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FINAL REPORT

ANALYSIS, DESIGN, FABRICATION AND TESTING OF THE MINI-BRAYTON ROTATING UNIT (MINI-BRU)

VOLUME II - FIGURES AND DRAWINGS

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ANALYSIS, DESIGN, FABRICATION
AND TESTING OF THE
MINI-BRAYTON ROATING UNIT
(MINI-BRU)

INTRODUCTION

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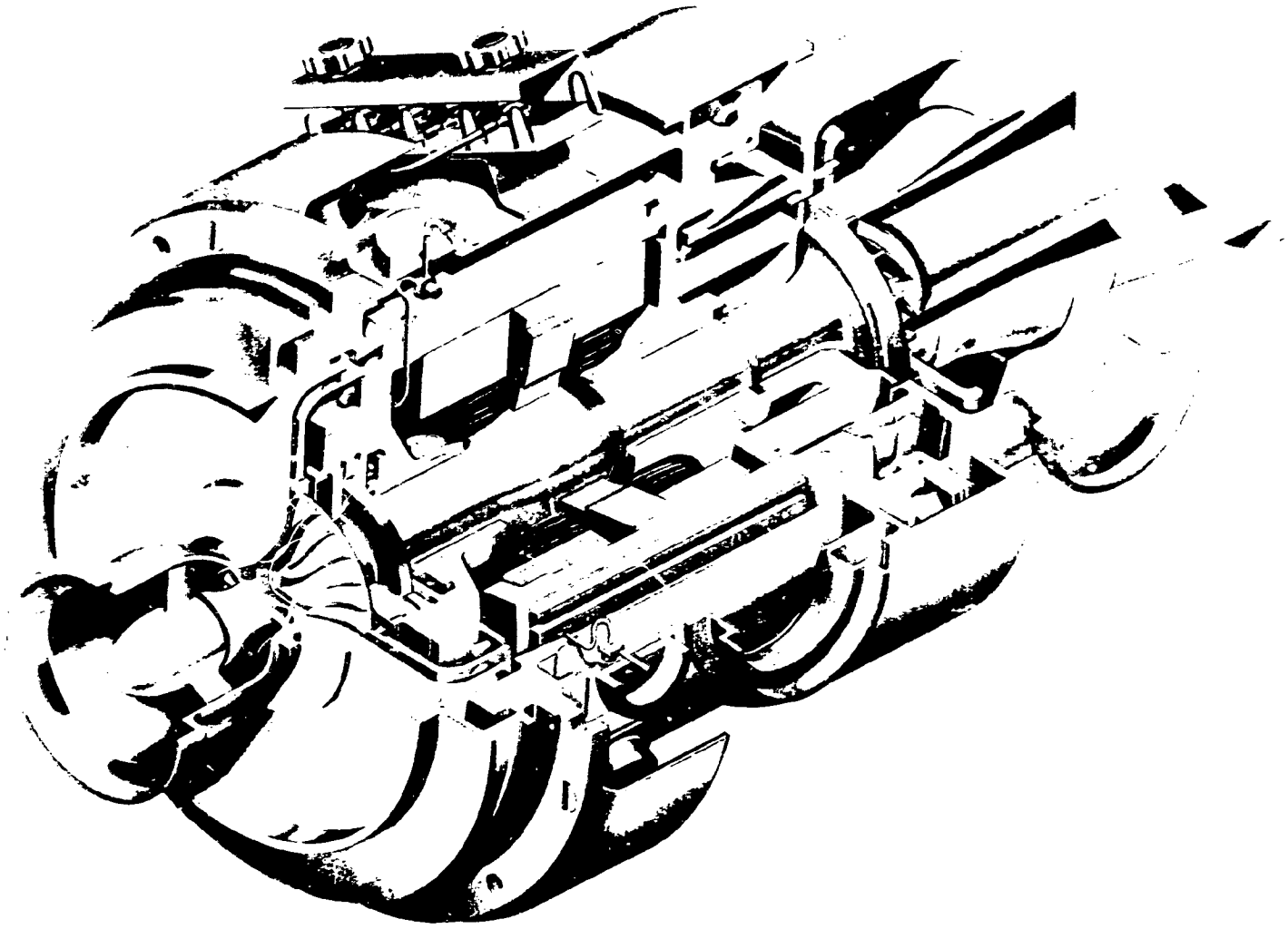
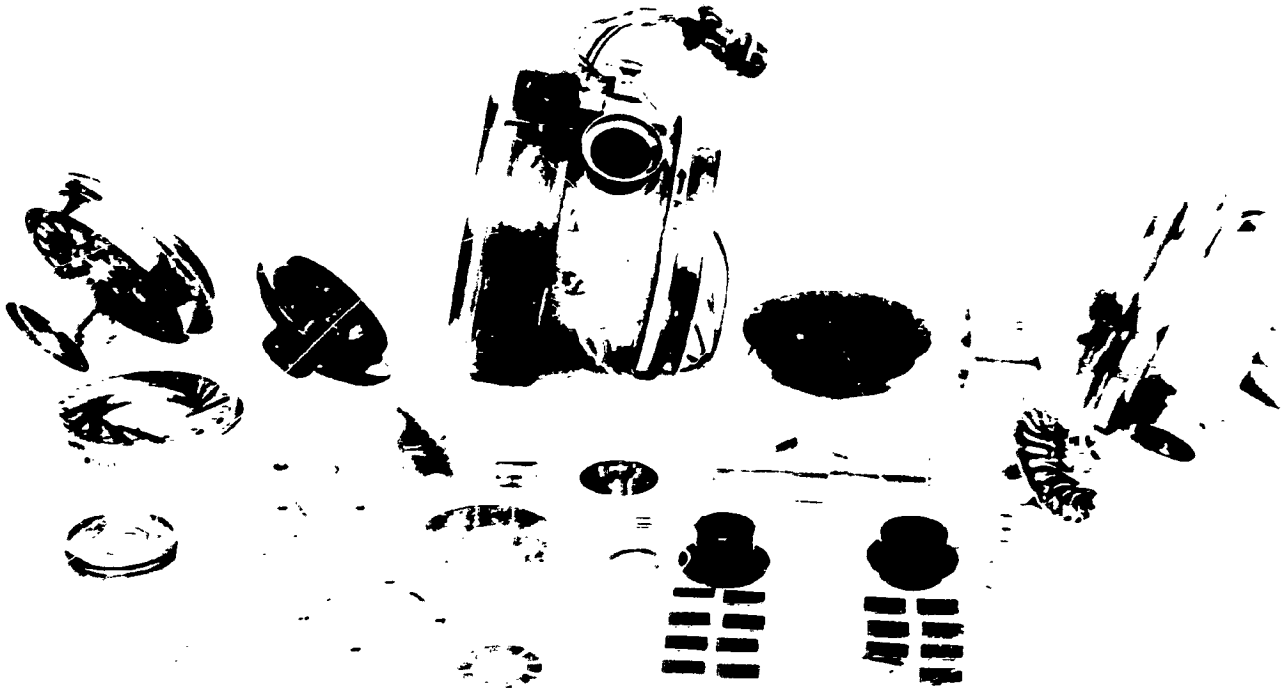


