

# ***DERIVATION & VERIFICATION OF PERFORMANCE QUALIFICATION SPECIFICATIONS FOR HIGH-STRENGTH HEPA FILTERS***

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# Prologue

"Delay always breeds danger and to protract a great design is often to ruin it."

— *Miguel de Cervantes (Saavedra)*

1547 - 1616 CE

# Introduction

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- implementation of high-strength HEPA filters contingent upon *new* Code section for filter qualification
- Code section prerequisites include filter test protocols and test stand
- filters subject to degradation *in situ*

# Need

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- The reliability of most current HEPA filters designs is limited by the use of non-reinforced *glass-fiber* filter media and their susceptibility to the adverse effects of many factors

# Objectives

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- provide users with more options to better ensure HEPA-filter reliability throughout service life – technically/economically
- enhance overall reliability of safety-related air treatment systems

# Methodology

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- establish filter mechanical robustness capabilities for several practical designs
- quantify to create test specifications for several levels of filter performance
- compile into new AG-1 Code section as requirements for h-s filter qualification

# Underlying Philosophy

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- simplicity and minimal expenditure of resources => adopt relevant attributes of FC/FK, *then* innovate
- draw from available resources and expertise, *i.e.*, members of ASME's CONAGT, other

FC HEPA Filter  
Qualification  
Procedure,  
Group I: 4 ea.

FC HEPA Filter  
Qualification  
Procedure,  
Group II: 4 ea.

FC HEPA Filter  
Qualification  
Procedure,  
Group III: 1 ea.

FC HEPA Filter  
Qualification  
Procedure,  
Group IV: 3 ea.

I. Test of  
resistance  
to rated air flow

I. Test of  
resistance  
to rated air flow

I. Test of  
resistance to  
spot flame

I. Test of  
resistance to  
hot air

II. Test aerosol  
penetration at  
rated and 20 %  
of rated airflow

II. Test aerosol  
penetration at  
rated and 20 %  
of rated airflow

II. Test aerosol  
penetration at  
rated airflow  
only

III. Preconditioning;  
Resistance-to-  
pressure test

III. Resistance-to-  
rough-handling;  
visual inspection

IV. Test aerosol  
penetration at  
20% of rated  
airflow only

IV. Test aerosol  
penetration at  
rated airflow;  
resistance to  
rated airflow

Successful  
Qualification

**FC qualif. process.**

Note: UL-586 qualification is an acceptable substitution for Group III and IV qualification tests.





FM HEPA Filter  
Qualification  
Sequence,  
Group I: 4 ea.

FM HEPA Filter  
Qualification  
Sequence,  
Group II: 1 ea.

FM HEPA Filter  
Qualification  
Sequence,  
Group III: 3 ea.

