GAS VS. ECONOMICS AND ENVIRONMENTAL QUESTIONS

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Introduction:

In the post-halon era, the problem facing gaseous agents for automatic extinguishers today is not just their volume/weight ratio, and their environmental impact problems, but also their "outrageous" costs of pound of firekill compared to what halons were and also compared to powder. I have been asked, as a businessman, to address this problem from a economics viewpoint with some thoughts about some practical resolutions for your more technically oriented consideration. First, you should understand that the very nature of our company's products dictate that we can absolutely not afford to have any prejudice or bias in favor of one extinguishant gas or another since the success of our products depend upon using the best available gas or gases for the purposes of our gelled products.

The Cost Problem

The first chart illustrates the problem Here, we use portable extinguisher examples since there has been no cup burner method of accurately comparing powder vs. gas efficacy up to now. You can see that the best HFC gas available weighs four times the powder equivalent and the agent costs nearly 80 times as much as the powder and 6 times more than halon 1211 today. But, you say, powder can not be used in for automatics, plus it has clean-up problems and is corrosive as well. We suggest that there may be methods available today that enable powder to be used in conjunction with gas for automatics and, if so, significant cost savings and other benefits could occur. The rest of the first chart shows various hybrids (gelled combinations of gas and powder) which have been tested at UL and/or elsewhere with the indicated cost benefits. In summary, hybrids cost 3 to 6 times less than the gas alone, can be made with "non-corrosive"[1] powder, have the same weight as the Halons and do not generate detectable traces of HF..

Automatic Extinguishers and Flooding:

The second chart shows a series of tests conducted by SBRC Dual Spectrum comparing a number of well known halon replacement gases to halon 1301 and halon 1211 in flooding

[1] Corrosion equivalent to distilled or deionized water. *Corrosion Testing* Labs, Newark DE. 1996

tests as well as some gelled combinations of gas and powder (hybrids) and also powder alone. These tests were conducted in a simulated engine compartment containing an engine block with air flow. You will note that the most effective agent was not a halon nor a hybrid, but powder alone, the second best was a hybrid and the third was a tie between CF3I and the **Halons.** The gas replacements for Halon weighed substantially more and cost more on a firekill per pound basis. But, these SBRC tests were not considered definitive regarding the ability of hybrids or powder alone to pass through clutter as well as gas does. Charts 3, 4, 5, 6 and 7 illustrate two tests in which it is difficult if not impossible for powder to pass through clutter. They are the FAA "potty bottle" tests and the NIST simulated car engine tests. It is difficult to imagine powder alone passing through the clutter of packed waste paper in a lavatory waste basket and also very difficult to use it in a car engine without an elaborate system of tubing and sensors. But gelled hybrids put out these fires with thorough agent dispersion in both potty bottle and car engine using the coiled light weight plastic tubing system shown in the charts. A clean agent could be used with the same coils but more agent would be required at the higher costs previously illustrated. The coiled tubes in the illustration represent an attempt to control fires through the use of tubing which holds high pressure (up to 1100 p.s.i.) but which ruptures when contacted by flame. The purpose of the flexible, light weight tubing is to bring the agent closer to the fire and to avoid expensive sensors while reacting rapidly to the early threat of fire. It also attempts to show that local applications of this sort may be more economical and more effective than total flooding in certain cases. Another example by another company, *Cease* Fire, is to enclose a hybrid gel or gas in a metal ball with a small sprinkler head that permits the agent to be fired into a selected target area. (show Cease Fire picture)

Taming the oowder particle:

We have no problem acknowledging that powder, as it is normally used, packs down, is sometimes corrosive, severely affects visibility, jams electronics and causes clean-up havoc. However. as you may note above, there are powders that are virtually non-corrosive, that can be made to behave like gas through clutter, that do not pack down

when they are in a gelled state, are non-conductive, and tend to prevent reignition. In view of some of the severe problems we face with gas alone, one might be wise to reconsider the use of hybrids in automatic extinguishment and the growing field of local applications.