Figure 1. - Mini-BRU.



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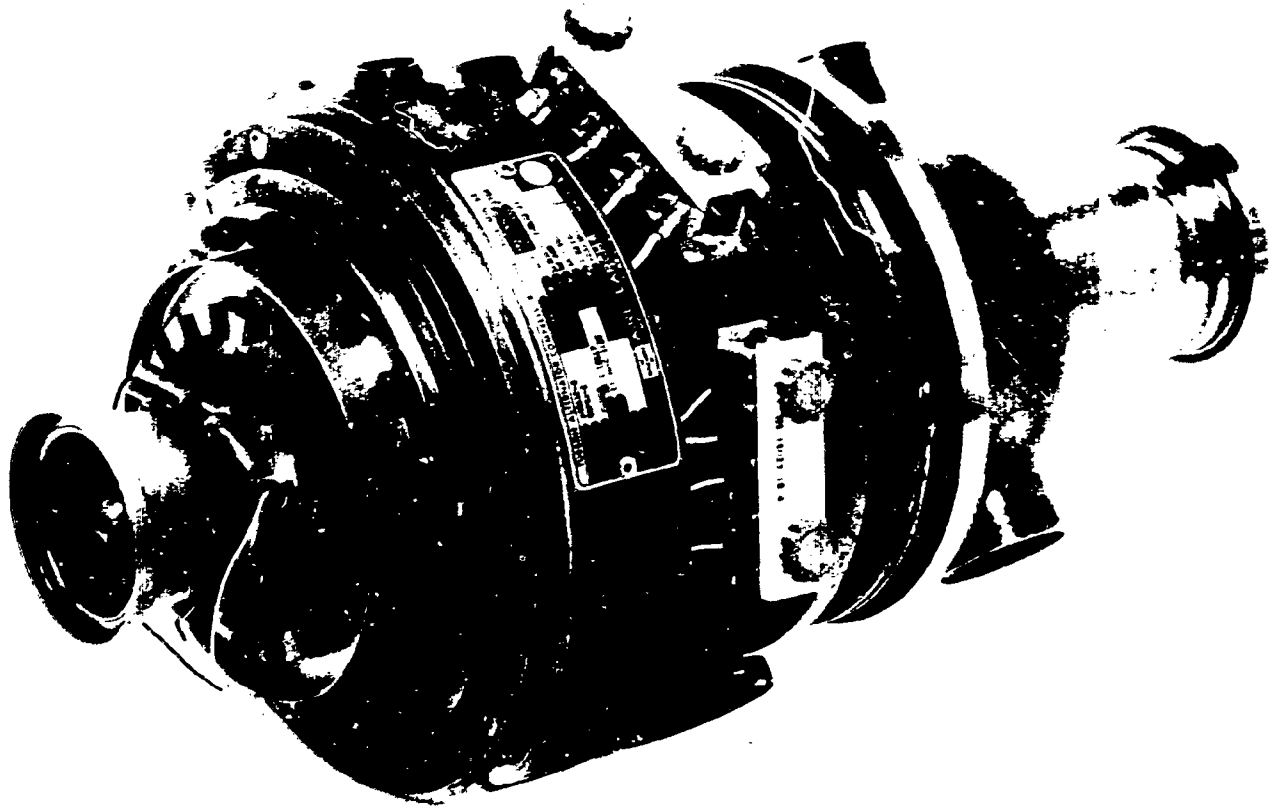
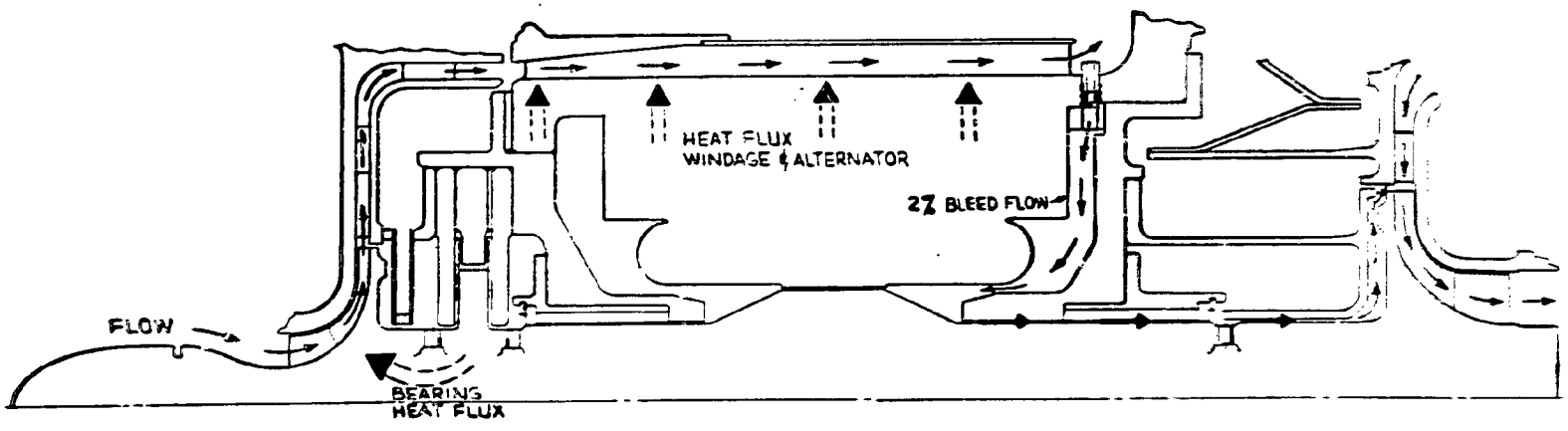


Figure 3. - Mini-BRU Unit Assembled.



