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AUTH.NAME AUTHOR AFFILIATION
KEISER,H.W. Pennsylvania Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
MURLEY,T. Office of Nuclear Reactor Regulation, Director (Post 870411

SUBJECT: Responds to Generic Ltr 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping."

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PP&L Pennsylvania Power & Light Company
Two North Ninth Street • Allentown, PA 18101 • 215/770-5151

AUG 10 1988

Harold W. Keiser
Senior Vice President-Nuclear
215/770-4194

Director of Nuclear Reactor Regulation
Attention: Dr. Thomas Murley
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
RESPONSE TO GENERIC LETTER 88-01 Docket Nos. 50-387
PLA-3060 FILE R41-1D and 50-388

Dear Dr. Murley:

The following is in response to Generic Letter 88-01, "NRC Position On IGSCC In BWR Austenitic Stainless Steel Piping."

Staff Position on Materials

Inspection programs presently established for Unit 1 and Unit 2 of the Susquehanna Steam Electric Station (SSES) are consistent with the material criteria in NUREG 0313, Rev. 2 except for:

1. Nickel based weld metal (other than Inconel 82). There are 13 Inconel 182 and Inconel 600 austenitic nickel based weldments that have to be included in each Unit's inspection program. These weldments will be included in SSES inspection programs before the next refueling outages for each unit.

2. Low carbon weld metal with less than 7.5% ferrite (as deposited). The SSES units were constructed using low carbon weld material with a specified minimum delta ferrite of 5.0%, consistent with the practice at the time. PP&L is confident that the low carbon weld metal used at SSES has sufficient ferrite percentage to be resistant to IGSCC. A review of a representative sample of low carbon weld material certifications for SSES showed a minimum percent ferrite ranging from 5.5% to 12% with most above 7.5%. Most BWR's have used the minimum 5% ferrite content weld materials and of all the HAZ cracking observed in BWR's, no cracks have initiated in or penetrated the weld metal. Given these considerations, PP&L's inspection programs will continue to consider the low carbon weld material used at SSES as resistant.

Staff Position on Processes

Within two years of commercial operation, SSES Unit #1 had stress improvement (SI) using the Induction Heating Stress Improvement Process (IHSI) on 111 welds. Prior to commercial operation, SSES Unit #2 had IHSI performed on 113 welds.

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All these welds are included in SSES inspection programs as Category B from NUREG 0313, Rev. 2.

Staff Position on Water Chemistry

Presently, PP&L has no plans to implement hydrogen water chemistry at SSES. We are following industry experience in this area and periodically re-evaluate our position.

Staff Position on Weld Overlay Reinforcement, Partial Replacement, Stress Improvement of Cracked Weldments, Clamping Devices

There are no weldments at SSES that were repaired due to IGSCC. When necessary to perform repairs, PP&L will determine the most appropriate method considering the criteria in NUREG 0313, Rev. 2.

Staff Position on Crack Evaluation and Repair Criteria

PP&L has developed a criteria manual to evaluate and disposition any flaws found during ISI. This manual contains plant specific flaw evaluation diagrams. Using these diagrams, we can determine if a discovered flaw requires immediate repair or if continued operation without repair is justified.

The development of the criteria manual and the flaw evaluation diagrams is based on the following:

- The methods and criteria used for crack evaluation follow the rules of Paragraph IWB-3640 of Section XI of the 1986 Edition of the ASME Boiler and Pressure Vessel Code.
- The crack growth rate used for weld locations which have received IHSI is:

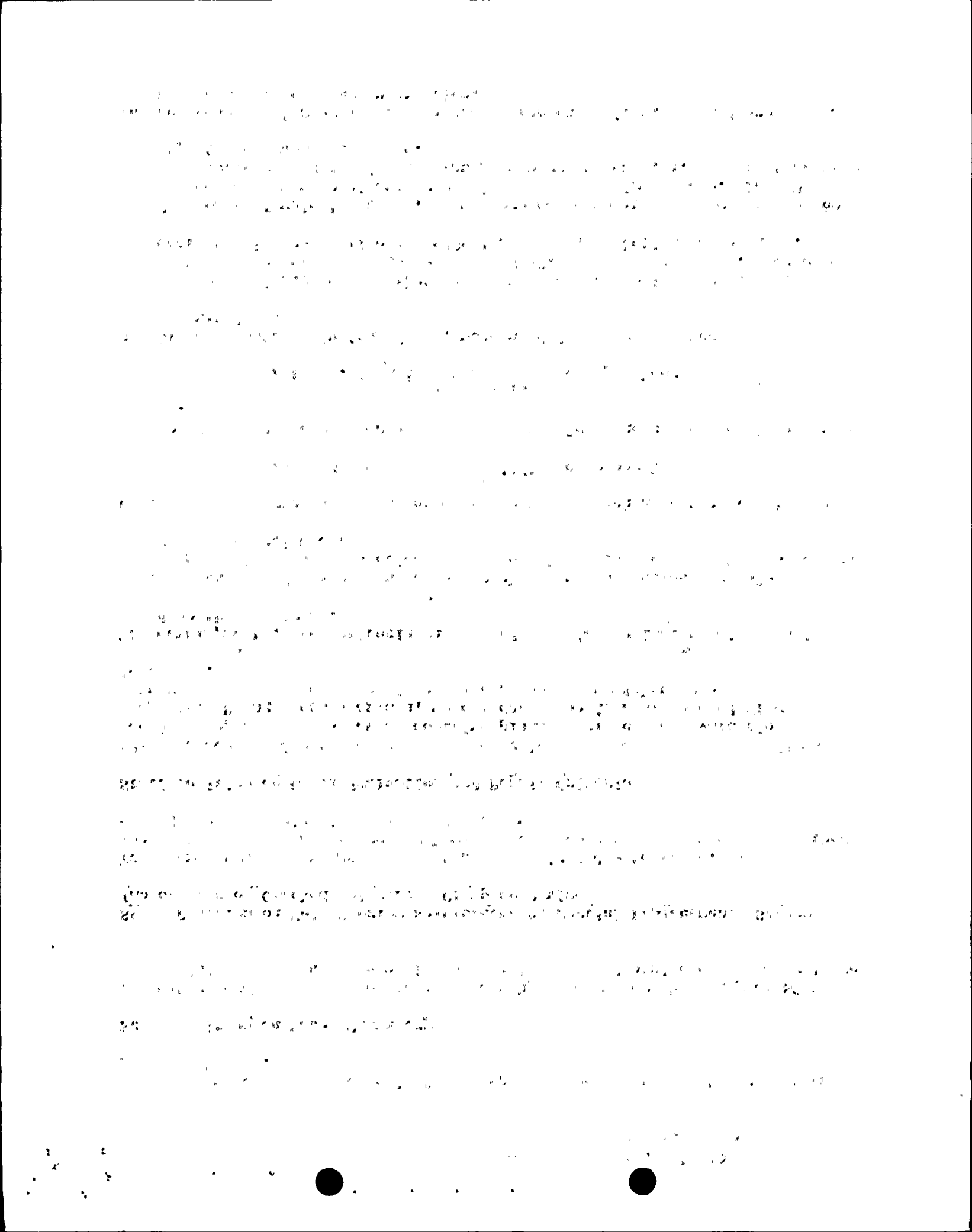
$$da/dt = 3.590 \times 10^{-8} \times K_I^{2.161} \text{ inches per hour}$$

- For weld locations which have not received IHSI the crack growth rate used is:

$$da/dt = 3.217 \times 10^{-8} \times K_I^{2.12} \text{ inches per hour}$$

- Linear elastic solutions for K_I were used in the crack growth calculations.
- The residual stress distribution assumed for non-IHSI welds where $t \geq 1$ inch is in accordance with the NUREG 0313, Rev. 2 requirement. For cases where $t < 1$ inch, a linear residual stress distribution was assumed.
- For non-IHSI weld locations, flaws were conservatively assumed to be 360 degree part through circumferential flaws at the ID surface. For IHSI weld locations, self similar flaw growth was assumed, i.e. a constant flaw aspect ratio was maintained.

The Susquehanna flaw evaluation diagrams from our criteria manual are included as an attachment for your information.



Staff Position on Inspection Method and Personnel

The inspection programs established for SSES presently incorporate the detailed volumetric procedures, equipment and examination personnel qualified by a formal program approved by the NRC as outlined in NUREG 0313, Rev. 2.

Staff Position Inspection Schedules

SSES has weldments which fall into the inspection schedules for Category A, B & D. Our inspection program presently complies with these schedules except for the Category D frequency. PP&L presently inspects these type of weldments at a frequency of 100% every 6 years while NUREG 0313, Rev. 2 requires 100% every two refueling outages. SSES inspection schedules will be adjusted prior to the next refueling outages to reflect this requirement.

There are 23 weldments in Unit 1 and 22 weldments in Unit 2 that are nonresistant with no stress improvement and have not been examined in accordance with the inspection method and personnel referenced in NUREG 0313, Rev. 2. These weldments will be inspected during each unit's next refueling outage. Presuming that no defects are found and all weldments are inspectable, these weldments will be included into our programs as Category D.

The breakdown of inspection categories for SSES is:

1. Category A with inspection schedule of 25% in 10 years (at least 12% in 6 years). Resistant material weldments for both Units are in the ASME Section XI inspection programs and presently meet this inspection schedule.

2. Category B with inspection schedule of 50% in 10 years (at least 25% in 6 years).

   Unit 1 : 56 weldments out of 111 are scheduled for inspection
   Unit 2 : 57 weldments out of 113 are scheduled for inspection

3. Category D with inspection schedule of all weldments every two refueling cycles.

   Unit 1 : 36 weldments (includes the 23 weldments from above)
   Unit 2 : 33 weldments (includes the 22 weldments from above)

Staff Position on Sample Expansion

The present sample expansion method for SSES meets the requirements of NUREG 0313, Rev. 2. However, the current procedure does not explicitly conform to the NUREG requirements. This procedure will be revised by October 31, 1988 to comply with the NUREG.

Staff Position on Leak Detection

The present detection method for SSES is in accordance with the recommendations of NUREG 0313, Rev. 2 with the following differences noted:

1. SSES Technical Specification for each unit limits the increase in unidentified leakage to two GPM within any four hour period. The specification also allows 4 hours to identify the source of leakage increase as not being service sensitive Type 304 or 316 austenitic stainless steel. PP&L feels this criteria is reasonable and is sufficiently restrictive to meet the intent of NUREG 0313, Rev. 2.

2. SSES Technical Specifications for each unit do not allow any time for repair of an inoperable leak detection channel. PP&L will investigate a revision to the Specification to allow a time period to repair an inoperable sump leak detection system prior to initiating a shutdown. The exact time period would be determined by evaluation and justified. The time period would be less than or equal to the 24 hour recommended maximum.

Staff Position on Reporting Requirements

PP&L will notify the NRC Senior Resident Inspector within 30 days if detected IGSCC cracks do not meet the IWB-3500 criteria of Section XI of the Code for continued operation without evaluation or if a change is found in the condition of welds previously known to be cracked. The evaluation of the cracks for continued operation and/or the repair plans will be submitted as part of the Outage Summary Report. If an alternate continued service evaluation (other than that provided for under "Staff Position on Crack Evaluation and Repair Criteria" of this letter) is performed on such cracks, PP&L will obtain NRC approval of the alternate evaluation procedures and acceptance criteria (ref. IWB-3640) prior to resumption of operation.

PP&L will add a statement to the Technical Specifications in the section on ISI that the Inservice Inspection Program for piping covered by the scope of Generic Letter 88-01 will be in conformance with the staff positions on schedule, methods and personnel, and sample expansion. This addition to Technical Specifications will be submitted before the next scheduled refueling outage.

If you have any questions, please contact Mr. J. B. Wesner at (215) 770-7906.

Very truly yours,

H. W. Keiser

Affidavit
Attachment

cc: NRC Document Control Desk (original)
NRC Region I
Mr. F. I. Young, Sr. Resident Inspector
Mr. M. C. Thadani, NRC Project Manager

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA)
: SS
COUNTY OF LEHIGH)

I, HAROLD W. KEISER, being duly sworn according to law, state that I am Sr. Vice President - Nuclear of Pennsylvania Power & Light Company and that the facts set forth on the attached response to NRC Generic Letter 88-01 are true and correct to the best of my knowledge, information and belief.

H Keiser

Harold W. Keiser
Sr. Vice President - Nuclear

Sworn to and subscribed
before me this 29th day
of July, 1988.

