



DEPARTMENT OF THE ARMY  
HEADQUARTERS, U. S. ARMY MATERIEL COMMAND  
5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001

19 November 1985

MS 18  
P9

US Nuclear Regulatory Commission  
Region I  
ATTN: Materials Licensing Branch  
631 Park Avenue  
King of Prussia, PA 19406

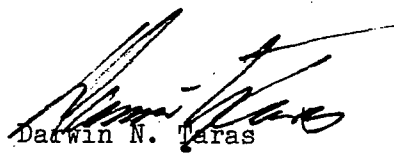
RE: NRC Control No. 17893; AMCSF-P/85-0165

Gentlemen:

The enclosed information is forwarded in response to the additional information requested regarding the US Army Communications-Electronics Command's NRC license No. 29-01022-07. Enclosure 2 furnishes the specific operator training program and legible diagrams of the Cs-137 source.

Please acknowledge receipt of correspondence on enclosed DA Form 209, Mail Reply Card.

Sincerely,

  
Darwin N. Taras  
Chief, Health Physics,  
Safety Office

Enclosures

Copies Furnished:

HQDA(DASG-PSP-E) WASH DC 20310-0505 2 cys w/encl

Director, AMC Field Safety Activity, Charlestown, IN 47111-9669 w/encl

Information in this record was deleted  
in accordance with the Freedom of Information  
Act, exemptions 2  
FOIA-2006-0258

FREE EXEMPT

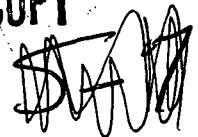
EE/7

17893

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NOV 22 1985





DEPARTMENT OF THE ARMY  
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND  
AND FORT MONMOUTH  
FORT MONMOUTH, NEW JERSEY 07703-5000

REPLY TO  
ATTENTION OF

AMSEL-SF-MR

12 November 1985

SUBJECT: Nuclear Regulatory Commission (NRC) Request for Additional  
Information

Commander  
US Army Materiel Command  
ATTN: AMCSF-P  
5001 Eisenhower Avenue  
Alexandria, VA 22333-0001

1. Reference:

- a. Message, AMCSF, DTG 041530Z Nov 85, subject: NRC License BML 29-01022-07.
- b. Letter, AMSEL-SF-MR, 11 October 1985, subject as above.

2. As requested in reference 1a, the following additional information is provided to supplement reference 1b.

a. The Operator Training Program outline is at Enclosure 1. Individuals entering this program and facility operators presently under the employ of this command will be required to pass, with a minimum grade of 75 percent, an examination that tests their understanding and knowledge of the information provided in this program. A copy of the examination, along with the correct answers are provided at Enclosures 2 and 3. Individuals failing this examination will be required to receive further training, with emphasis given to the specific area(s) in which the individual lacks proficiency. After this additional training is provided, the individual will be re-evaluated in the same manner.

b. Resubmitted at Enclosures 4 and 5 are technical data regarding the Amer sham Corporation Model CDC.641, Type X.64/1, [ ] Cesium 137 Sealed Source and legible engineering drawings for the R-Metrics Limited Source Container. 8/2

4. CECOM - Providing leaders the decisive edge.

FOR THE COMMANDER:

5 Encl

*Steven A Horne*  
STEVEN A. HORNE  
Acting Chief, Safety Office

Operator Training Program

Operators of the irradiator facility authorized by this license must be approved by the Radiation Control Committee (RCC). Approval of the RCC is contingent upon the completion of the following training:

a. The individual must complete the following training as provided by the Radiation Protection Officer (RPO), the Radiation Facility Supervisor, and/or their designated qualified representatives, as applicable.

<u>Subject</u>	<u>Duration</u>	<u>Type Training</u>
Interaction of Radiation with Matter	2 hours	Lecture and/or Training Film
Biological Effects of Radiation	1 hour	Lecture and/or Training Film
Principles and Practices of Radiation Safety	4 hours	Lecture and/or Training Film
Radiation Instrumentation, Detection and Dosimetry	1 hour	Lecture and/or Training Film

This requirement may be satisfied if the individual has previously received formal training and/or experience meeting or exceeding the above criteria. Training and/or experience will be evaluated by the RCC on a case-by-case basis.

b. The individual must also complete training which will be presented by the RPO, the Radiation Facility Supervisor or his designated qualified representatives, as applicable:

<u>Subject</u>	<u>Duration</u>	<u>Type Training</u>
Radiation Emergency Procedures	1 hour	Lecture and/or Training Film
Familiarization with NRC License and Supporting Documentation	2 hours	Lecture
Familiarization with the Physical Plant and Design of the Irradiator	2 hours	Lecture
Operation and Maintenance of Facility (Instruction)	1 hour	Demonstrations
Operation and Maintenance of Facility (Practical Operation)	2 hours	Operation of facility under direct supervision

EXAMINATION

1. The Curie is a unit of:
  - a. volume
  - b. absorbed dose
  - c. activity
  - d. power density
  
2. A Curie is equal to:
  - a.  $2.22 \times 10^5$  cpm
  - b.  $6.02 \times 10^{23}$  cpm
  - c.  $3.7 \times 10^{10}$  dps
  - d.  $4.5 \times 10^{-7}$  dpm
  
3. The Rad is a unit of:
  - a. Exposure of X- or gamma radiation in air
  - b. Radiation absorbed dose; 100 ergs/gram
  - c. Roentgen equivalent man
  - d.  $3.7 \times 10^{10}$  disintegrations per second
  
4. An alpha particle has:
  - a. a positive electrical charge
  - b. a negative electrical charge
  - c. no charge (neutral)
  
5. A beta particle has:
  - a. a positive electrical charge
  - b. a negative electrical charge
  - c. no charge (neutral)
  
6. The atomic number of an element reflects:
  - a. the number of neutrons
  - b. the number of protons
  - c. the number of electrons
  - d. the total number of neutrons and protons
  
7. For Cobalt-60 (Co-60), the number 60 (sixty) indicates the:
  - a. Half-life
  - b. Number of radioactive particles
  - c. Atomic number
  - d. Atomic weight
  
8. Which type of radiation harms you least in the case of external exposure?
  - a. alpha
  - b. beta
  - c. gamma
  - d. neutrons

9. What radiation harms you most in the case of ingestion or inhalation of radioactive isotopes?
- alpha
  - beta
  - gamma
  - neutrons
10. Which of the following types of radiation is the most penetrating?
- alpha
  - beta
  - gamma
11. An alpha particle can be stopped by:
- a piece of paper
  - a piece of 1/4" plywood
  - a concrete block
  - a 1/4" thick piece of lead
  - all of the above.
  - none of the above
12. The best means of protection from ionizing radiation is:
- time
  - distance
  - shielding
  - all of the above
  - none of the above
13. The Maximum Permissible Dose (MPD) for radiation workers (whole body) is:
- 0.5 rem/yr
  - 3.0 rem/yr
  - 5.0 rem/yr
  - 75 rem/yr
14. When not in use, all film badges are stored in a designated area with a control film badge. This reason(s) for this is (are):
- To more accurately compare their exposure with the control badge
  - To keep all film badges away from radiation areas when not being worn
  - To measure the amount of radiation the storage area is exposed to
  - all of the above
  - a and b only

15. Of the following types of dosimetry, which is (are) required of all personnel working in the control room.

- a. film badge
- b. "chirpee" type monitor
- c. pocket dosimeter

16. What is the procedure to check the operational status of the Geiger-Mueller (G-M) survey meter? \_\_\_\_\_

17. Which of the following types of radiation will the G-M survey meter detect?

- a. Alpha
- b. High energy beta
- c. Gamma
- d. a and c only
- e. b and c only

18. Your G-M survey meter is on the x100 scale and indicates a reading of 1.5. What is the radiation level in the room?

- a. 150 mR/hr
- b. 1500 mR/hr
- c. 15 R/hr
- d. 150 R/hr

19. What dosimetry/instrumentation does one person entering the exposure room require?

- a. film badge
- b. "chirpee" type monitor
- c. pocket dosimeter
- d. all of the above
- e. a and b only

20. When operating the underground vault irradiator, what is the maximum number of individuals allowed in the control room while the source(s) are in the "up" position?

- a. 1
- b. 2
- c. 4
- d. 6

21. Upon entering the control room you notice that the control room area monitor is reading 5 mR/hr. You should:

- a. Proceed as normal
- b. Notify the Supervisor or RPO. There is no leak
- c. Notify the Supervisor or RPO. A possible source leak condition exists
- d. Change the battery on the area monitor

22. The source plug mechanism is equipped with a multiple interlock system. If any one interlock is opened while the source is in the "up" position, the source will immediately return to its lead shield.

