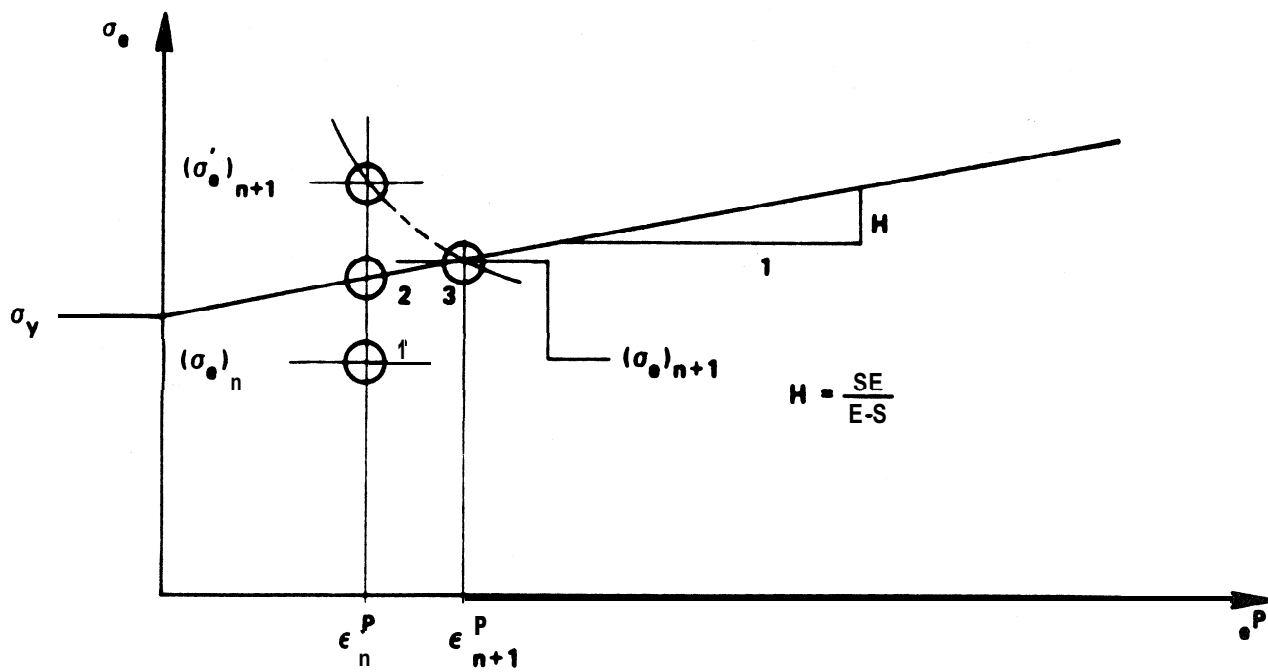


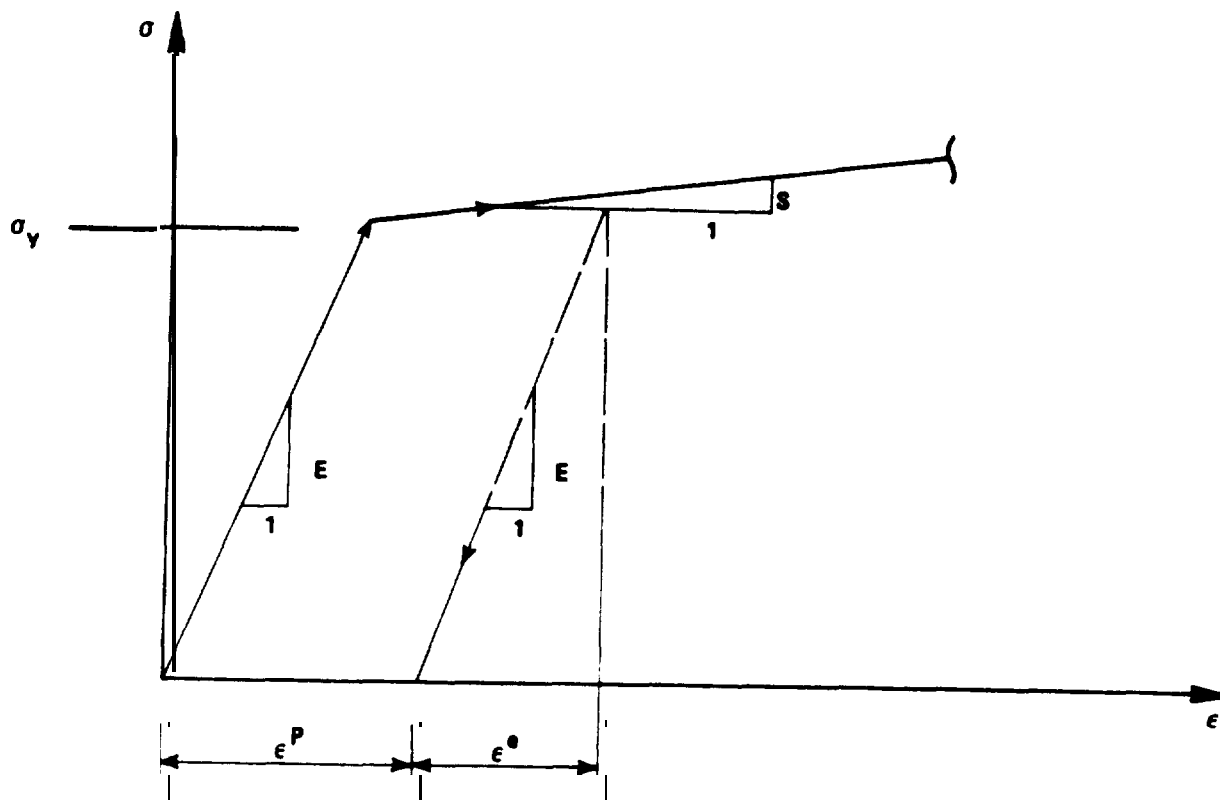
STRAIGHT PIPE ELEMENT

FIGURE: 2.1.1



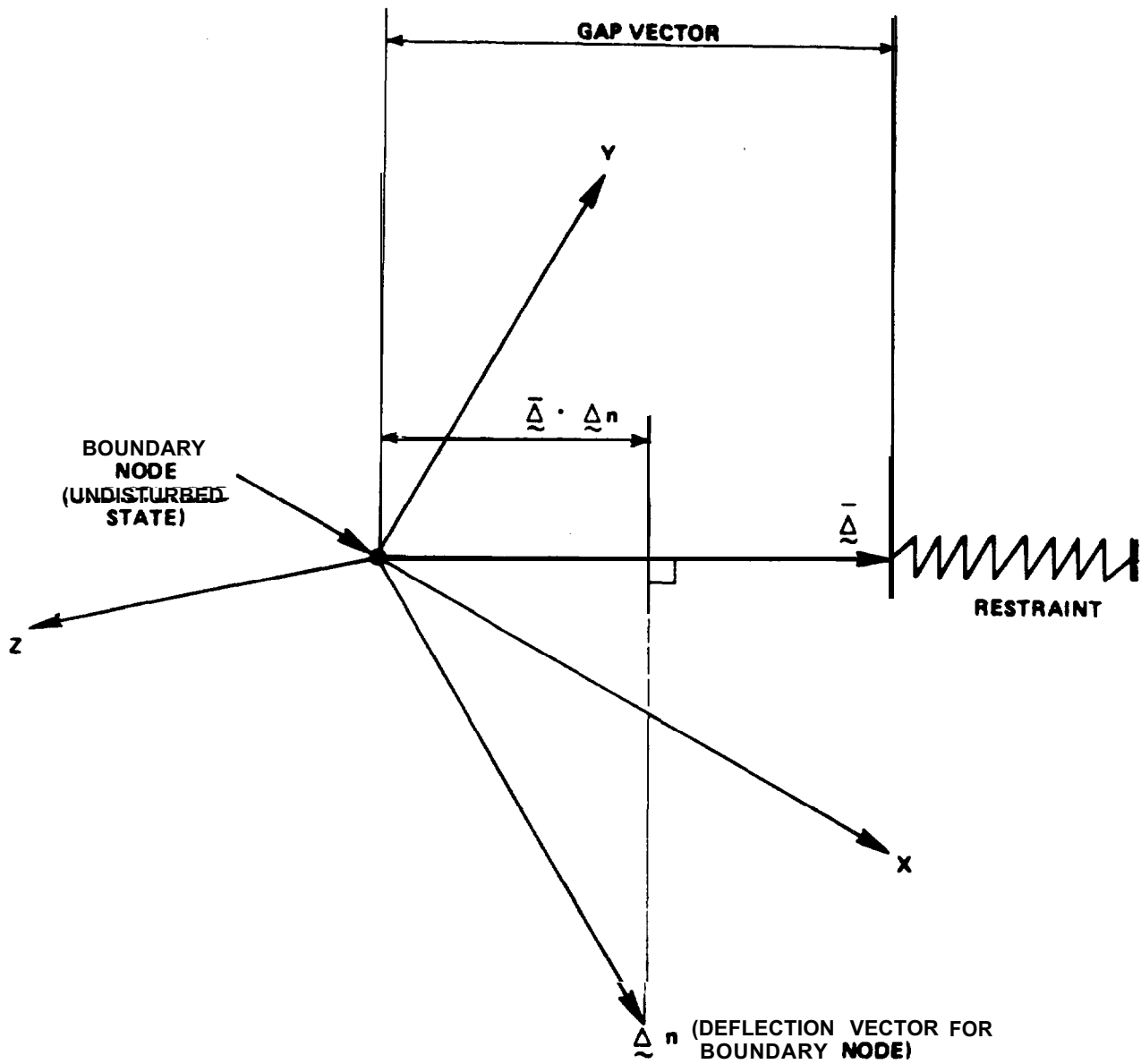
EFFECTIVE STRESS STRAIN CURVE

FIGURE: 2.1.2



STRESS - STRAIN CURVE FOR A BI-LINEAR STRAIN HARDENING MATERIAL

FIGURE: 2.1.3



GAP MODEL AT RESTRAINT

FIGURE: 2.1.4

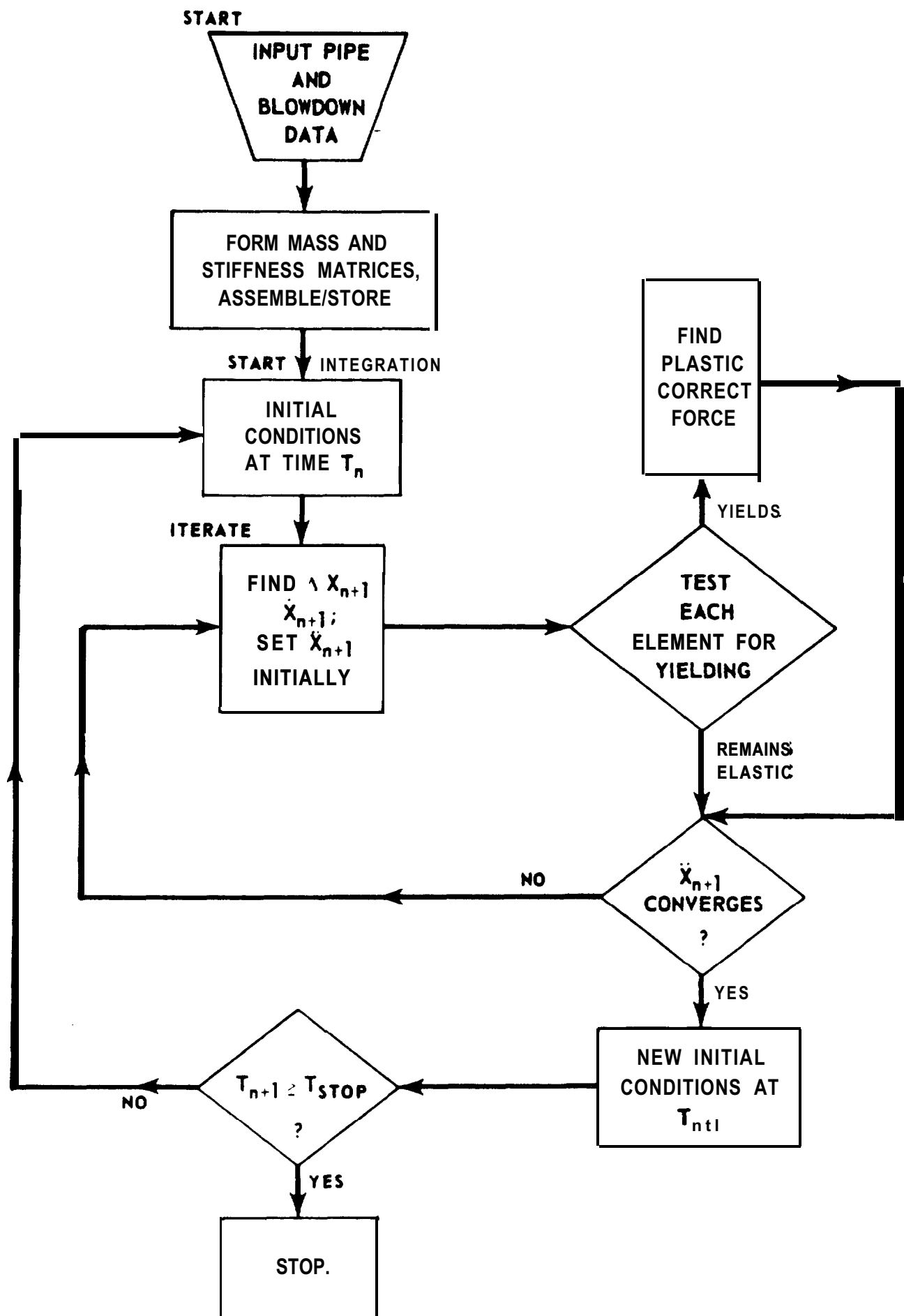


FIGURE 2.1.5

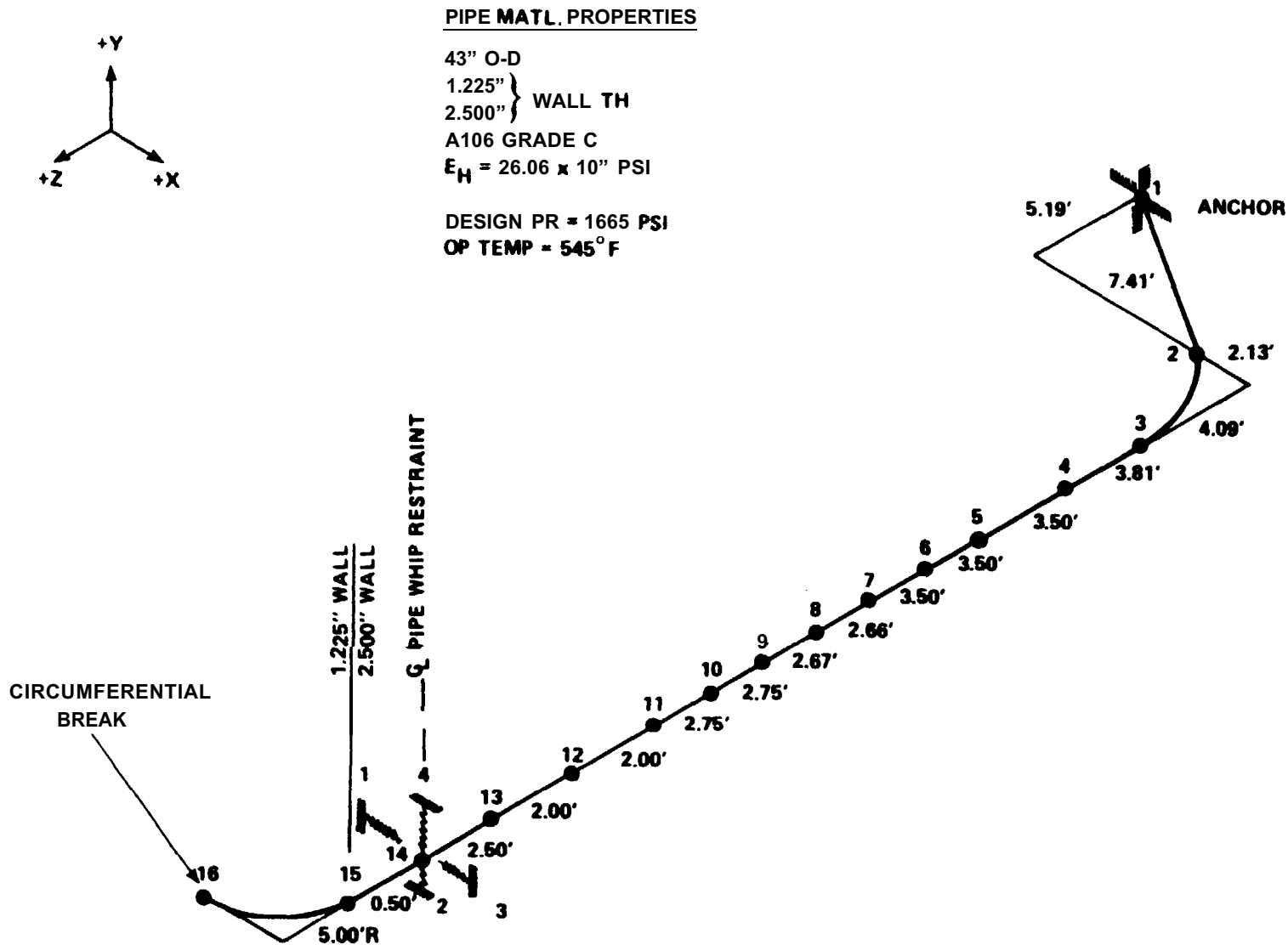
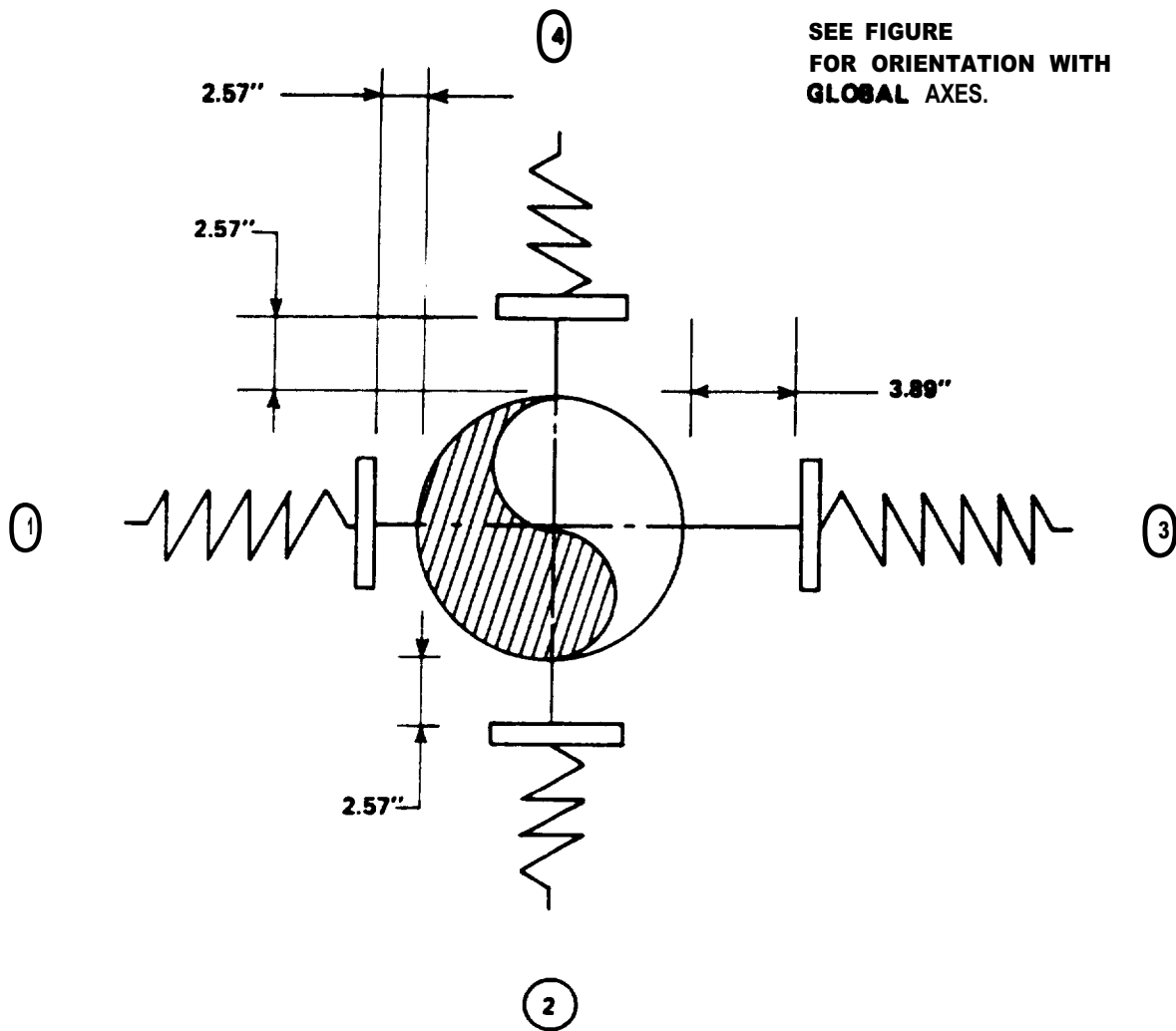
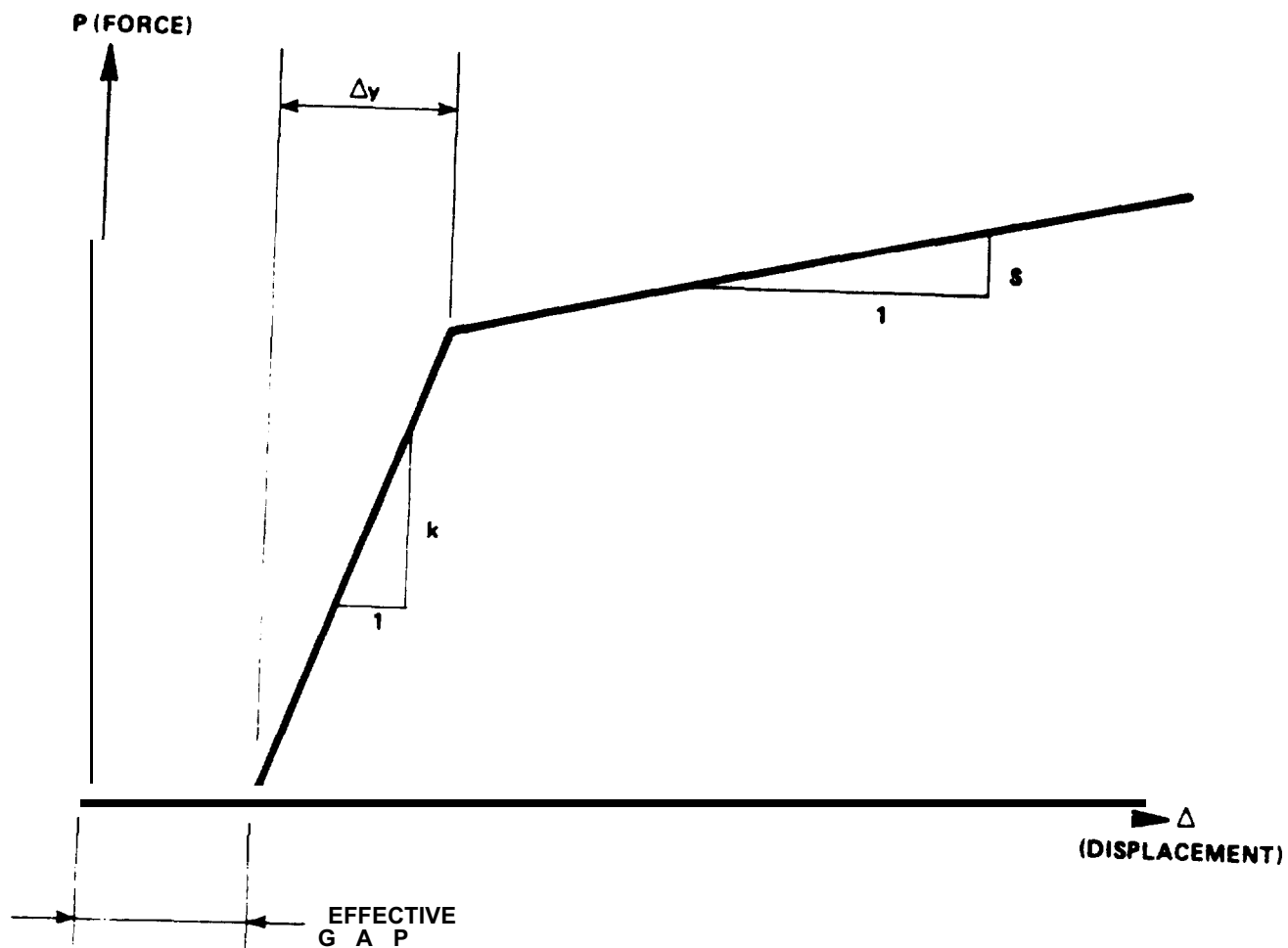