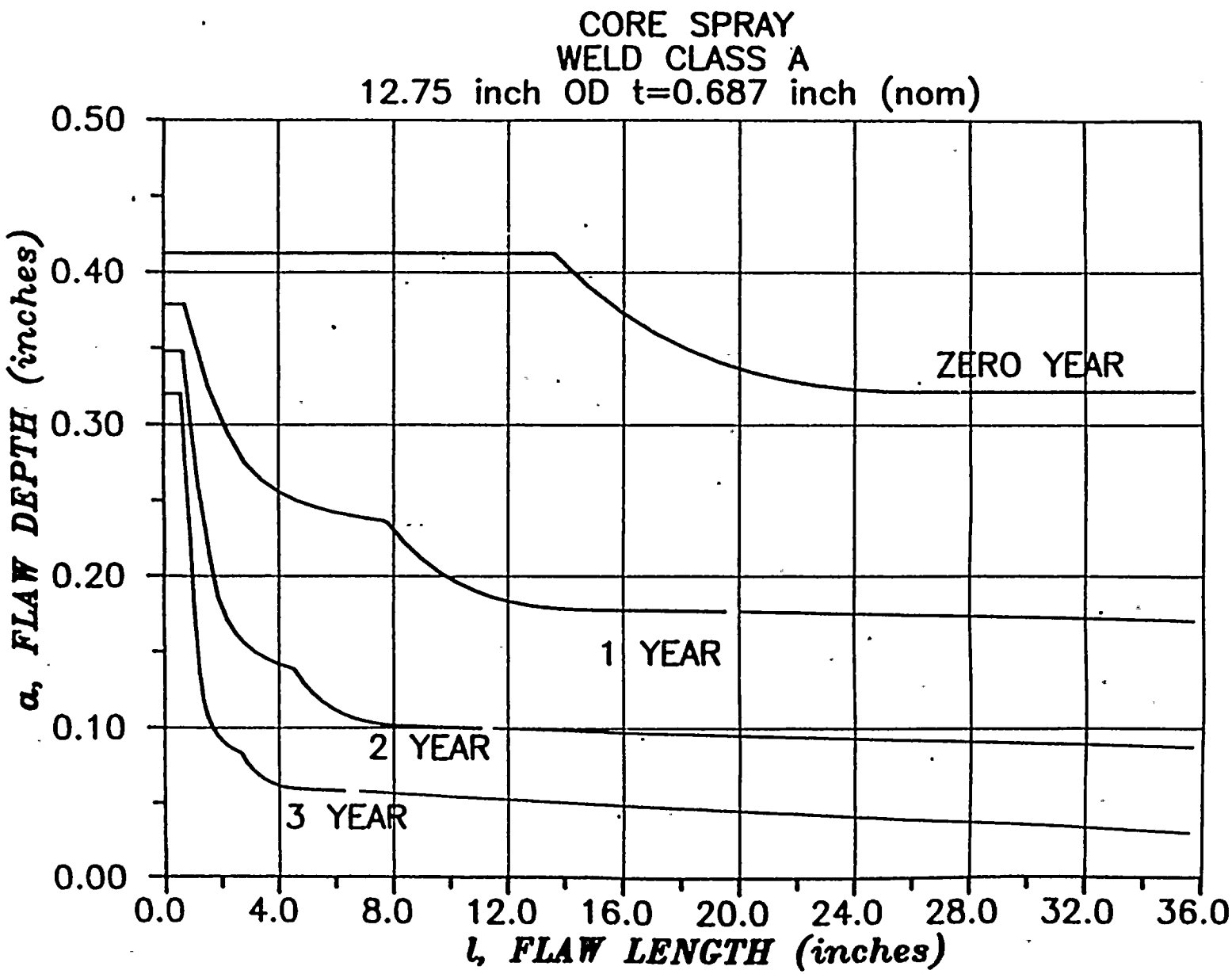
Helen J. Wolfer

Notary Public

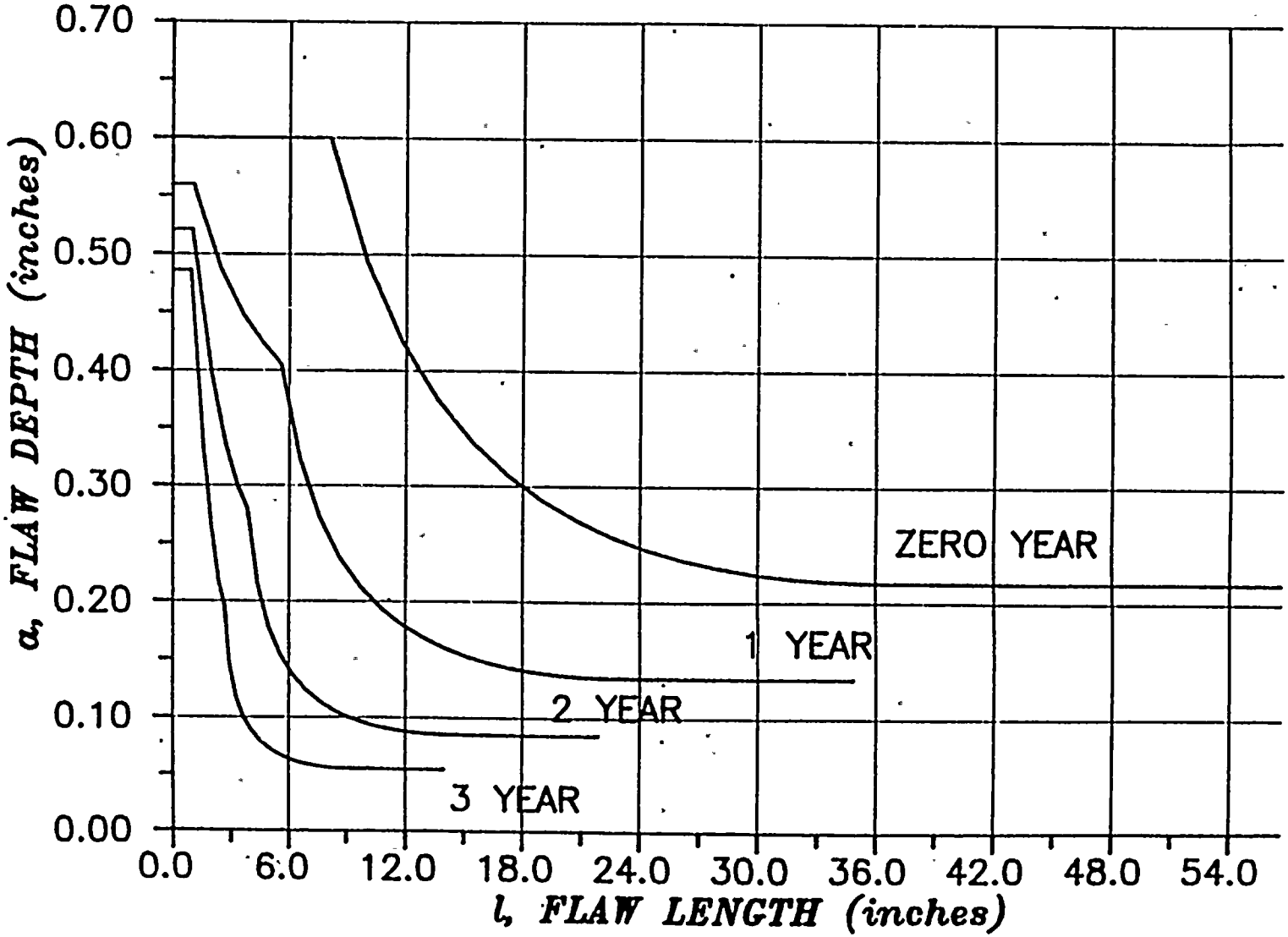
HELEN J. WOLFER, Notary Public
Allentown, Lehigh County, Pennsylvania
My commission expires April 4, 1989

