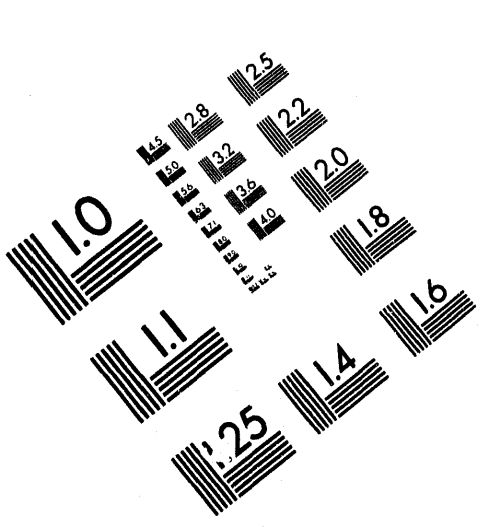

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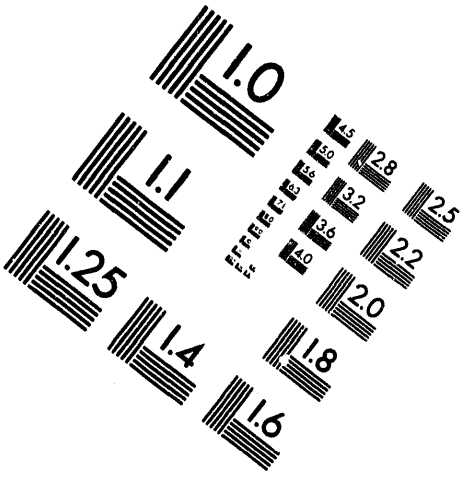

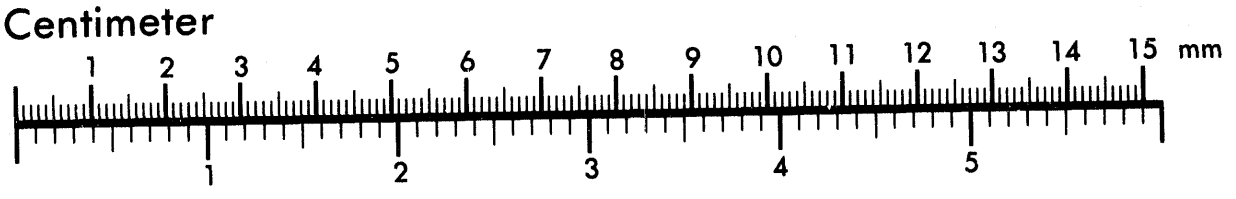

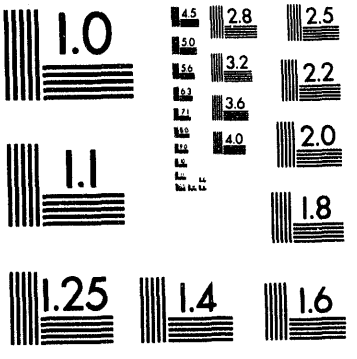

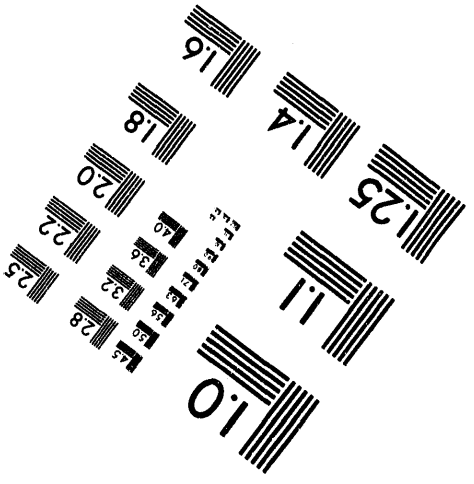

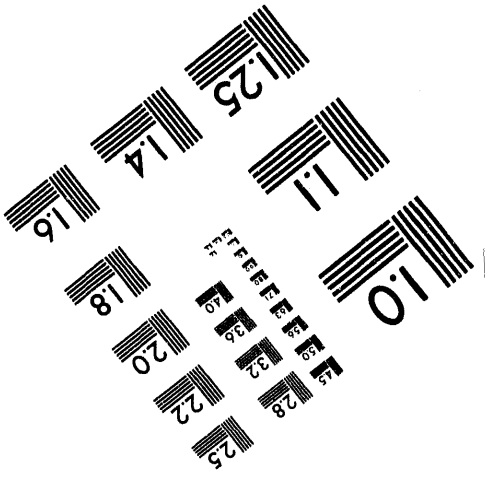

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CRITICAL MASS CONTROL SPECIFICATIONS