FIGURE: 2.3.1



EFFECTIVE GAPS AT RESTRAINT AT NODE 14

FIGURE: 2.3.2

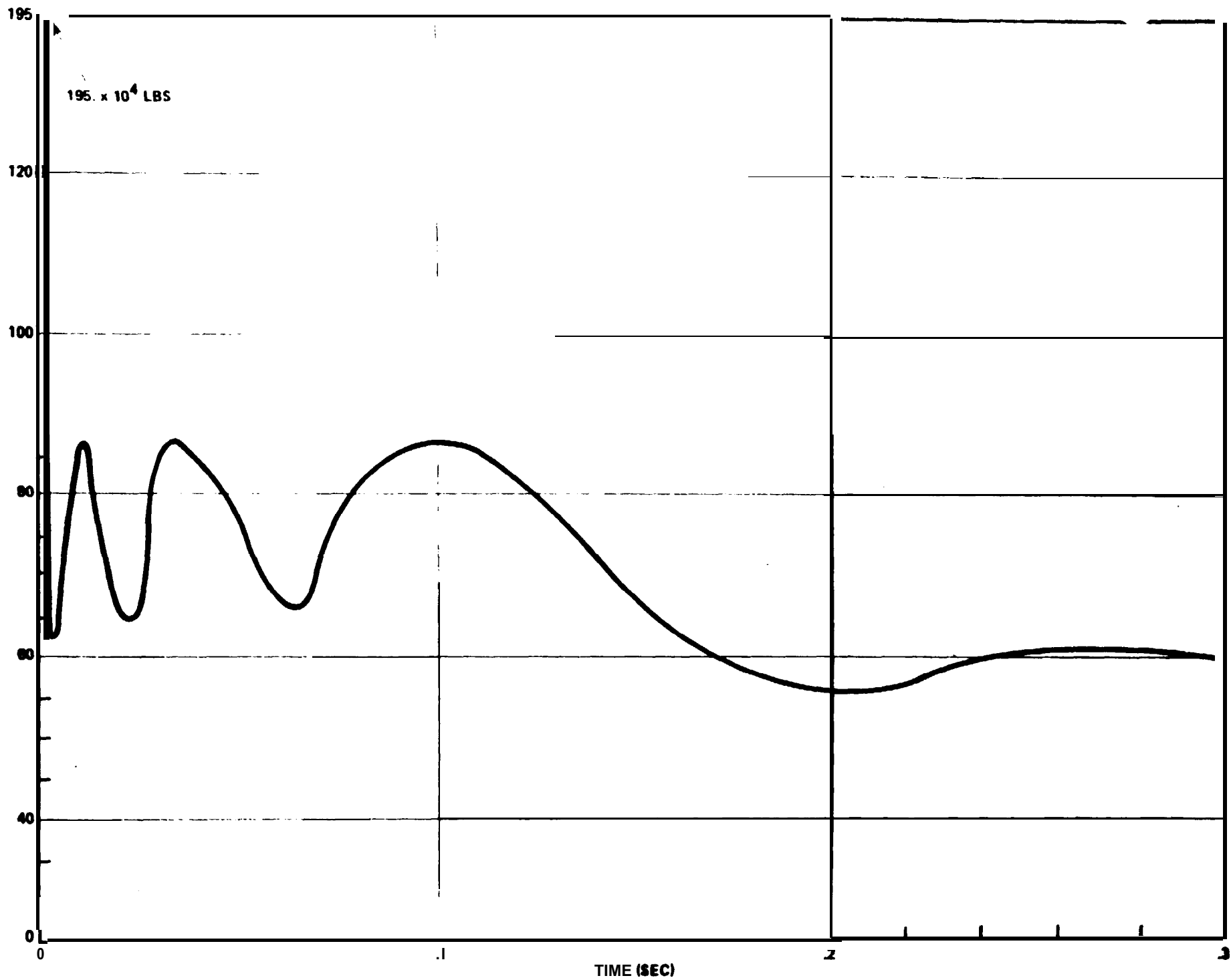


<u>SPRING a</u>	<u>k (psi)</u>	<u>s (psi)</u>	<u>Δy (in)</u>
1	6.66×10^6	2.99×10^4	0.16
2	"	"	"
3	5.95×10^6	"	0.20
4	6.66×10^6	"	0.15

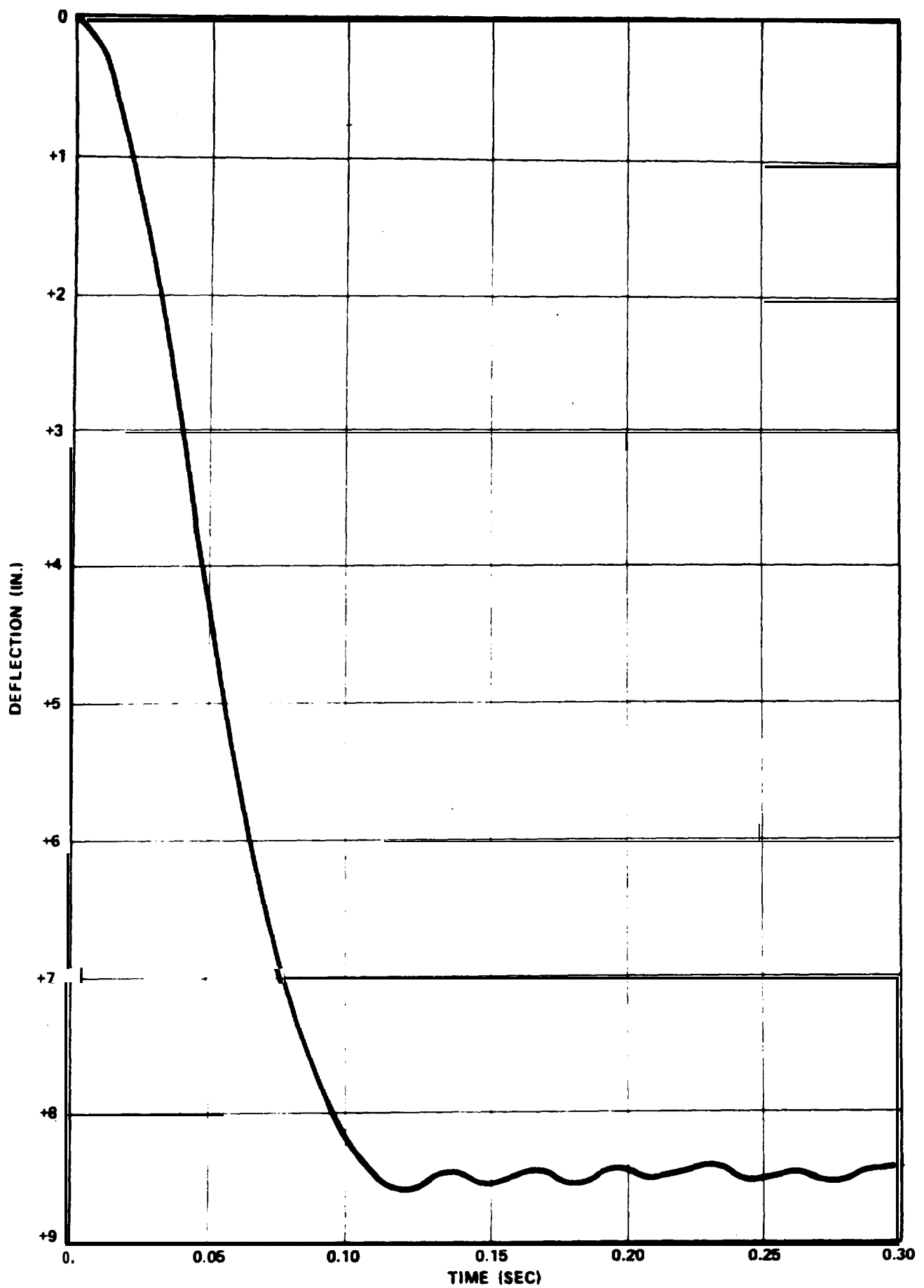
FORCE - DISPLACEMENT DIAGRAM FOR RESTRAINTS