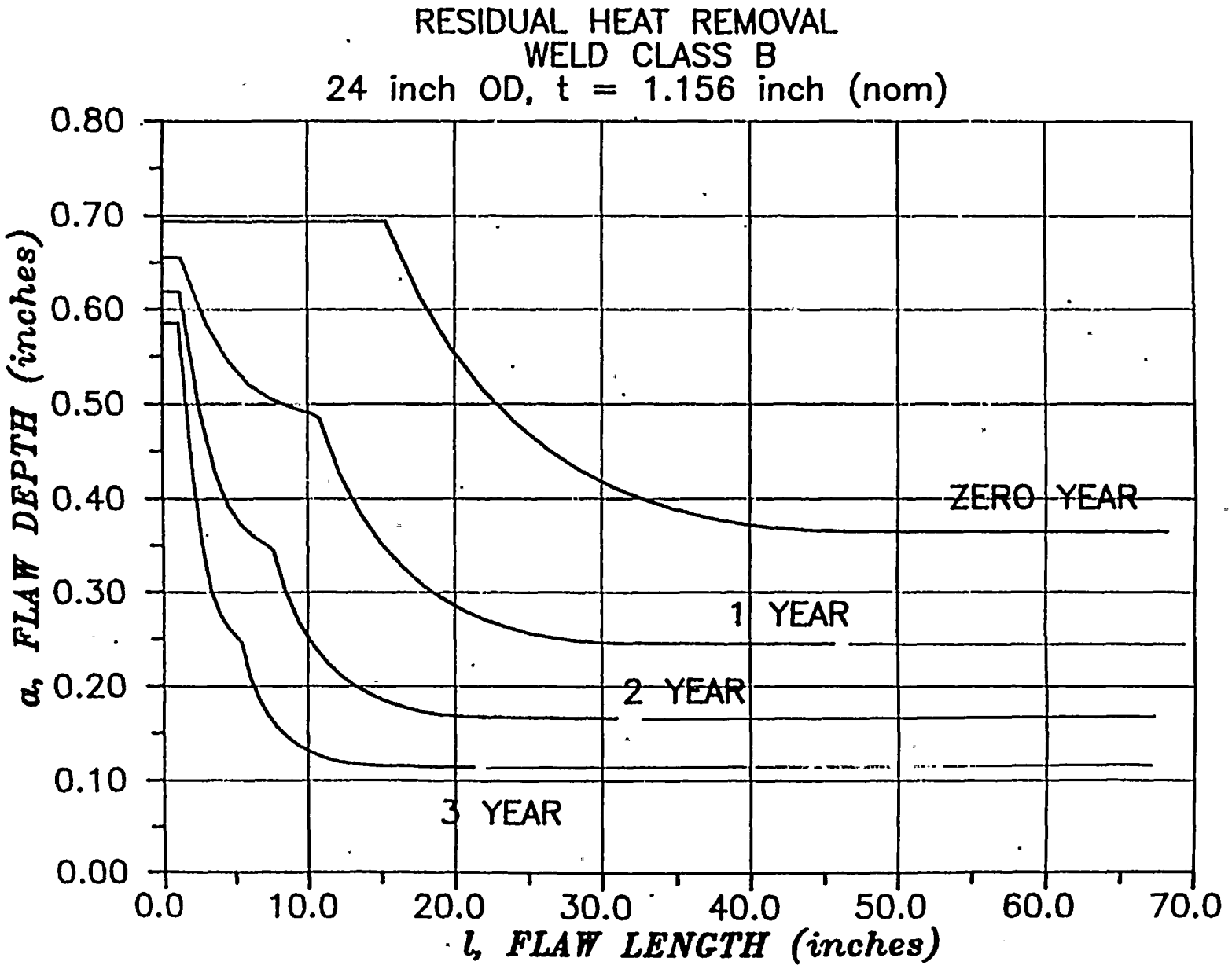
rmh/msc2003681

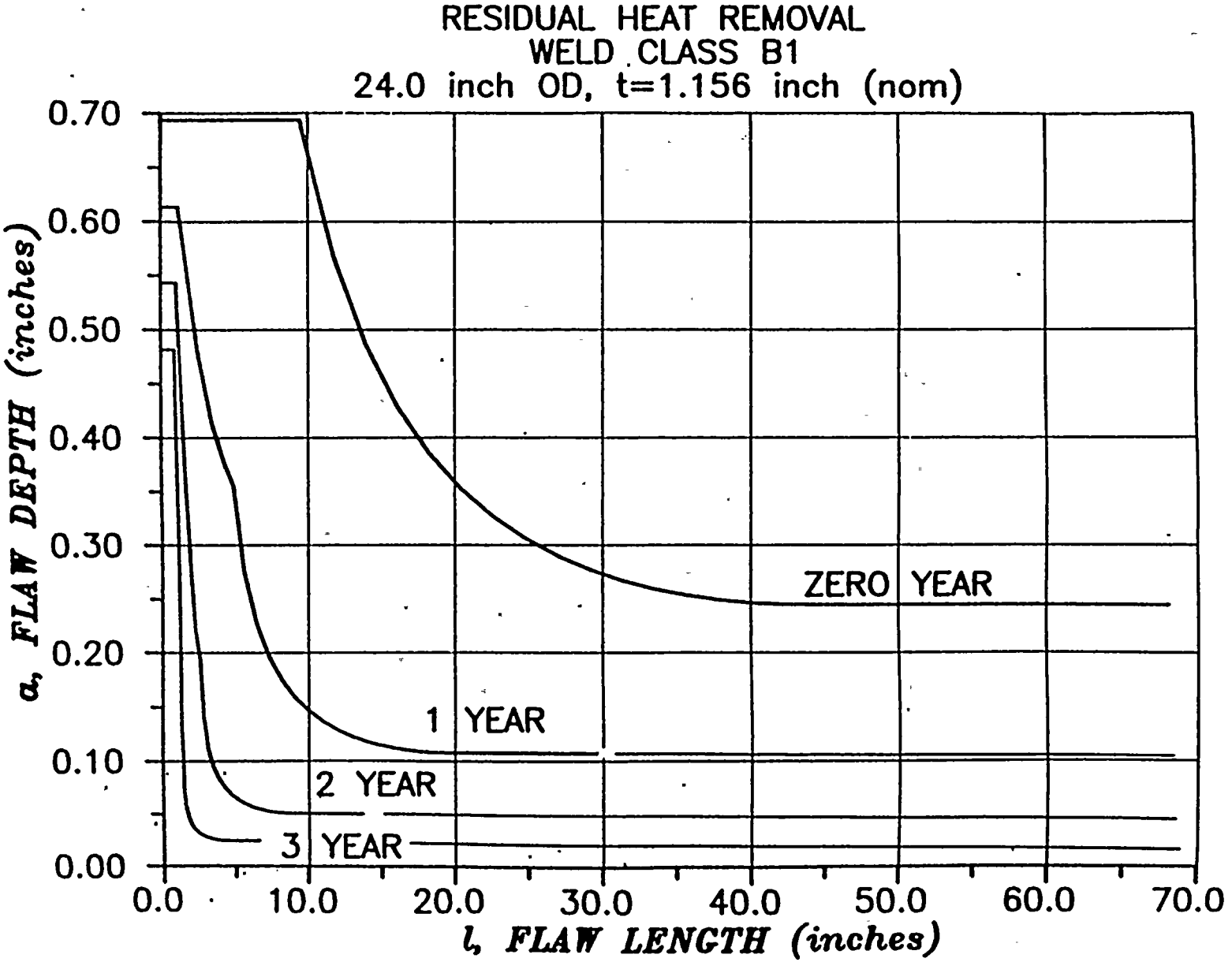
SUSQUEHANNA FLAW EVALUATION DIAGRAMS

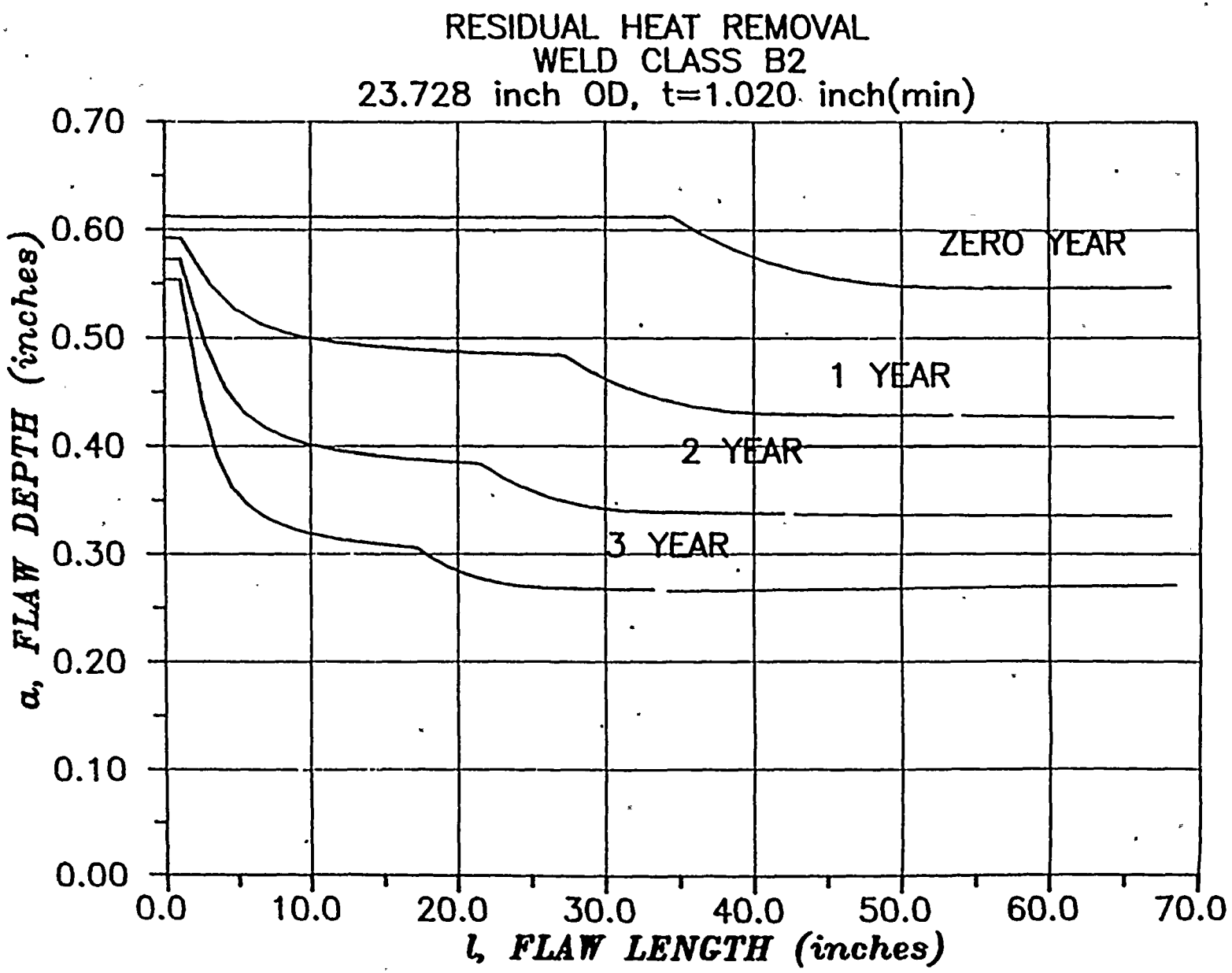

CORE SPRAY
WELD CLASS A
12.75 inch OD t=0.687 inch (nom)
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
l, FLAW LENGTH (inches)

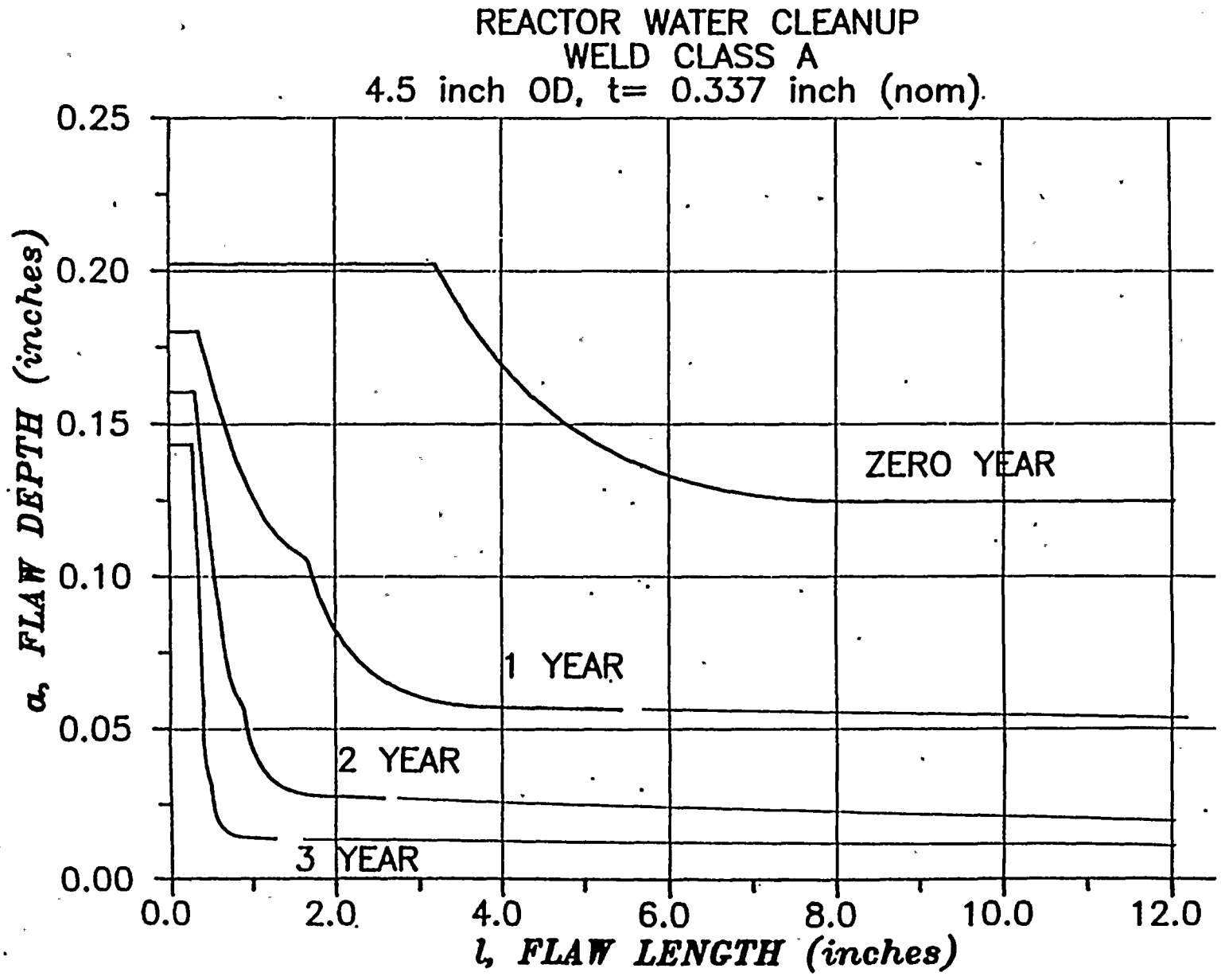
RESIDUAL HEAT REMOVAL
WELD CLASS A
20 inch OD, t = 1 inch (nom)