HOODS 7-C AND 9-B

AUTHOR

R. E. Smith

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CRITICAL MASS CONTROL SPECIFICATIONS:

HOODS 7-C AND 9-B

By:

R. E. SMITH

FINISHED PRODUCTS TECHNOLOGY
RESEARCH AND ENGINEERING
CHEMICAL PROCESSING DEPARTMENT

January 23, 1961

[redacted]

CRITICAL MASS CONTROL SPECIFICATIONS:

HOODS 7-C AND 9-B

I. INTRODUCTION

The critical mass control specifications for Hoods 7-C and 9-B have become obsolete due to needed storage within the confines of Hood 9-C, and equipment modifications.

II. DISCUSSION

Nuclear safety in Hood 7-C and 9-B depends almost entirely on controlling the mass and geometry of the plutonium compounds not confined by the processing equipment. Generally, the processing vessels and associated piping are designed and arranged in the hood to be critically safe at full operating capacity. This safety is not assured, however, if plutonium masses outside of the equipment exceed certain proportions of geometry and mass. For those cases where always safe geometry confinement cannot be assured, administrative controls are established.

Of particular concern are the accumulations of plutonium compounds on the floor areas from spills and leaks during equipment operation and maintenance, and the accumulations, in containers, from housekeeping and maintenance. These plutonium compound build-ups not only influence the criticality of other nearby plutonium masses, but are, themselves, acted upon by neutron sources in the vicinity.

III. SPECIFICATIONS

A. Feed Composition

The plutonium nitrate feed to the prereduction tank will be limited as follows:

Plutonium concentration:	270 g/l (maximum)
Excess free HNO_3:	0.5 mol/l (minimum)
Pu^{240} concentration:	3% * (minimum)

* Under normal HAPO pile operations, this would correspond to about 400 MWD/T (minimum).

B. Plutonium Compounds Inside of Process Equipment

1. Safe by Geometry

The processing vessels and associated piping that are arranged in the hoods to be critically safe at full operating capacity are:

Hood 7-C

The PRT, THT, FKT, FCT, and FST vessels are "geometry safe" from thermal chain reactions when plutonium precipitation and heavy reflection are excluded, and 3% or greater Pu^{240} and 0.5 M excess nitrate are guaranteed. In this application, thermal chain reactions are arbitrarily defined as chain reactions occurring in aqueous solutions having an atomic ratio of H/Pu $>$ 50. For aqueous solutions, this corresponds to about 450 g/l. These vessels with a 5500 g limit are safe from thermal chain reactions. An operational limit of 5500 g has been established to prevent intermediate or fast chain reactions.

	Limit (Total)	(Solution Concentration Limit)
a. Prereduction tank (PRT)	5500 g Pu	270 g Pu/l
b. Transfer head tank (THT)	5500 g Pu	270 g Pu/l
c. Filtrate kill tank (FKT) and filtrate catch tank (FCT)	5500 g Pu	270 g Pu/l
d. Filtrate storage tank (FST)	5500 g Pu	270 g Pu/l
e. Feed filter		270 g Pu/l
Hood 9-B		
a. Reactor (RCTR)	5500 g Pu	270 g Pu/l
b. Powder pan (plexiglas, 5¼" ID by 4-3/4" high)	2500 g Pu	
c. Primary and secondary fluorinator off-gas filters	4500 g Pu	

	Limit (Total)	(Solution Concentration Limit)
d. Vacuum receiver tank (VRT)	5500 g Pu	270 g Pu/l
e. Condensate receiver tank (CRT)	5500 g Pu	270 g Pu/l
f. Overflow tank	5500 g Pu	270 g Pu/l
g. Vacuum cleaner bag	2500 g Pu	270 g Pu/l

2. Not Safe by Geometry

Hood 7-C

All vessels safe by geometry, with assumptions given previously.