IN 43" MAIN STEAM LINE

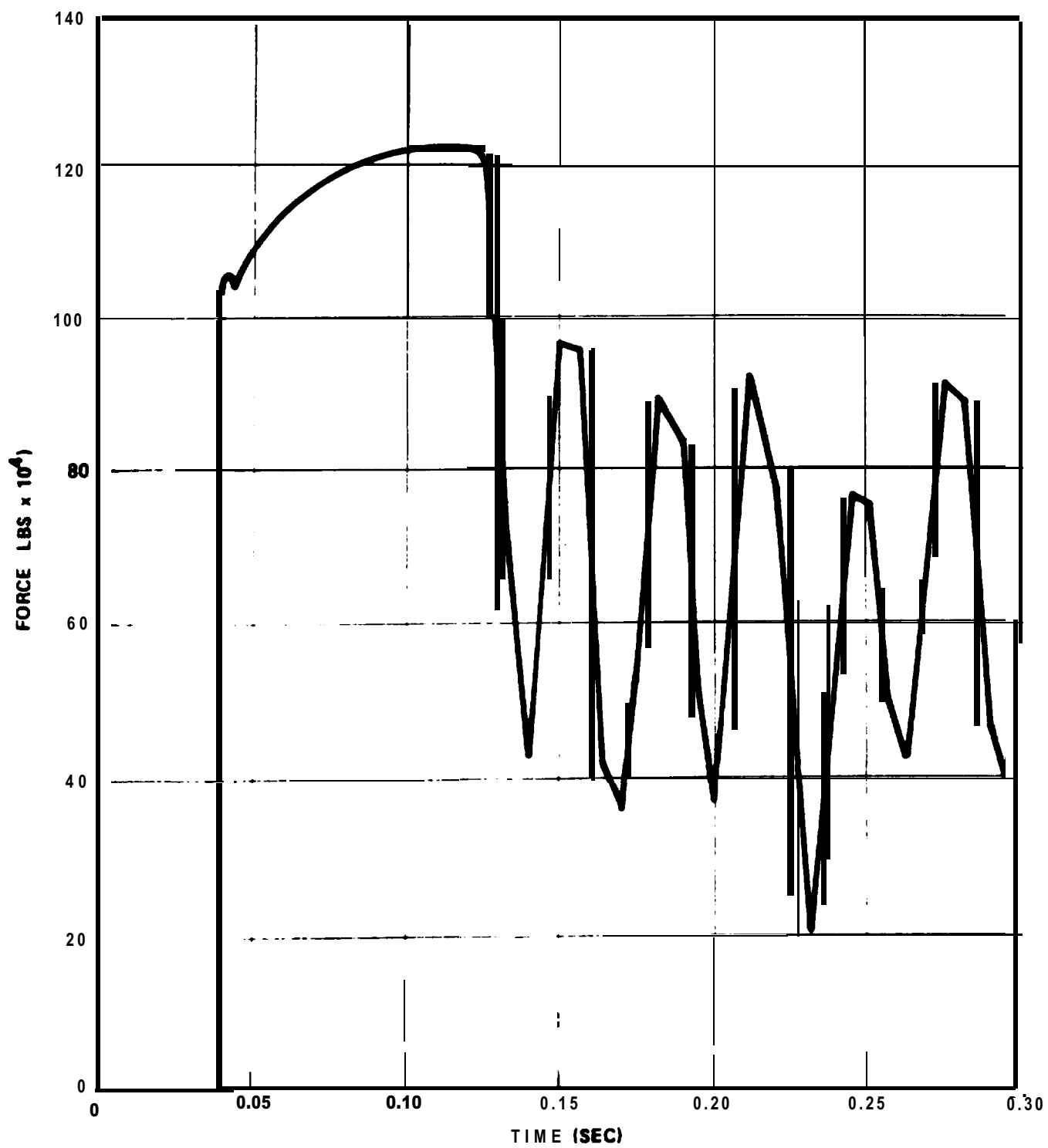
FIGURE: 2.3.3



BLOWDOWN FORCE VS. TIME AT NODE 16 IN MAIN STEAM LINE
FIGURE: 2.3.4

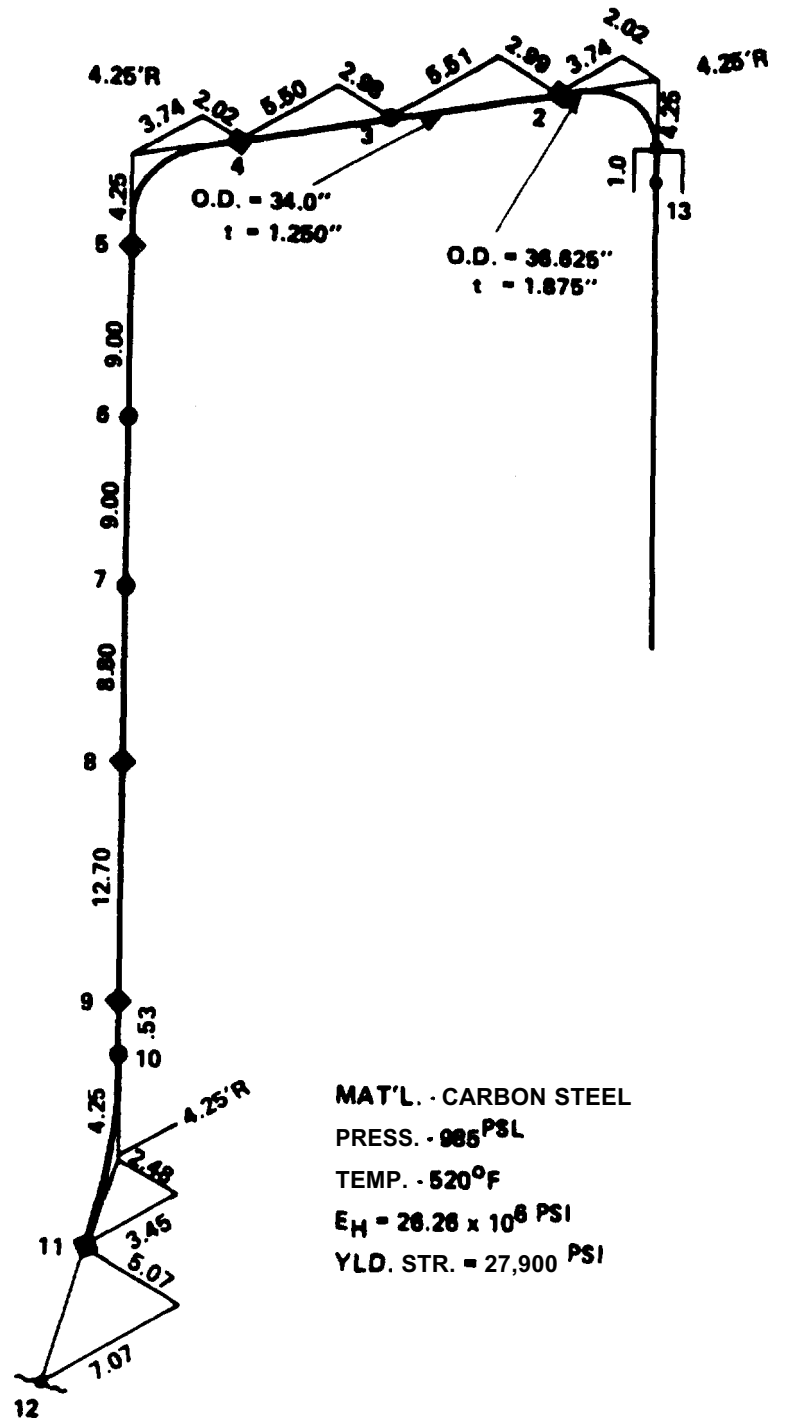
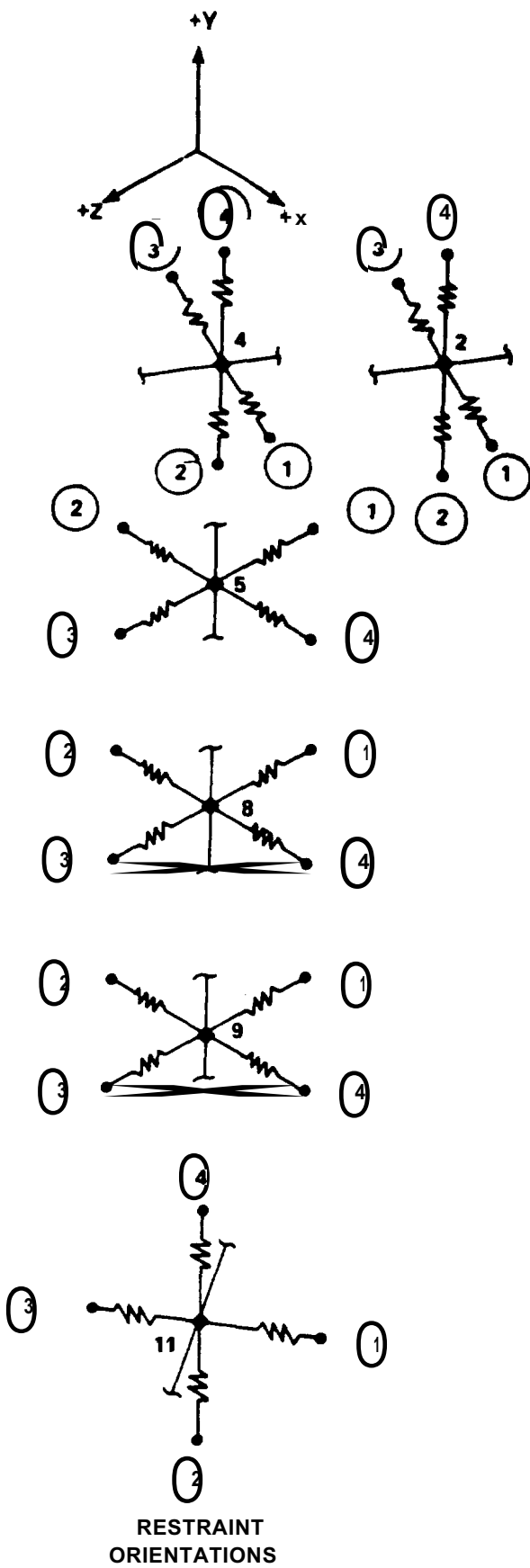


**DEFLECTION OF RESTRAINT
(NODE #14)
IN (+ x) DIRECTION
FIGURE: 2.3.5**



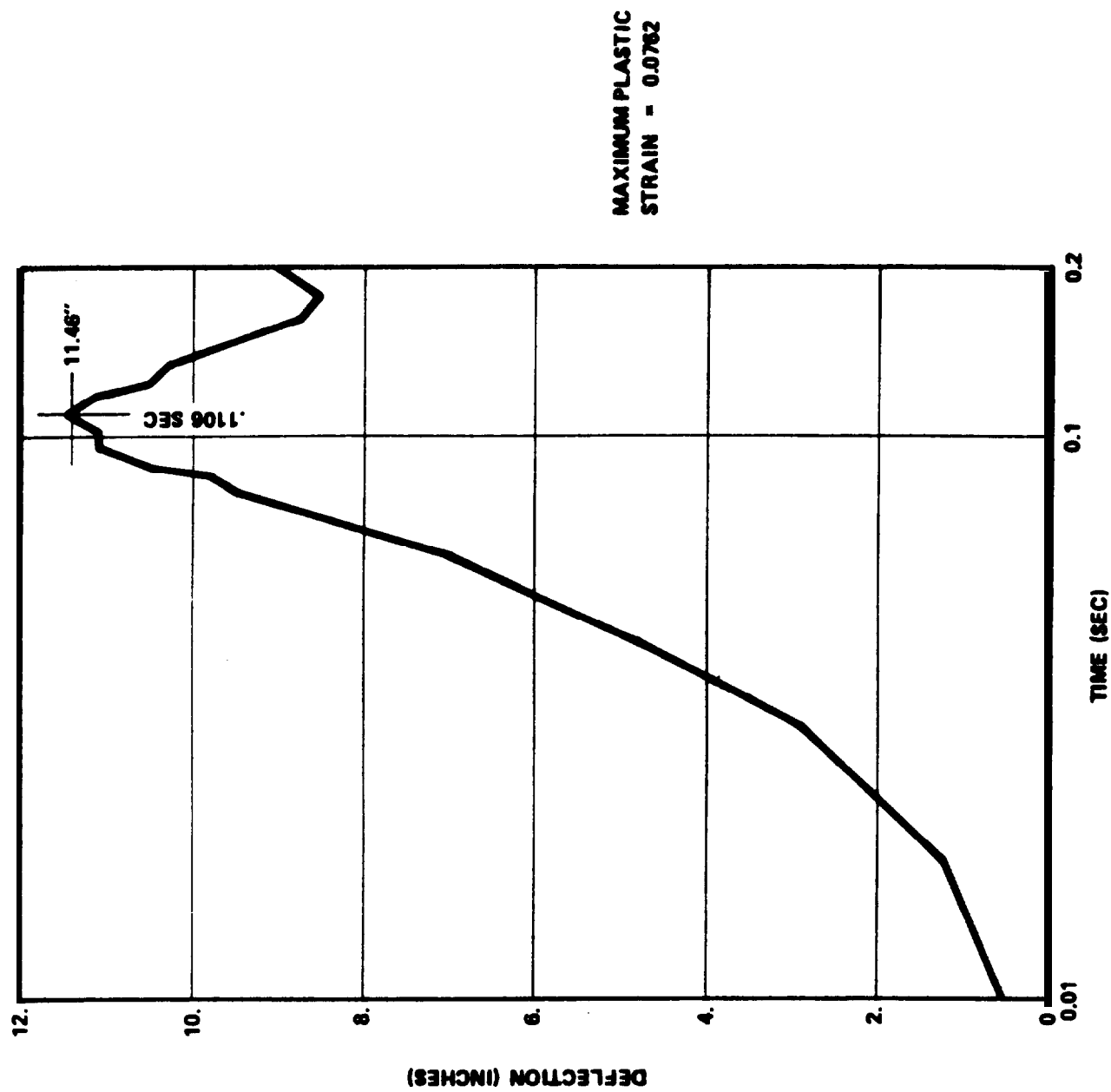
FORCE ON RESTRAINT
AT NODE #14

FIGURE: 2.3.6



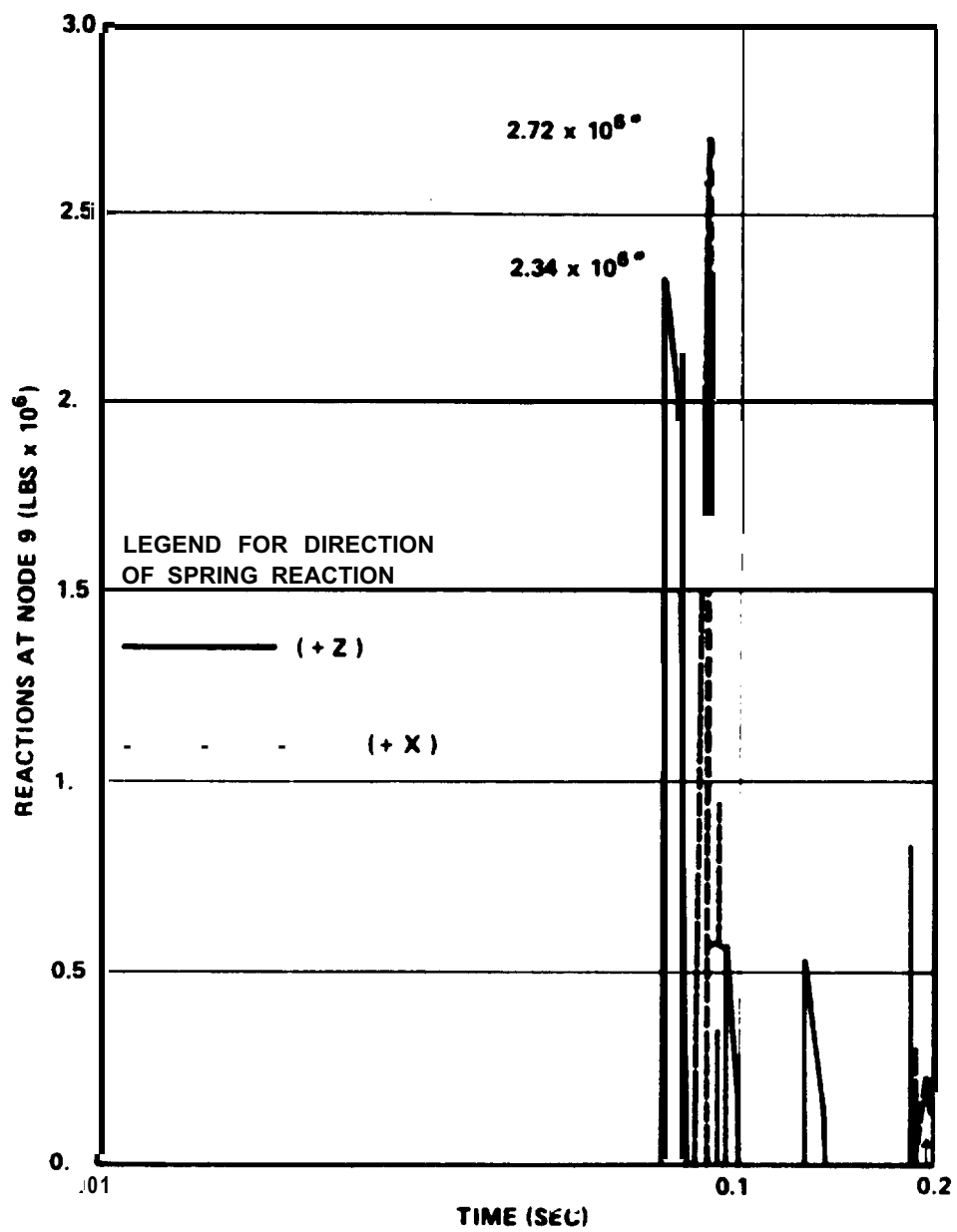
MAIN STM. LINE TRANSVERSE BREAK AT NOOE #12

FIGURE: 2.3.7



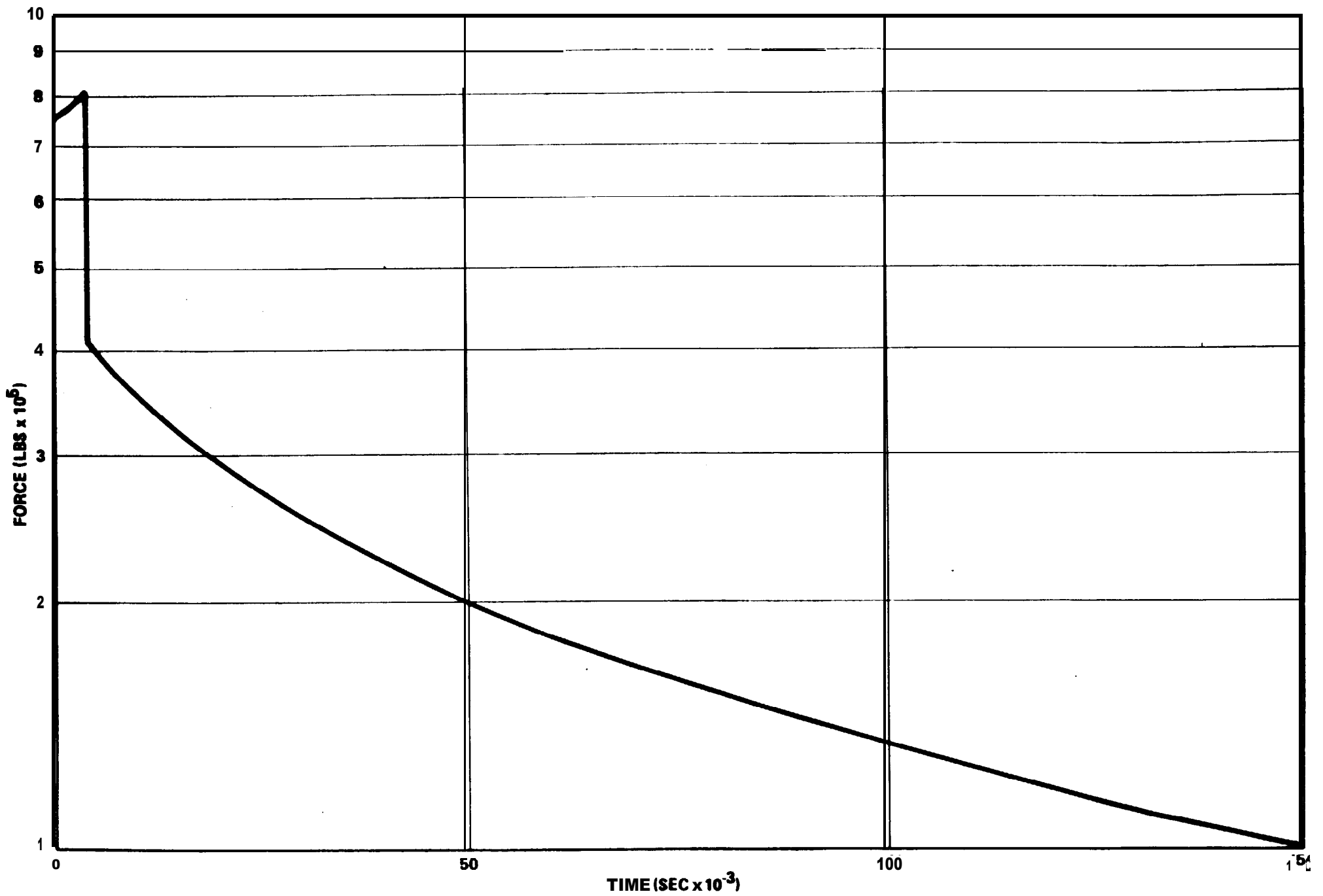
MAIN STEAM LINE (BREAK AT NODE 12) DEFLECTION OF
NODE 12 VERSUS TIME

FIGURE: 2.3.8



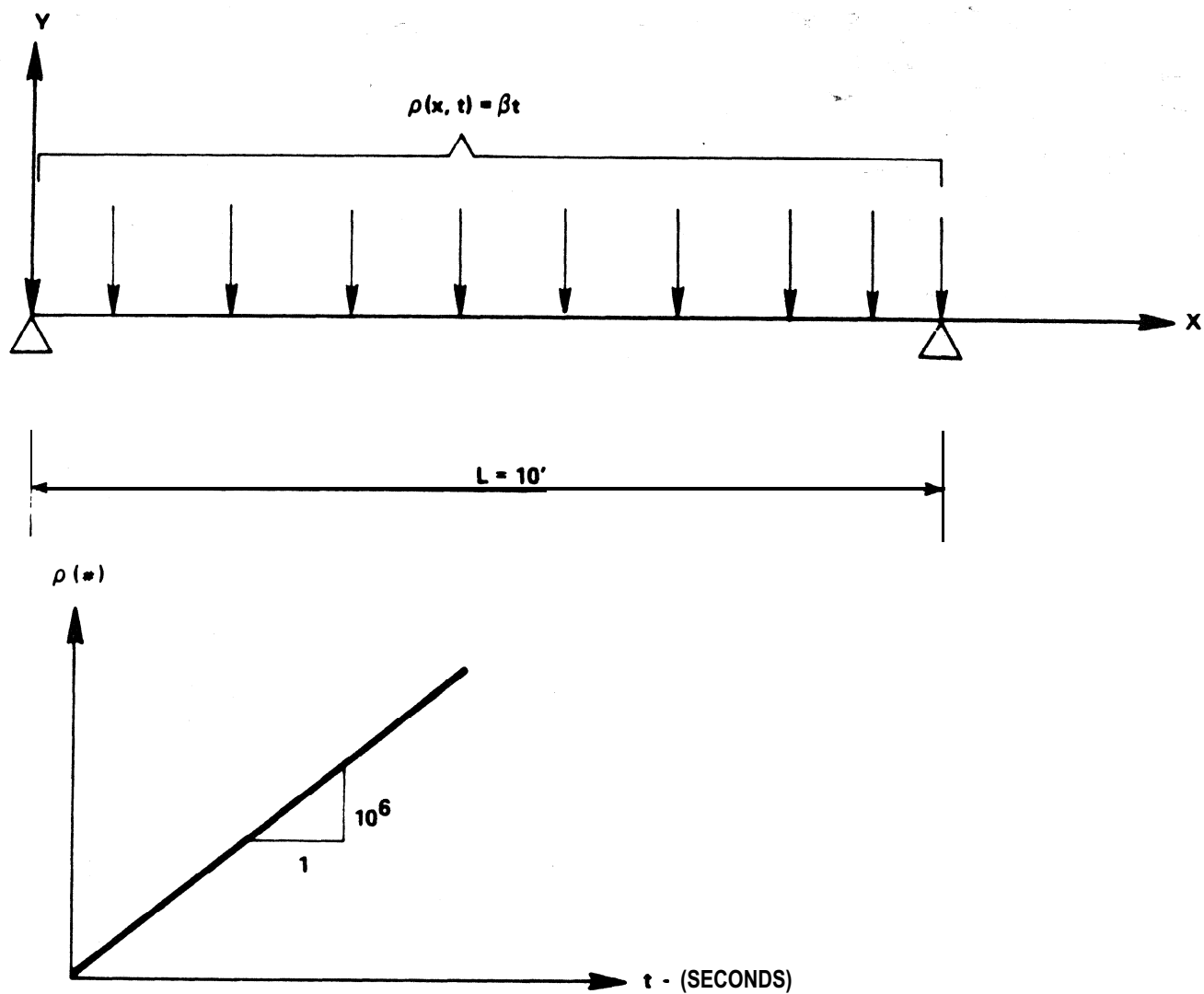
MAIN STEAM LINE BREAK AT NODE 12 REACTION AT PIPE WHIP RESTRAINT AT NODE.9 IN + X & + Z DIRECTIONS VERSUS TIME

FIGURE: 2.3.9



MAIN STEAM BLOWDOWN FORCE

FIGURE: 2.3.10



$$\begin{aligned}
 E &= 30 \times 10^6 \text{ psi} \\
 I &= 28.1 \text{ in}^4 \\
 \beta &= 10^6 \# / \text{SEC.} \\
 \gamma &= 0.25 \\
 w &= 18.9 \# / \text{FT.} \\
 M_0 &= \frac{wL^2}{8}
 \end{aligned}$$