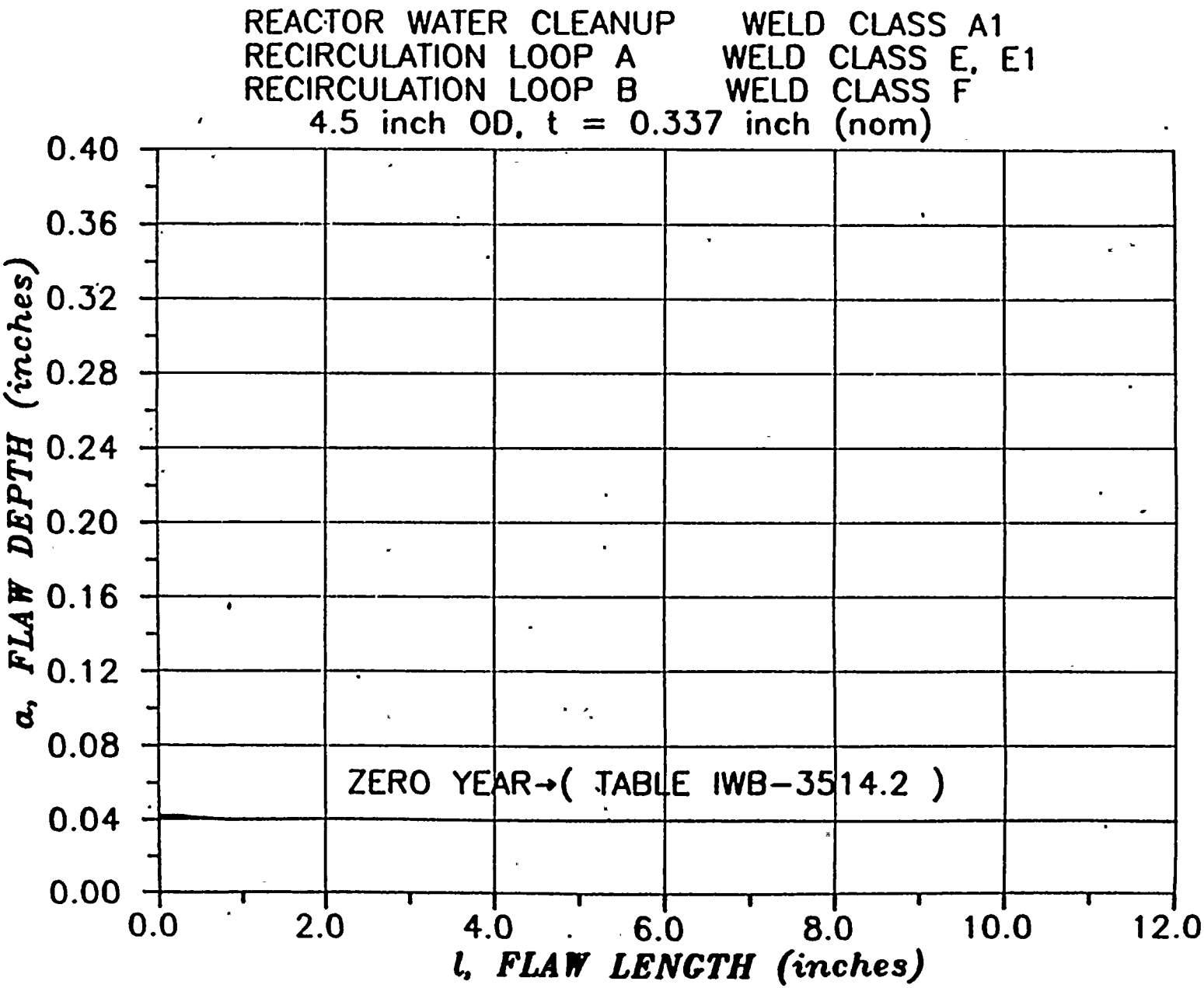


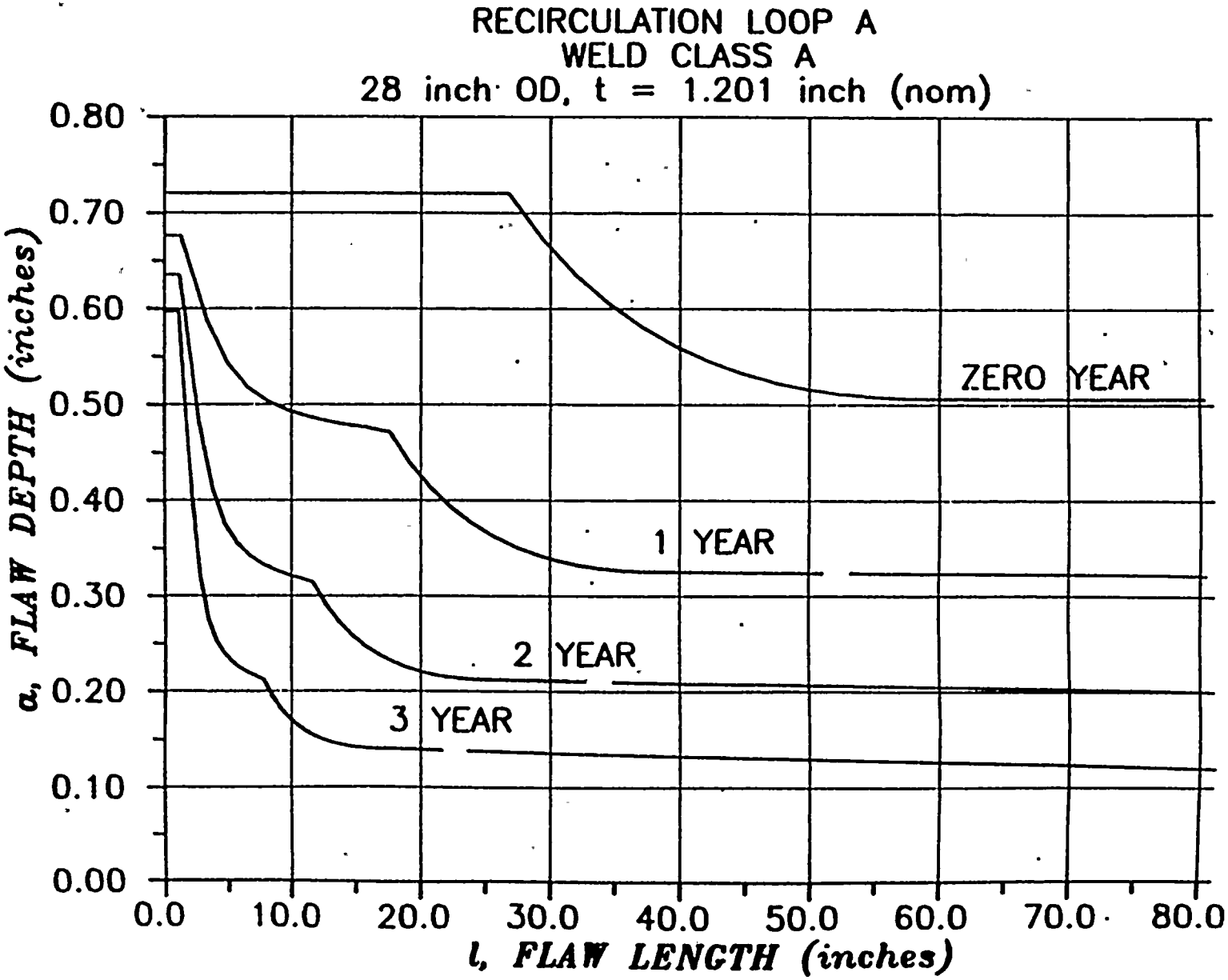

RESIDUAL HEAT REMOVAL
WELD CLASS B
24 inch OD, t = 1.156 inch (nom)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
l, FLAW LENGTH (inches)

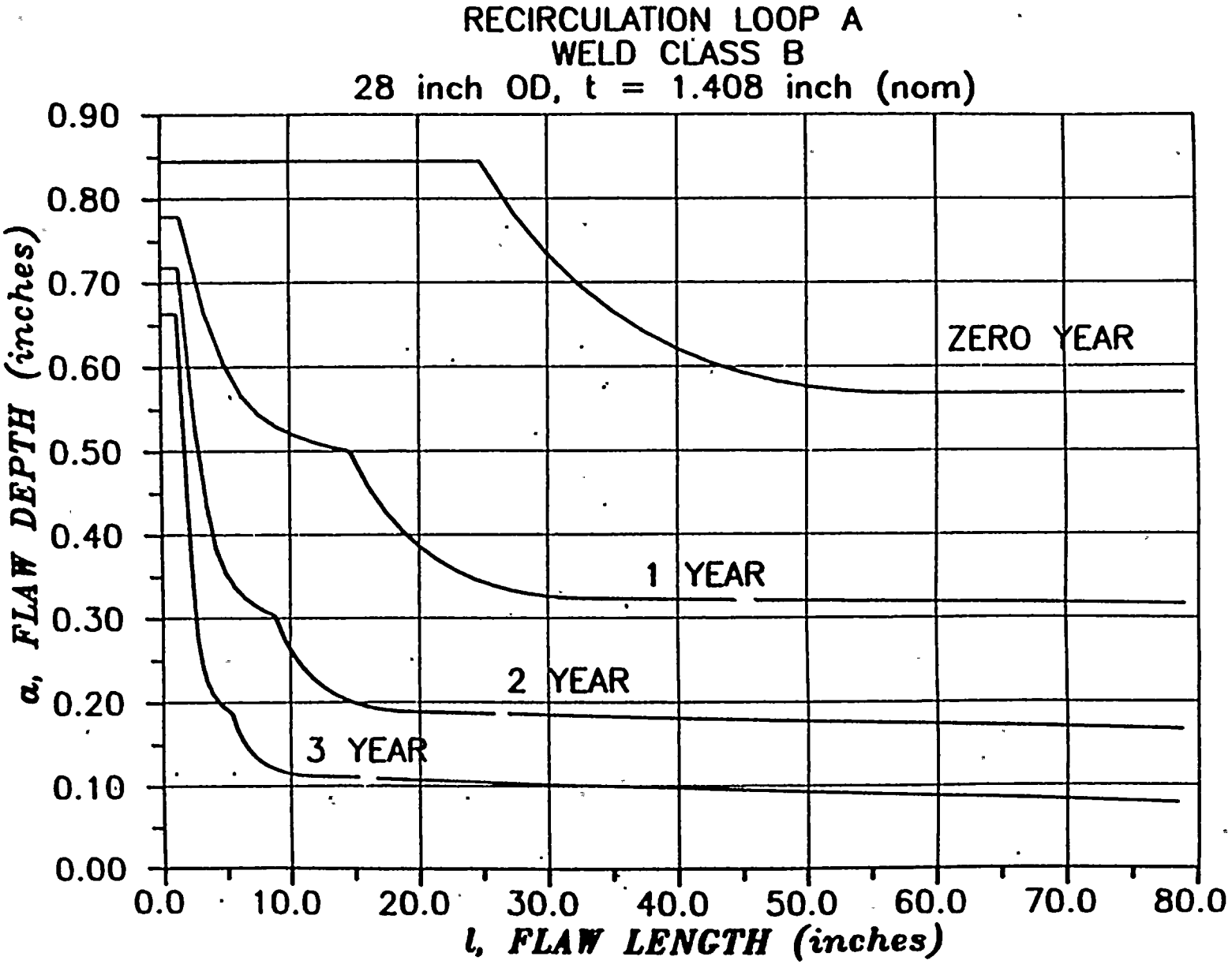

RESIDUAL HEAT REMOVAL
WELD CLASS B1
24.0 inch OD, t=1.156 inch (nom)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
l, FLAW LENGTH (inches)

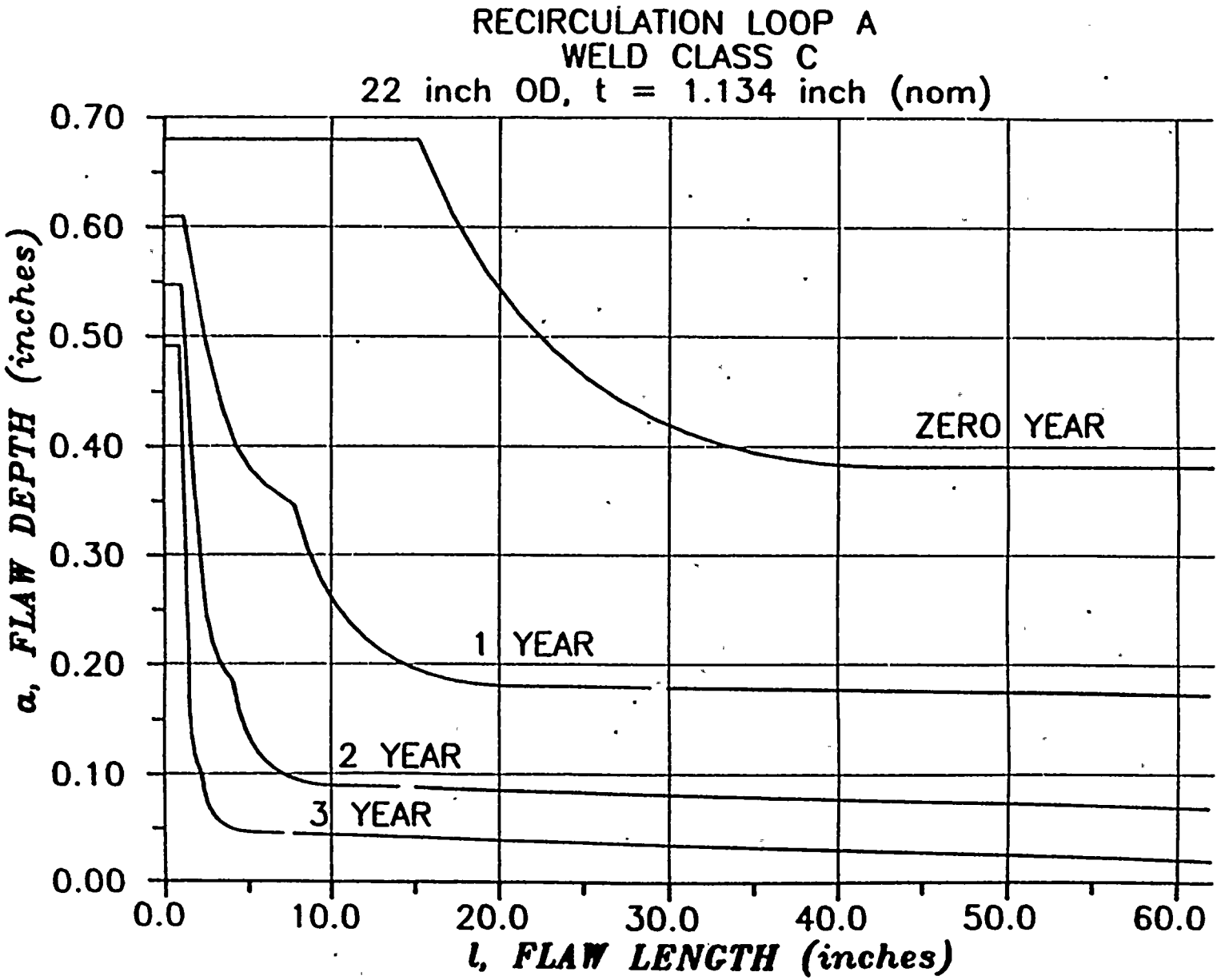

RESIDUAL HEAT REMOVAL
WELD CLASS B2
23.728 inch OD, t=1.020 inch(min)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
l, FLAW LENGTH (inches)

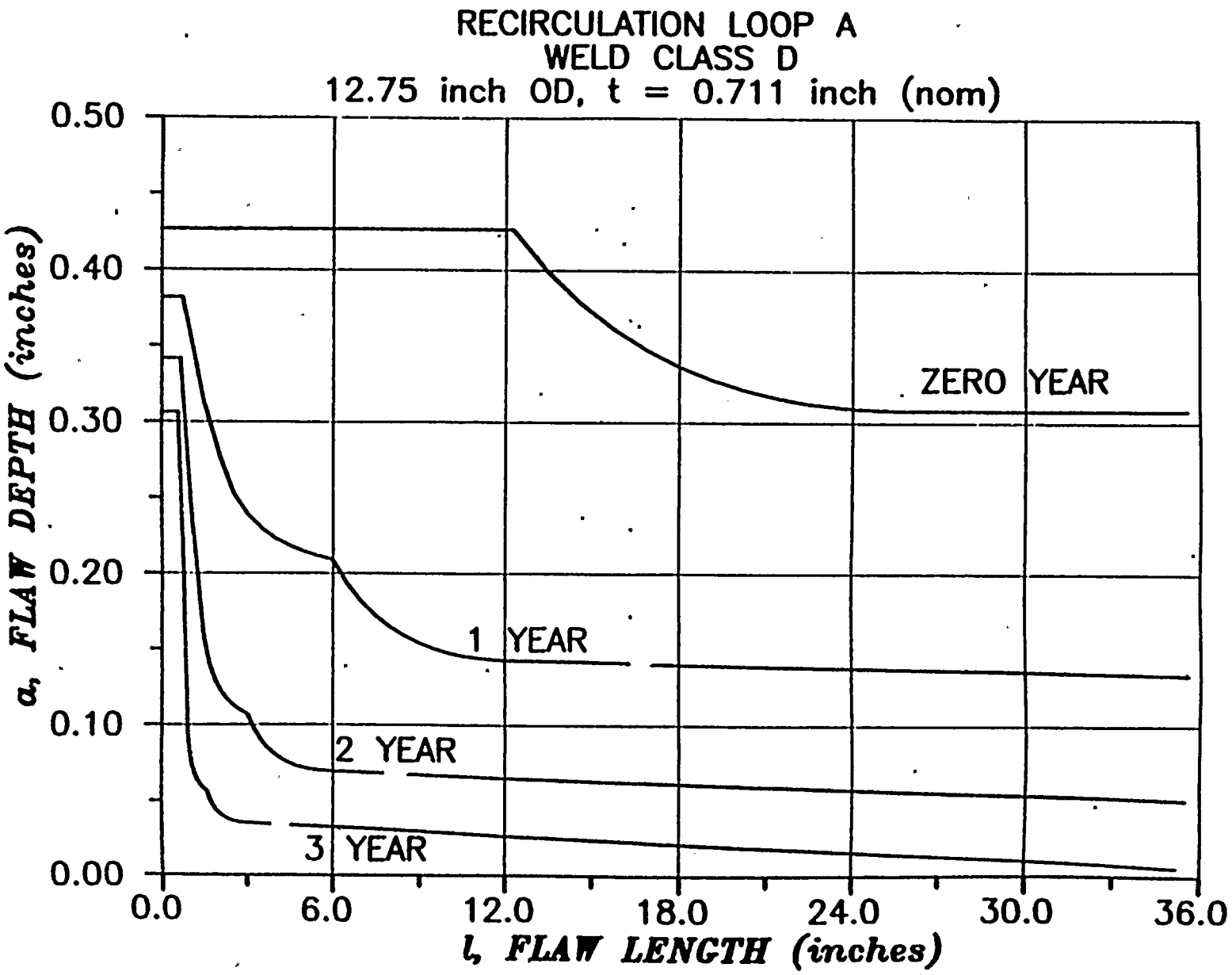

REACTOR WATER CLEANUP
WELD CLASS A
4.5 inch OD, t= 0.337 inch (nom)
0.25
0.20
0.15
0.10
0.05
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
2.0
4.0
6.0
8.0
10.0
12.0
l, FLAW LENGTH (inches)