Hood 9-B

Vacuum drum filter (VDF) discharge chute and calciner inlet hopper (see Figure I for maximum level of accumulation).

C. Pu Compounds Outside of Processing Equipment

1. Hood 7-C

Since the quantities of Pu solutions or slurries which accumulate on the floor cannot be accurately determined, the primary means of control must be visual appraisal of the accumulation.

2. Hood 9-B

The specification allows for accumulation of a Pu compound at only one point - beneath the drum filter and calciner inlet. Since the quantity of this compound, $Pu(C_2O_4)_2$, which piles up on the floor as a result of equipment failure or maintenance work, cannot be measured and controlled directly, the primary means of control must be frequent visual appraisal of the geometry and size of the accumulation. The results of these appraisals would, in turn, define the action required to assure nuclear safety based on the specification stated herein.

IV. SPECIFIC LIMITATIONS

A. Hood 7-C

Solutions containing plutonium, which spill to the floor and drain to the sump, will be limited to a depth of ½" maximum above the top of the sump. Of this ½", 1/8" may be solids. Safety will be enhanced through good housekeeping.

B. Hood 9-B

	Material	Geometry Limit Maximum	Comparable Mass Limit
1.	$Pu(C_2O_4)_2$ accumulations (floor area beneath vacuum drum filter)	18" x 18" x ½"	1.3 kgs Pu
2.	$Pu(C_2O_4)_2$ accumulations (in chute and calciner inlet hopper)	As defined by Figure 1	300 gms Pu
3.	$Pu(NO_3)_4$ and waste solutions (floor of bottom section of hood)	- - -	1.0 kg Pu
4.	Miscellaneous powder accumulations	1/64" evenly distributed	0.6 kg Pu

C. Calciner Level

The containers will be limited to four of one pint in volume (maximum) and one of one liter in volume (maximum). All of the containers will be limited to four inches diameter (maximum). The one liter container is to be located on top of the calciner at least 18 inches from the calciner inlet in the space provided, and will be used only to store and dry $Pu(C_2O_4)_2$ (see Figure 2 for container location). The other four containers will be maintained on 12 inch centers (minimum) and as far from process equipment as is practical. (The containers will thus be a minimum of 12 inches from the calciner tube center line and 12 inches from the discharge line of the calciner.) All five containers can be level full at any one time.

B. Hood 9-B

All one-pint containers may be level full at one time.

1. Maintain at least a 12-inch spacing between full containers.

2. Filled containers should be spaced as far as is practical from the installed equipment and removed from the hood or sent back into the process immediately after filling.

3. When cleaning a floor or disposing of powder in a container, remove the powder accumulation nearest the seal-out port or the process equipment to which the powder will be disposed first, so that subsequent containers do not pass by or over a Pu mass.

4. Transport no more than one container at a time.

VII. REFERENCES

1. TID-7016, "Nuclear Safety Guide".

2. HW-58506, "Nuclear Safety Specification - Hood 9-A", R. E. Smith, December 15, 1958. (This document replaces HW-58506.)

VIII. APPROVALS

Issued by: R. E. Smith Date 1-24-61
Manager, Finished Products Technology

Reviewed by: R. L. Stevenson Date 1-20-61
Advance Process Development

Approved by: V. R. Cooper Date 1/24/61
Manager, Research and Engineering

Accepted by: W. M. Mobley Jr. Date 1-26-61
Manager, Finished Products

D. Hydrofluorinator Level

Three containers are allowed on this level. Two of the containers will be restricted to seven inches diameter (maximum) and four inches high (maximum). The third container will be limited to one pint in volume (maximum) and four inches diameter (maximum).