Decomposition Bwroducts:

Perhaps the greatest concern one can have regarding today's gas extinguishant technology is illustrated by the flooding tests that were conducted by the Coast Guard on the STATE OF MAINE in Alabama last summer where several of the new gases were tested along with our agent, *Envirogel*, to flood a 500 cubic meter space which contained a variety of large and sometimes hidden fires. The baseline, Halon 1301, put out theses fires with 340 Ibs. of extinguishant which would have cost $590. in 1990. The most effective new gas agent used put out the fire with 578 Ibs. but the agent sells for about $12/lb. amounting to $6,941 today which is 12 times the 1990 pricing. All the other agents tested did even worse including our own agent, ***Envirogel,*** which did not put out some of the hidden fires at all and needs further distribution system refinement. The cost of $12.00/ lb or more for gas agents means the cost of putting out shipboard fires using gas is outrageous to the shipping industry since new hardware is also required to install these new agents. But the story gets worse. None of the gas agents put out any of the large fires without generating at least 1400 ppm[2] of Hydrogen Fluoride or more, generally much more. Halon 1301 generated 400 ppm which is considered emergency level at best while MSDS standards call for no more than 100 ppm. At a recent Coast Guard meeting, the Navy proposed to water-wash down the area after a gas extinguishant was used, but estimated the cost of extinguishing and then washing down a room would be about $7,000 per room. The commercial shipbuilders stated this was an unacceptably high cost. This all means that the present gases should not be used alone for flooding in occupied space unless a scavenging agent is found to cope with the HF. There is some evidence, which is still insufficient, that 5- 10% content of certain powders when gelled with some of the better known new gases can lower the amount of HF generated to 400 ppm. This would be like walking through a

[2] Quick-look report "An evaluation of IMO's gaseous agent test protocol." USCG 8/26/96

mild sandstorm, and the addition of powder would lower the cost of the gas used. Use of more powder **(40%)** has scavenged or eliminated the HF to the point where the FTIR used at **NMERI** did not detect any trace of decomposition byproducts. This **40%** powder content would be like walking through a sand blizzard, but it raises the main questions for this meeting:

III. Environmental Questions

We will attempt to list some questions requiring careful consideration by all of us but especially for toxicologists worldwide:

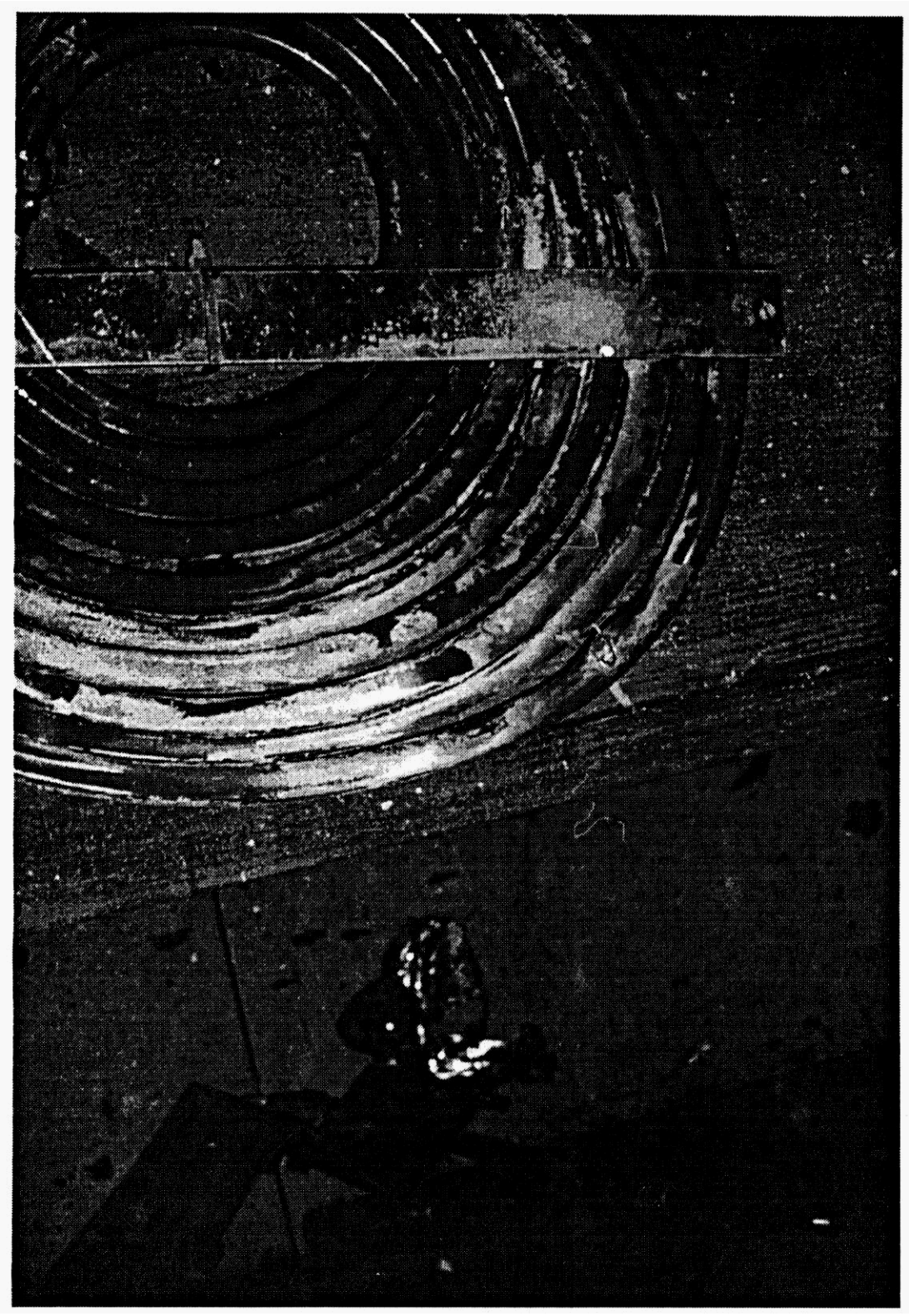
- Which is more harmful in occupied space, a powder that has chemistry acceptable to short term inhalation but partially affects visibility or the present **HFC** gases with their high HF generation at LOAEL concentrations that can put out the fire? (See Chart 8)
- With a gel of gas and powder, the manufacturer can supply to the toxicologist (a) the amount of concentration of both powder and gas needed to flood a container, (b) the range and median of particle sizes, (c) the time required to flood a container, and (d) the hang time of the particulate. What other criteria does the toxicologist need to make an evaluation of this kind of product?
- What are the acceptable levels of HF, CO and other toxic byproducts of decomposition that we can strive to reach or design to meet for the use of gas in both occupied and unoccupied space?
- When can you have answers to these questions and what additional evidence do you need in order to supply these answers?