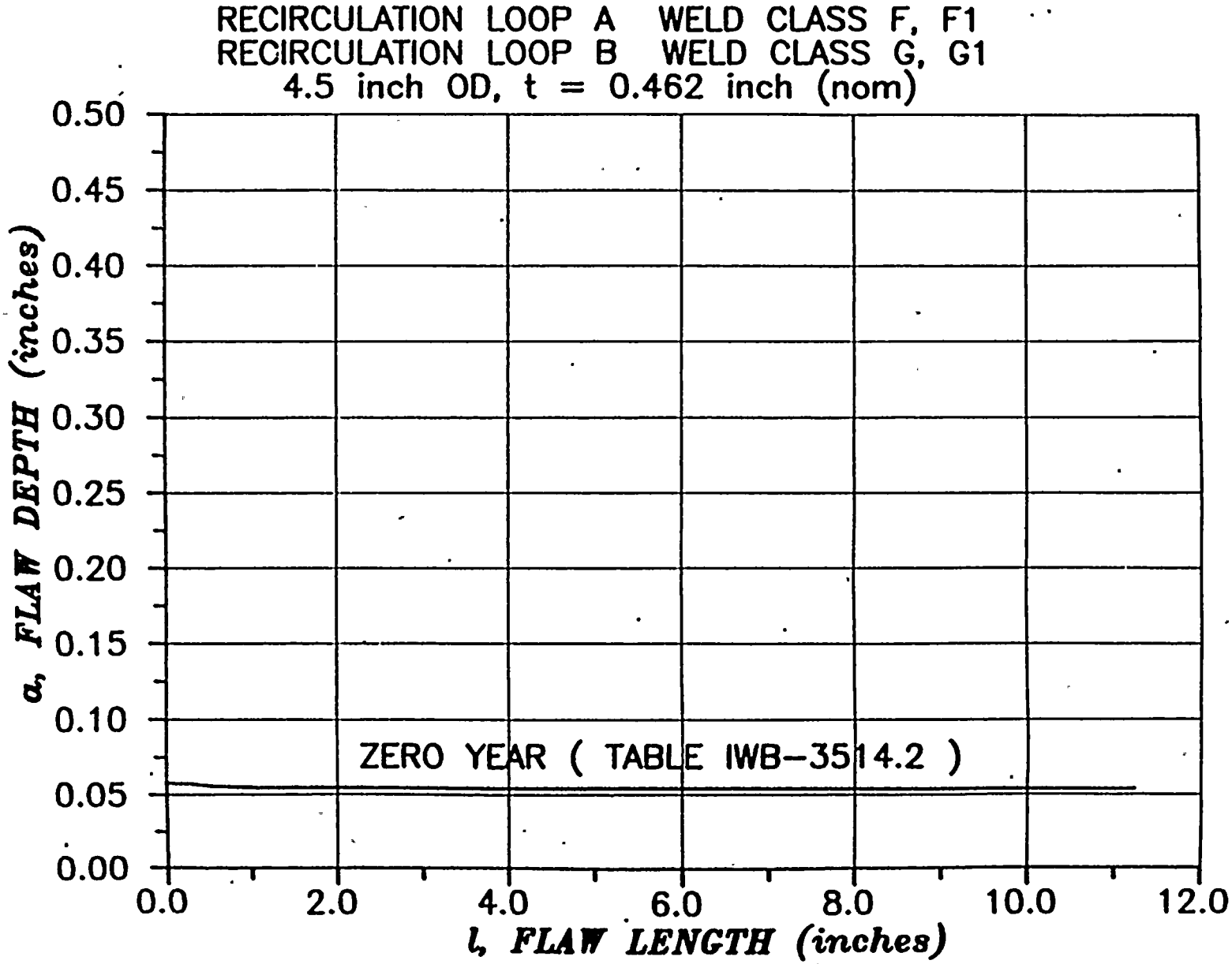

REACTOR WATER CLEANUP WELD CLASS A1
RECIRCULATION LOOP A WELD CLASS E, E1
RECIRCULATION LOOP B WELD CLASS F
4.5 inch OD, t = 0.337 inch (nom)
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
a, FLAW DEPTH (inches)
ZERO YEAR→(TABLE IWB-3514.2)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
l, FLAW LENGTH (inches)

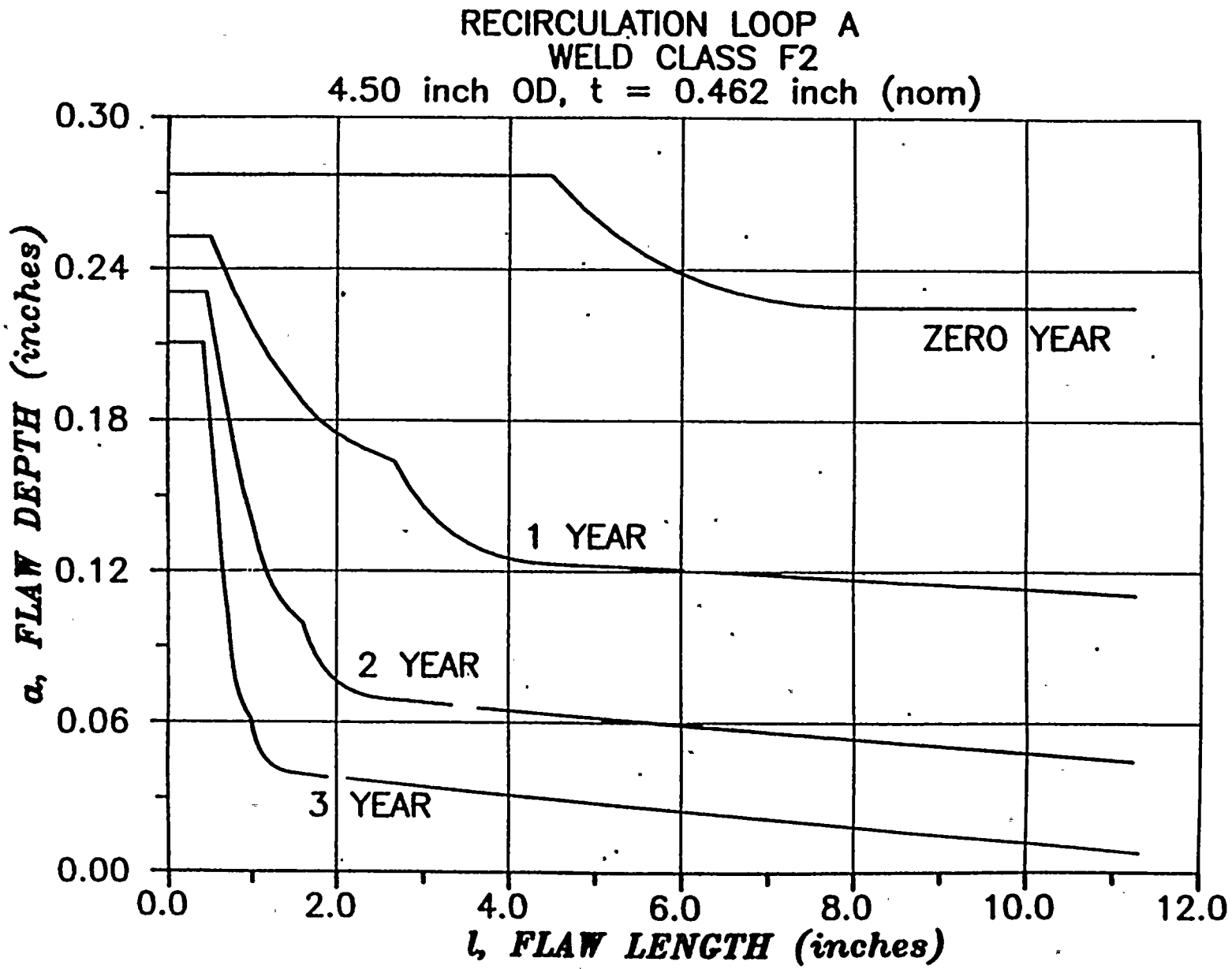

RECIRCULATION LOOP A
WELD CLASS A
28 inch OD, t = 1.201 inch (nom)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
l, FLAW LENGTH (inches)


RECIRCULATION LOOP A
WELD CLASS B
28 inch OD, t = 1.408 inch (nom)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
l, FLAW LENGTH (inches)

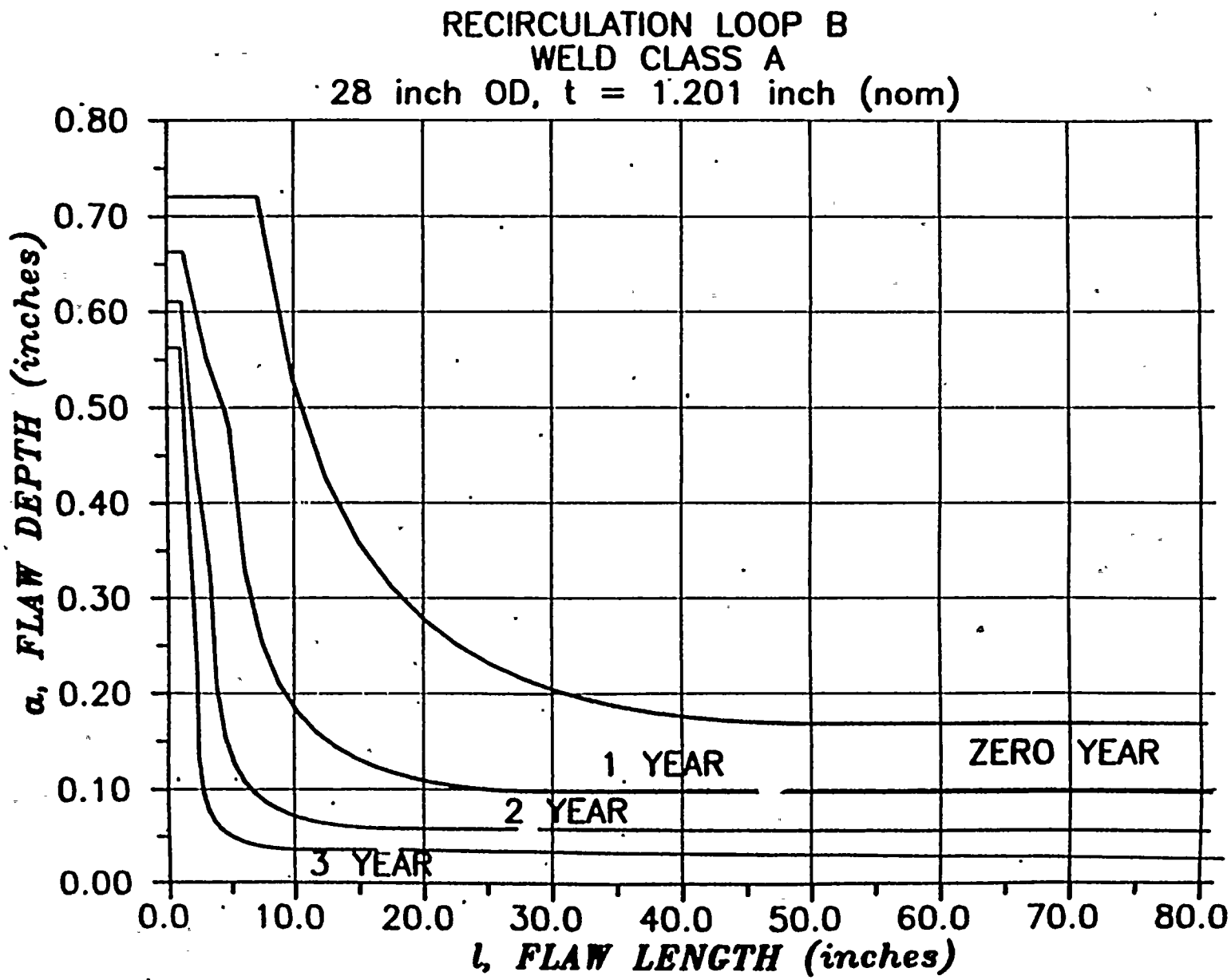

RECIRCULATION LOOP A
WELD CLASS C
22 inch OD, t = 1.134 inch (nom)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
l, FLAW LENGTH (inches)