I. Test of  
resistance  
to rated air flow

I. Test of  
resistance to  
spot flame

I. Test of  
resistance to  
hot air

II. Test aerosol  
penetration at  
rated and 20 %  
of rated airflow

II. Test aerosol  
penetration at  
rated airflow  
only

III. Preconditioning;  
Test of Resistance-to-  
pressure-impulse

IV. Test of  
resistance-to-  
rough-handling;  
pack tightness;  
visual inspection

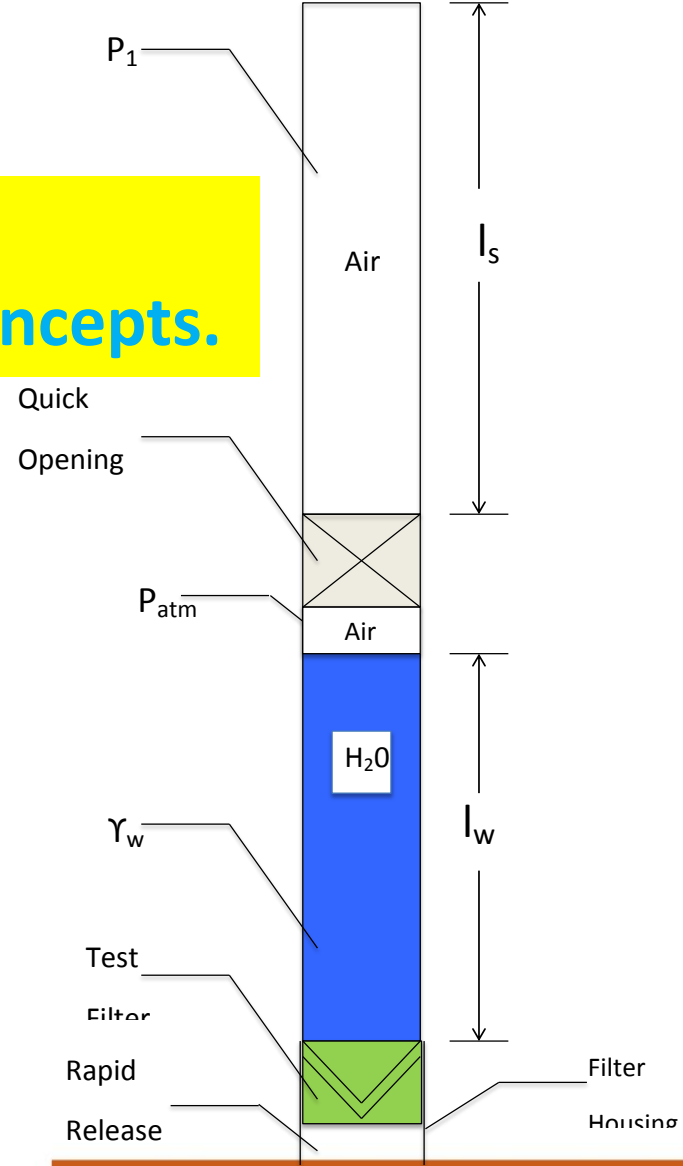
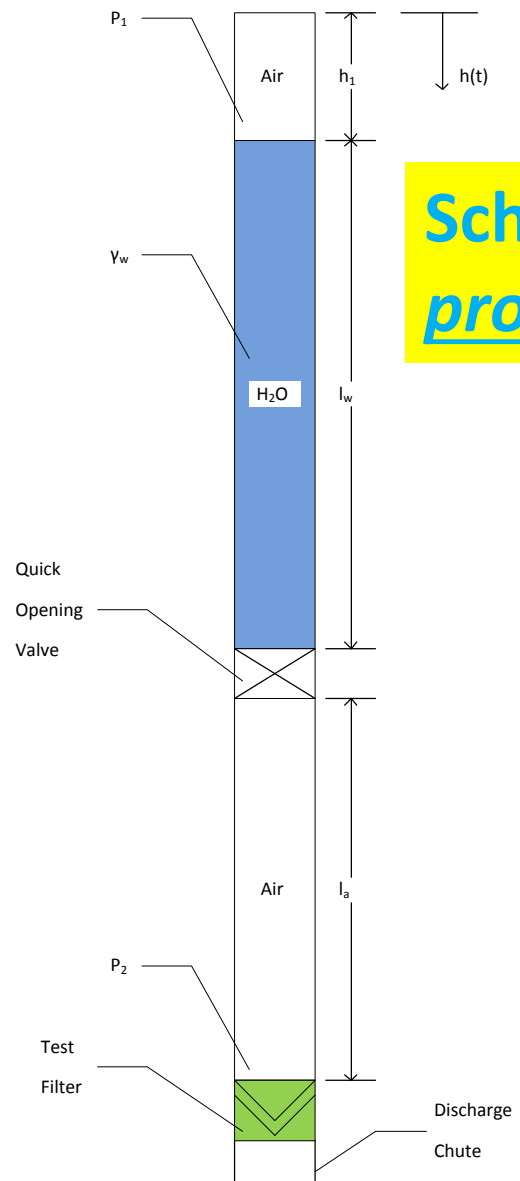
V. Test aerosol  
penetration at 20%  
of rated airflow and  
at rated airflow