- a. True
- b. False

23. The source will be kept in its storage container with the lead plug over the source when:

- a. The source is not in use
- b. Individuals are in the exposure room
- c. A leak test of the source indicates the source is leaking
- d. Radioactive contamination is found in the room
- e. all of the above.
- f. a and c only

24. The primary purpose for the lead and ferrite shielding installed between the exposure and control rooms is to protect personnel from:

- a. alpha radiation
- b. beta radiation
- c. gamma radiation
- d. neutrons

25. You are operating the underground vault irradiator. You have discovered that the source has leaked. What should you do?

- a. Cut off the air supply to the source controls
- b. Shut off the control room exhaust fan
- c. Take wipes of selected areas in the exposure room
- d. Leave the underground vault area
- e. a and b only
- f. a, b and d only

26. In the event of an electrical power failure, the source capsule must be manually returned to the lead storage area.

- a. True
- b. False

27. You are trapped in the exposure room. Suddenly you hear the warning alarm indicating that the source is about to be raised to the "up" (exposure) position. The FIRST thing you should do is:

- a. Bang on the view window and scream for help
- b. Set the emergency stop switch to the "up" position
- c. Set the emergency stop switch to the "down" position
- d. Ensure your dosimetry is positioned to accurately measure your exposure

28. The irradiator source is stuck in the "up" position. The FIRST thing you should do is:

- a. Enter the exposure room and manually lower it
- b. Call the RPO or Radiation Facility Supervisor
- c. Call the fire department
- d. Notify the Nuclear Regulatory Commission

29. The irradiator source will not go into the exposure or "up" position. Which of the following situations would not be an explanation for this?

- a. Electrical power failure
- b. Interlock malfunction
- c. Emergency switch in exposure room is in the "up" position
- d. Main control panel emergency stop switch is in the "down" position

30. Ionizing radiation exposure poses its greatest threat to the developing fetus during the:

- a. first trimester
- b. second trimester
- c. third trimester
- d. fourth trimester

31. We are continually exposed to natural background radiation. Which of the following is not a source of natural background radiation:

- a. Radiation from the naturally radioactive materials in the ground
- b. Medical & dental x-rays
- c. Radiation from outer space
- d. Radiation from Radon gas accumulated in a residence

32. The half-life of a radioactive source is defined as:

- a. Half the useful lifetime of the source
- b. The time it takes for the source activity to decrease by one-half
- c. One-half the time it will take for the source to decrease to an activity of zero
- d. none of the above



33. Increasing the distance between yourself and a gamma radiation source lowers your absorbed exposure because:
- Radiation intensity decreases rapidly with distance
  - Radiation loses speed with distance
  - Radiation tires easily
  - Gamma radiation is completely absorbed in a few feet of air
34. The Roentgen is a unit of:
- Exposure of X- or gamma radiation in air
  - Radiation absorbed dose; 100 ergs/gram
  - Roentgen equivalent man
  - $3.7 \times 10^{10}$  disintegrations per minute
35. You are in a radiation area with an exposure rate of 30 mR/hr. How long will it take you to receive an exposure of 2 mR?
- 1 min
  - 2 min
  - 4 min
  - 10 min
36. The NRC defines a Radiation Area as any area with a radiation level greater than or equal to:
- 1 Rad in any one hour
  - 10 Rads in any one hour
  - 5 millirems in any one hour
  - 1 millirem in any two hours
37. The term "ALARA" describes:
- The mechanism of interlock alarm systems
  - The concept of minimizing radiation exposure
  - A radiation detection device similar to the "chirpee"
  - The "Annual Limits Associated with Radiation Accidents"
38. All radiation workers are required to have periodic radiation physicals.
- True
  - False
39. Eating, drinking and smoking is permitted in the control room but is strictly prohibited in the exposure room
- True
  - False

40. Under what provision/regulation is training/instruction required to be given to radiation workers?

- a. 21 CFR Part 30
- b. 49 CFR Part 50
- c. 10 CFR Part 19
- d. 3 CFR Part 17

41. An acute exposure is defined as:

- a. an exposure to a large dose of radiation over a short period of time
- b. an exposure to a small dose of radiation received repeatedly over a long period of time
- c. an exposure of 5 mR per year

42. A chronic exposure is defined as:

- a. an exposure to a large dose of radiation received over a short period of time
- b. an exposure to a small dose of radiation received repeatedly over a long period of time
- c. an exposure of 5 mR per year
- d. an exposure which makes the individual chronically ill

43. Radiation detection and measuring devices are necessary because you cannot see, hear, smell or feel radiation.

- a. True
- b. False

44. Which of the following is most sensitive to the effects of radiation?

- a. hands
- b. body trunk
- c. lens of the eye
- d. feet

45. Dose rate is defined as:

- a. the amount of radiation released from a radioactive source per unit time
- b. The total amount of radiation absorbed per unit volume
- c. the amount of radiation absorbed per unit time
- d. the speed of light

Given the following, answer the following three questions:

$$\Gamma = \frac{R/\text{hr}}{1 \text{ m/Ci}}$$

$$\Gamma (\text{Cs-137}) = .33 \qquad \Gamma (\text{Co-60}) = 1.32$$

46. What is the exposure, in air, from a Co-60 source with an activity of 600 Ci at 1 meter?

- a. 800 R/hr
- b. 450 R/hr
- c. 200 R/hr
- d. 1000 R/hr

47. What is the exposure at 2 meters?

- a. 800 R/hr
- b. 450 R/hr
- c. 200 R/hr
- d. 1000 R/hr

48. What is the exposure, in air, from a Cs-137 source with an activity of 450 Ci at 1 meter?

- a. 150 R/hr
- b. 100 R/hr
- c. 300 R/hr
- d. 400 R/hr

Given:

$$A_n = A_o e^{-\lambda t} \qquad \lambda = .693/T_{1/2}$$

$$T_{1/2}(\text{Co-60}) = 5.27 \text{ yrs} \qquad T_{1/2}(\text{Cs-137}) = 30 \text{ yrs}$$

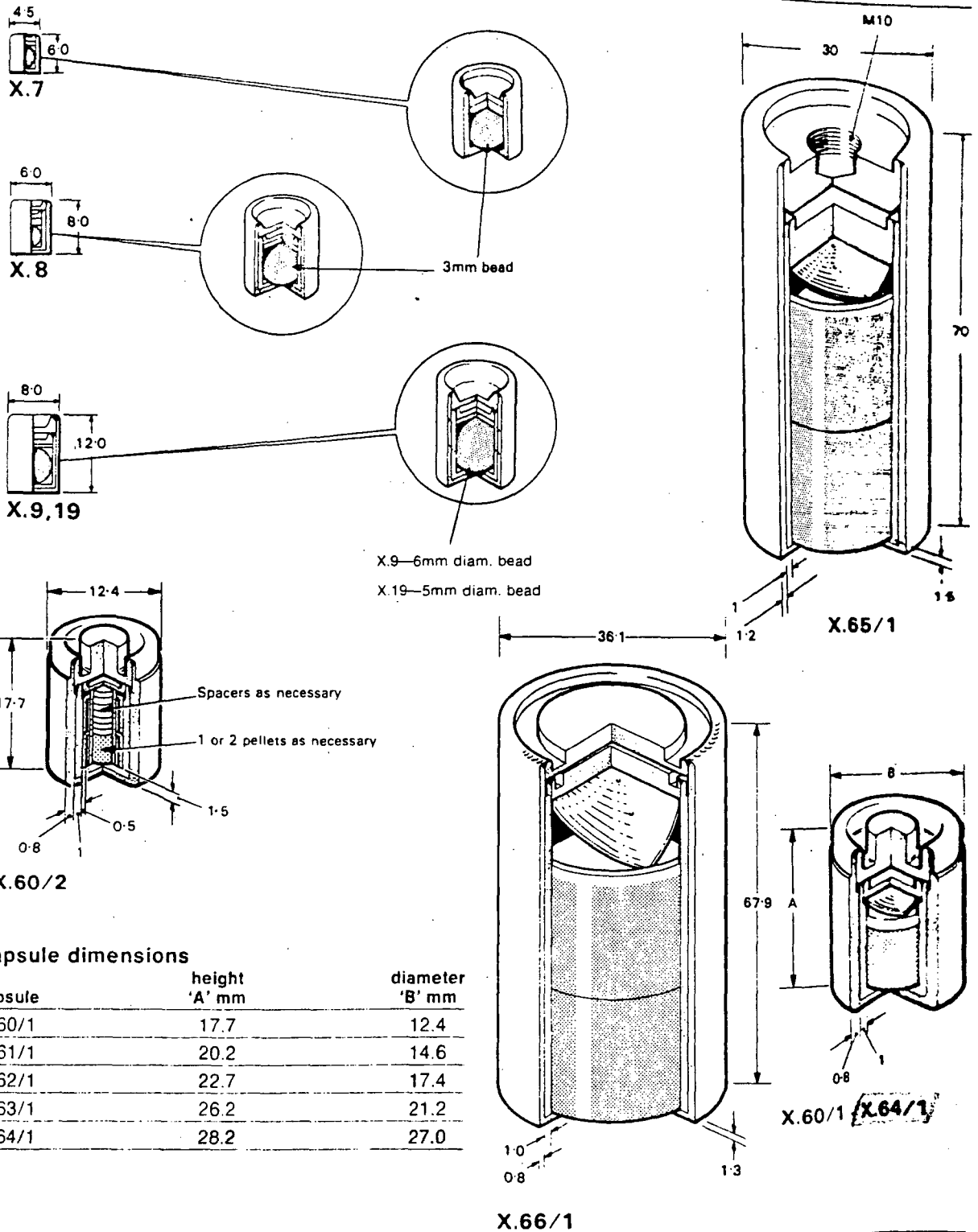
49. The activity of a Co-60 source on 1 January 1970 was assayed as 1000 Ci. What was the activity of this source on 1 January 1985?