ELASTIC BEAM UNDER UNIFORM DYNAMIC LOAD

FIGURE: 3.1.1

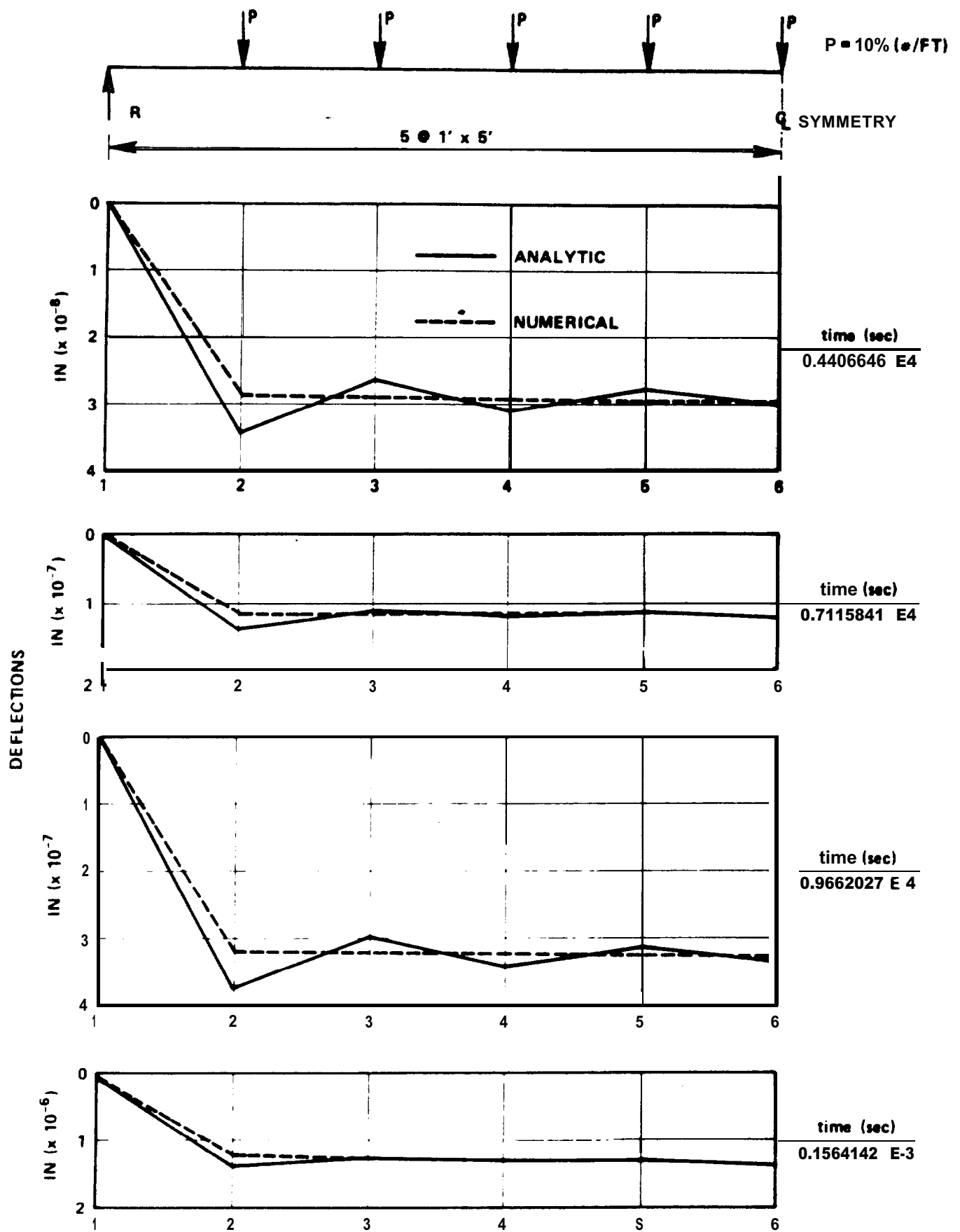
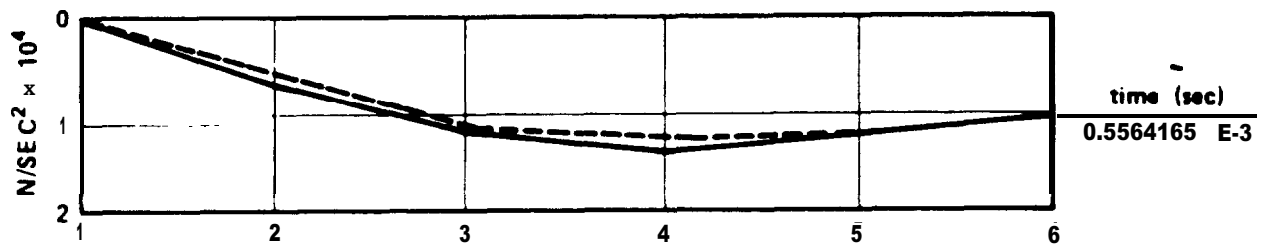
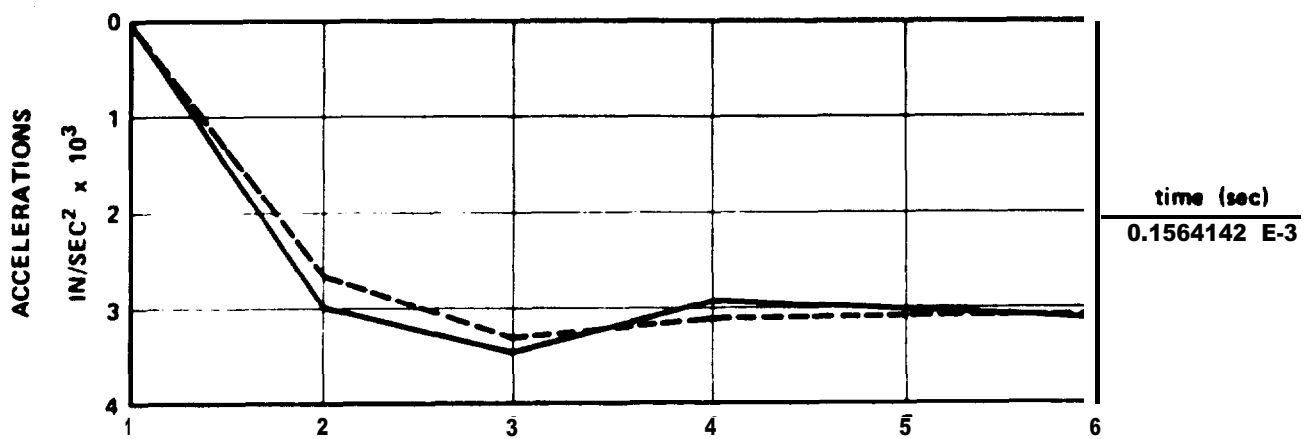
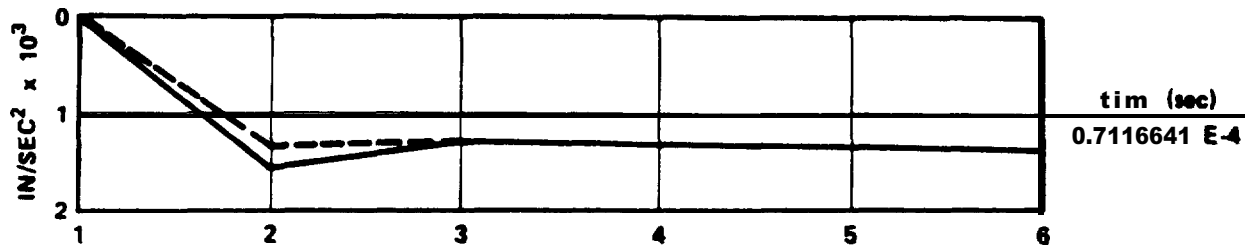


FIGURE: 3.1.2A

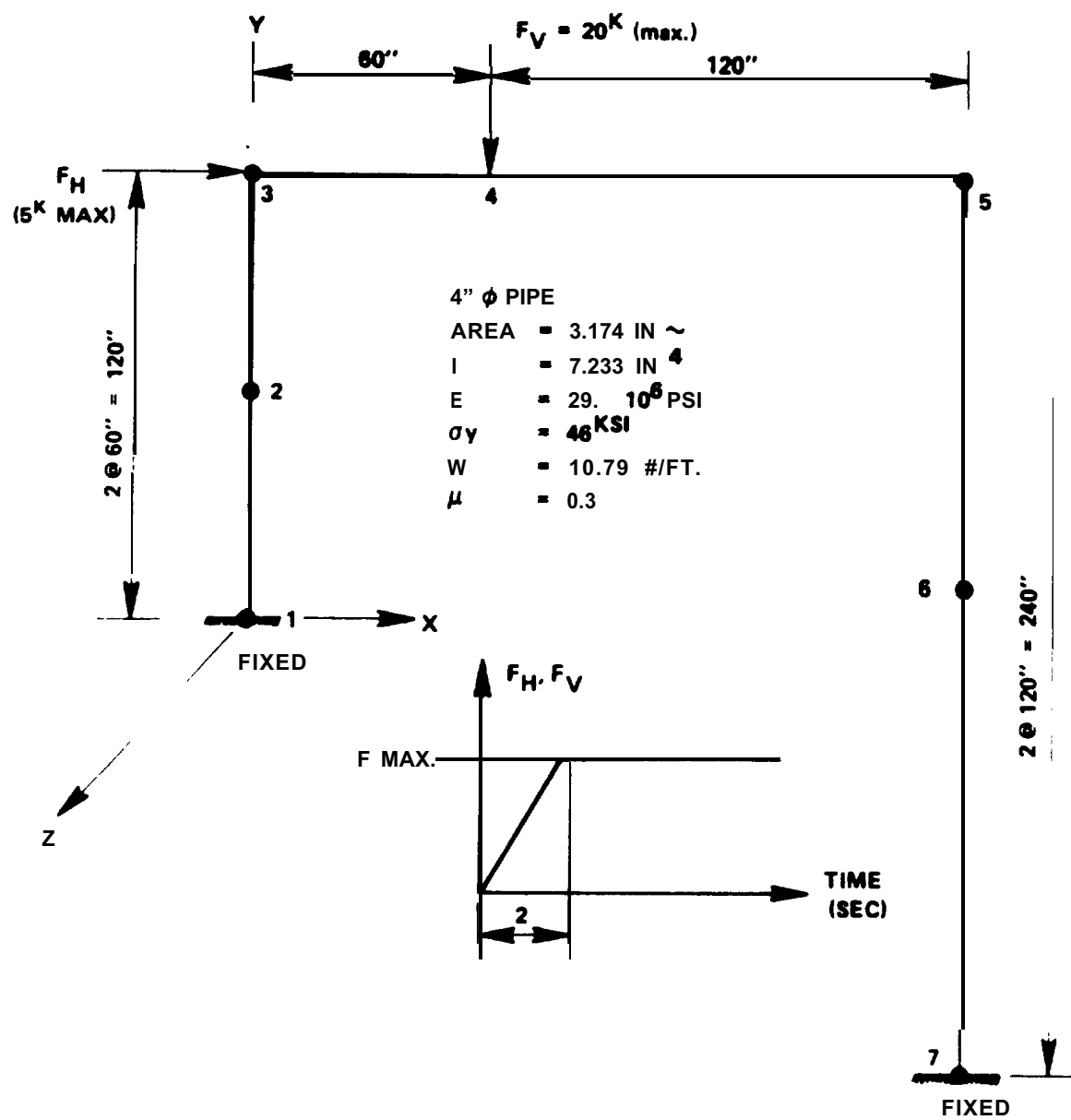


———— ANALYTIC

----- NUMERICAL

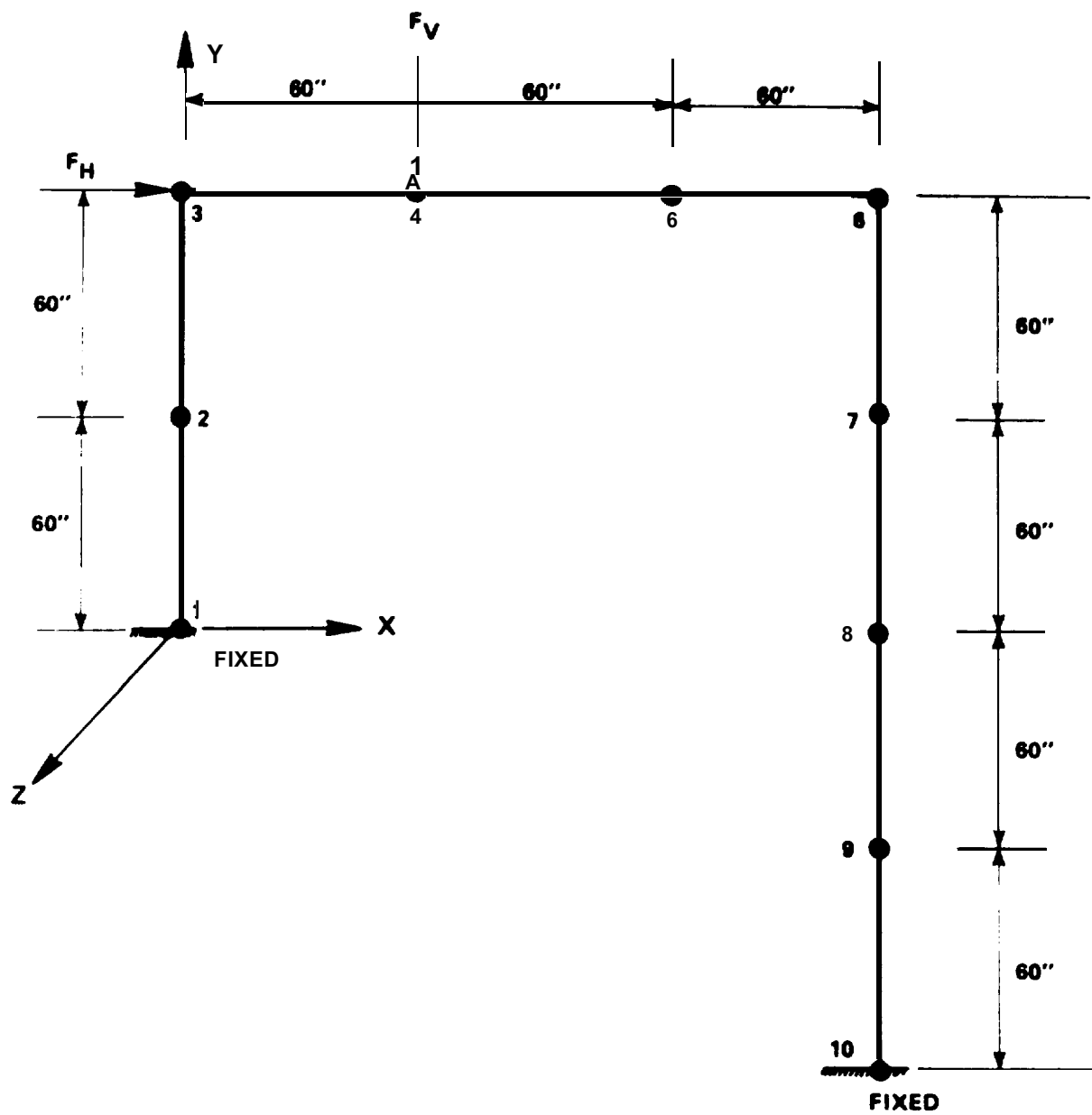
ACCELERATION HISTORY
UNIFORM SIMPLE BEAM

FIGURE: 3.1.2B



7 MASS PLANE FRAME

FIGURE: 3.1.3A



10 MASS PLANE
FRAME

FIGURE: 3.1.3B

ELASTIC FRAME

LEGEND:

- PLAST (5 MASSES)
- PLAST (10 MASSES)
- REF - [11] (10 MASSES)