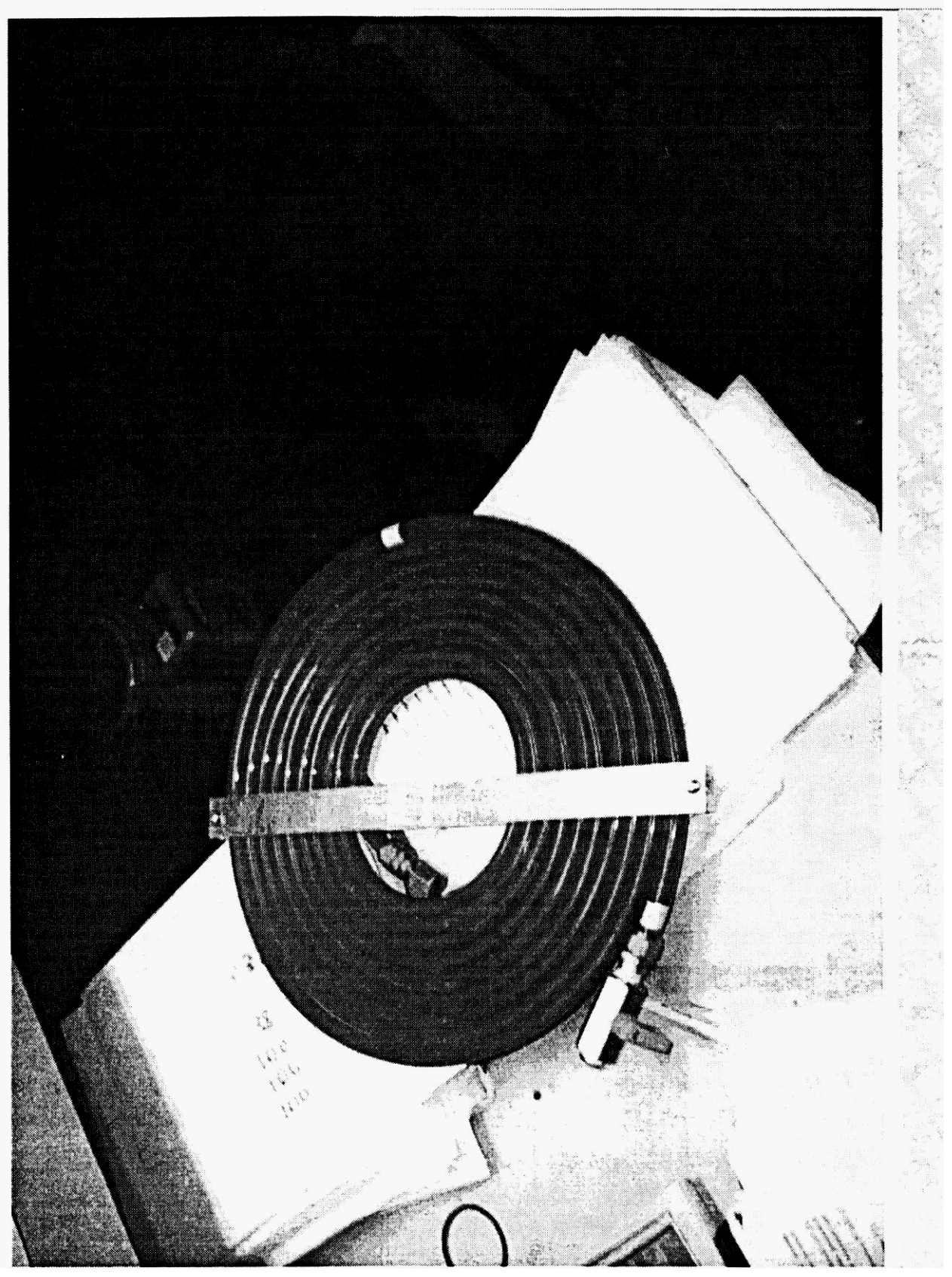
* * * *

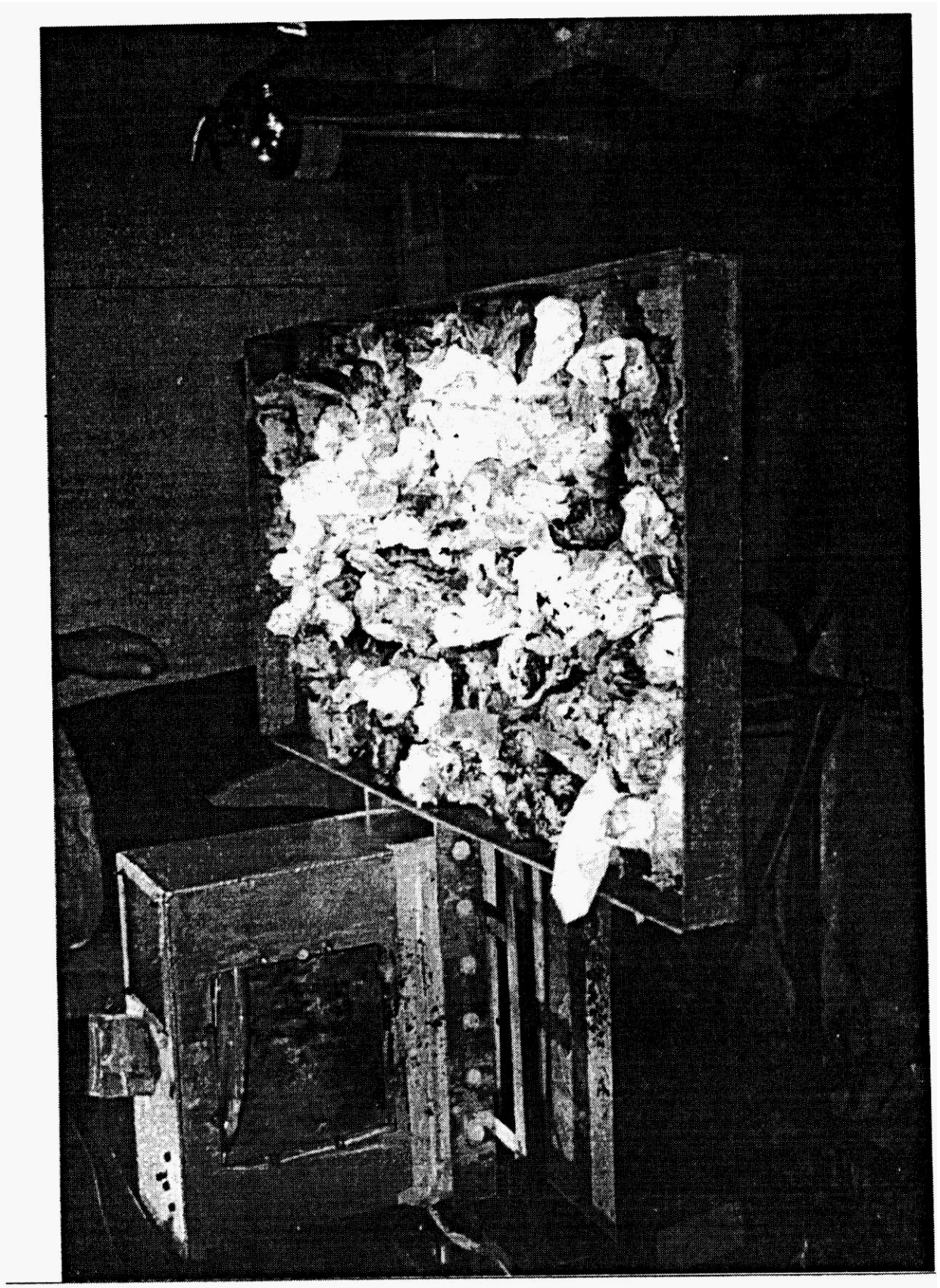
Harry Stewart, Powsus - May 7, 1997

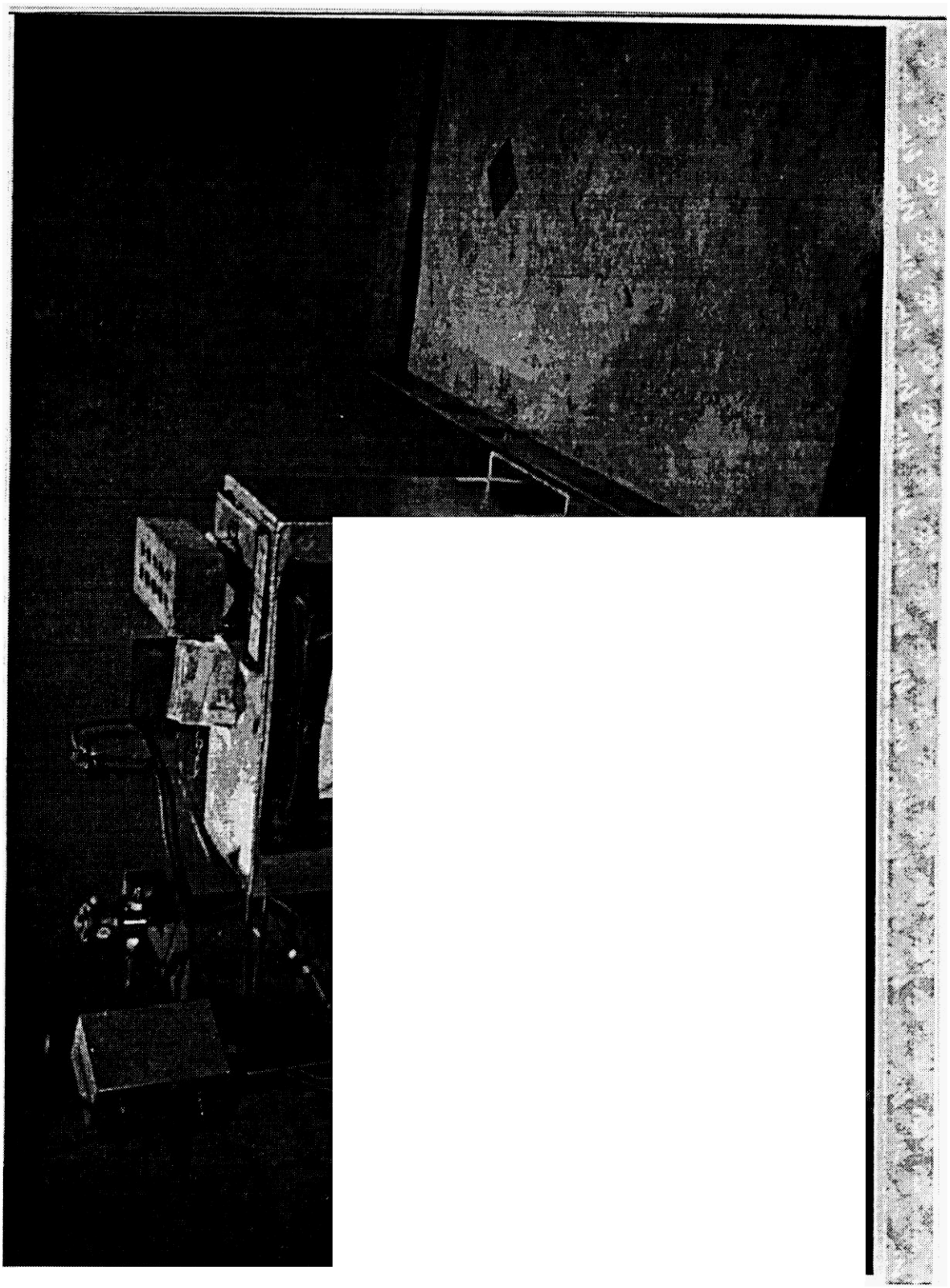
GAS, POWDER, HYBRID COMPARISON SUMMARY

	GAS	POWDER	HYBRID(40%PWDR)
1	CLEAN	DIRTY	SEMI CLEAN/DIRTY
2	GOOD AUTOMATICS	POOR AUTOMATICS	GOOD AUTOMATICS
3	THRU CLUTTER	POOR CLUTTER	THRU CLUTTER
4	**GENERATES HF**	**NO HF**	**NO HF**
5	EXPENSIVE	CHEAP	MODERATE
6	GOOD LOCAL APPS	POOR LOCAL APPS	GOOD LOCAL APPS
7	EXCELLENT VISIBILITY	NO VISIBILITY	SANDSTORM
8	**REIGNITION NOT PREVENTED**	PREVENTS REIGNITION	PREVENTS REIGNITION
9	NON-CORROSIVE	GENERALLY CORROSIVE	NON-CORROSIVE