The large containers will be used only to receive fluorinator off-gas filter brushings and filter housing powder and, when not in use, will be placed in such a position that no powder can accumulate in them. Powder is not to be stored in these containers but should be removed from the hydrofluorinator level immediately after filling. The smaller container can be used to receive the contents of the larger container, but at no time will the amount of powder held in containers outside of the process vessels exceed that which can be maintained in one of the larger containers level full. When containing powder, the containers will be maintained on 12 inch centers (minimum) and a minimum of 12 inches from process equipment.

E. Bottom Level

Four containers will be allowed on this level. The containers will be restricted to one pint in volume (maximum) and four inches diameter (maximum). All four containers may be level full at any one time, but will be maintained on 12 inch centers (minimum) and a minimum of 12 inches from process equipment when level full.

V. HOOD INSPECTION BY FINISHED PRODUCTS OPERATION

As a secondary means of mass control, it is recommended that the gross amount of Pu outside of the Hood 9-B processing equipment, as defined by a visual inspection, be limited to 50% (1.6 kgs) of the gross amount of plutonium compounds permitted under Part IV. This visual inspection will be performed routinely by Finished Products Operation. Finished Products Operation will take whatever action the inspection reveals to be necessary.

VI. CLEAN-UP AND HANDLING PROCEDURES

A. Hood 7-C

When flushing the hood, the liquid level on the floor shall not exceed a height of ½-inch above the top of the sump. Flushing of the hood with liquid is only permitted after the plutonium solutions and any solids have been removed from the inside of the processing equipment.