50. The activity of a Cs-137 source was assayed as 450 Ci on 1 July 1950. What was the activity of this source on 1 July 1980?

ANSWER SHEET

- |                             |            |
|-----------------------------|------------|
| 1. c.                       | 26. b.     |
| 2. c.                       | 27. c.     |
| 3. b.                       | 28. b.     |
| 4. a.                       | 29. c.     |
| 5. b.                       | 30. a.     |
| 6. b.                       | 31. b.     |
| 7. d.                       | 32. b.     |
| 8. a.                       | 33. a.     |
| 9. a.                       | 34. a.     |
| 10. c.                      | 35. c.     |
| 11. e.                      | 36. c.     |
| 12. d.                      | 37. b.     |
| 13. c.                      | 38. a.     |
| 14. e.                      | 39. b.     |
| 15. a.                      | 40. c.     |
| 16. Perform a battery check | 41. a.     |
| 17. e.                      | 42. b.     |
| 18. a.                      | 43. a.     |
| 19. d.                      | 44. c.     |
| 20. d.                      | 45. c.     |
| 21. c.                      | 46. a.     |
| 22. a.                      | 47. c.     |
| 23. e.                      | 48. a.     |
| 24. c.                      | 49. 140 Ci |
| 25. f.                      | 50. 225 Ci |

# Cesium-137 source capsules



## Capsule dimensions

capsule	height 'A' mm	diameter 'B' mm
X.60/1	17.7	12.4
X.61/1	20.2	14.6
X.62/1	22.7	17.4
X.63/1	26.2	21.2
X.64/1	28.2	27.0

# Cesium-137 sources

Sources up to 3 curies contain the radionuclide as a bead of cesium glass; the higher activity sources contain compressed pellets of cesium chloride.

Encapsulation is in welded stainless steel. Sources up to 300mCi are supplied with single or double encapsulation; higher activity sources are doubly encapsulated.

## Quality control

Wipe test A  
Bubble test D  
Immersion test M (for capsules X.7, 8, 9, 19)  
Helium leak test H (for capsules X.60/1-66/1)

A Test Report is supplied with each source or batch of sources, stating the measured equivalent activity for sources up to 3Ci; for higher activity sources, the nominal content is stated, together with the exposure rate measured according to the procedure in ICRU Report 18.

## Prototype testing:

capsule type	IAEA Special form	ANSI Classification
X.7	SFC.23	C64444
X.8	SFC.24	C64444
X.9	SFC.25	C64444
X.19	SFC.117	C64444
X.60/1		E63534
X.60/2		E63534
X.61/1		E63534
X.62/1		E63534
X.63/1		E63534
X.64/1		E63534
X.65/1		E63534
X.66/1		E63534

nominal equivalent activity*	single encapsulation		double encapsulation source code
	type X.7 source code	type	
1mCi	CDC.701	X.8	CDC.801
3mCi	CDC.703	X.8	CDC.803
5mCi	CDC.704	X.8	CDC.804
10mCi	CDC.705	X.8	CDC.805
20mCi	CDC.706	X.8	CDC.806
30mCi	CDC.707	X.8	CDC.807
50mCi	CDC.708	X.8	CDC.808
100mCi	CDC.709	X.8	CDC.809
200mCi	CDC.710	X.8	CDC.810
300mCi	CDC.711	X.8	CDC.811
500mCi		X.19	CDC.190

1Ci		X.19	CDC.191
			CDC.192
			CDC.93

\*tolerance -0, +25%  
for definition of equivalent activity, see page 00.

nominal content†	
	CDC.6024
	CDC.6025
	CDC.601
	CDC.611
	CDC.621
	CDC.631
	CDC.641
	CDC.651
	CDC.661

†dependent on specific activity of the caesium chloride; content normally within -0, +25% of stated nominal.

## Availability

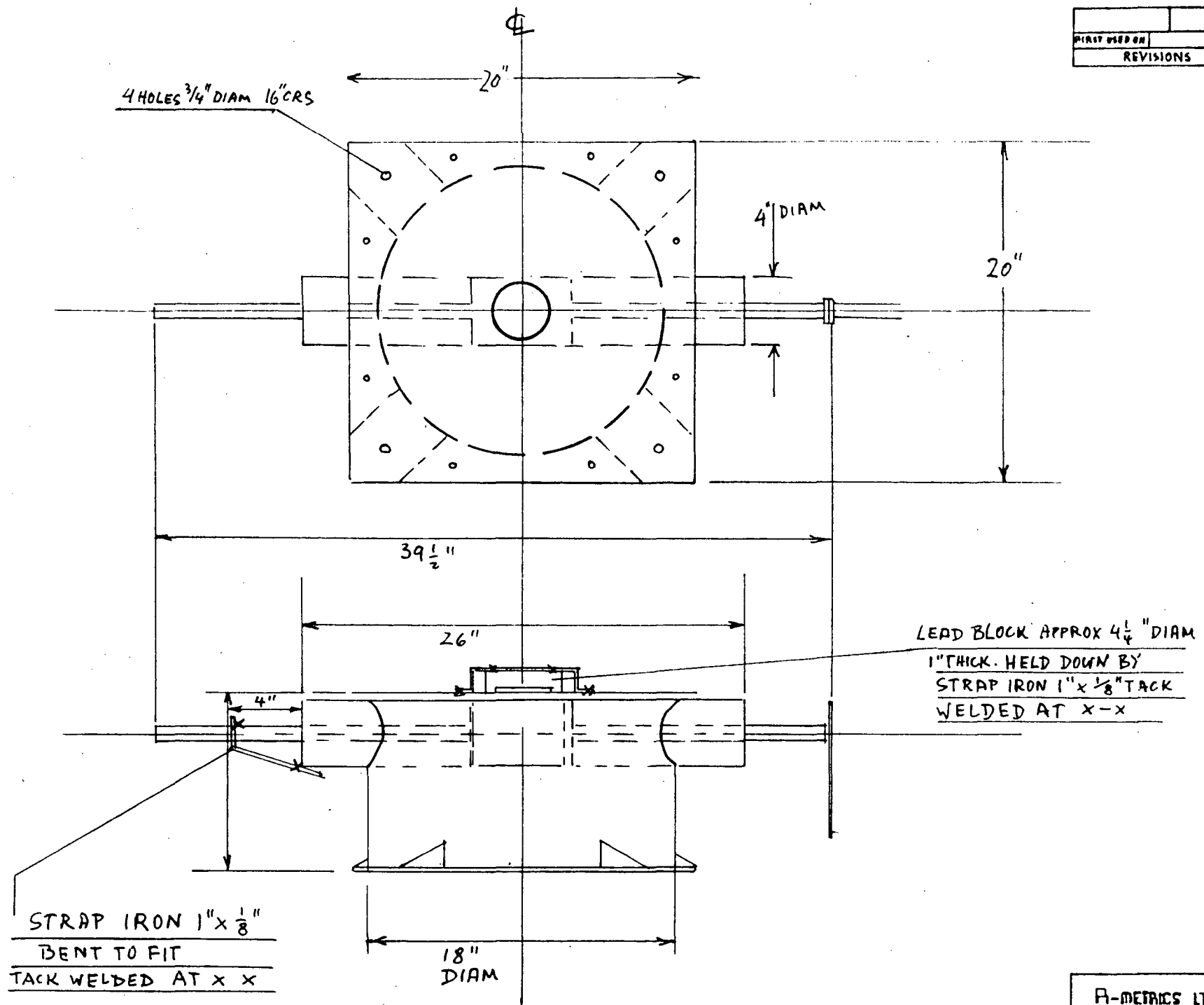
Sources up to [ ] D4  
Sources over [ ] D\*

Cesium-137 sources, 3mCi [ ] can be supplied calibrated with measured radiation output (code H.50).

