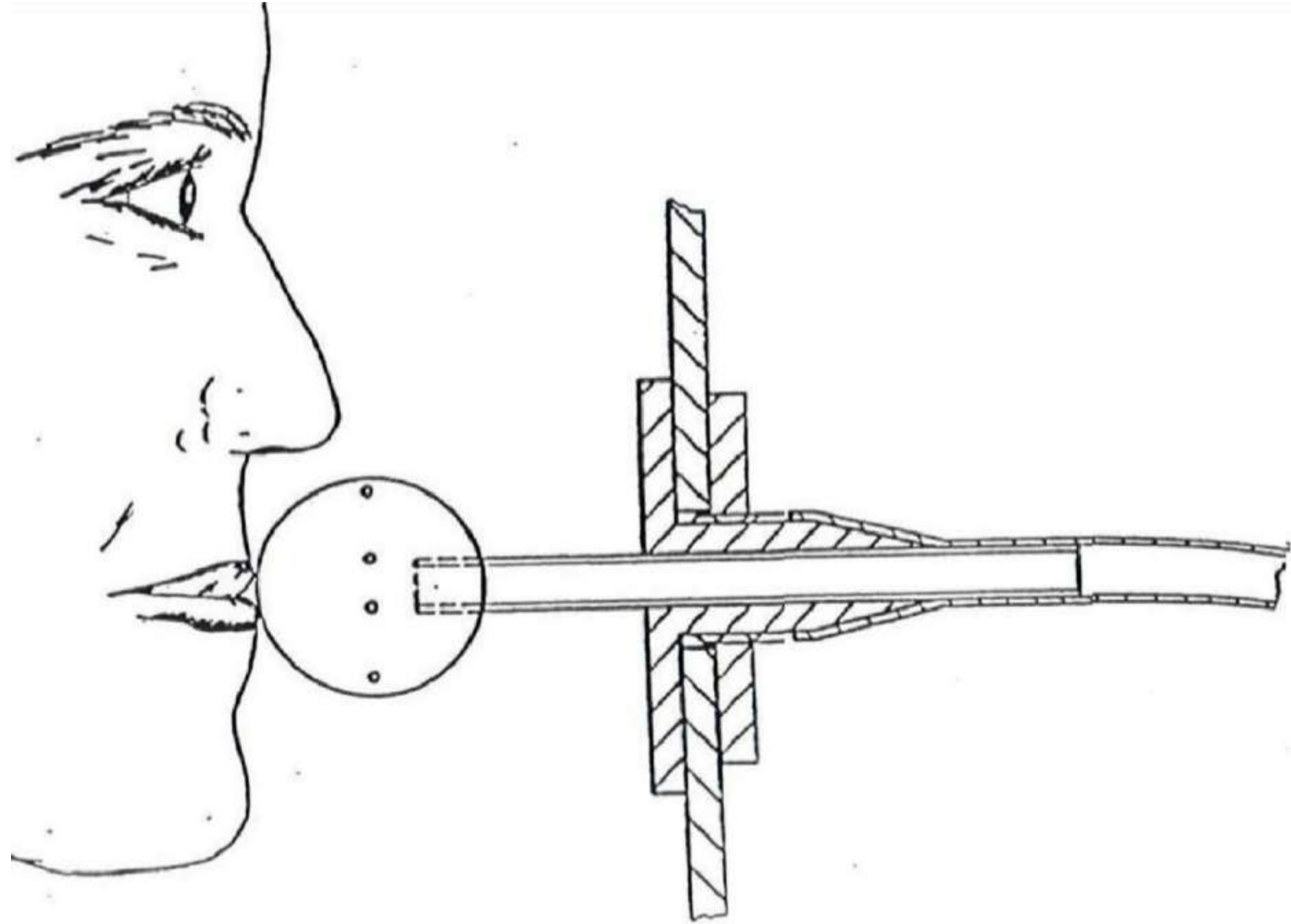
# ZHUANG et al (2003)