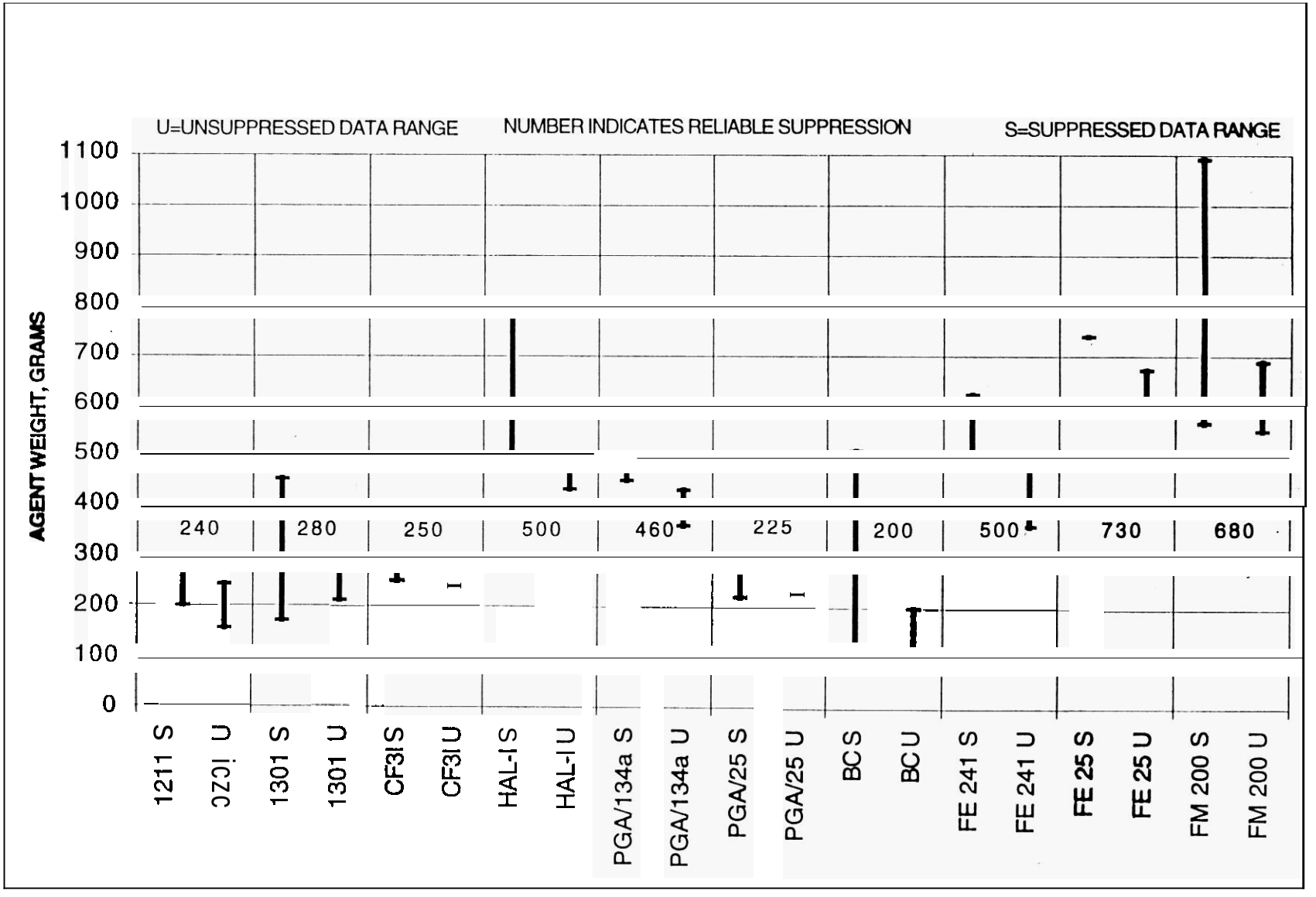








PANFIRE TEST RESULTS
ENGINE COMPARTMENT WITH AIRFLOW



Sheet1

GAS vs POWDER ECONOMICS 1997

WEIGHT: (LBS.)	PRODUCT:	FIREKILL RATING	COST/LB.	TOTAL $ COST OF AGENT:	SIDE EFFECTS
	STRAIGHT:				
2.5	ABC POWDER	1A10BC	$0.75	$1.88	CLEAN-UP, CORROSION, POOR AUTOMATICS
5	HALON 1211	1A10BC	$5.00	$25.00	OZONE DEPLETION
10	BEST HFC	1A10BC	$15.00	$150.00	HYDROGEN FLUORIDE,+ WEIGHT, +SPACE
	HYBRIDS:				
5	BEST HFC+ABC	1A10BC	$9.30	$46.50	REDUCED CLEAN-UP, NO HF,+ CORROSION
6	WORST HFC+APP	1A10BC	$3.00	$18.00	REDUCED CLEAN-UP, NO HF, NO CORROSION, + WT.
5	BEST HFC+ APP	1A10BC	$10.20	$51.00	REDUCED CLEAN-UP, NO HF, NO CORROSION