Calibration accuracy: ±5% overall uncertainty.

Enc 1 5

DATE USED ON	
REVISIONS	



LEAD BLOCK APPROX 4 1/4" DIAM  
1" THICK. HELD DOWN BY  
STRAP IRON 1" x 1/8" TACK  
WELDED AT X-X

STRAP IRON 1" x 1/8"  
BENT TO FIT  
TACK WELDED AT X X

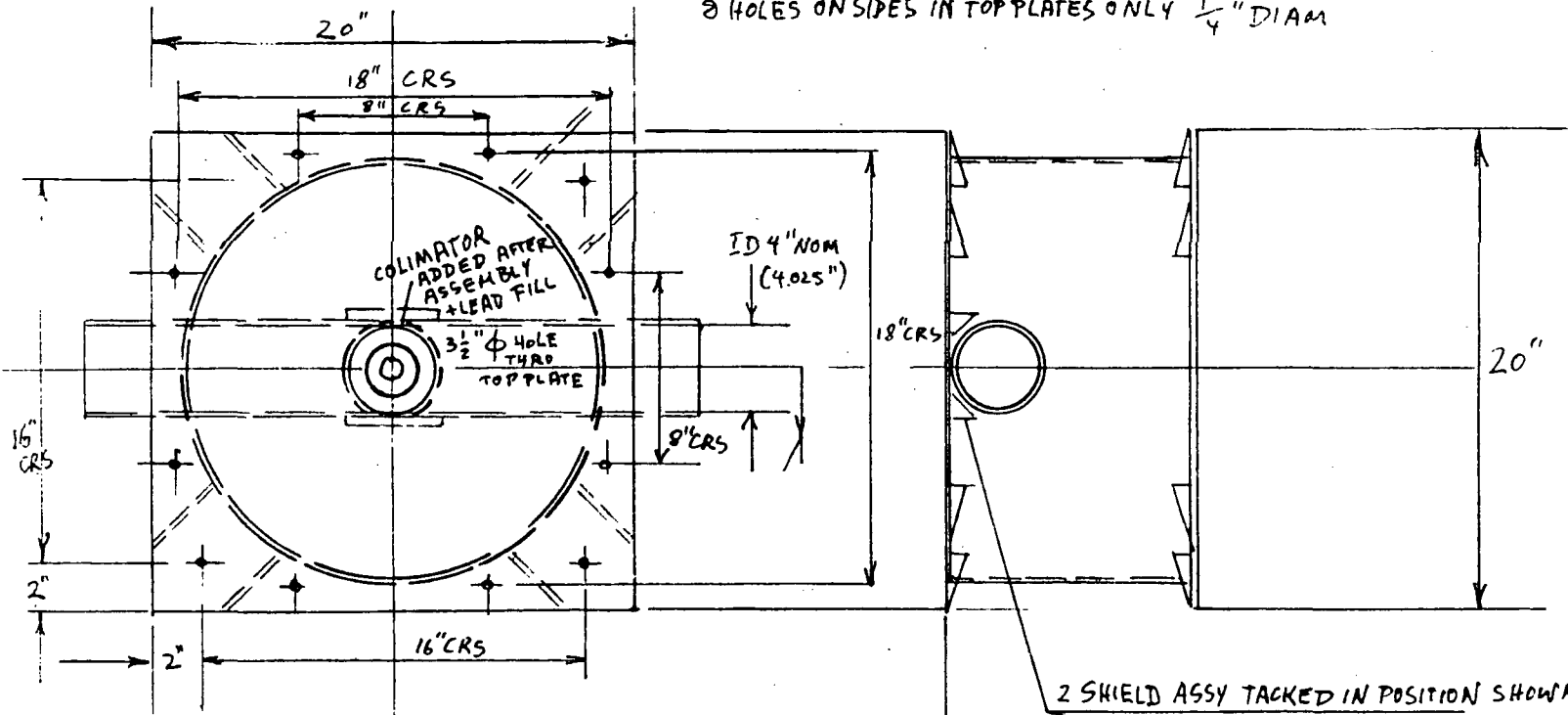
MODIFICATIONS MADE FOR TRUCK SHIPMENT

MATERIAL WELDED STEEL CONTAINER FILLED WITH LEAD	DIMENSIONS INCHES	SCALE	DATE
DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY

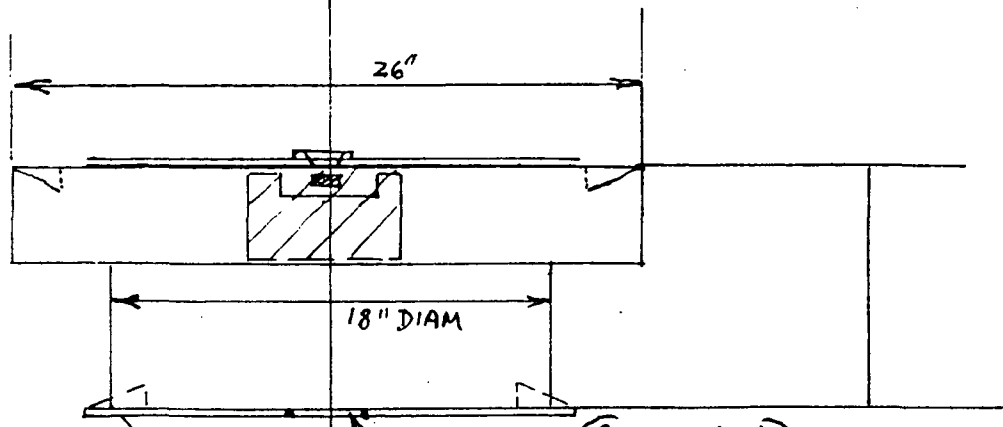
A-METRICS LTD OAKVILLE ONTARIO	
450C Cs137 CONTAINER	
PROPOSED MODIFICATIONS	
SCALE	DATE
CHECKED BY	APPROVED BY

4 HOLES IN CORNERS IN EACH PLATE  $\frac{3}{4}$ " DIAM  
 2 HOLES ON SIDES IN TOP PLATES ONLY  $\frac{1}{4}$ " DIAM

FIRST USED ON
REVISIONS



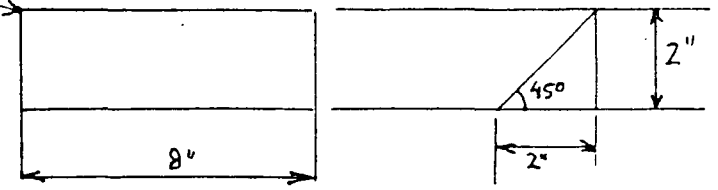
2 SHIELD ASSY TACKED IN POSITION SHOWN



GUSSET PLATE  
APPROX AS SHOWN

5" DIAM HOLE  
FOR LEAD POURING  
COVER WELD IN  
AFTER LEAD FILL

SECTION A-A



SHEET METAL FOLDED TO TRIANGULAR CROSS SECTION  
 PACKED TIGHT WITH TUNGSTEN TURNINGS FILLED WITH  
 LEAD AND WELDED SHUT