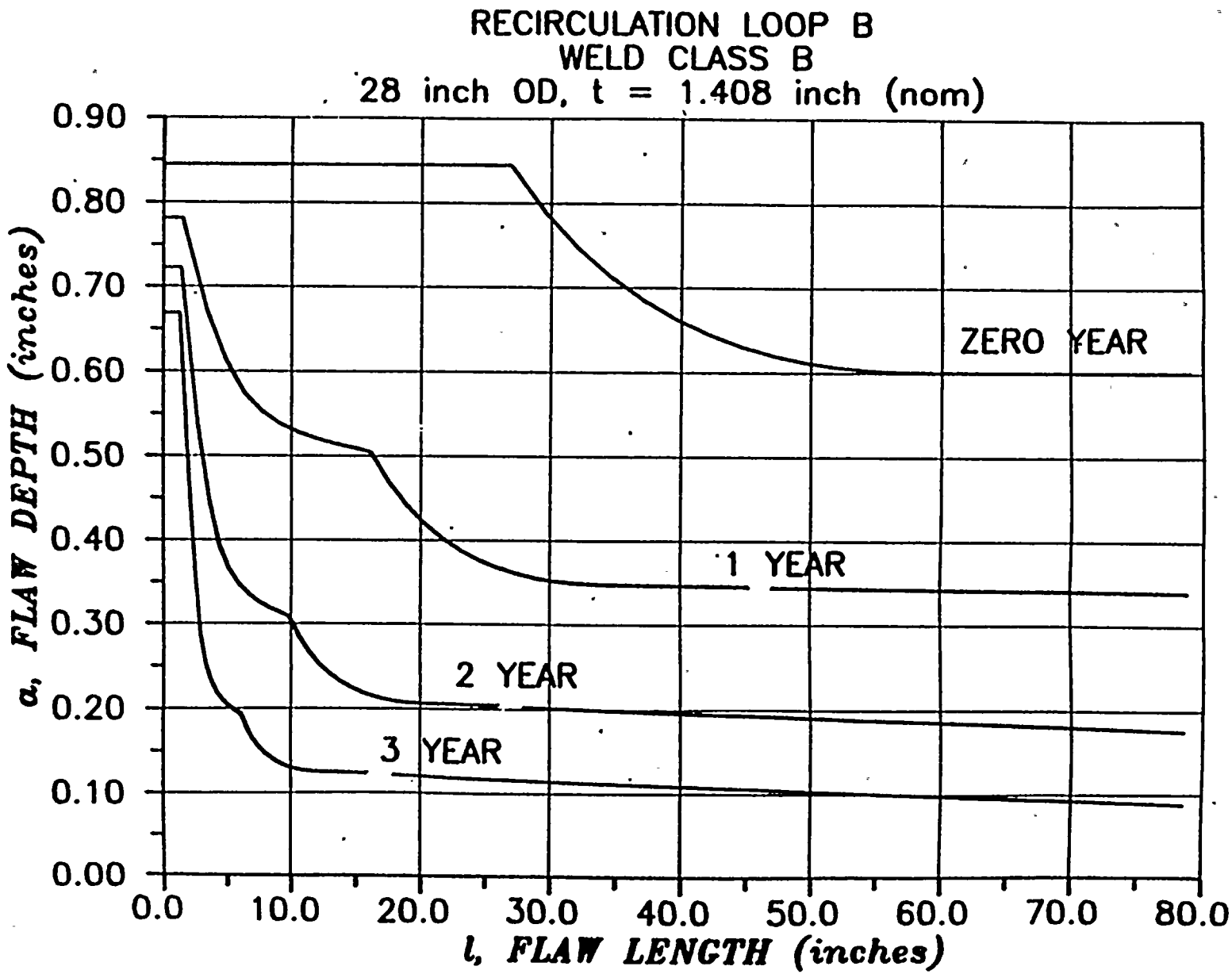

RECIRCULATION LOOP A
WELD CLASS D
12.75 inch OD, t = 0.711 inch (nom)
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
6.0
12.0
18.0
24.0
30.0
36.0
l, FLAW LENGTH (inches)

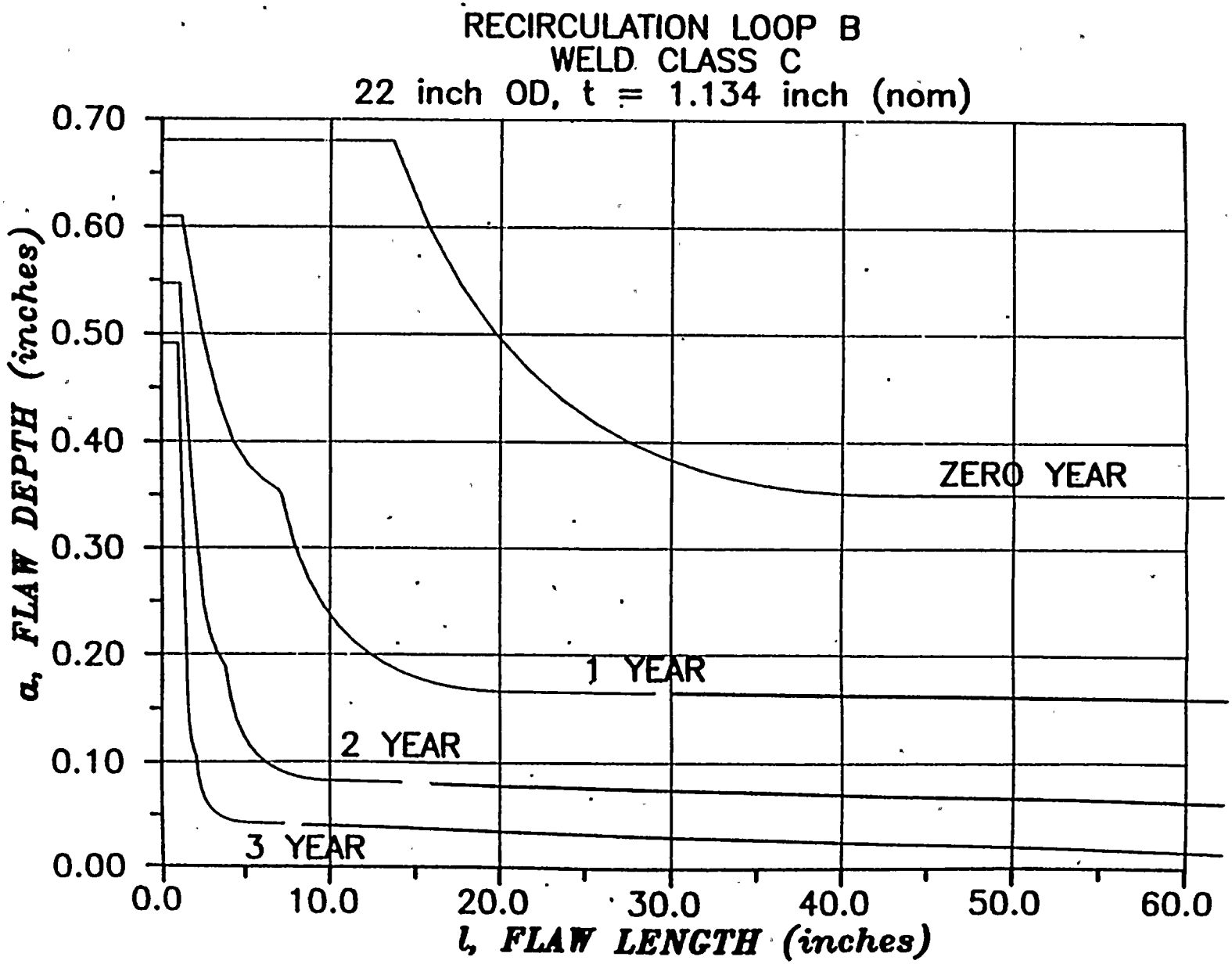

RECIRCULATION LOOP A WELD CLASS F, F1
RECIRCULATION LOOP B WELD CLASS G, G1
4.5 inch OD, t = 0.462 inch (nom)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
a, FLAW DEPTH (inches)
ZERO YEAR (TABLE IWB-3514.2)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
l, FLAW LENGTH (inches)

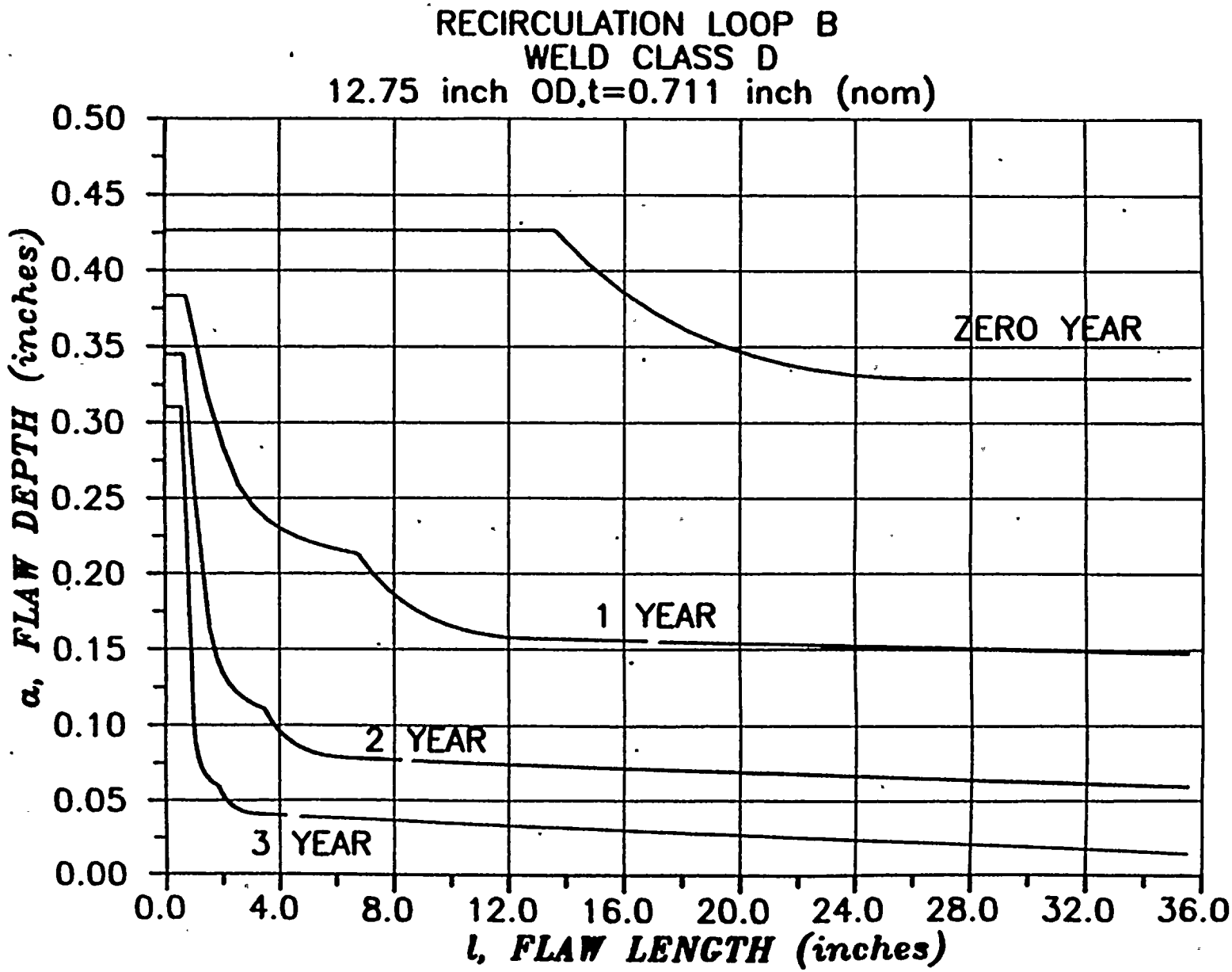


NOTE: Use this curve only for Weldolet side of weld. Flaws in the 28" ø run pipe adjacent to the weldolet weld must be evaluated on a case by case basis.