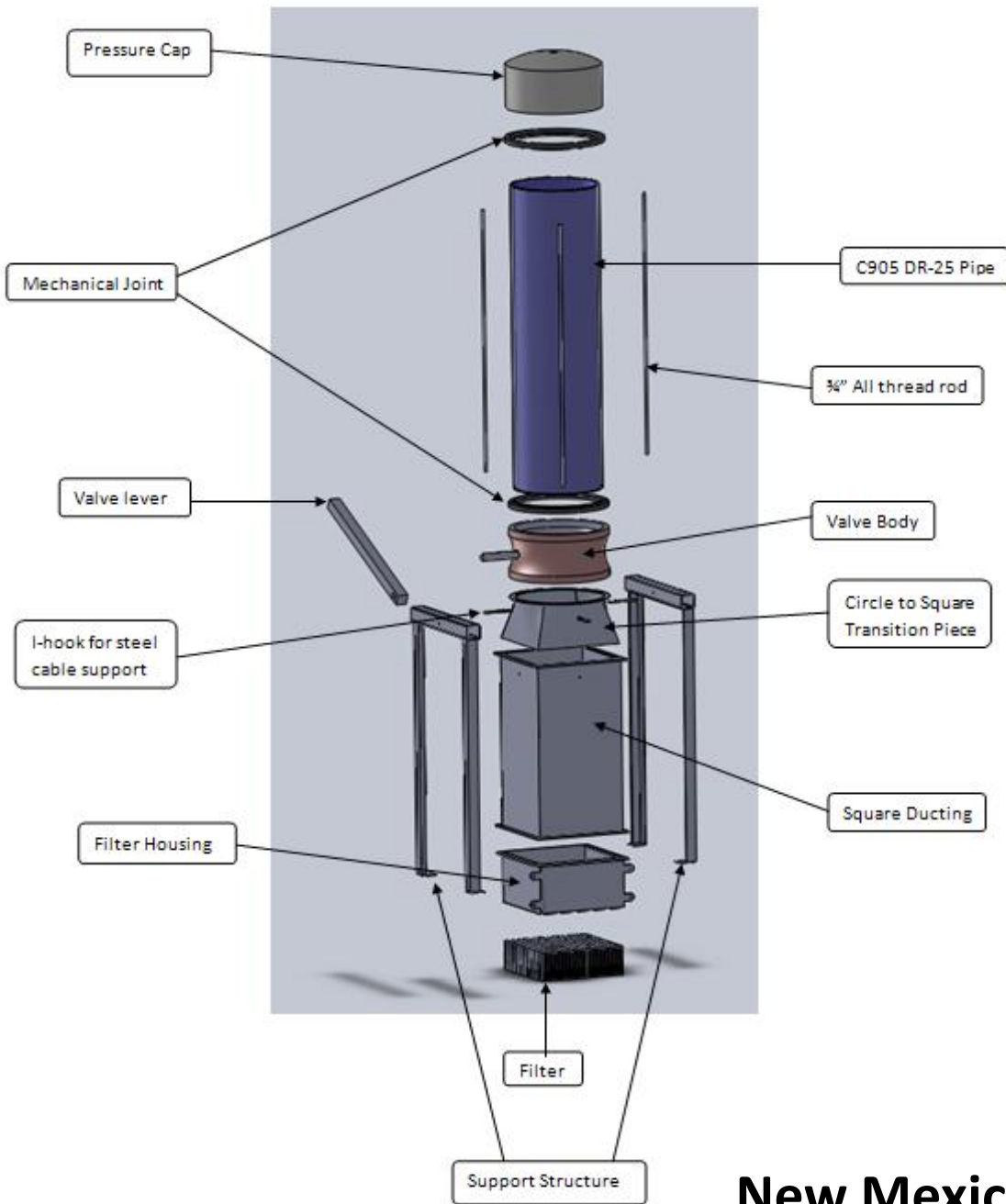
Note: UL-586 qualification is an acceptable substitution for Group II and III qualification tests.

Successful  
Qualification

Ex qualif. process.

# Schematics of falling and propelled H<sub>2</sub>O-column concepts.





Rendering for  
full-scale proto-  
type test rig.



Filter post-impact by falling H<sub>2</sub>O column [ $>25$  psid].

# Summary of Current Status

- proposed Code section document has been once balloted
- responses to ballot comments ongoing
- post-response re-ballot anticipated in very near term

# Conclusions

- draft Code section document is proceeding through ASME approval process
- impulse pressure test may eventually be replaced by a so-called “*liquid pressure*” test
- resources expended were relatively minimal
- qualification needs to be performed at an NQA-1 testing laboratory

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**Thank You**

*for Your kind attention.*

*Questions?*