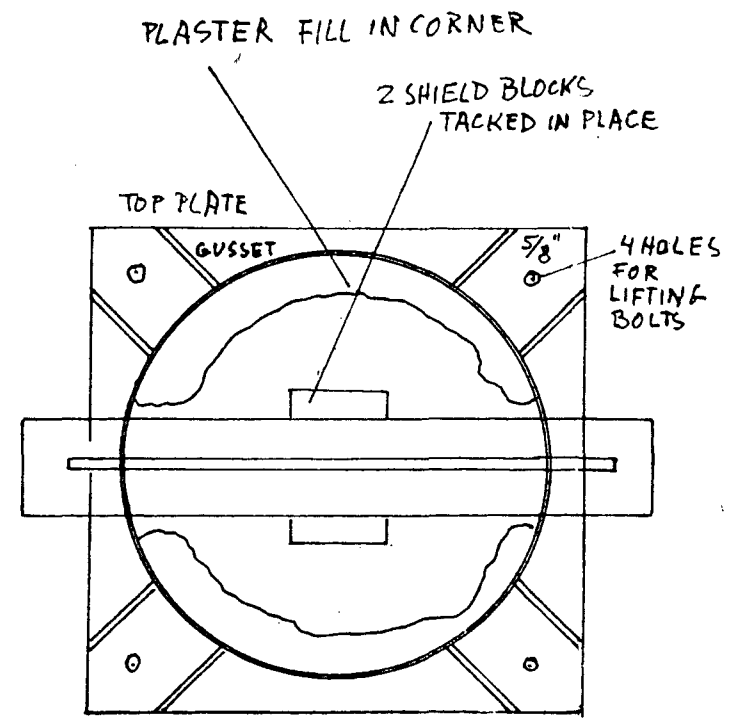
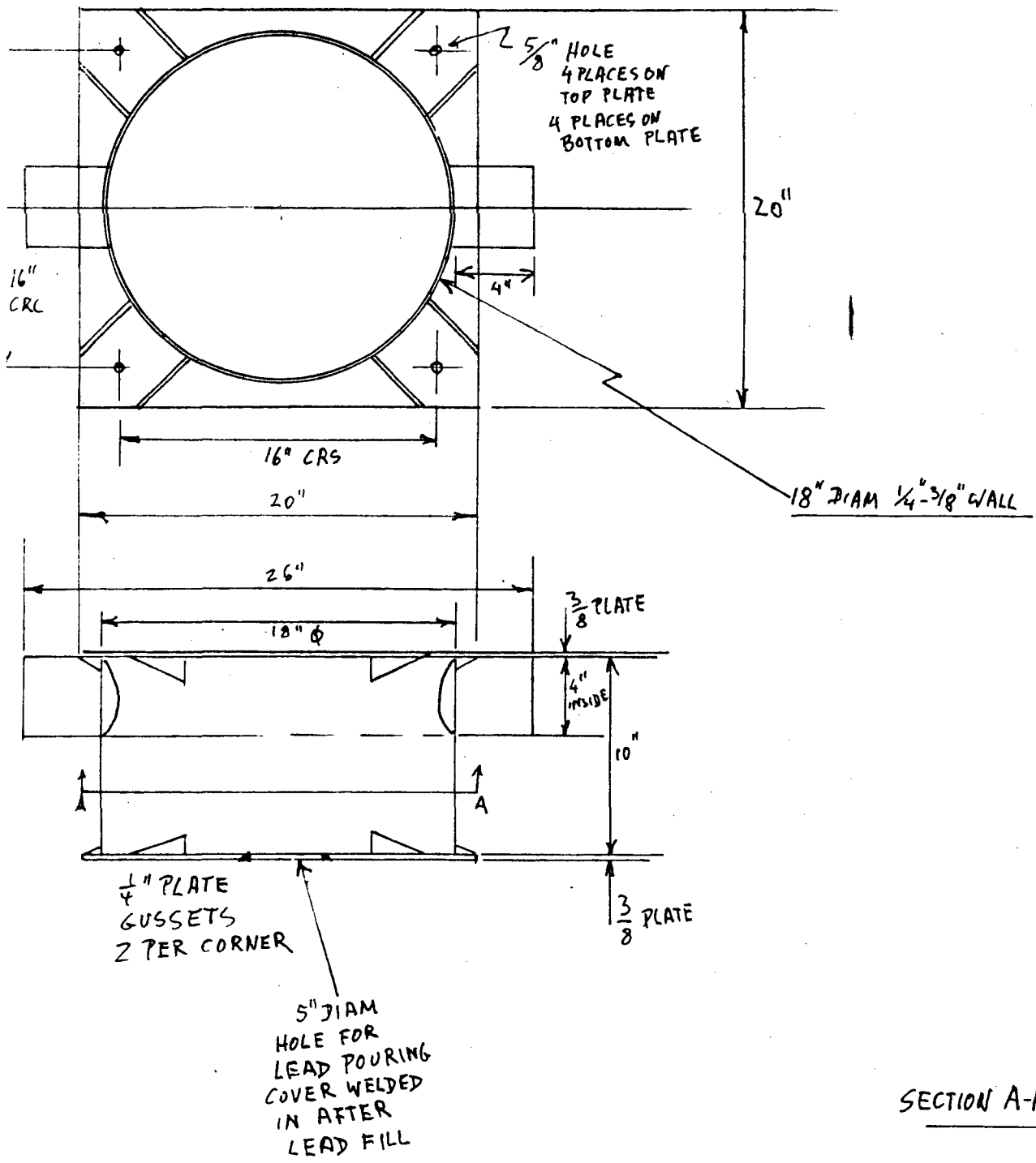
DRWG "A"/1