RECIRCULATION LOOP B
WELD CLASS A
28 inch OD, t = 1.201 inch (nom)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
1 YEAR
ZERO YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
l, FLAW LENGTH (inches)


RECIRCULATION LOOP B
WELD CLASS B
28 inch OD, t = 1.408 inch (nom)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
l, FLAW LENGTH (inches)


RECIRCULATION LOOP B
WELD CLASS C
22 inch OD, t = 1.134 inch (nom)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
10.0
20.0
30.0
40.0
50.0
60.0
l, FLAW LENGTH (inches)


RECIRCULATION LOOP B
WELD CLASS D
12.75 inch OD,t=0.711 inch (nom)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
a, FLAW DEPTH (inches)
ZERO YEAR
1 YEAR
2 YEAR
3 YEAR
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
l, FLAW LENGTH (inches)

Appendix A

FLAW DIAGRAMS FOR 15 WELDS IN WELD CATEGORY C

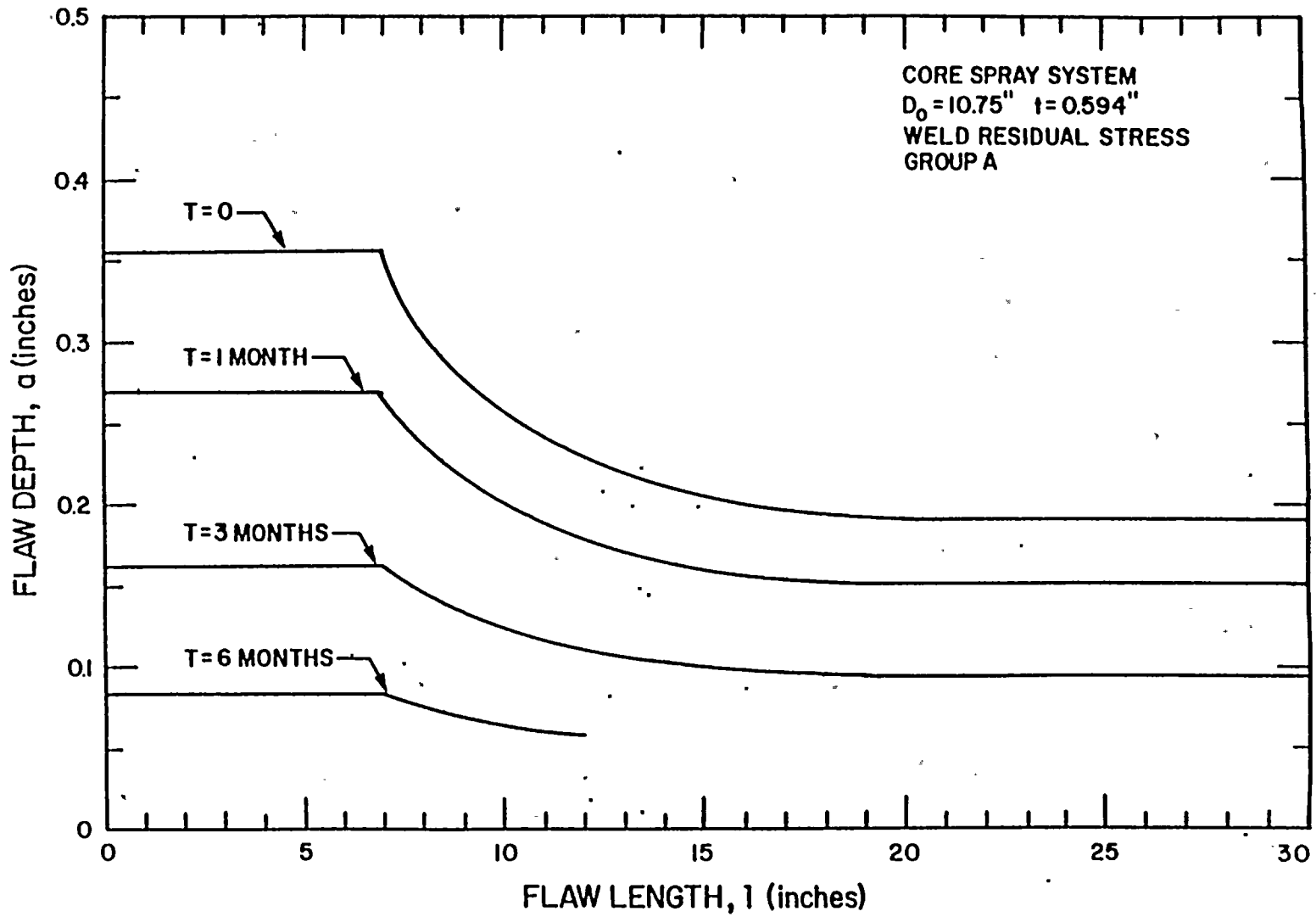


Figure A-1 - Allowable Flaw Sizes For Core Spray System For Weld Group A (Weld Category C).

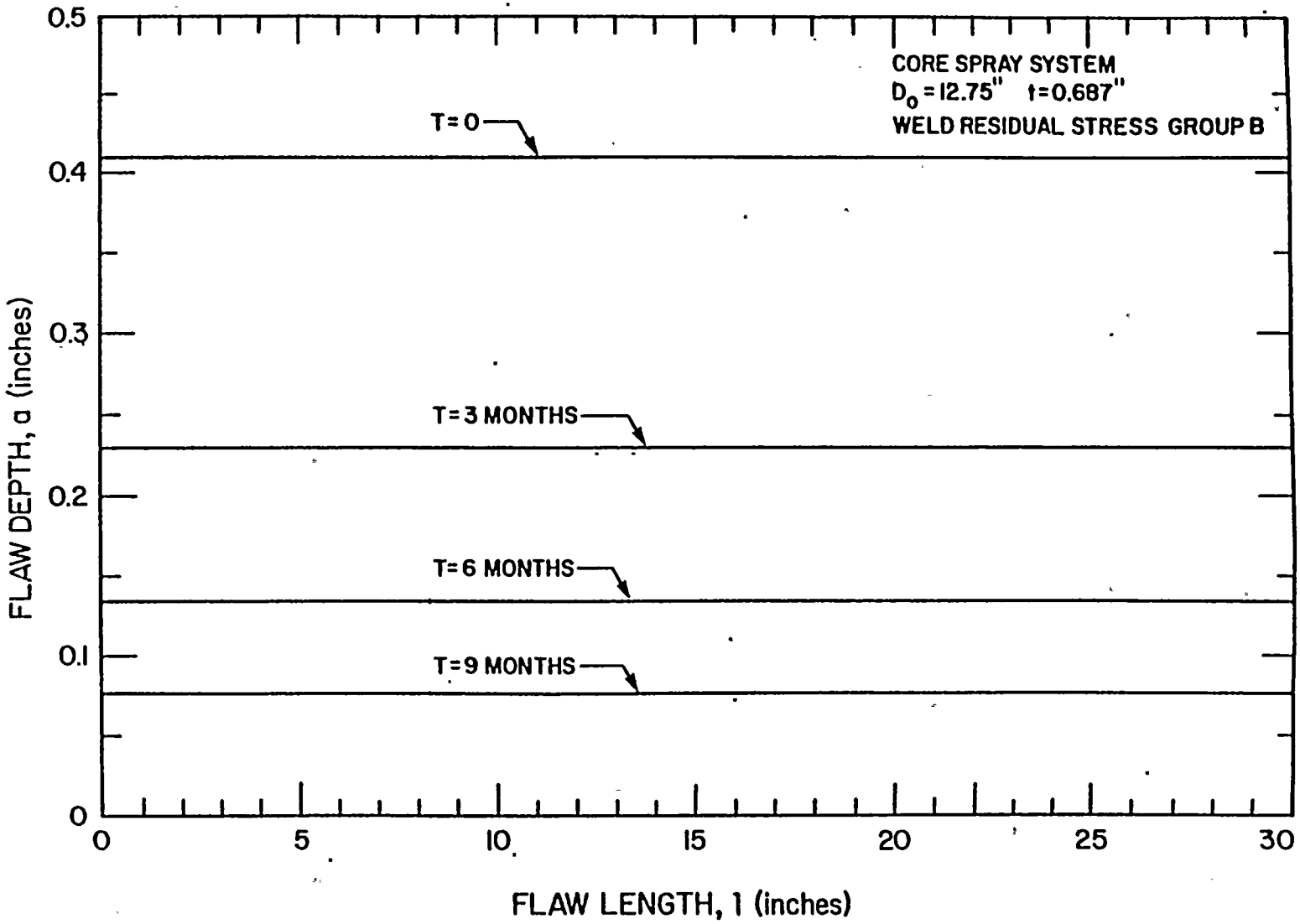


Figure A-2 - Allowable Flaw Sizes For Core Spray For Weld Group B (Weld Category C).

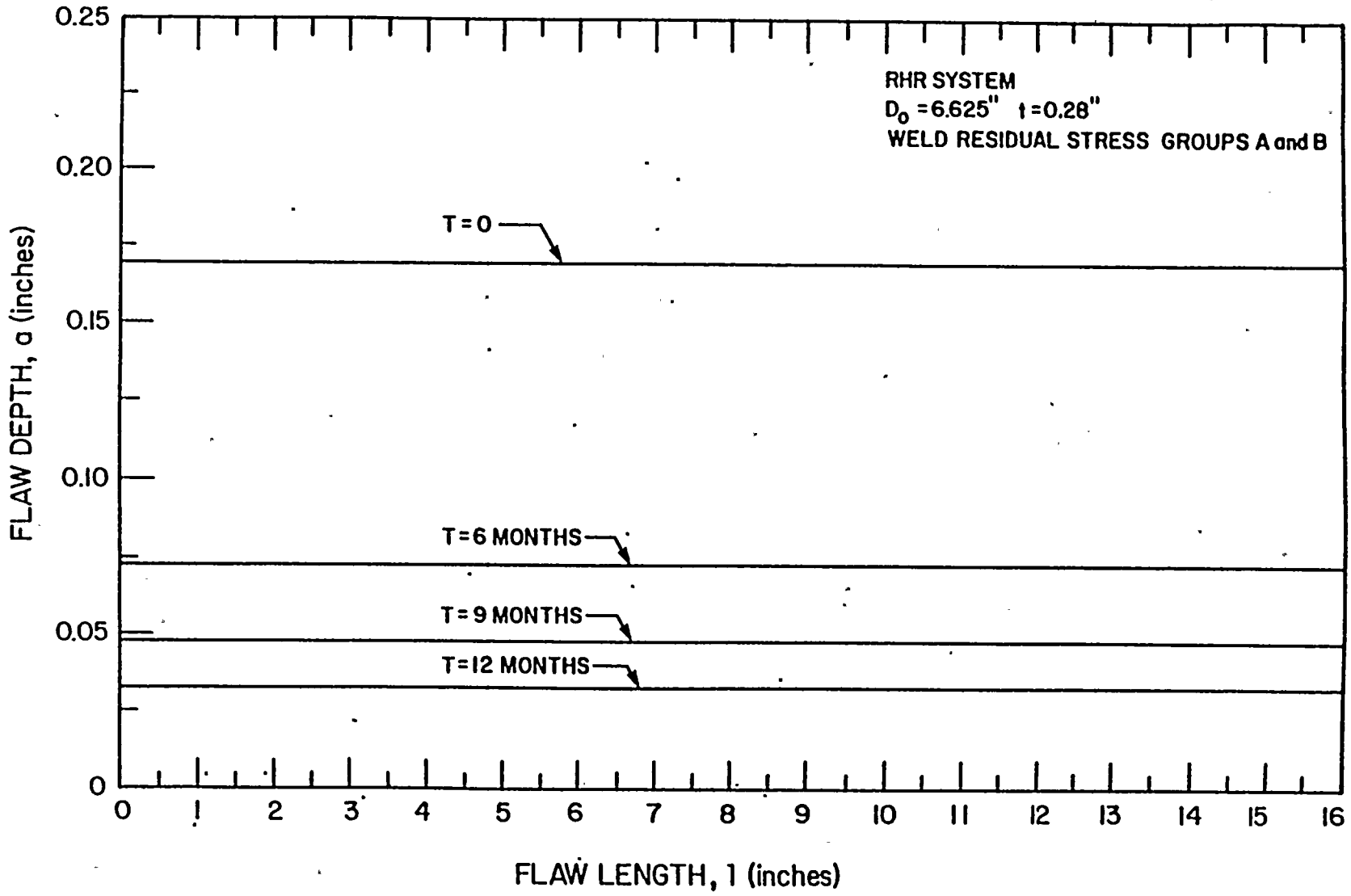


Figure A-3 - Allowable Flaw Sizes For Residual Heat Removal System For Weld Groups A and B (Weld Category C).

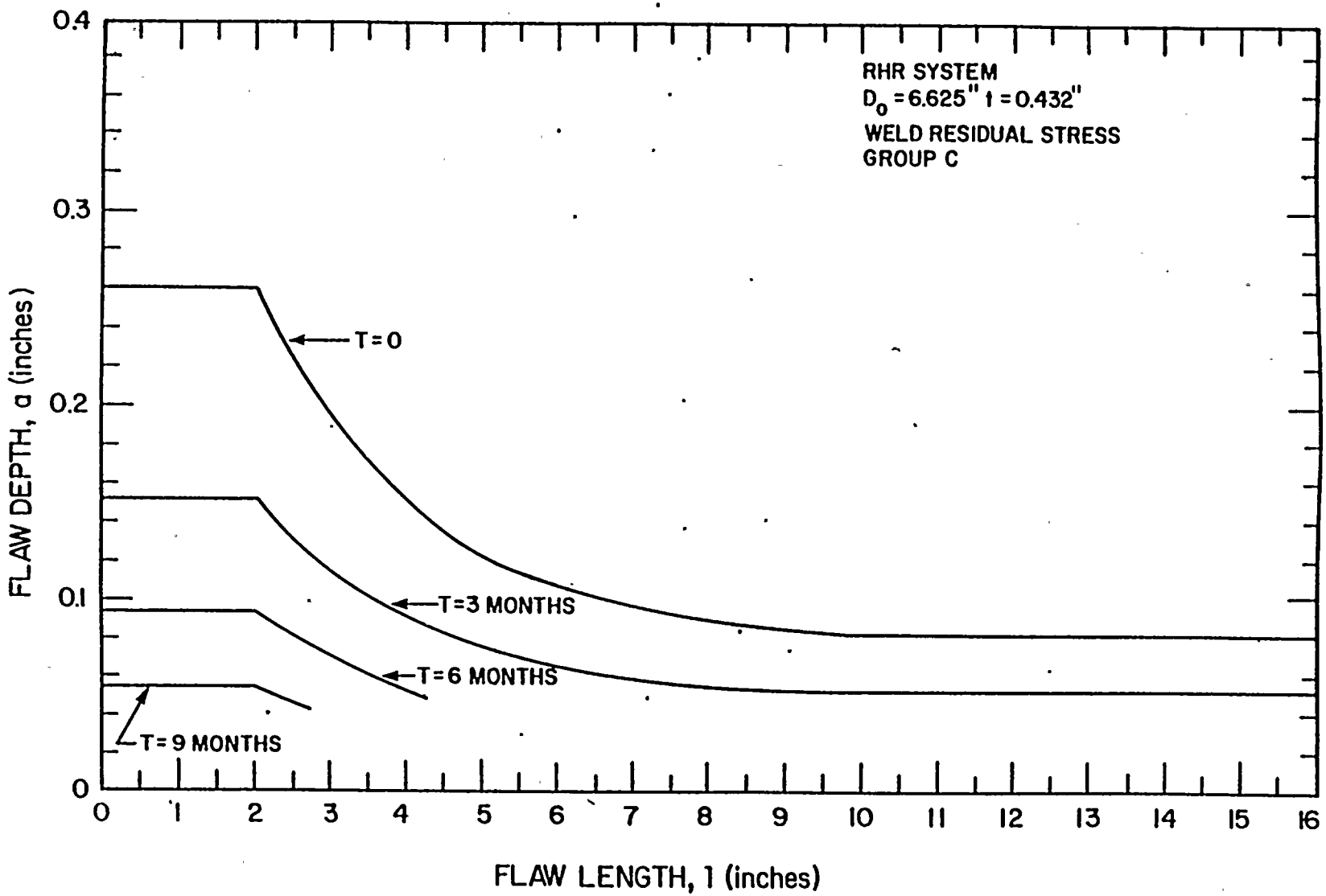


Figure A-4 - Allowable Flaw Sizes For Residual Heat Removal System For Weld Group C (Weld Category C).