*That is, this study identified  
gross misfits only.*

# IN-MASK PROBES

*Note that the in-mask probes used in US WPF studies are likely to seriously under-sample in-mask contaminants and therefore overestimate WPF: i.e. in reality the lower WPF may be factors lower.*





# HOWIE et al (1996)

*In a study of powered respirators during asbestos removal operations investigators undertook the standard CEN leakage test to identify suitable devices.*

*WPF for the investigators were also measured.*

# HOWIE et al (1996)

*All investigators achieved  $QnFF > 20,000$  for their study respirators as measured for the same individual respirators using the same EN ball-type in-mask probes used during the WPF study.*

# HOWIE et al (1996)

## *Investigator WPF*

<u><i>Investigator</i></u>	<u><i>n</i></u>	<u><i>WPF range</i></u>
<i>J*</i>	<i>11</i>	<i>2 – 21k</i>
<i>W</i>	<i>38</i>	<i>5 - &gt;600</i>
<i>H</i>	<i>13</i>	<i>2 – 46k</i>
<i>T</i>	<i>8</i>	<i>47 - 14k</i>

*\* JJ 1 facepiece type, all others  
4 facepiece types*

# HOWIE et al (1996)

*Statistically, the WPF achieved by the investigators did not differ from that achieved by the workmen.*

*The workmen's 95<sup>th</sup> %ile WPF was 42.*

# HOWIE et al (1996)

*Given that all investigators had achieved QnFF >20,000, a 95<sup>th</sup> %ile WPF of about 40 in the workplace suggests that QnFT failed to adequately indicate workplace performance.*

# **VALIDITY OF SIMULATED WPF DATA**

# PF DATA COMPARISON

## FULL FACE POWERED

<u>Device</u>	<u>Lab</u>	<u>WPF</u>	<u>Sim WPF</u>
R2	>50.000	55 <sup>1</sup>	11,000 <sup>2</sup>
R3	>50,000	49 <sup>1</sup>	22,500 <sup>2</sup>
R4	>50,000	8.4 <sup>1</sup>	998 <sup>2</sup>

*1 Howie et al (1996)*

*2 Johnston et al (2000)*

# PF DATA COMPARISON VARIOUS

<u>Device</u>	<u>WPF</u>	<u>Sim WPF</u>
MSA PAPR	gm 35 <sup>1</sup>	>1,700 <sup>2</sup>
AF Blasting Helmet	2,900 <sup>3</sup>	>40,000 <sup>3</sup>

*1 Myers & Peach (1983), 2 Ayer  
(1981), 3 Parker et al (1997)*

# SUMMARY

*Only one published study claimed to have demonstrated a useful relationship between QnFF and WPF.*

*But analysis of the data from that study failed to demonstrate a useful relationship for individual wearers.*

# CONCLUSION

*On the available data  $QnFT$  cannot be used to identify that a given facepiece achieves a satisfactory fit on a given individual.*

**SO WHAT?**

# SO WHAT?

*If an employer is led to believe that the RPE provided to his employees has been demonstrated to give each individual adequate performance, he might fail to take all technically feasible steps to minimise his employees' exposures.*

# SO WHAT?

*If an individual employee is given an impression that the RPE provided gives a good fit he may put himself at risk by failing to minimise contaminant emissions and/or may enter areas he would otherwise avoid.*

# SO WHAT?

*Misinterpretation of QnFT data may therefore put the wearer at avoidable risk.*

# SO WHAT?

*QnFT could give employers  
and RPE suppliers a defence  
in Civil Court.*

# WHAT CAN QnFT ACHIEVE?

*It might be able to identify  
gross misfits, but this is  
unproven as yet.*

*However, fit testing is an  
excellent indoctrination and  
training aid.*

# AFTERTHOUGHT

*Given the Control Hierarchy,  
and its endorsement in EU  
Directives and UK  
Regulations, why is effort  
being put into RPE fit testing  
rather than into properly  
testing control measures??*