MATERIAL	STEEL FILLED WITH LEAD	DIMENSIONS INCHES	SCALE	ENG APPR.
FINISH		WEIGHT	DRAWN BY RFM	APPR BY

A-METRICS LTD OAKVILLE ONTARIO	
SOURCE SHIELD CONTAINER ASSY	
SCALE	ENG APPR.
DRAWN BY RFM	APPR BY



DATE USED ON	
REVISIONS	



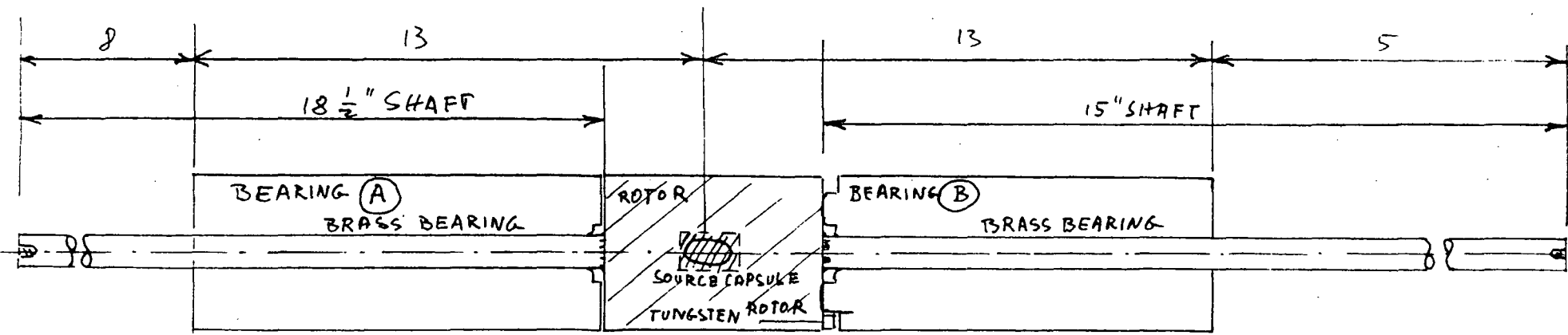
DRWG "A"-2

SECTION A-A SET UP TO POUR LEAD

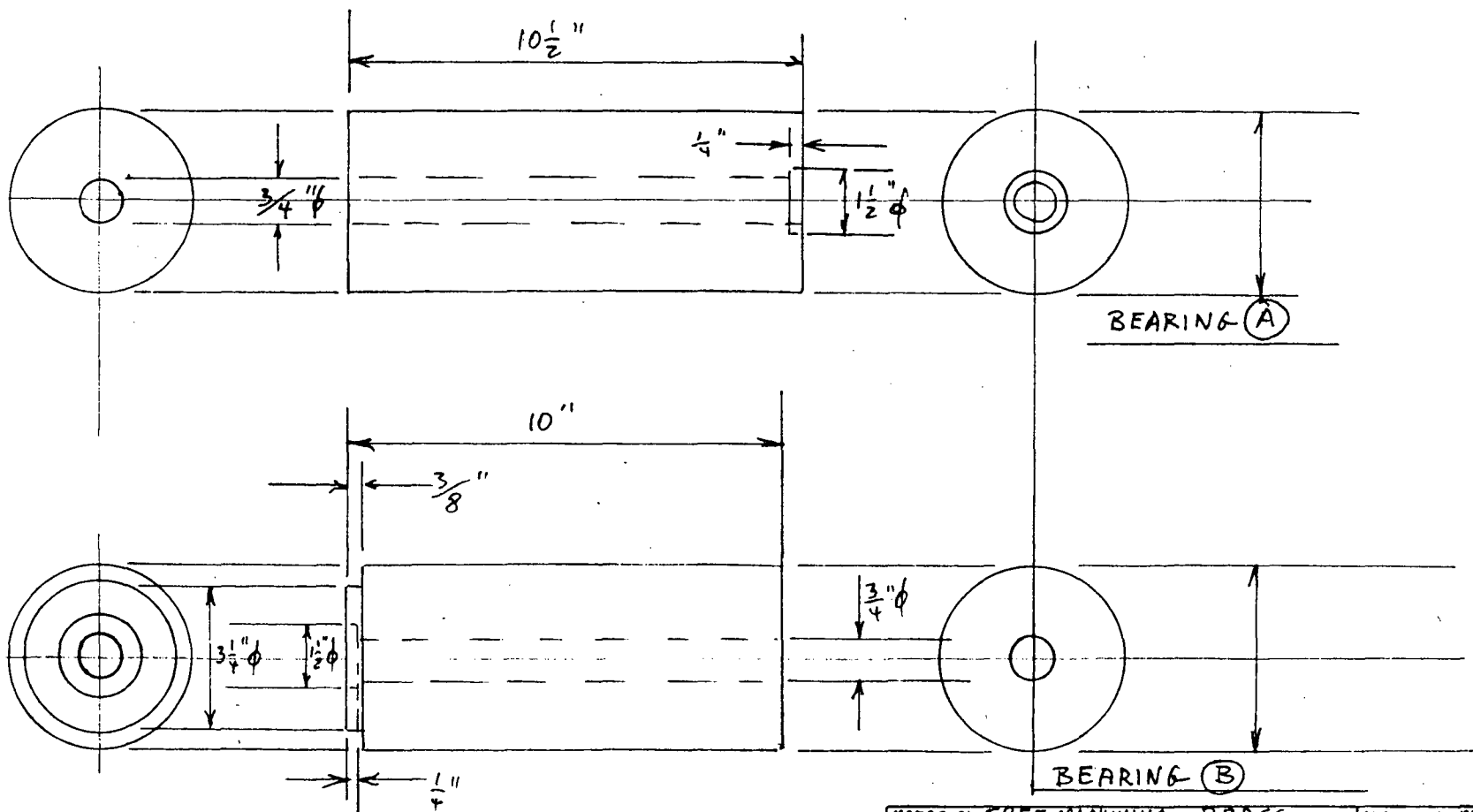
486 WYECROFT 845-6036
A-METRICS LTD OAKVILLE ONTARIO
450 C CESIUM 137
SOURCE SHIELD
MATERIAL MILD STEEL PIPE + PLATE
DIMENSIONS INCHES
SCALE
ENG APPR. RFA
DRAWN BY RFA/APP. BY

MATERIAL MILD STEEL PIPE + PLATE	DIMENSIONS INCHES	SCALE	ENG APPR. RFA
CONSTRUCTION NO DIMEN	WEIGHT		DRAWN BY RFA/APP. BY

DATE USED ON	
REVISIONS	



ASSEMBLY WITH ROTOR IN SIDE TUBE

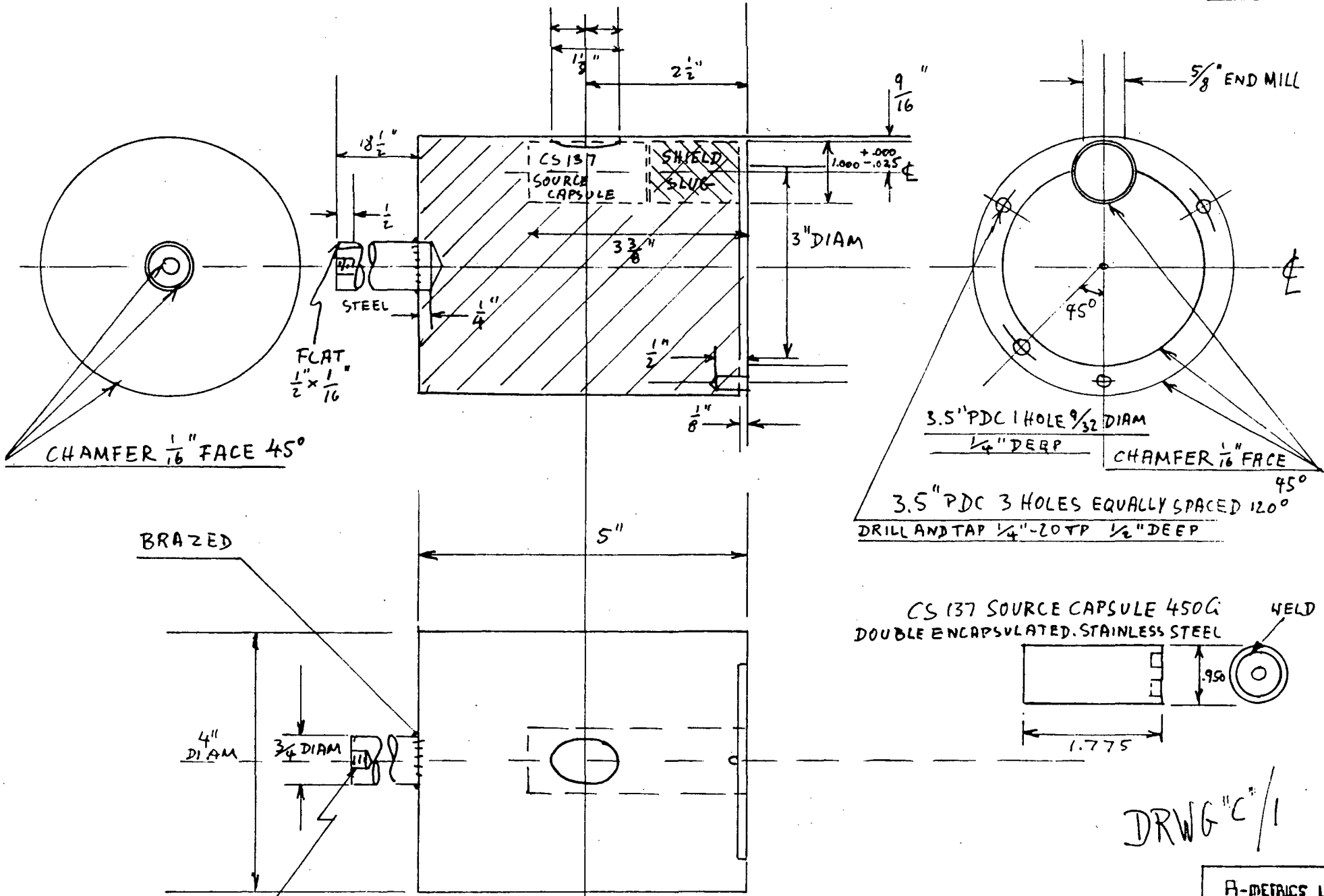


DRWG "B"