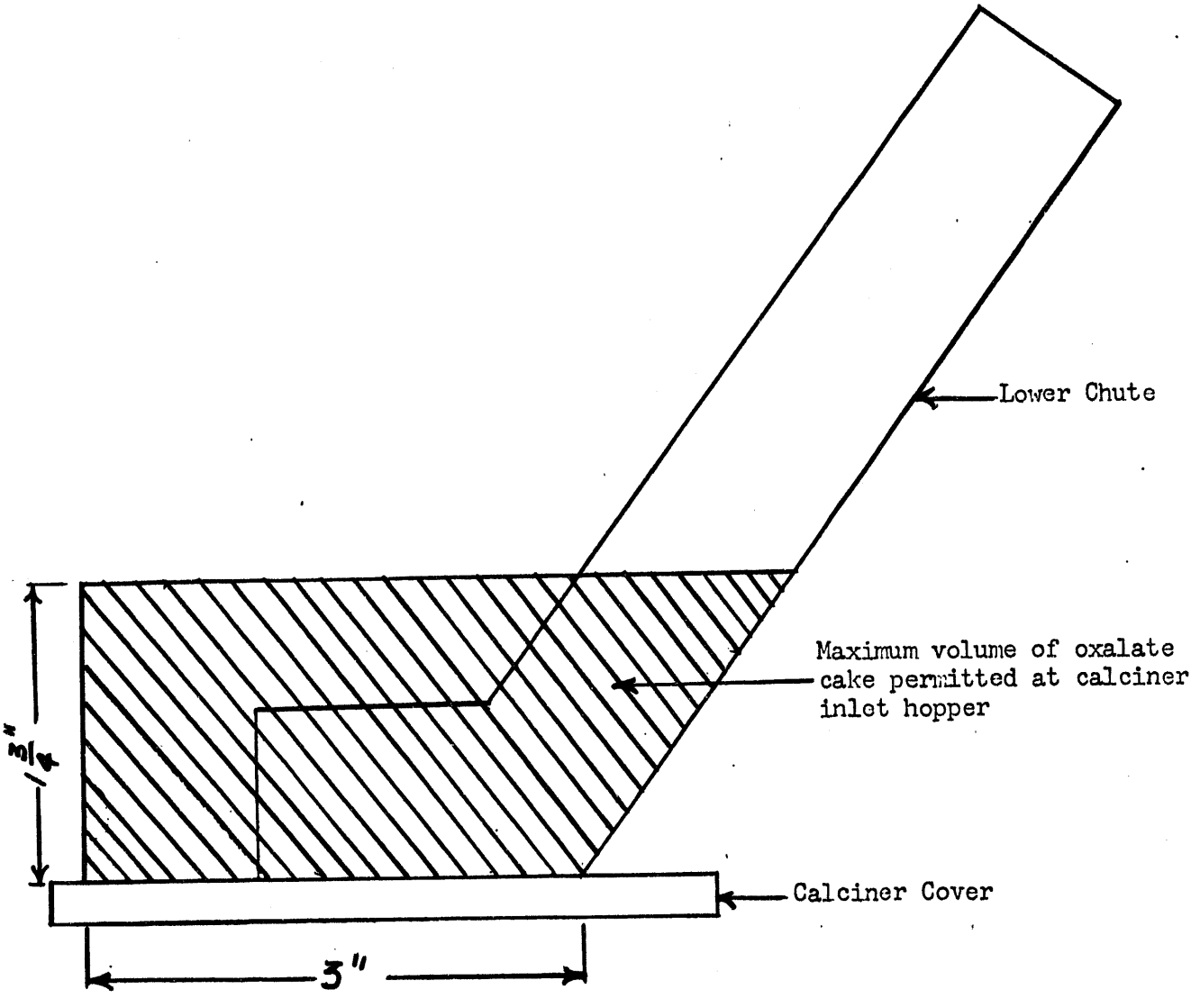

FIGURE 1

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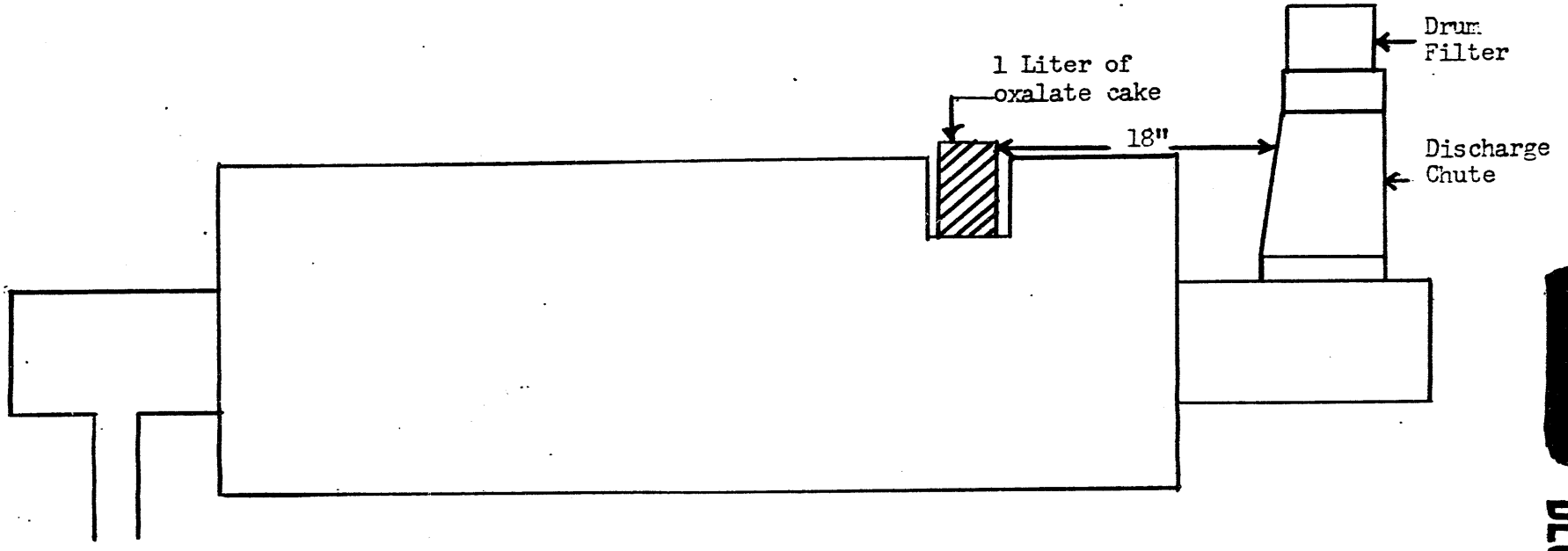

FIGURE 2

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