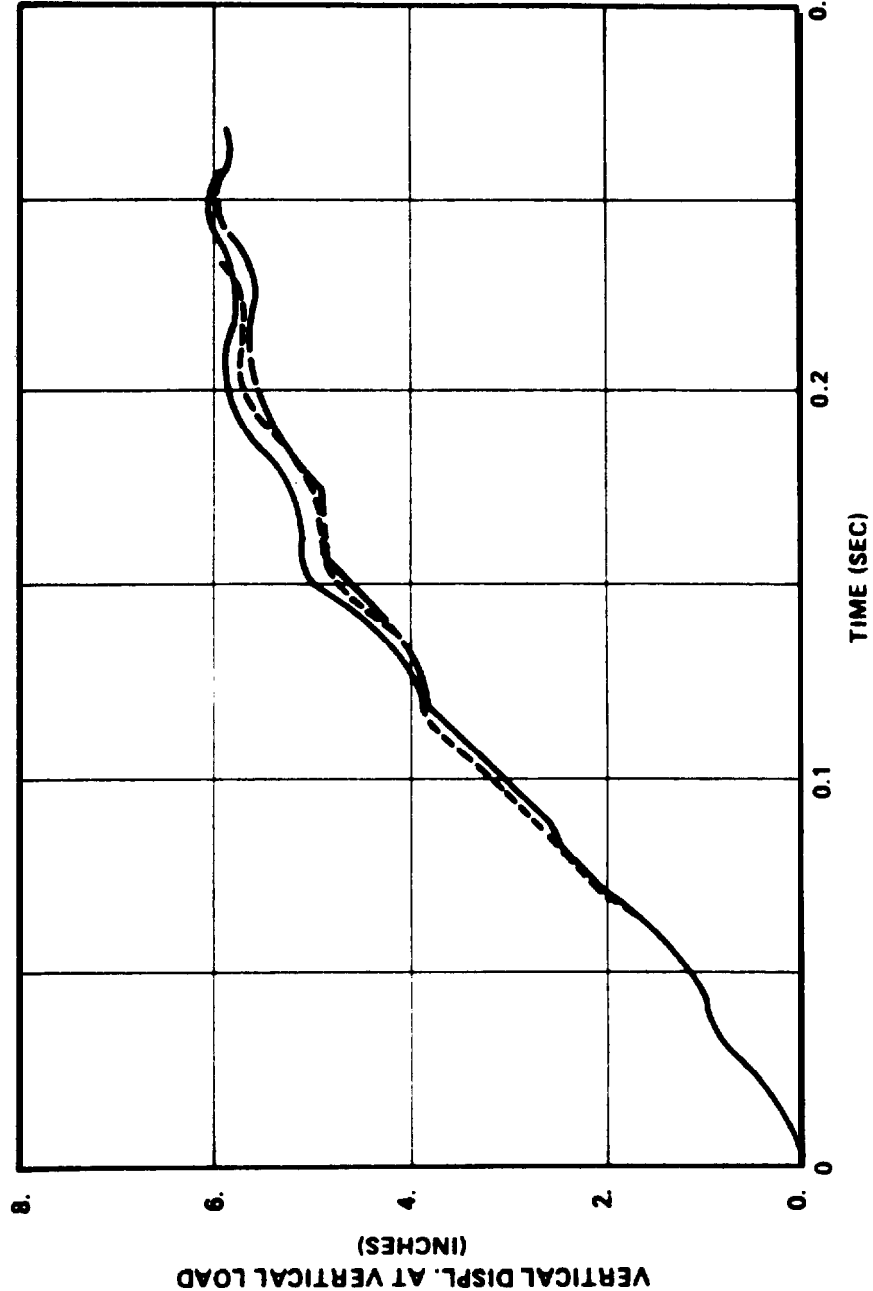


FIGURE: 3.1.4A

ELASTIC FRAME

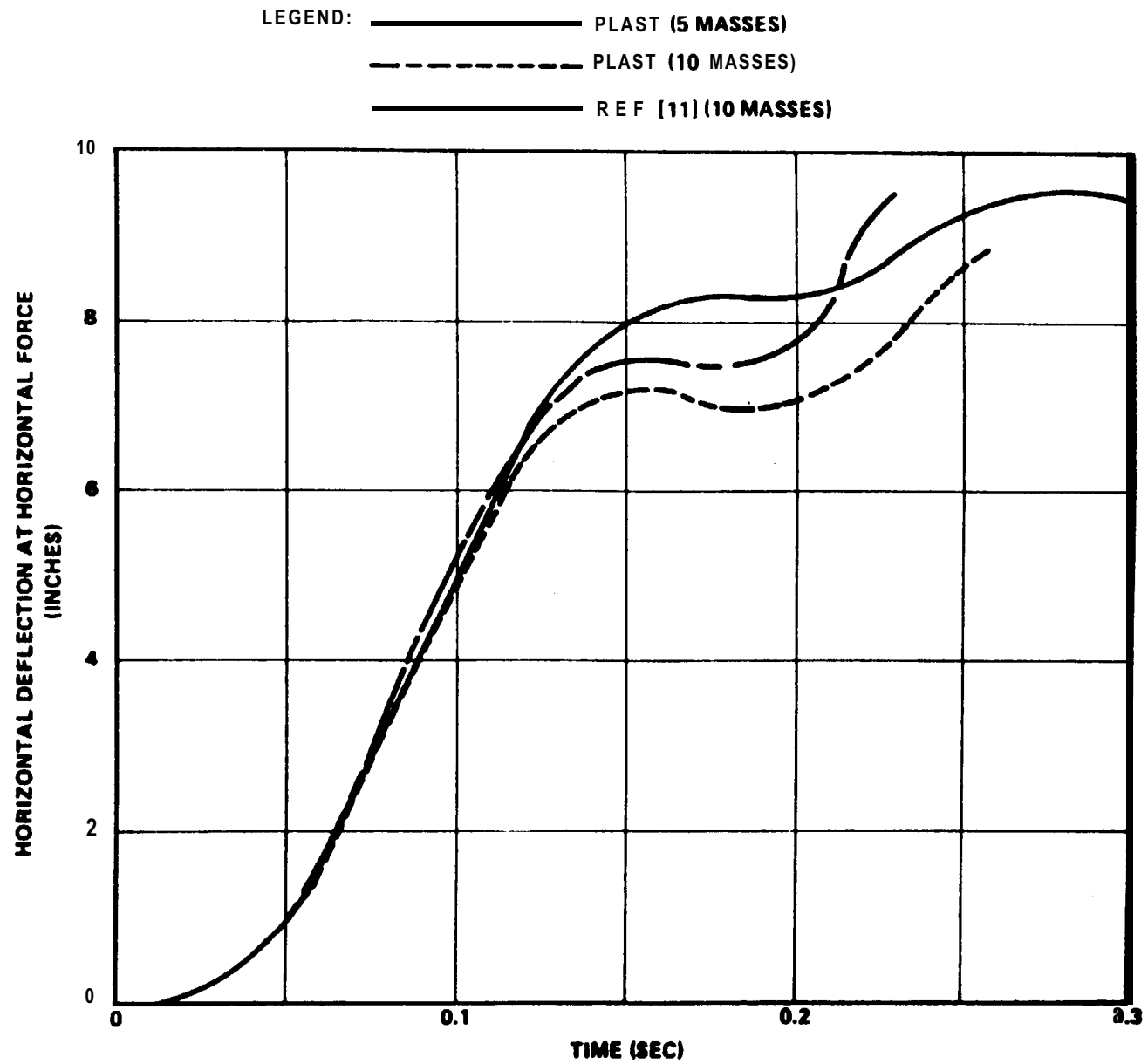


FIGURE: 3.1.4B

ELASTIC-PLASTIC FRAME

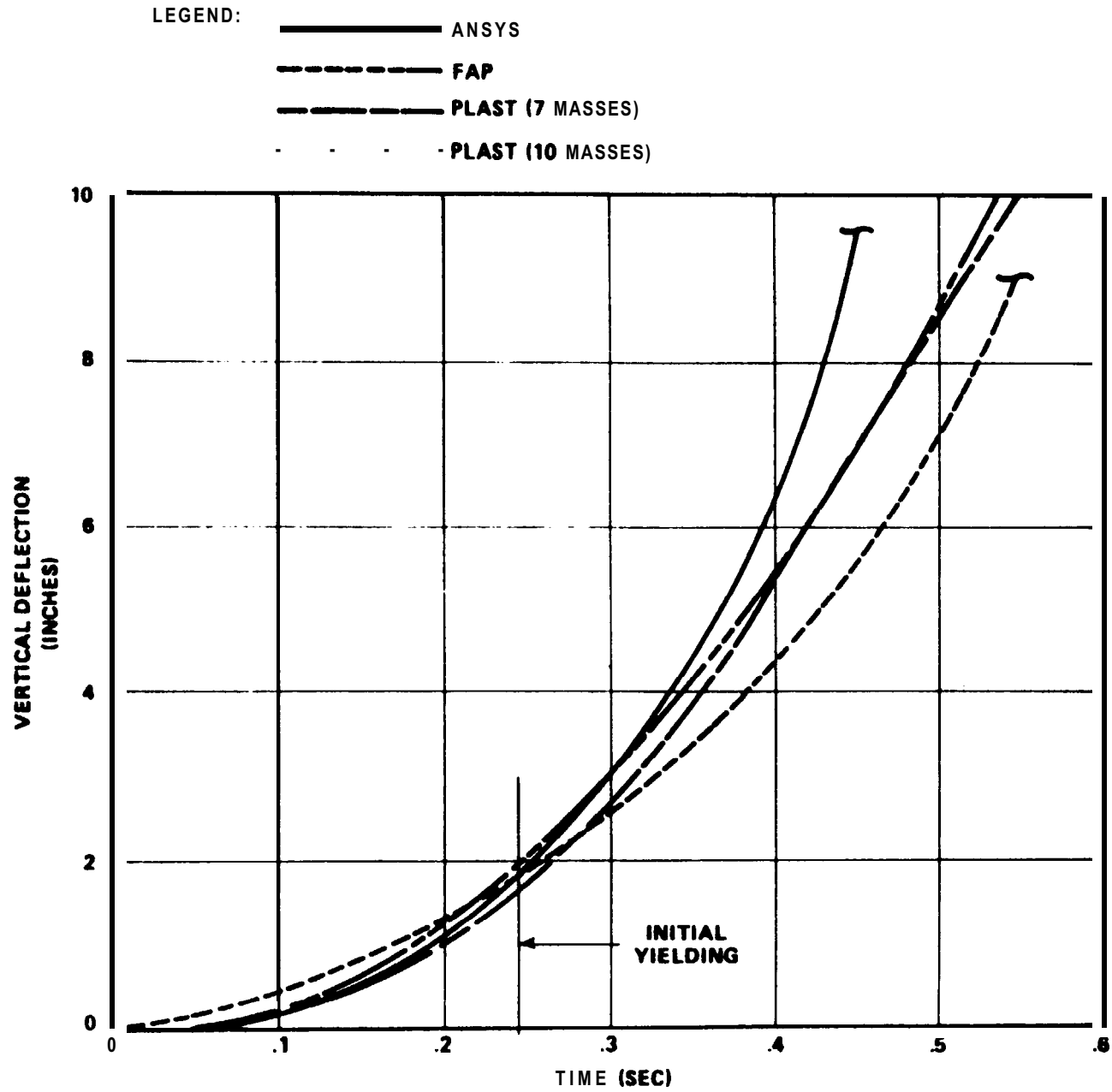


FIGURE: 3.1.5A

E ASTIC-PLASTIC FRAME

LEGEND:

- ANSYS
- - - FAP
- - - PLAST (7 MASSES)
- - - PLAST (10 MASSES)

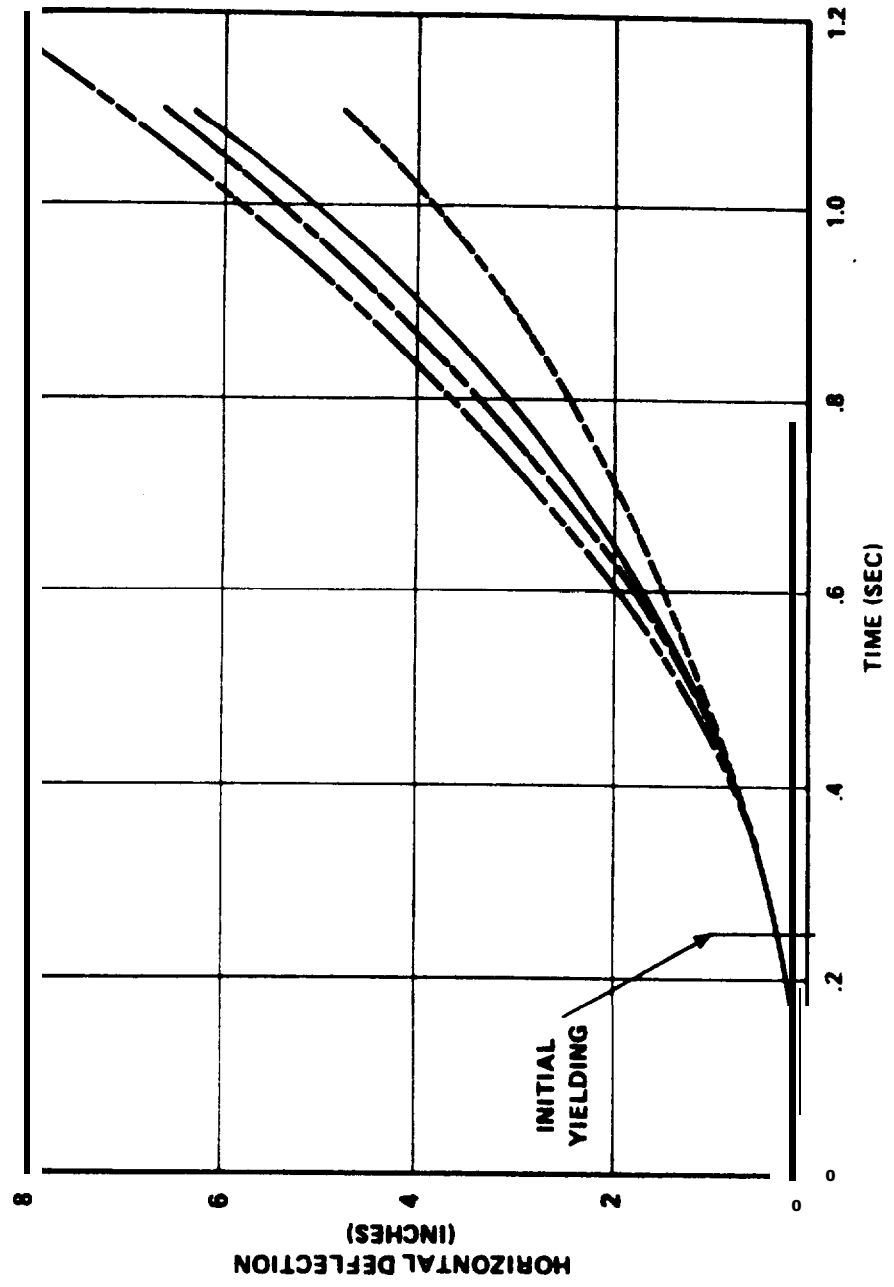
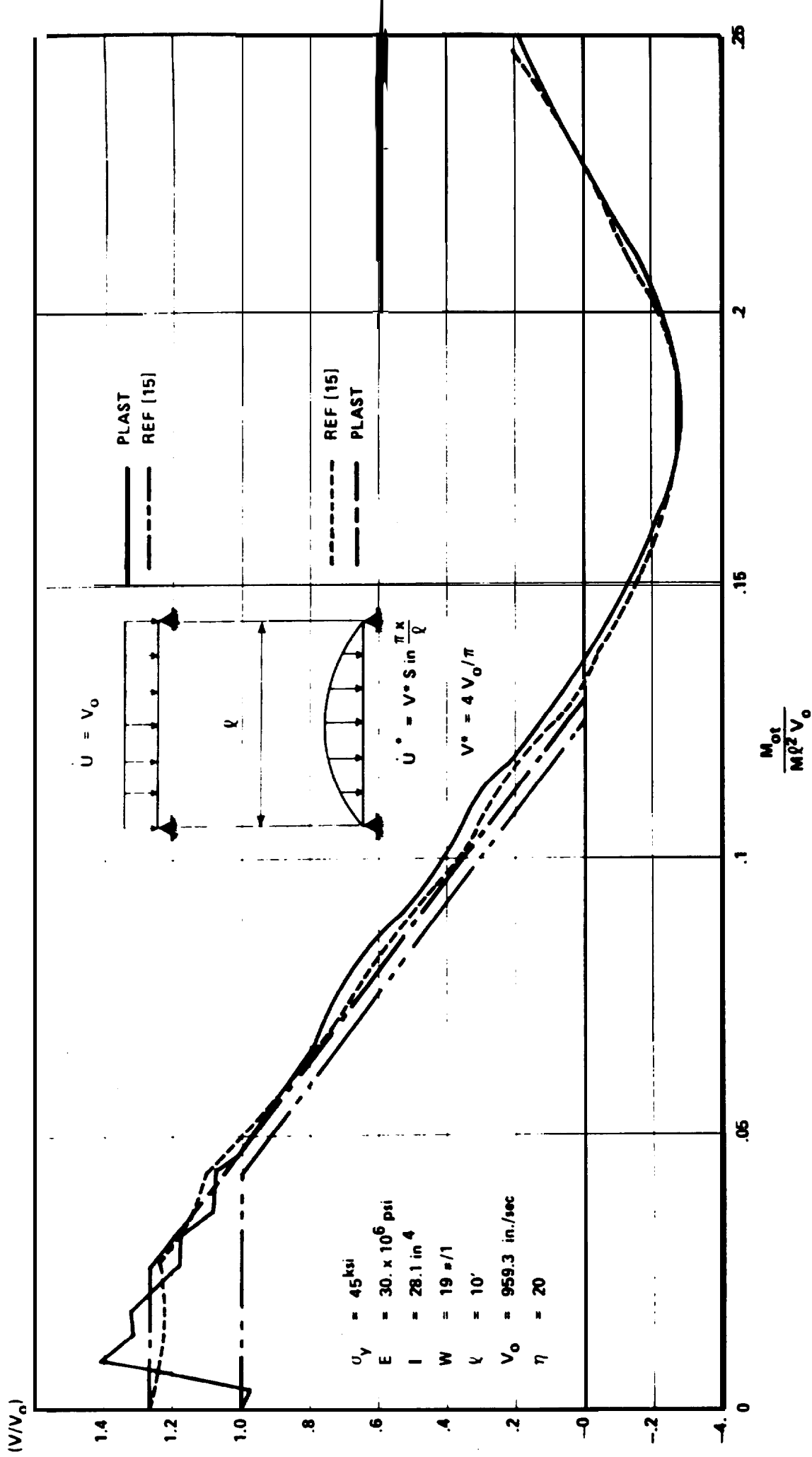