A-METRICS LTD OAKVILLE ONTARIO
SOURCE SHIELD BEARINGS A+B

FIRST USED ON	
REVISIONS	

USE 3/4" DIAM END MILL



CHAMFER 1/16" FACE 45°

FLAT 1/2 x 1/16

BRAZED

4" DIAM

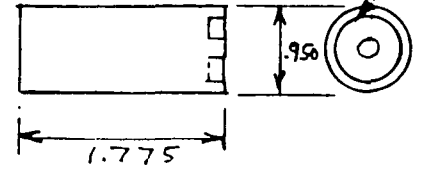
3/4" DIAM

1/4"-20

3.5" PDC 1 HOLE 9/32" DIAM  
1/4" DEEP

3.5" PDC 3 HOLES EQUALLY SPACED 120°  
DRILL AND TAP 1/4"-20 TP 1/2" DEEP

CS 137 SOURCE CAPSULE 450G  
DOUBLE ENCAPSULATED. STAINLESS STEEL

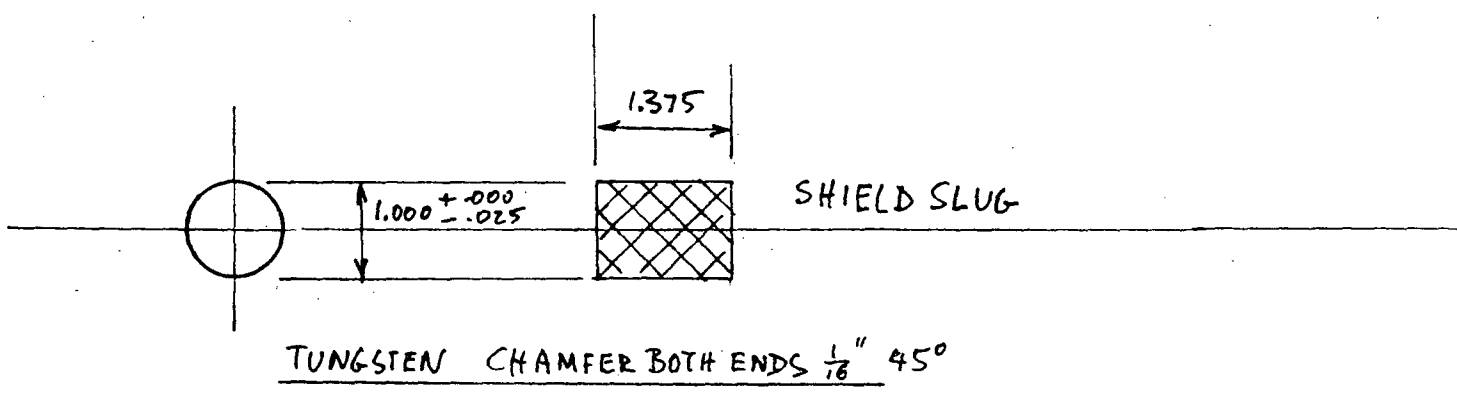
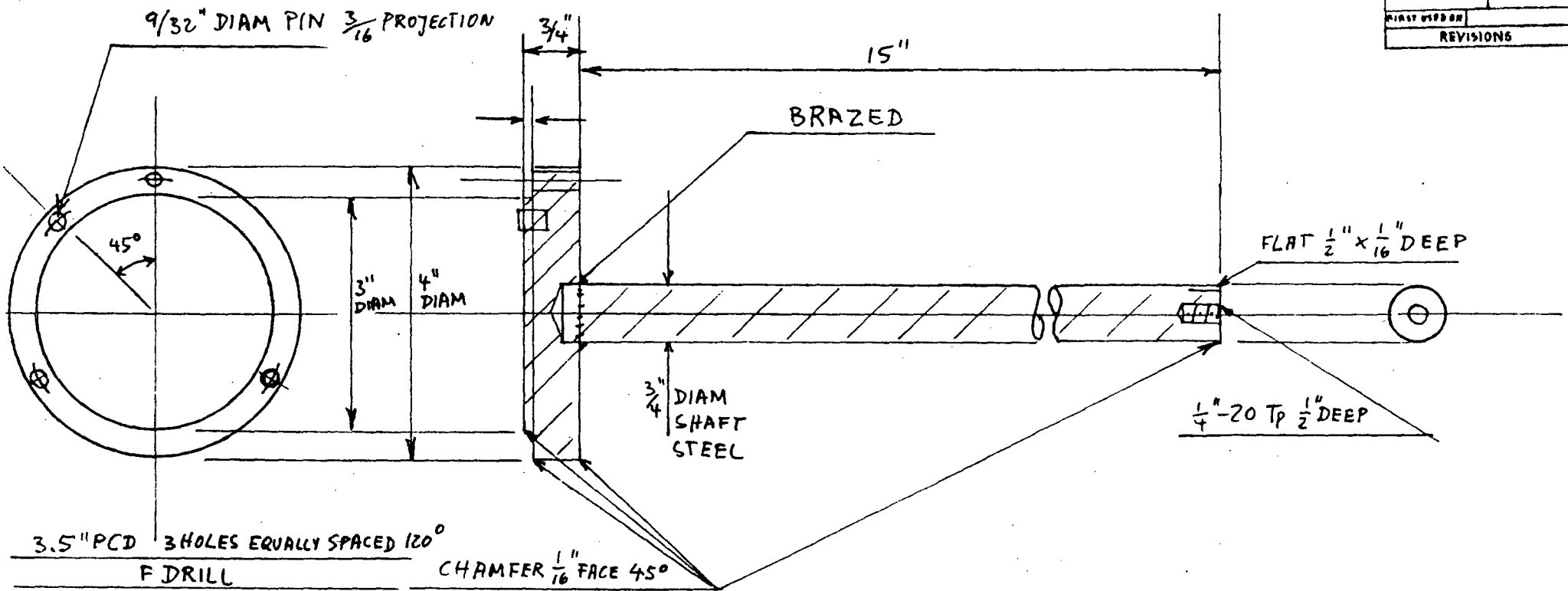


DRWG "C" / 1

MILD STEEL SHAFT 3/4" DIAM

MATERIAL MALLOY 1000 (TUNGSTEN)	DIMENSIONS INCHES	SCALE	ENG APPR
FINISH	WEIGHT	REVISIONS	DATE

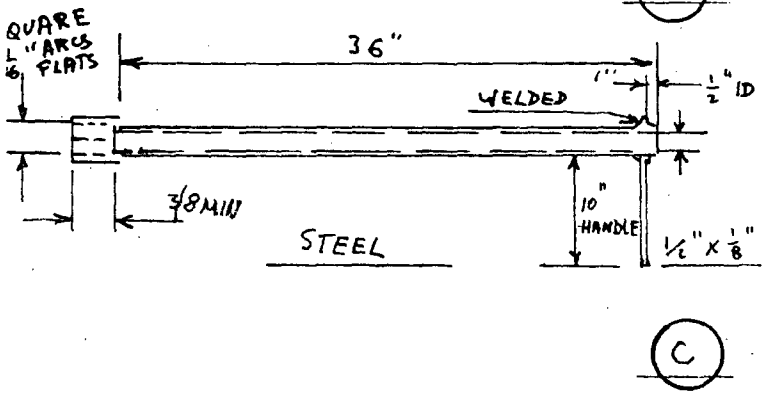
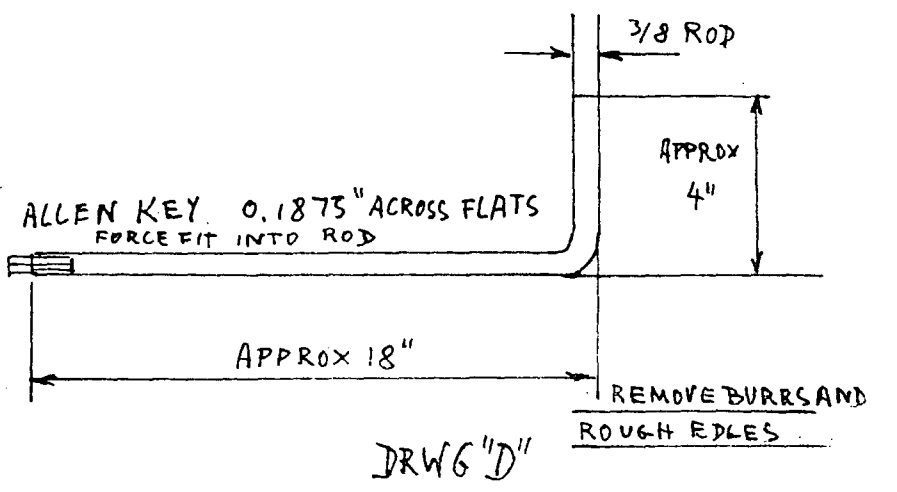
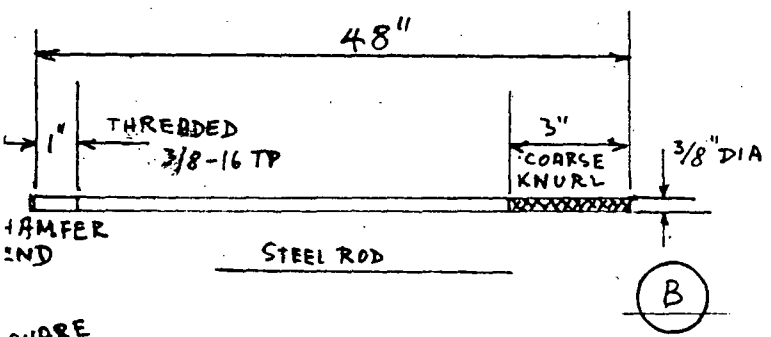
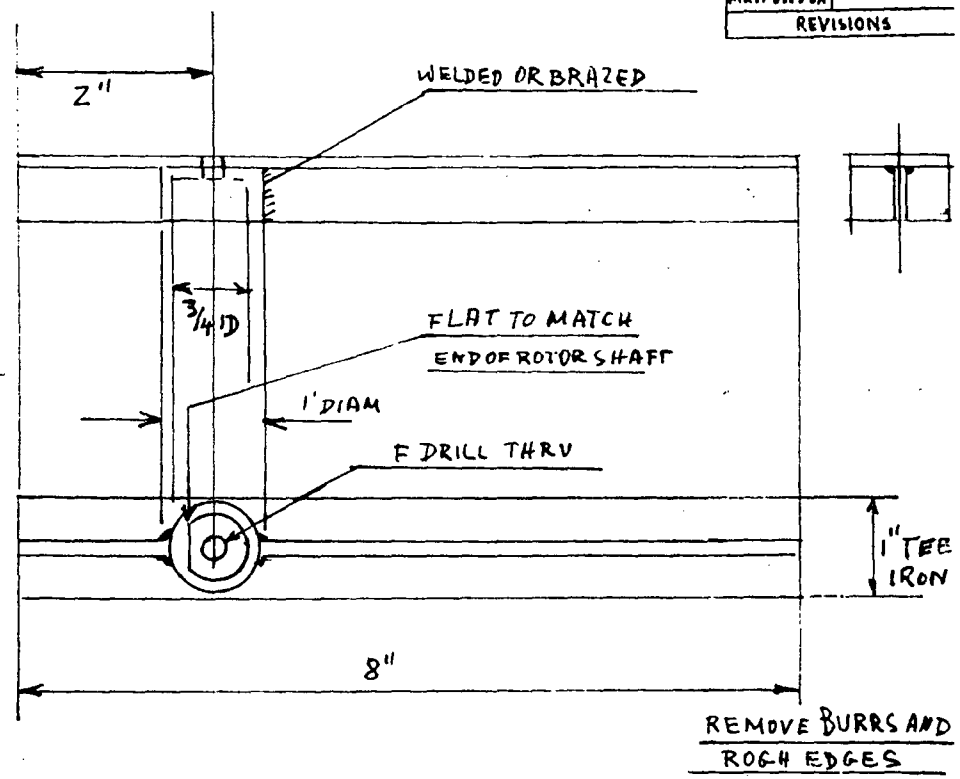
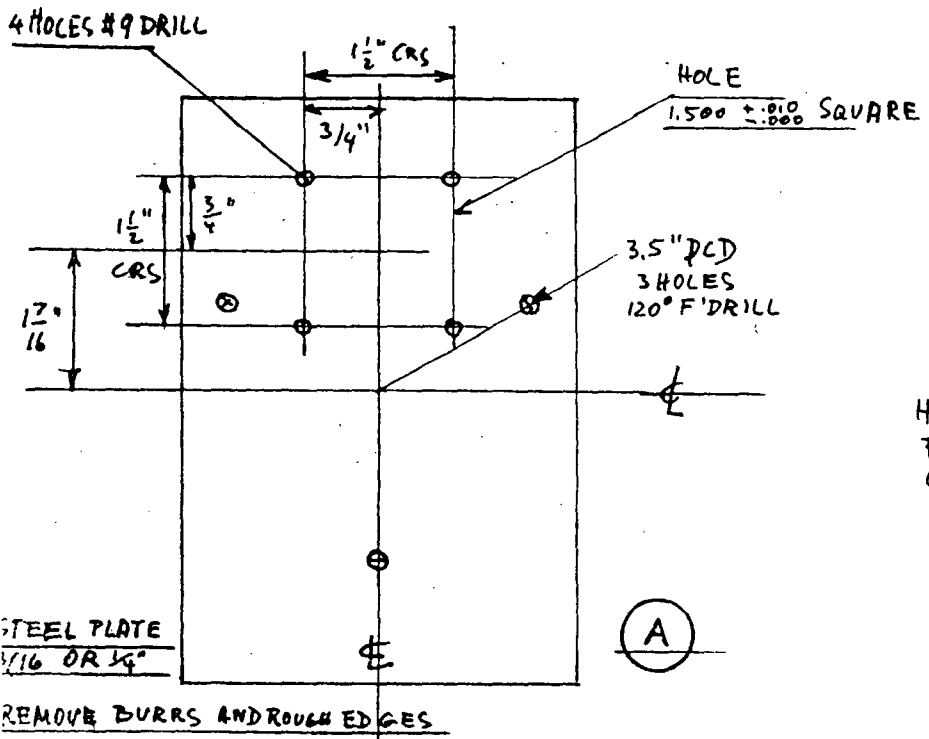
FIRST VERSION
REVISIONS