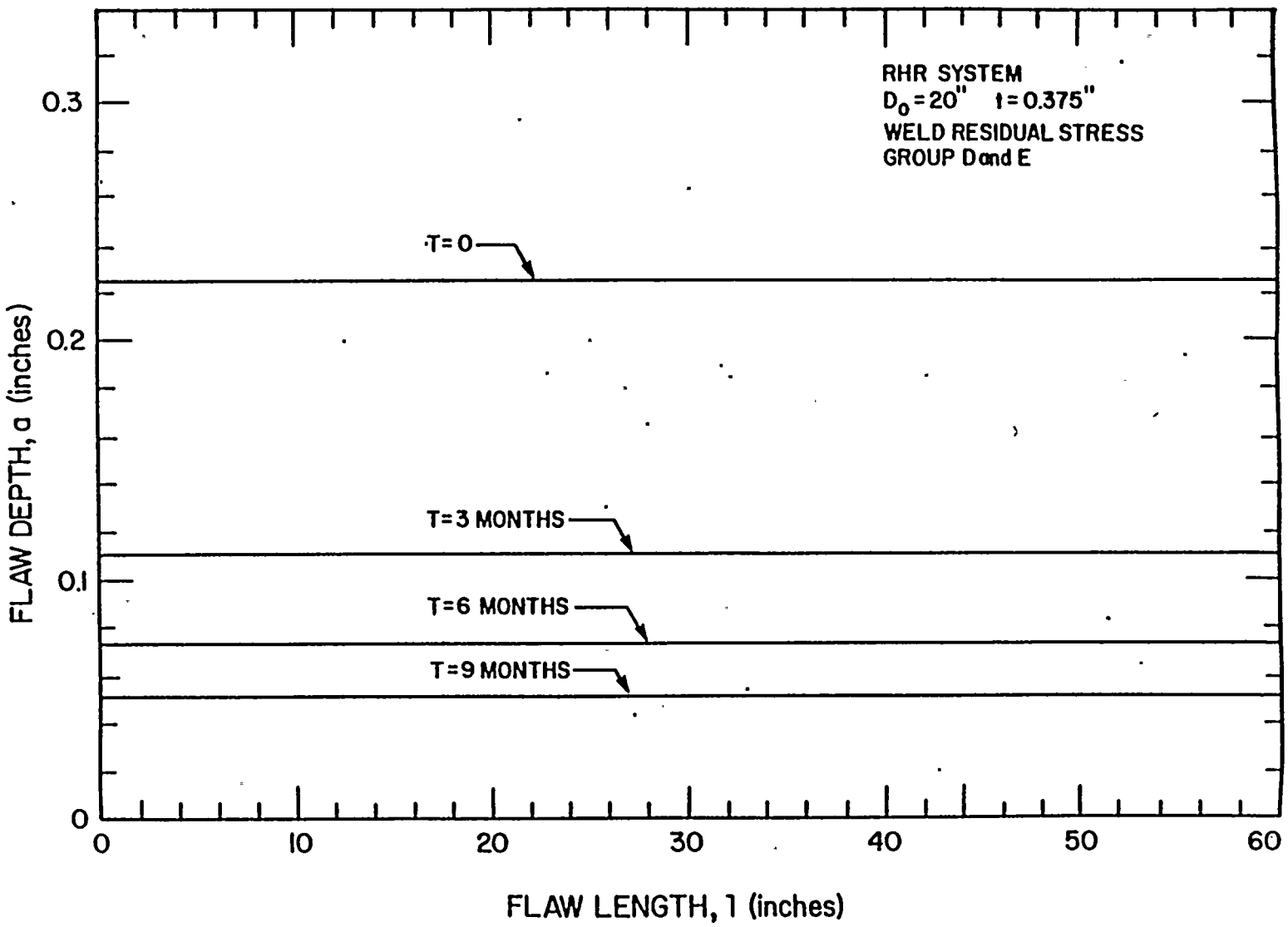


Figure A-5 - Allowable Flaw Sizes For Residual Heat Removal System For Weld Groups D and E (Weld Category C).

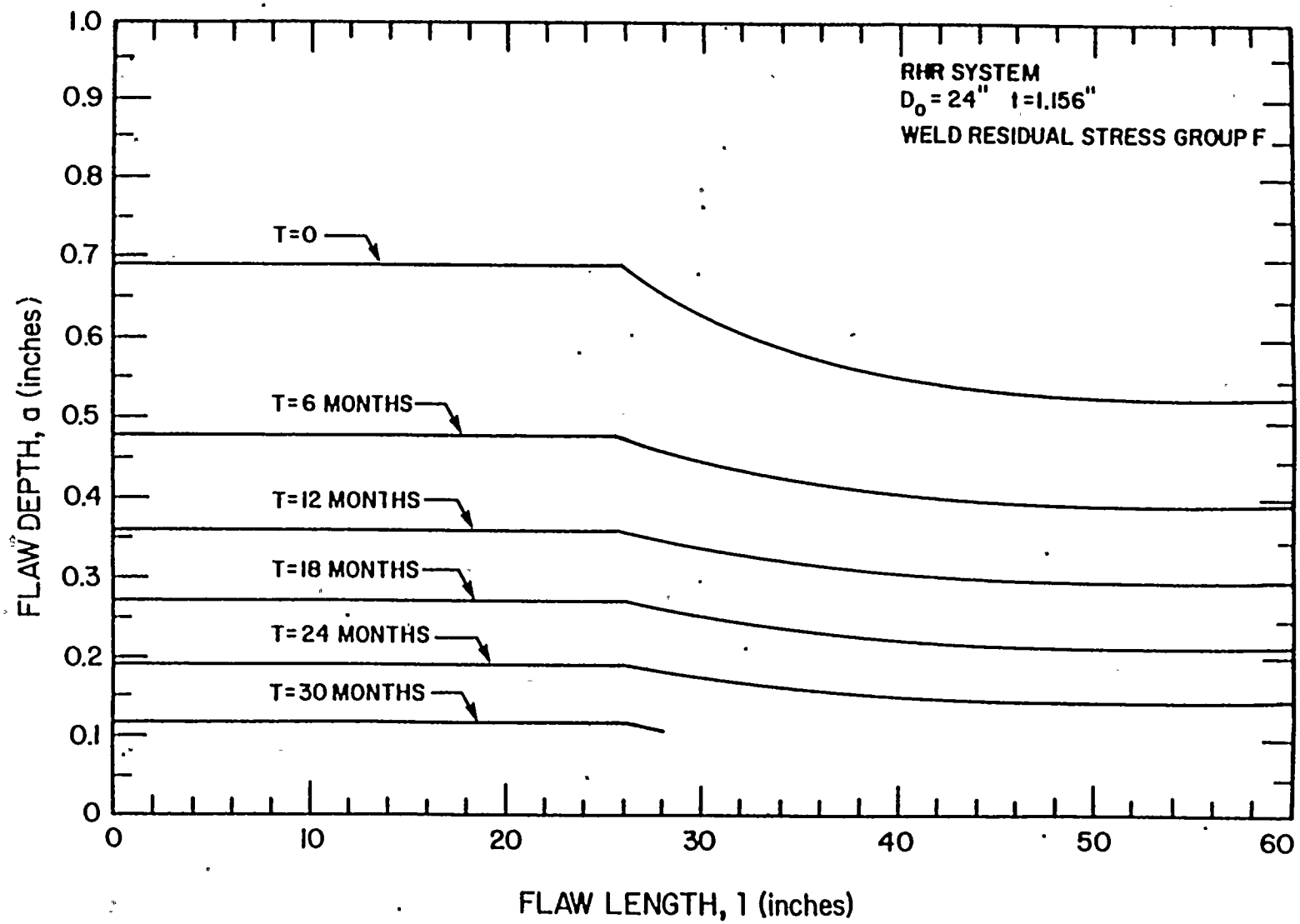


Figure A-6 - Allowable Flaw Sizes For Residual Heat Removal System For Weld Group F (Weld Category C).

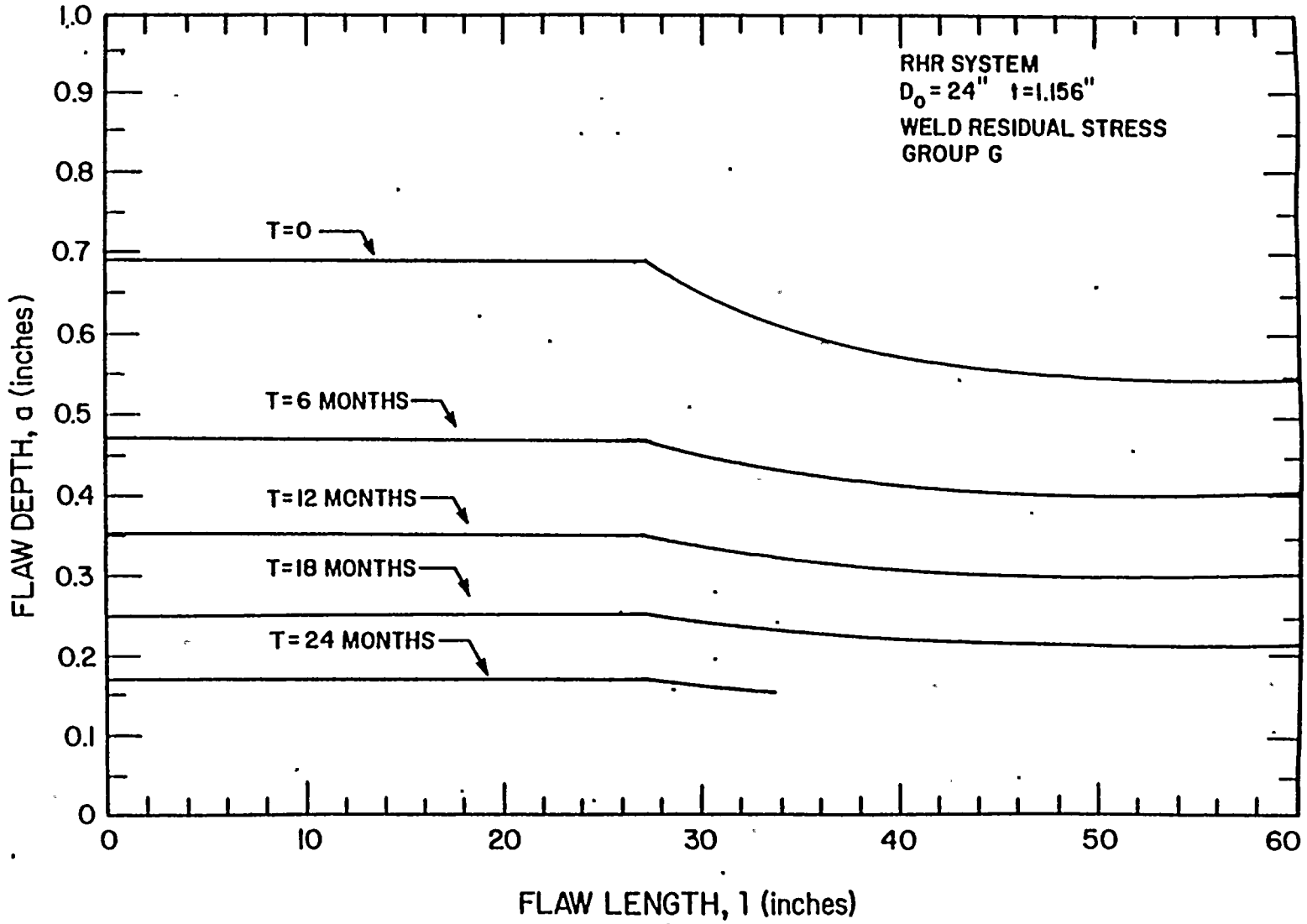


Figure A-7 - Allowable Flaw Sizes For Residual Heat Removal System For Weld Group G (Weld Category C)..