FIGURE: 3.1.5B

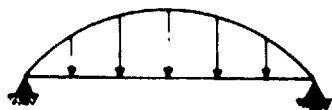


CENTRAL VELOCITY VS. TIME

FIGURE 3.1.6A

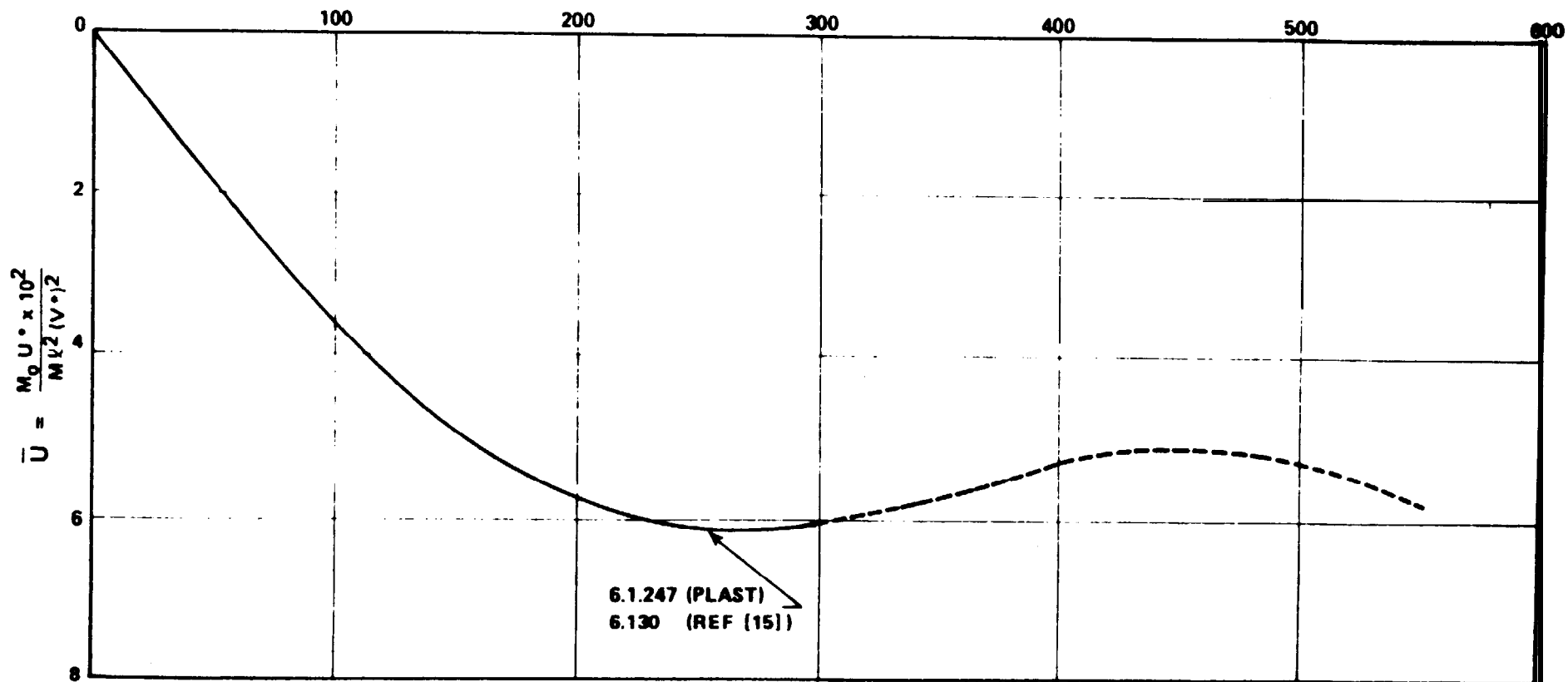
$$V^* = \frac{4V_0}{\pi}$$

$$U^* = V^* \sin \frac{\pi x}{l}$$



$$\frac{\tau}{H} \longrightarrow$$

— REF [15] & PLAST
- - - PLAST



$$\tau = \frac{10^2 M_0 t}{M V^* l^2}$$

$$H = \frac{1}{1.8\pi \sqrt{\eta^*}}$$

$$\eta^* = 20$$

CENTRAL DEFLECTION VERSUS TIME

FIGURE: 3.1.6B

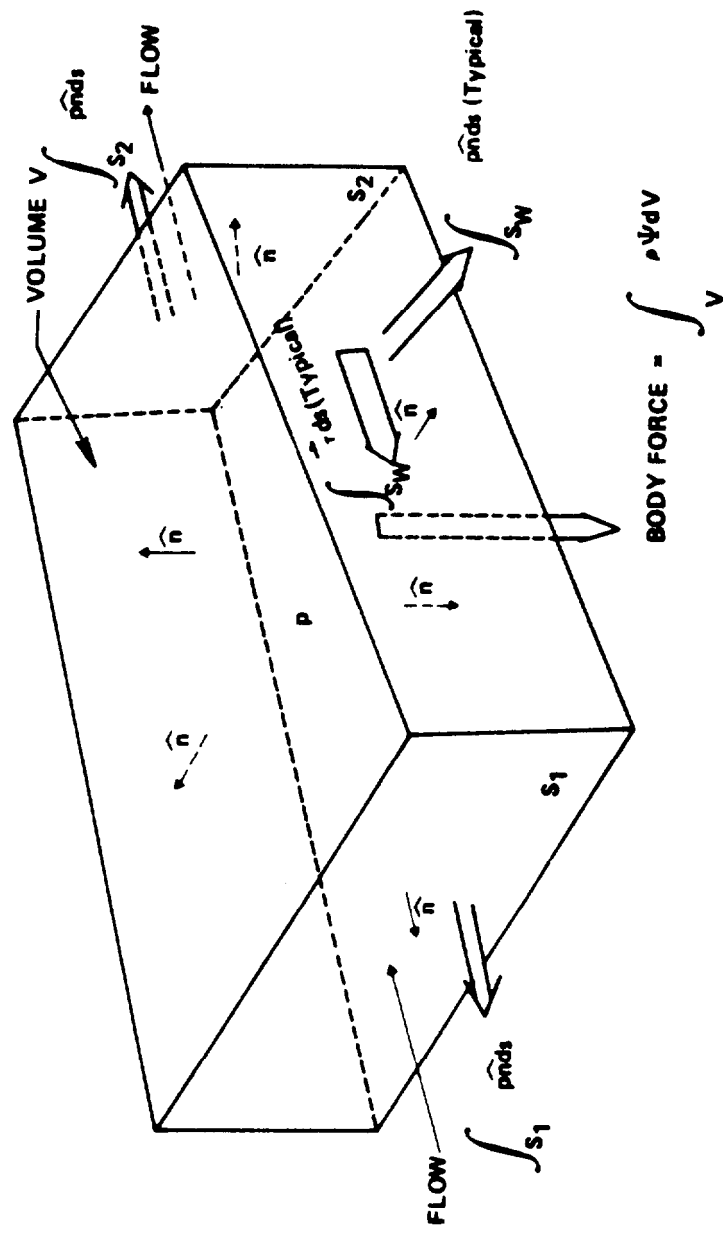


FIGURE 4.1
FLUID CONTROL VOLUME

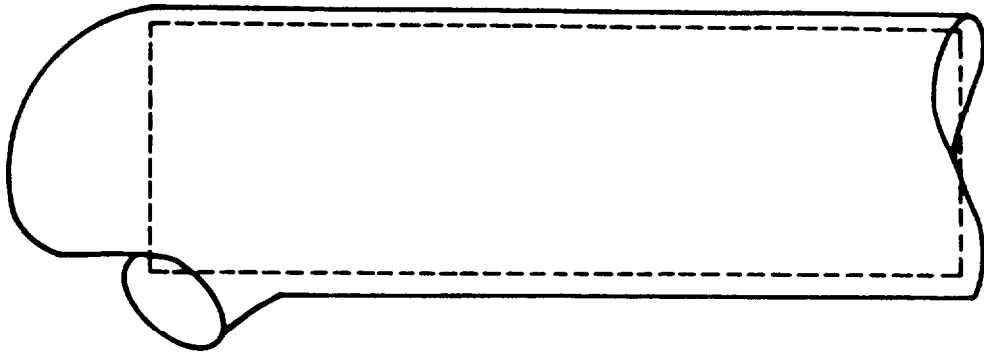


FIGURE 4.2
CIRCUMFERENTIAL BREAK CONTROL VOLUME

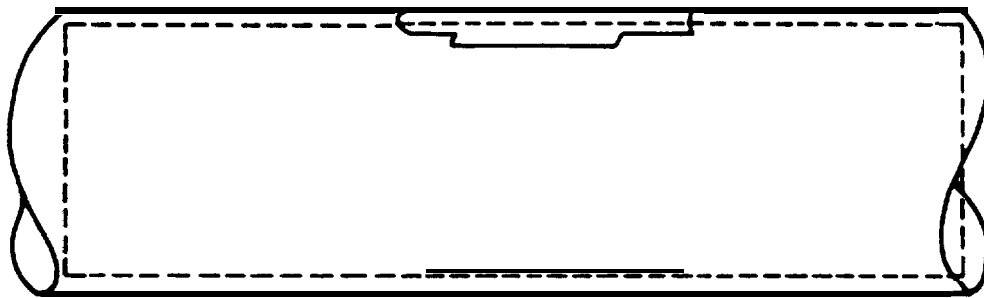


FIGURE 4.3
LONGITUDINAL BREAK CONTROL VOLUME

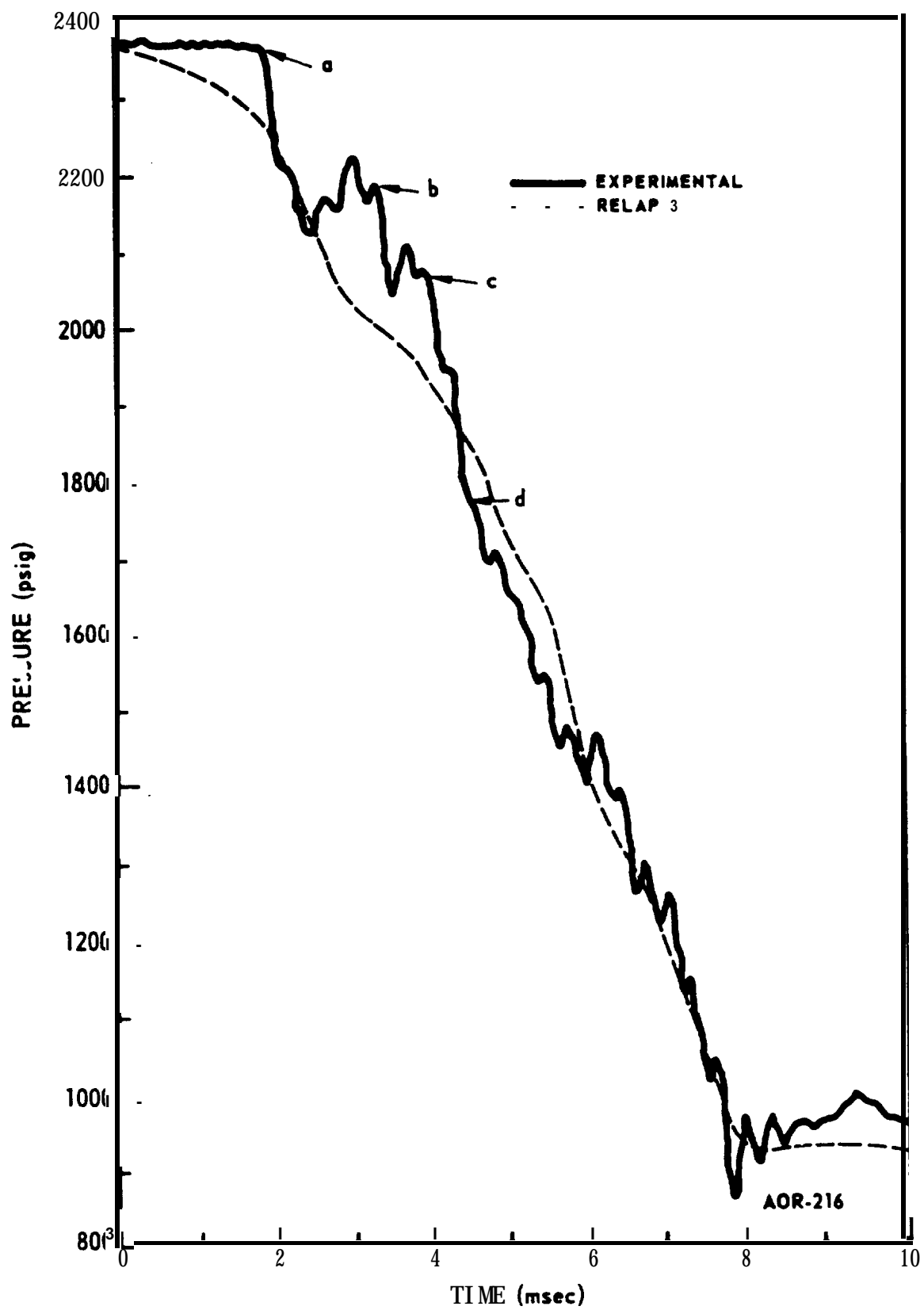


FIGURE 4.4

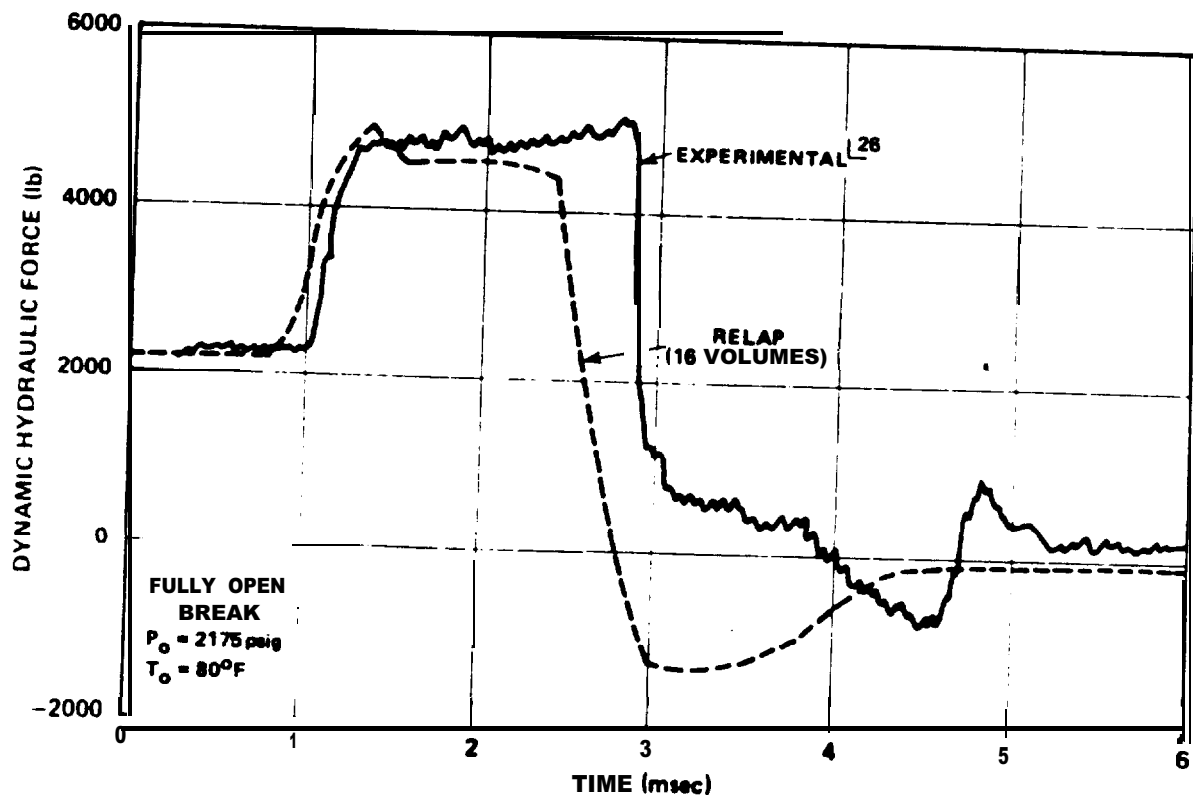
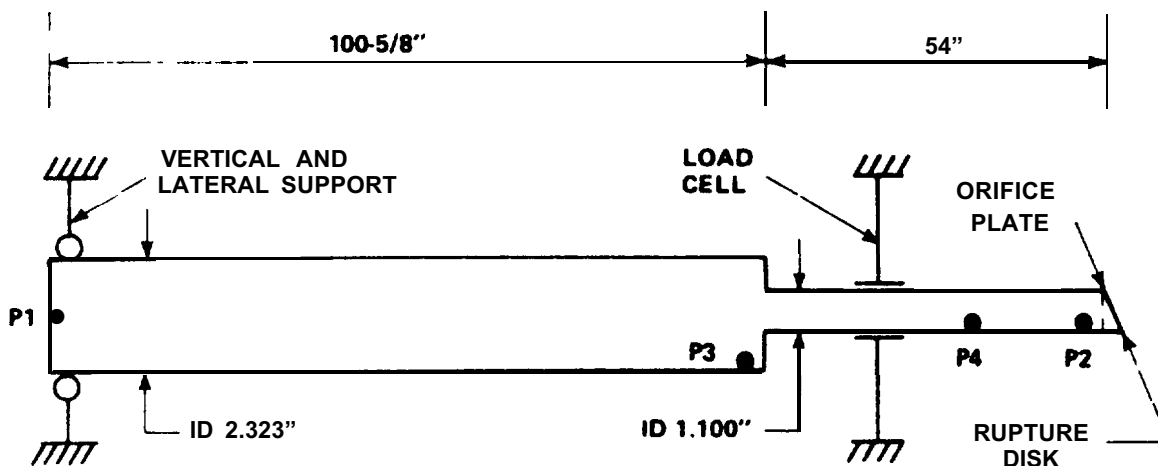


FIGURE 4.5



X = LENGTH OF SMALL PIPE, INCHES

WITH NO EXTENSION 21 INCHES

WITH EXTENSION A 28-1/2 INCHES

WITH EXTENSION B 54 INCHES

P = PRESSURE TRANSDUCER

P2 IS 1-3/4 INCHES FROM RUPTURE DISC

P4 IS 19-1/4 INCHES FROM AREA CHANGE

WHEN NO PIPE EXTENSION WAS PRESENT, THERE WAS NO PRESSURE TRANSDUCER P4.

ORIFICE DIAMETERS OF 39/64 AND 11/32 INCH ARE USED; AREAS ARE 30 AND 10% OF SMALL PIPE, THICKNESS OF ORIFICE PLATE IS 3/16 INCH.

ORIFICE PLATE IS REMOVED FOR STUDIES WITH FULL-OPEN BREAK.

FIGURE 4.6
IDAHO NUCLEAR CORPORATION PIPE EXPERIMENT

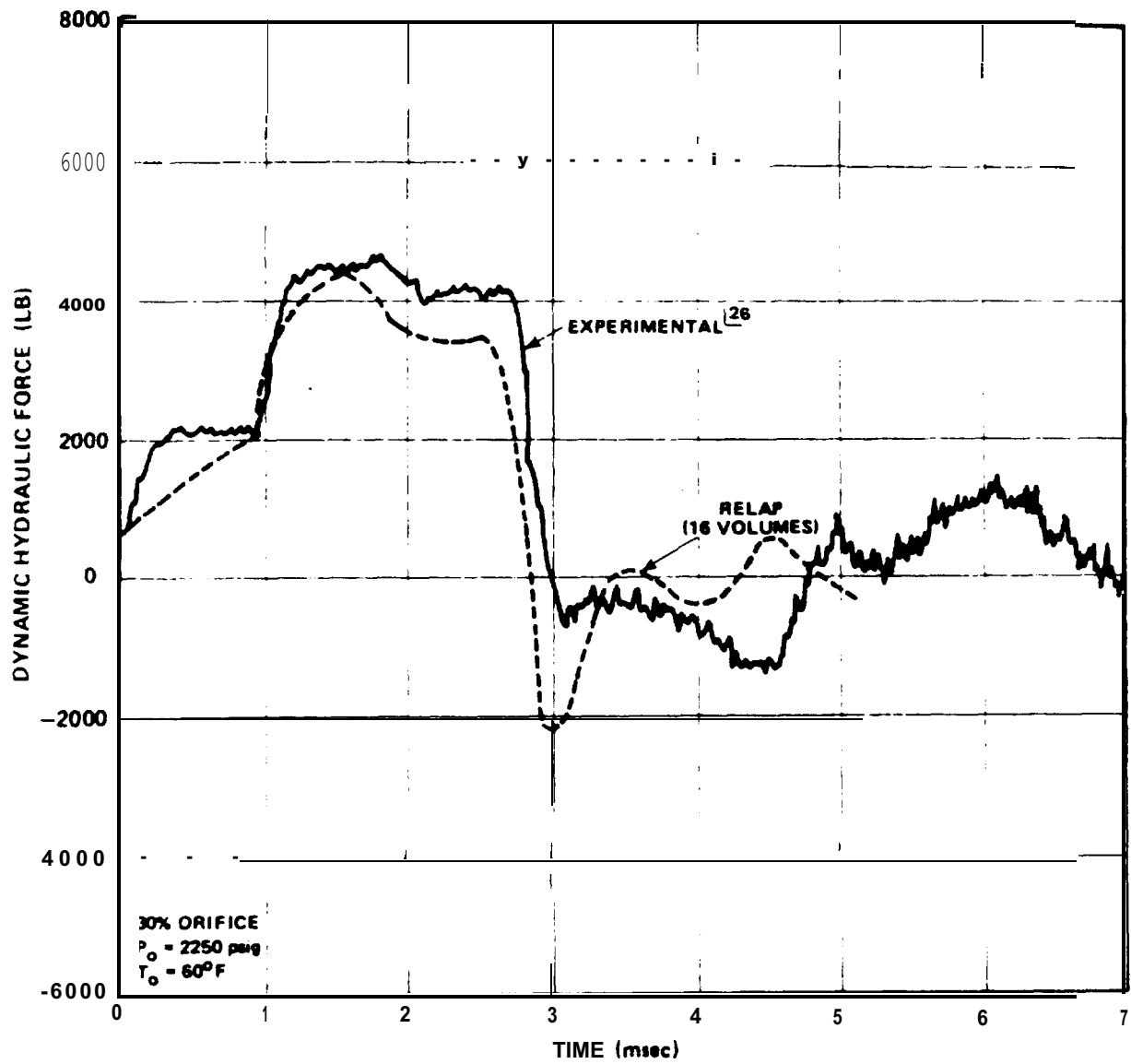


FIGURE 4.7

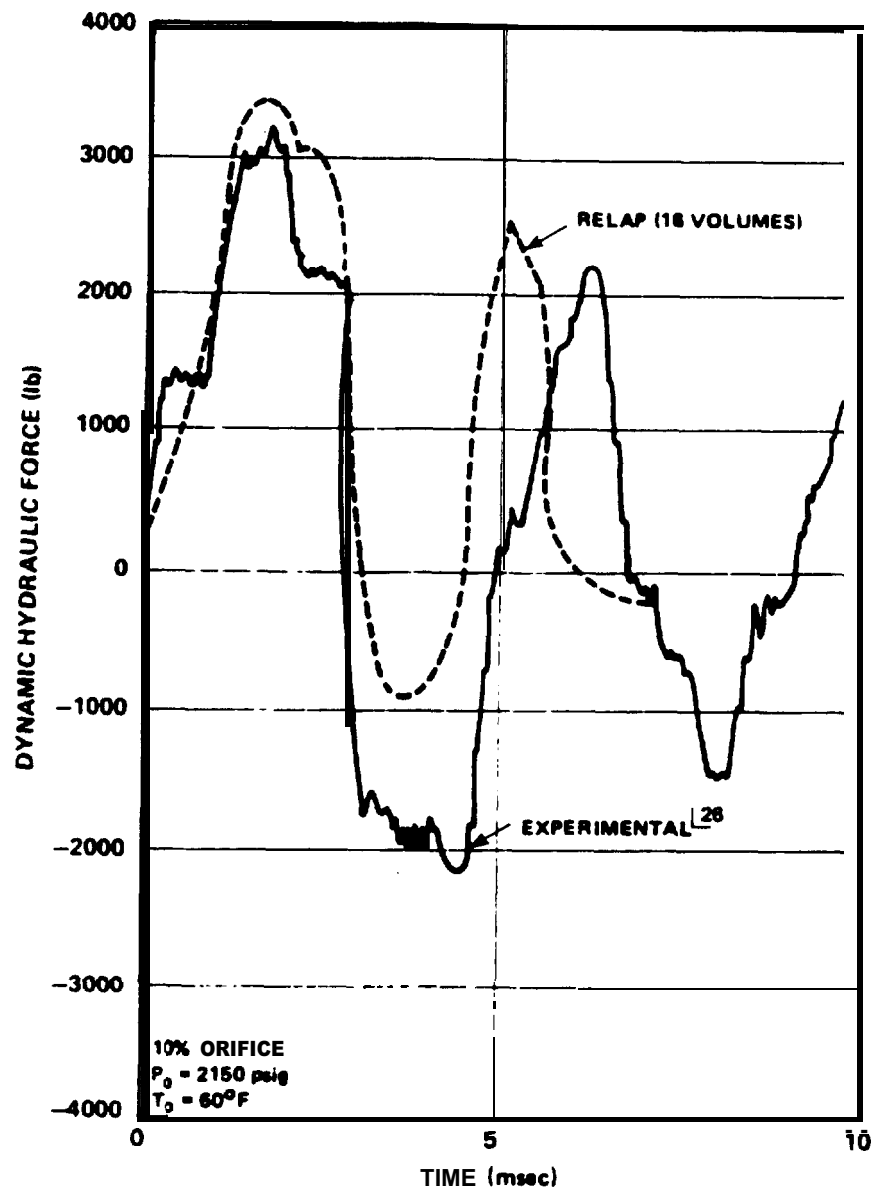
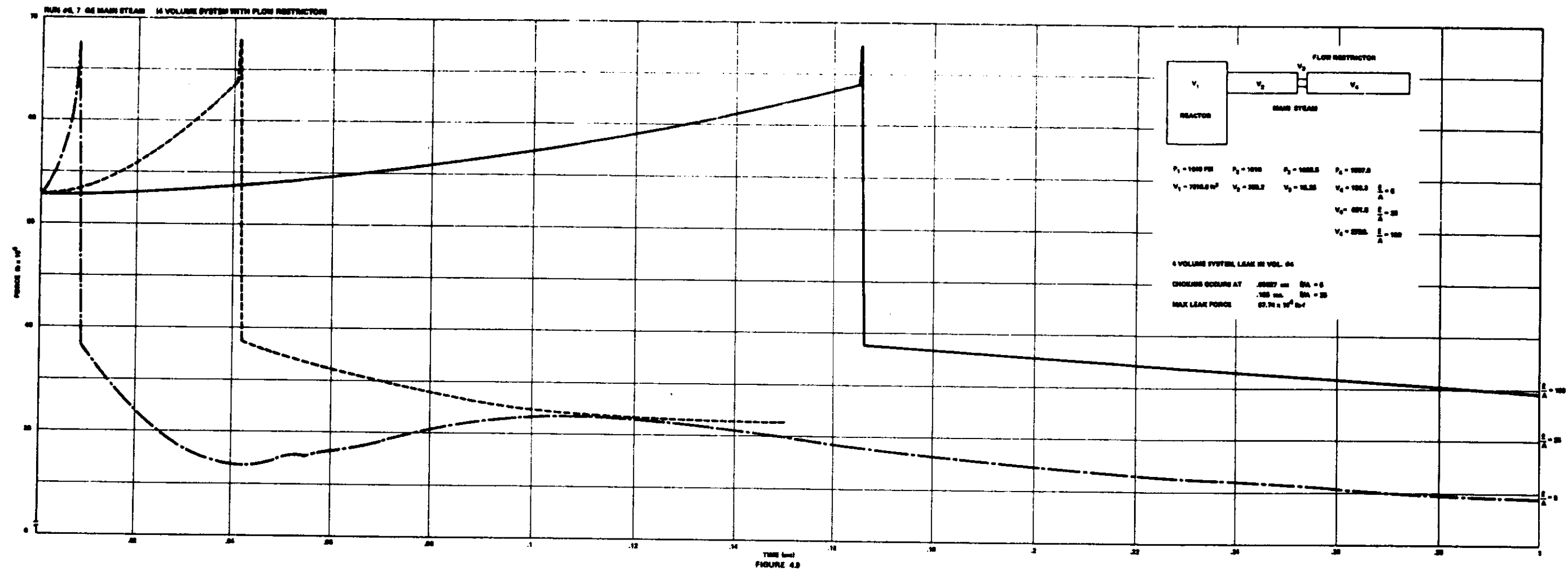