DRWG "C" / 2

A-METRICS LTD. OAKVILLE ONTARIO
SOURCE SHIELD
ROTOR END + SHIELD SLUG

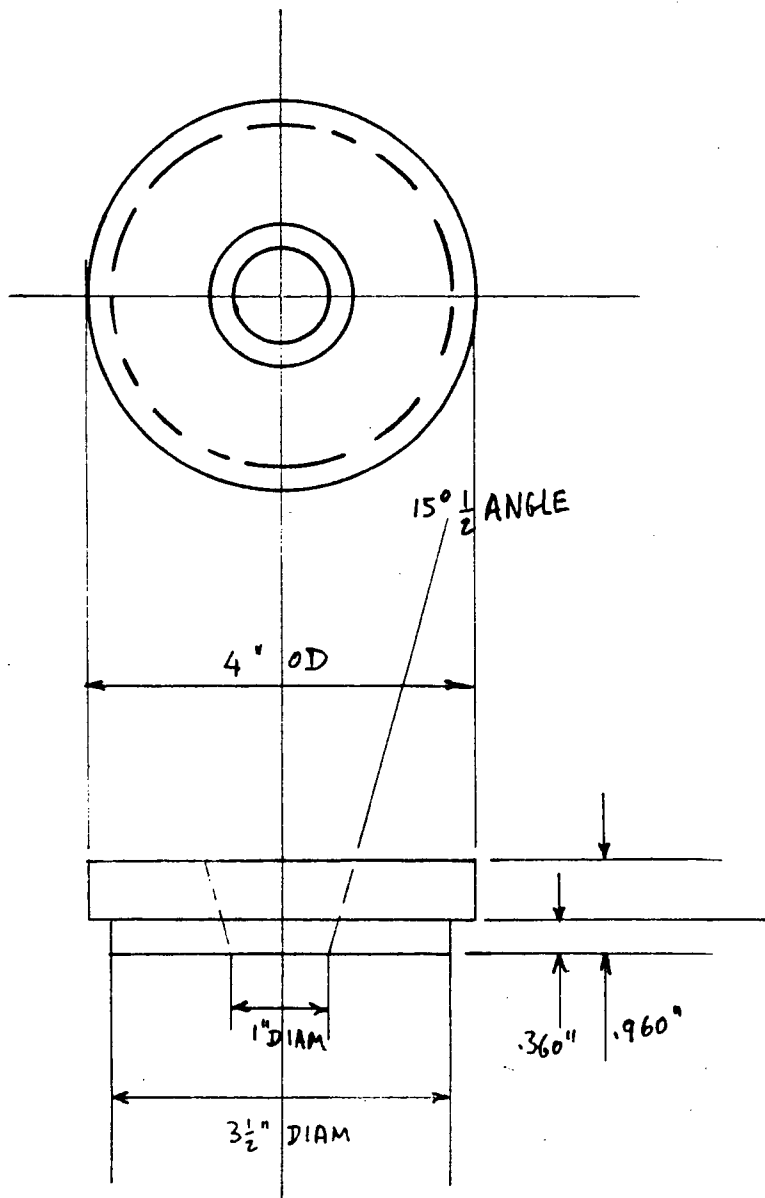
FIRST USED ON	
REVISIONS	



DRWG "D"

A-METRICS LTD  
OAKVILLE ONTARIO  
450 C 65137 SOURCE  
TRANSFER TOOLS

PLANT USED ON
REVISIONS



DRWG "E"

A-METRICS LTD OAKVILLE ONTARIO	
SOURCE SHIELD	
TOP SHIELD	
MATERIAL MALLORY 1000 TUNGSTEN	DIMENSIONS INCHES
FINISH	WEIGHT
SCALE	ENG APPR.
DRAWN BY RCM	APPR. BY

MATERIAL MALLORY 1000 TUNGSTEN	DIMENSIONS INCHES	SCALE	ENG APPR.
FINISH	WEIGHT	DRAWN BY RCM	APPR. BY

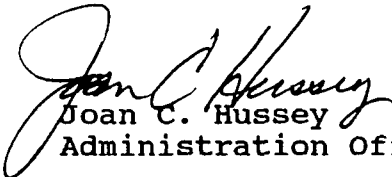
14 October 1995

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Duty Appointment

1. Alice M. Frampton, AMSEL-SF-RER, Telephone, 73112 X6432.
2. Effective: Immediately
  - a. Appointed as: CECOM and Fort Monmouth Dosimetry Custodian.
  - b. Designated as: N/A
  - c. Assigned as: N/A
3. Authority: AR 40-14
4. Purpose: To conduct the CECOM and Fort Monmouth Dosimetry Program IAW applicable regulations.
5. Period: Until officially relieved or released from appointment.
6. Special Instructions: This appointment supersedes the previous appointment of Mr. Francesco Piazza, 15 June 1994.

FOR THE COMMANDER:

  
Joan C. Hussey  
Administration Officer

DISTRIBUTION:  
Individual Concerned  
AMSEL-SF-RER  
SELFM-RM-AP  
SELFM-ADJ