FIGURE 4.8



RUN #8 GE MAIN STEAM 1/A = 5

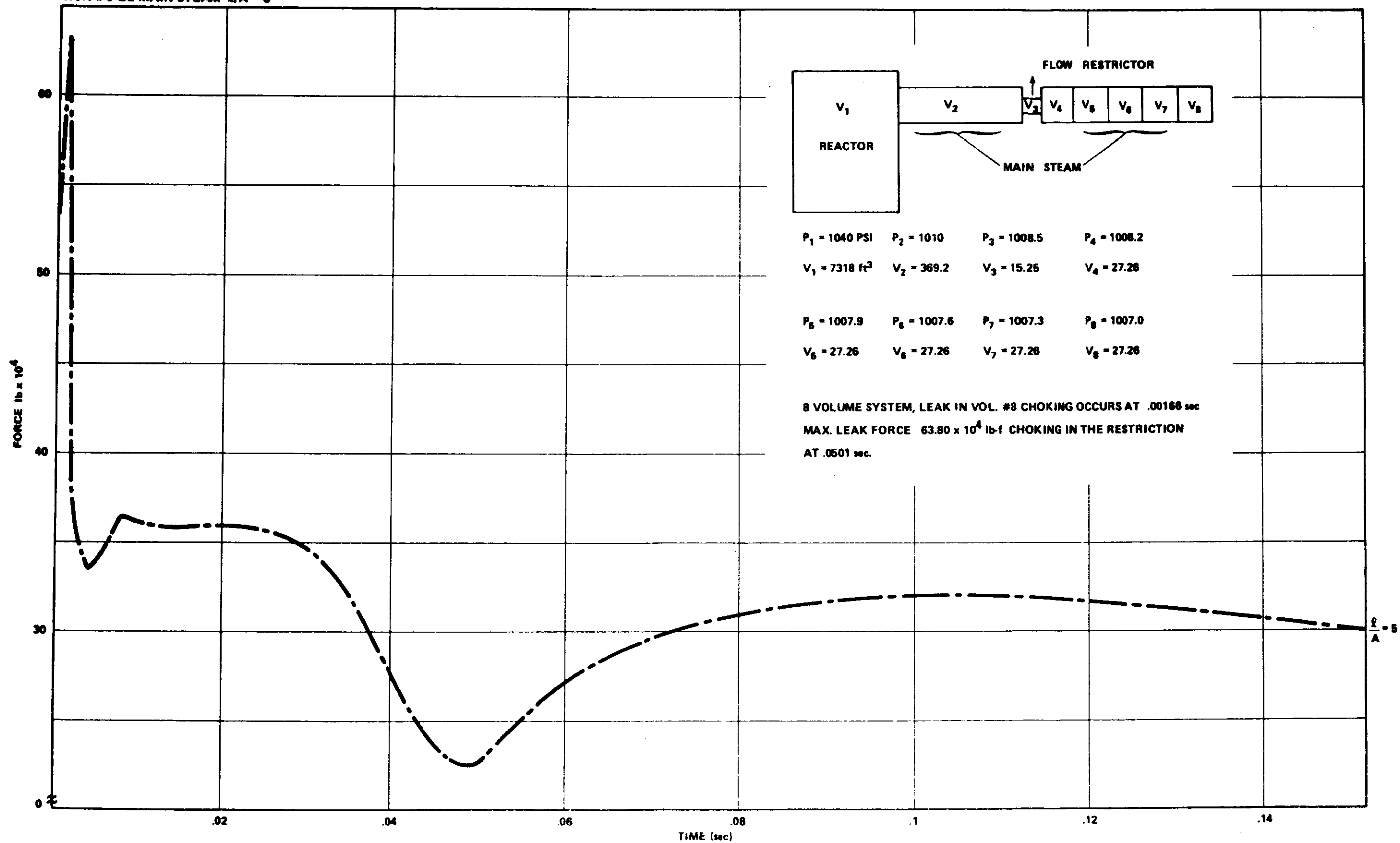
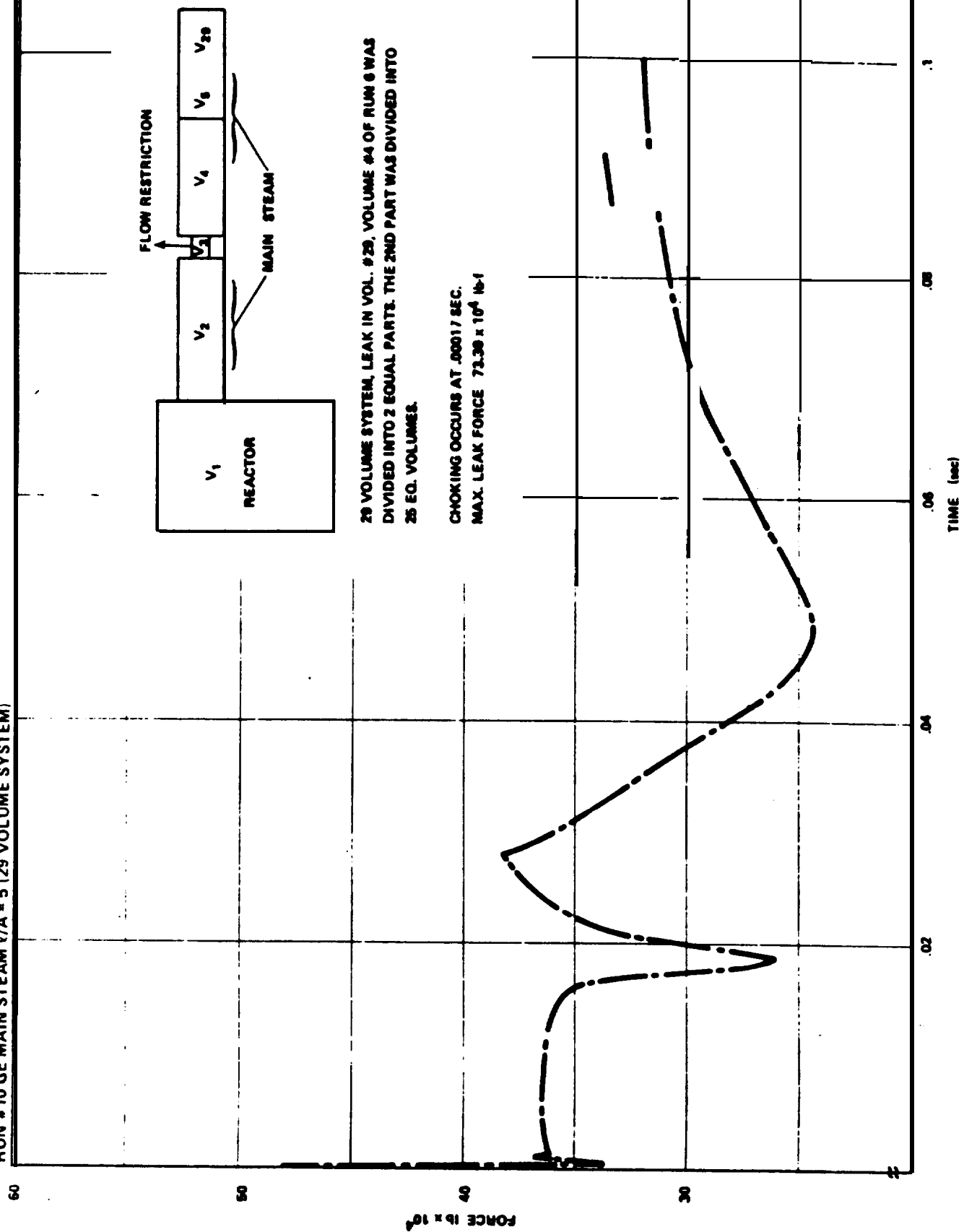


FIGURE 4.10

RUN # 10 GE MAIN STEAM V/A = 5 (29 VOLUME SYSTEM)



29 VOLUME SYSTEM, LEAK IN VOL. # 29. VOLUME #4 OF RUN 6 WAS DIVIDED INTO 2 EQUAL PARTS. THE 2ND PART WAS DIVIDED INTO 25 EQ. VOLUMES.

CHOKING OCCURS AT .00017 SEC.
MAX. LEAK FORCE 73.38×10^4 LB-F

FIGURE 4.11

RUN #9 GE MAIN STEAM (53 VOLUME SYSTEM) Z/A - 5

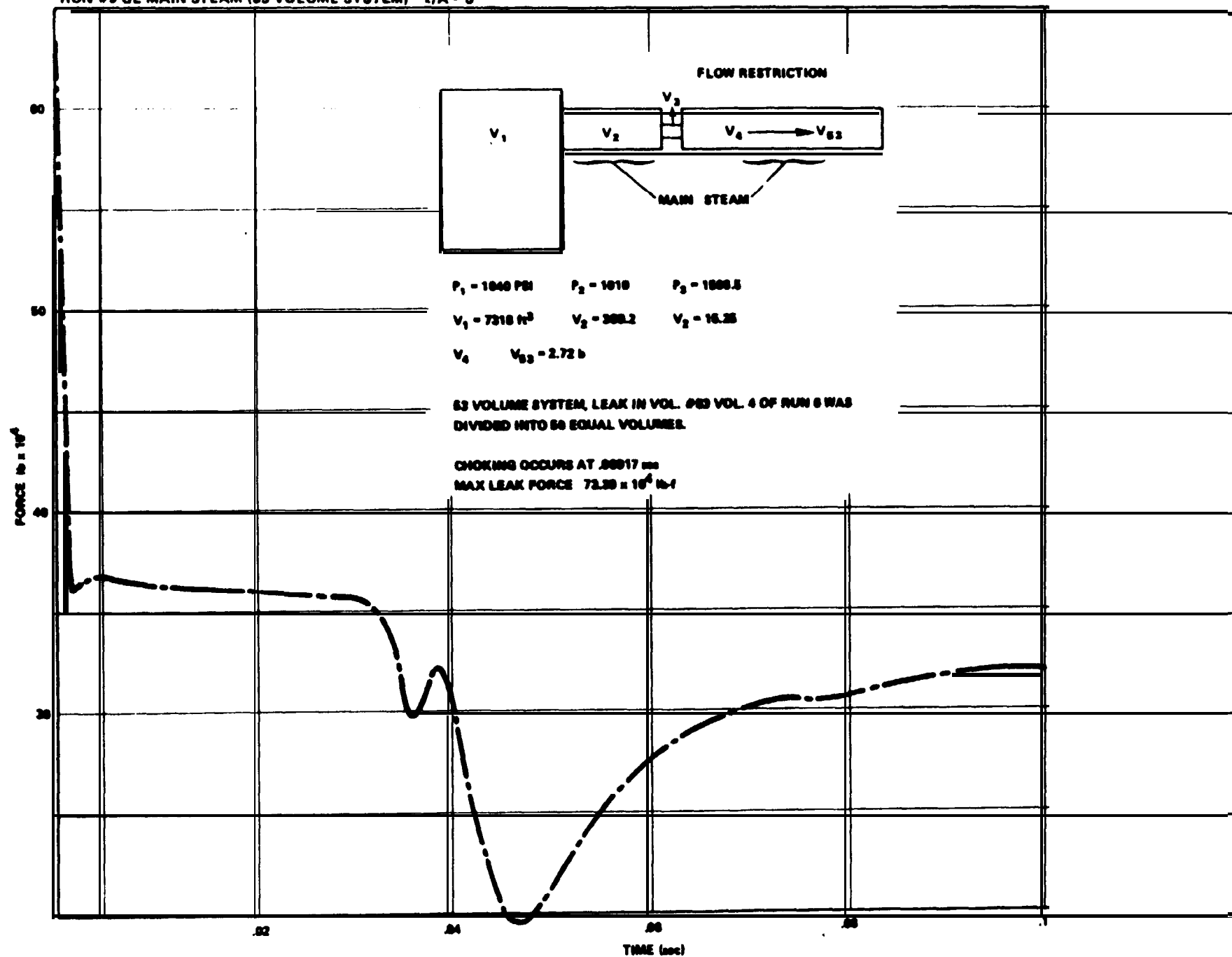
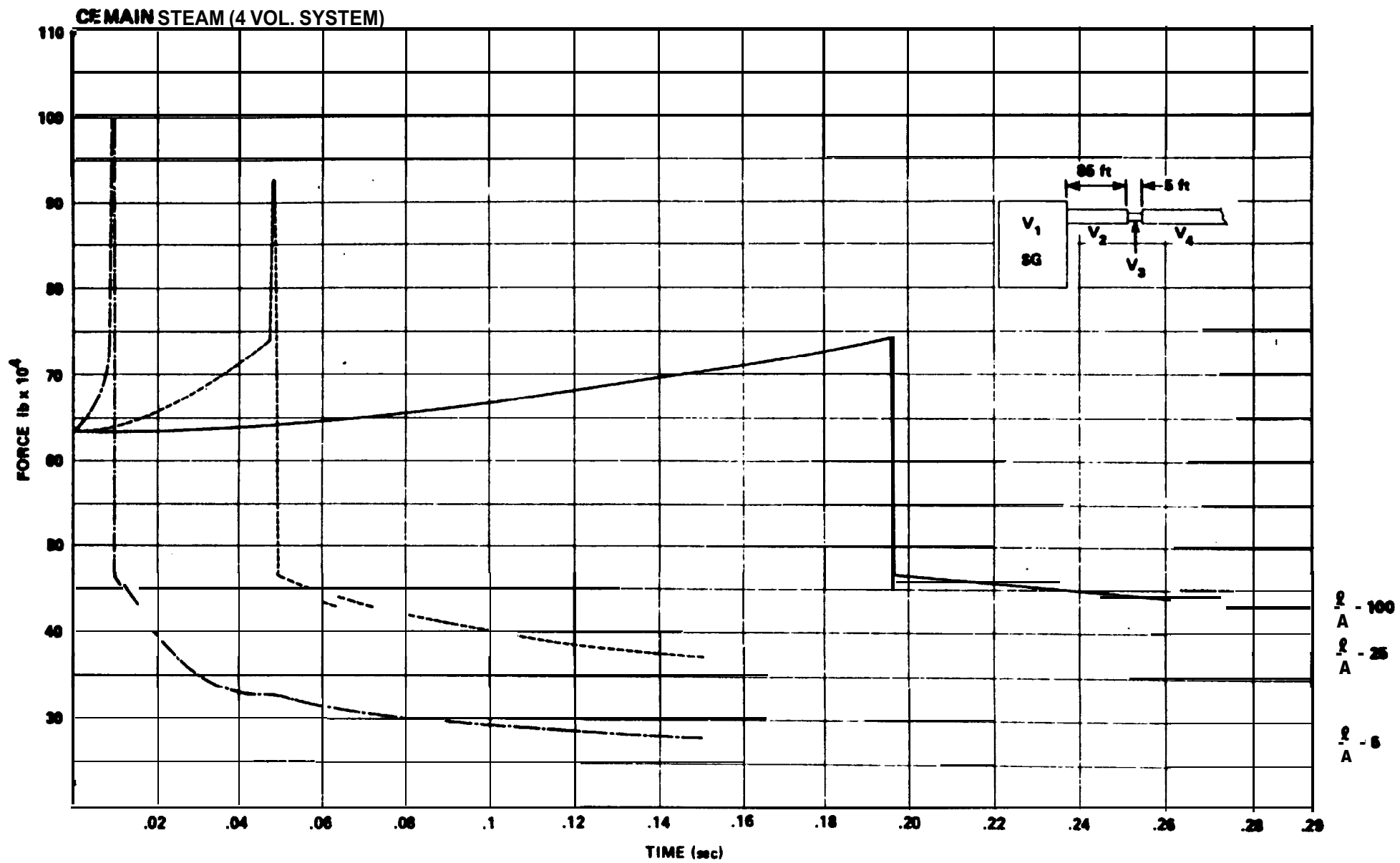
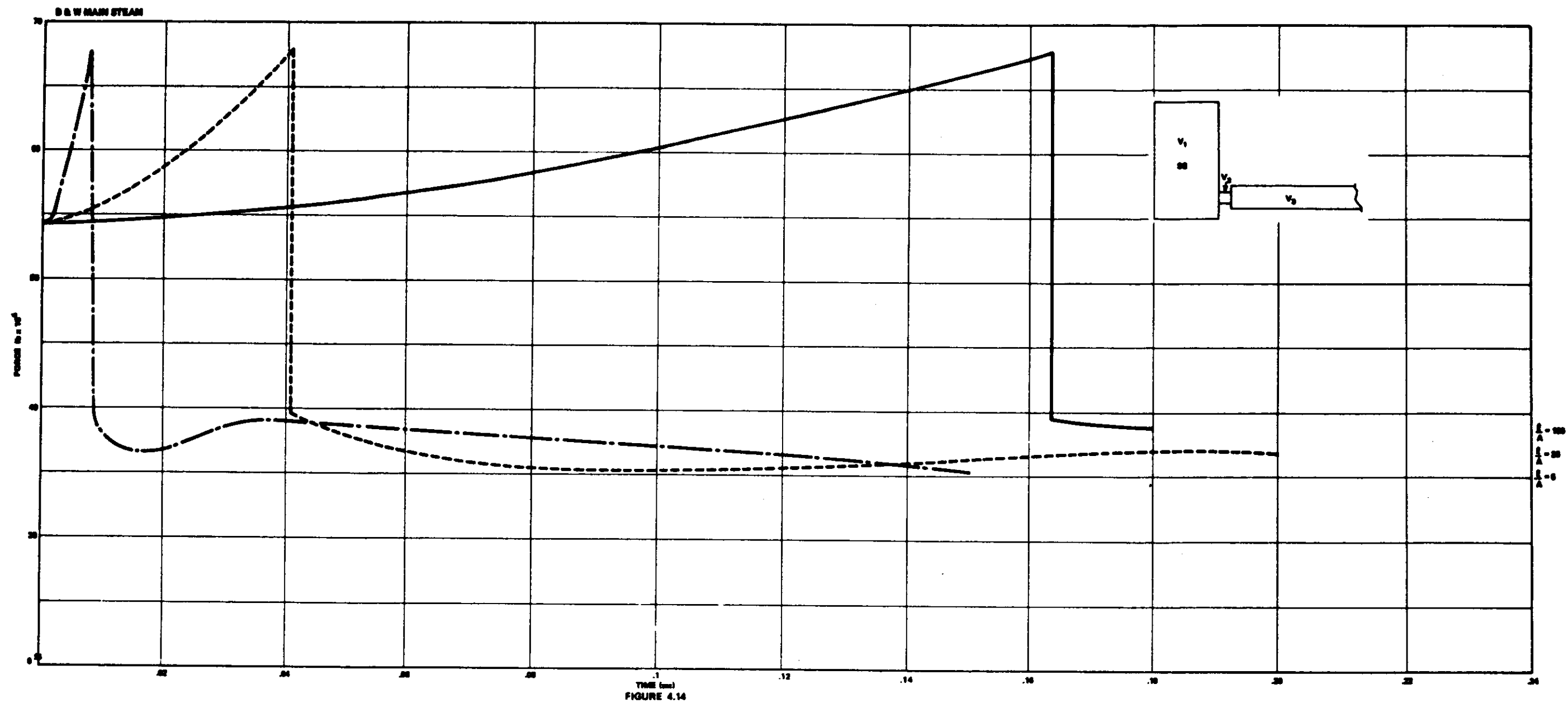


FIGURE 4.12





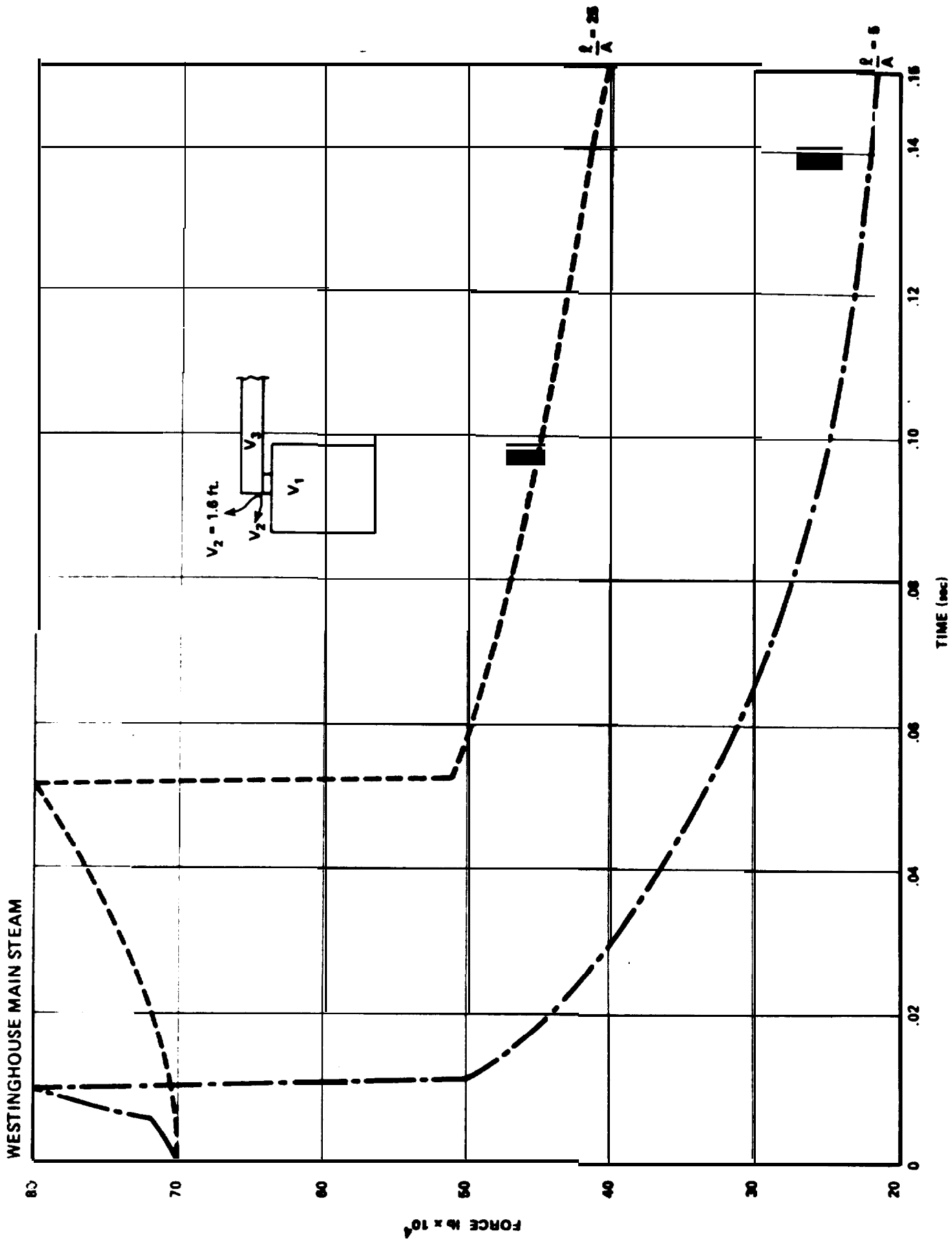


FIGURE 4.15

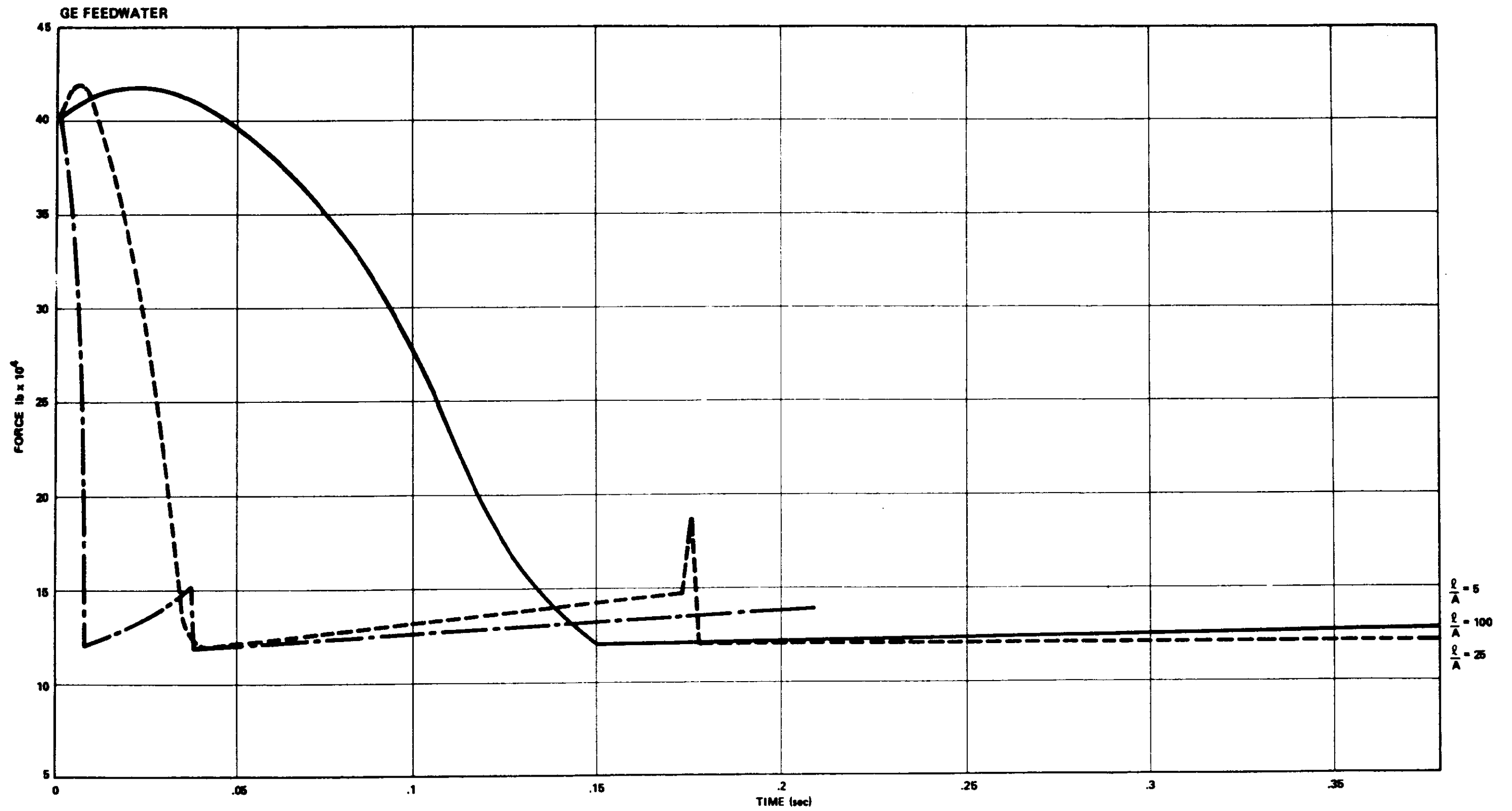


FIGURE 4.16

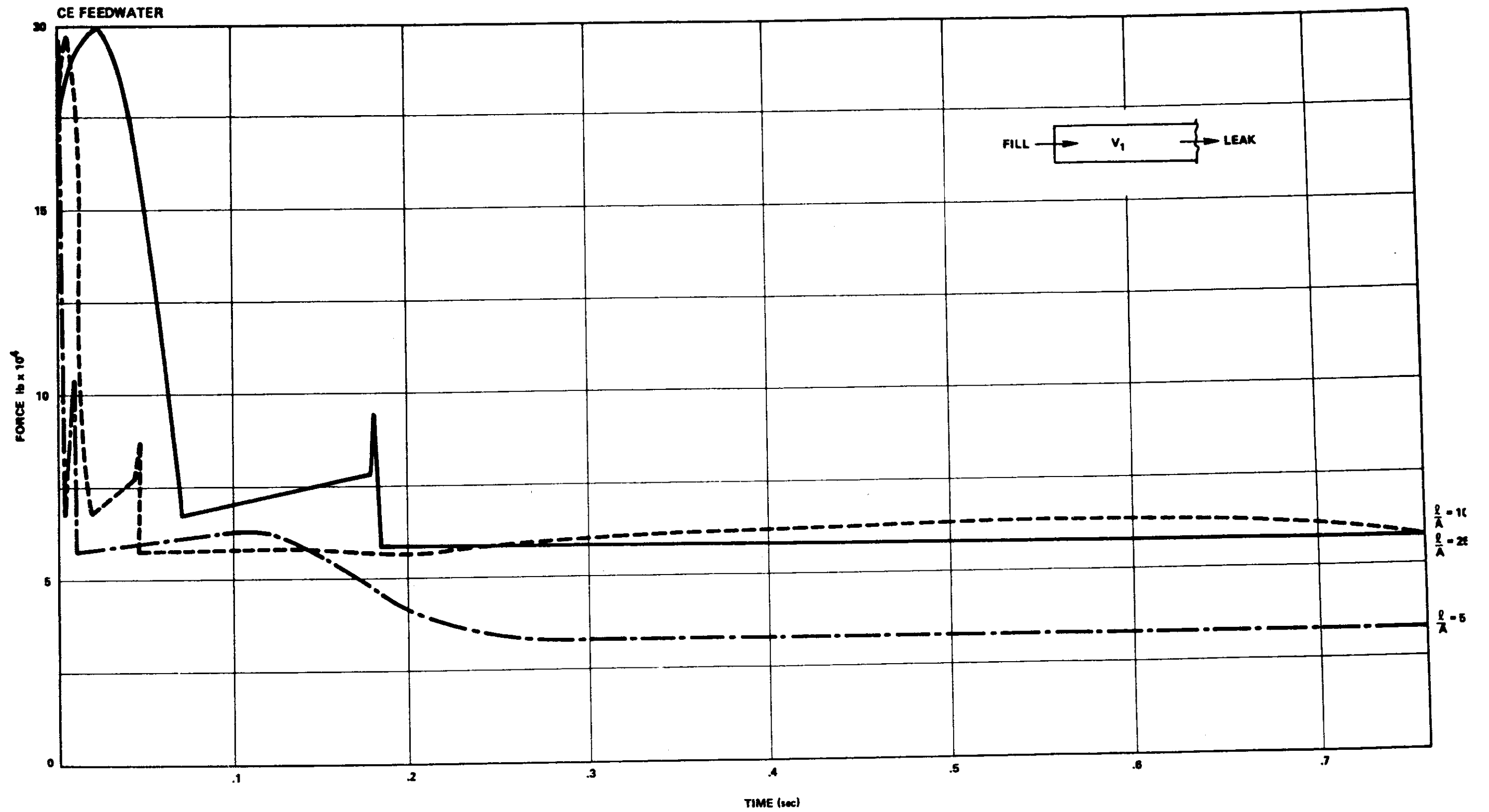


FIGURE 4.17

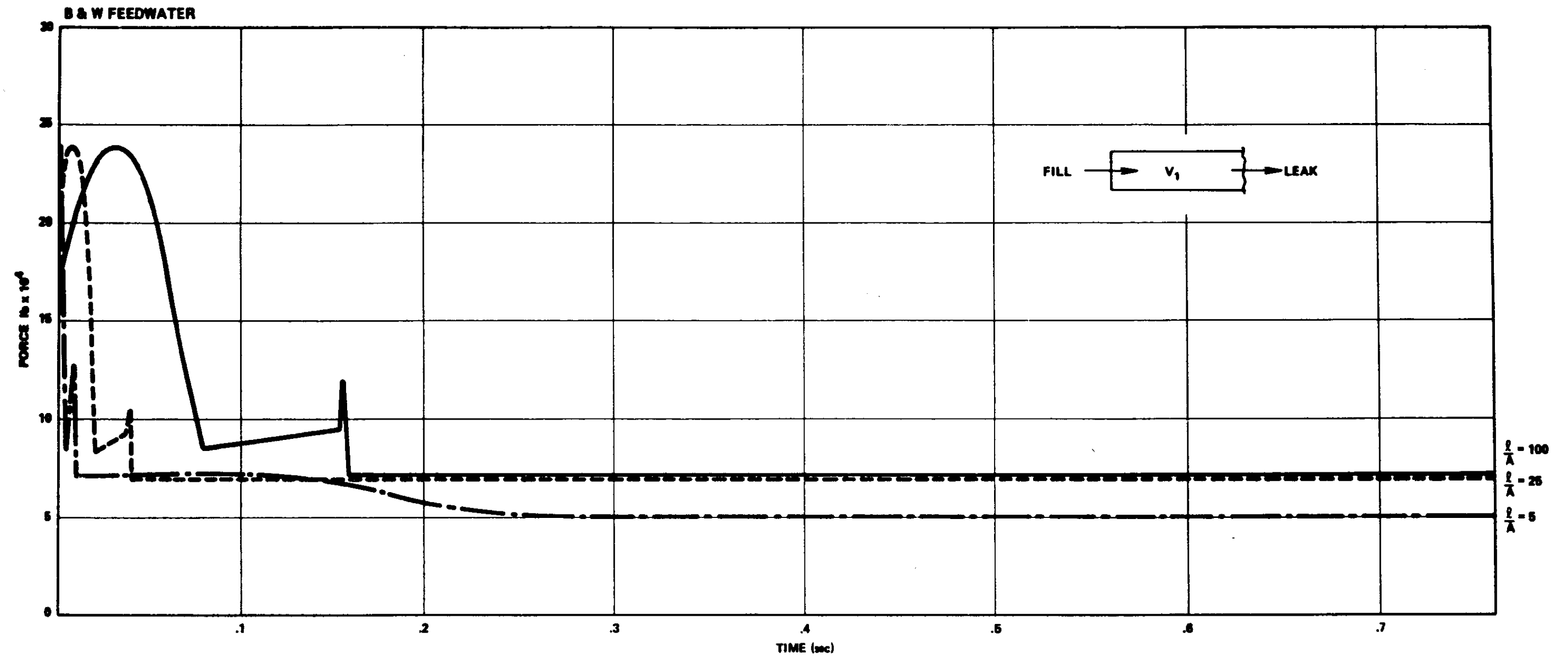


FIGURE 4.18

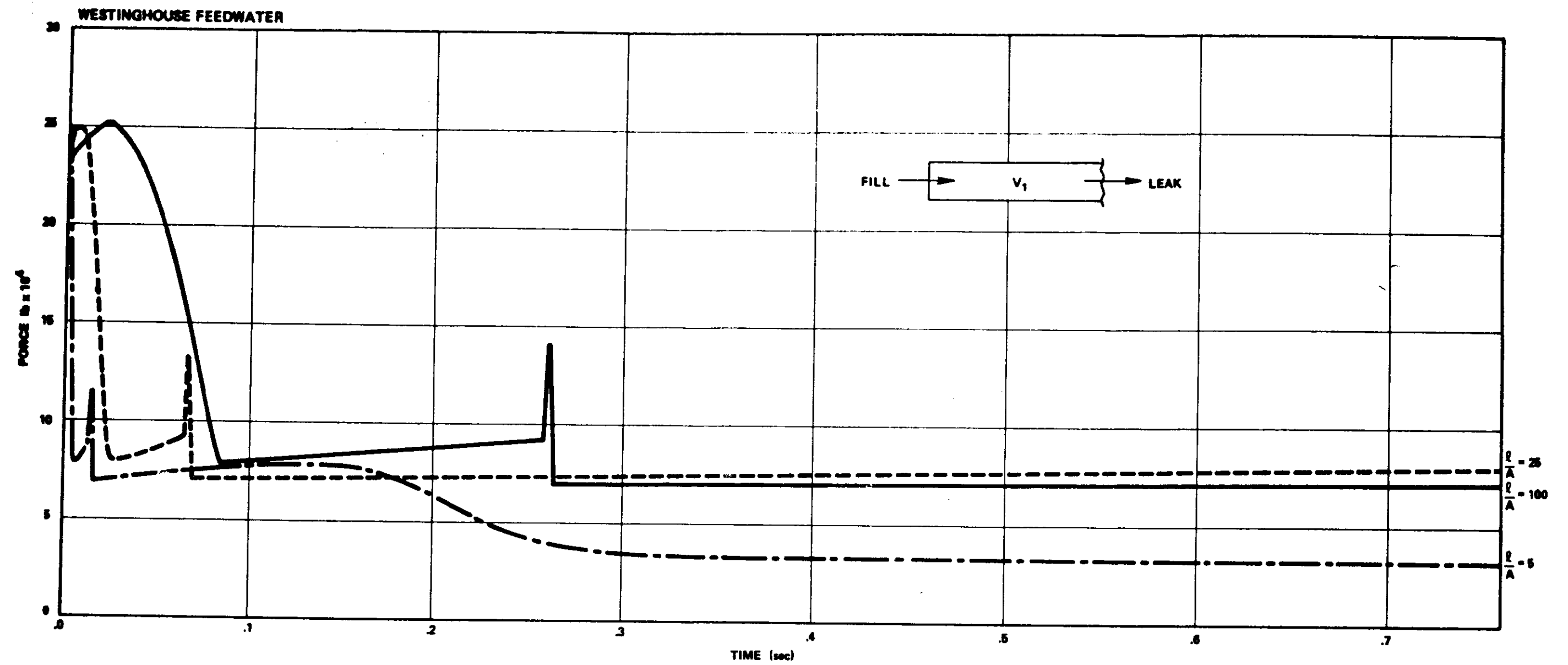


FIGURE 4.19