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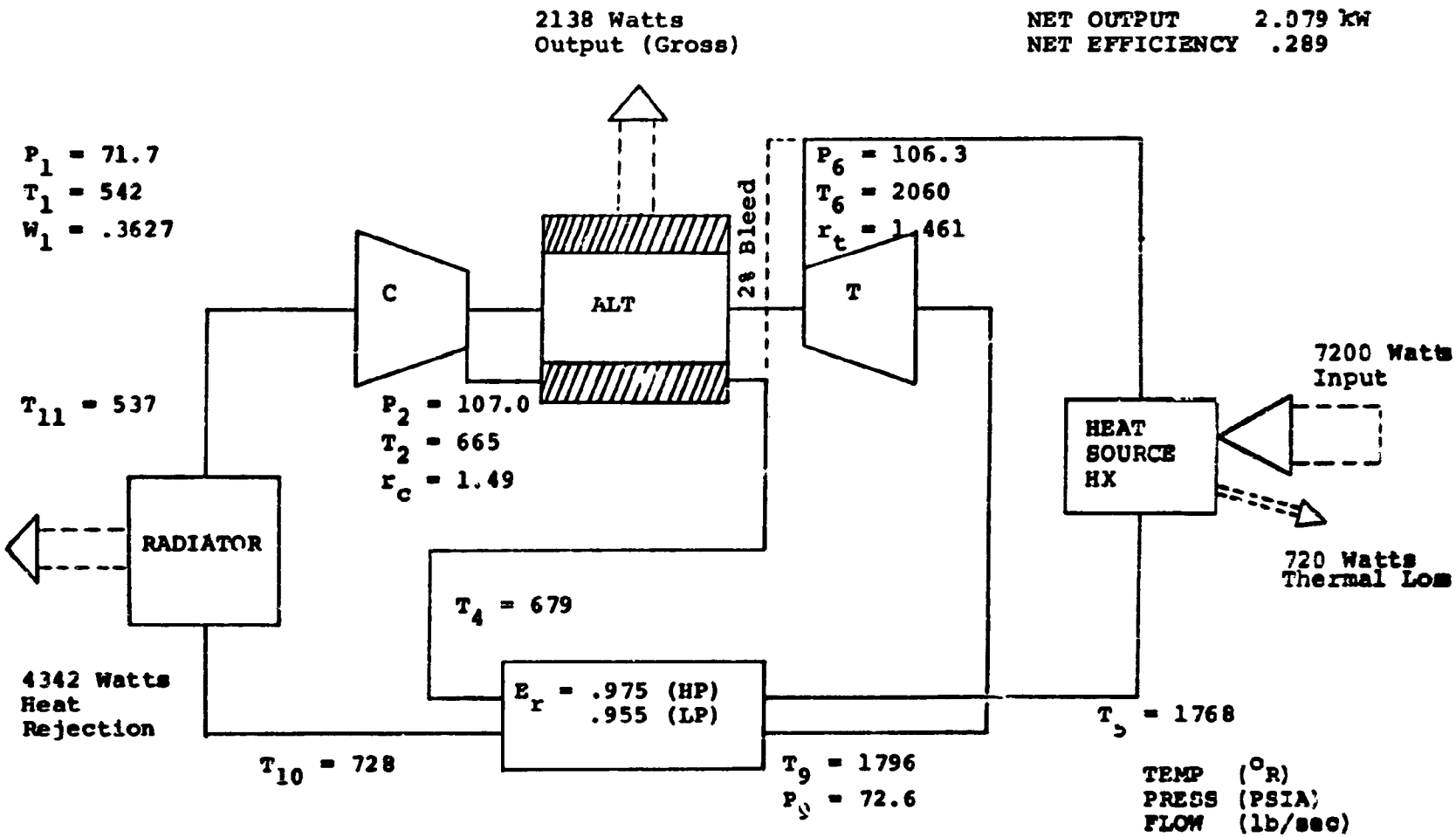

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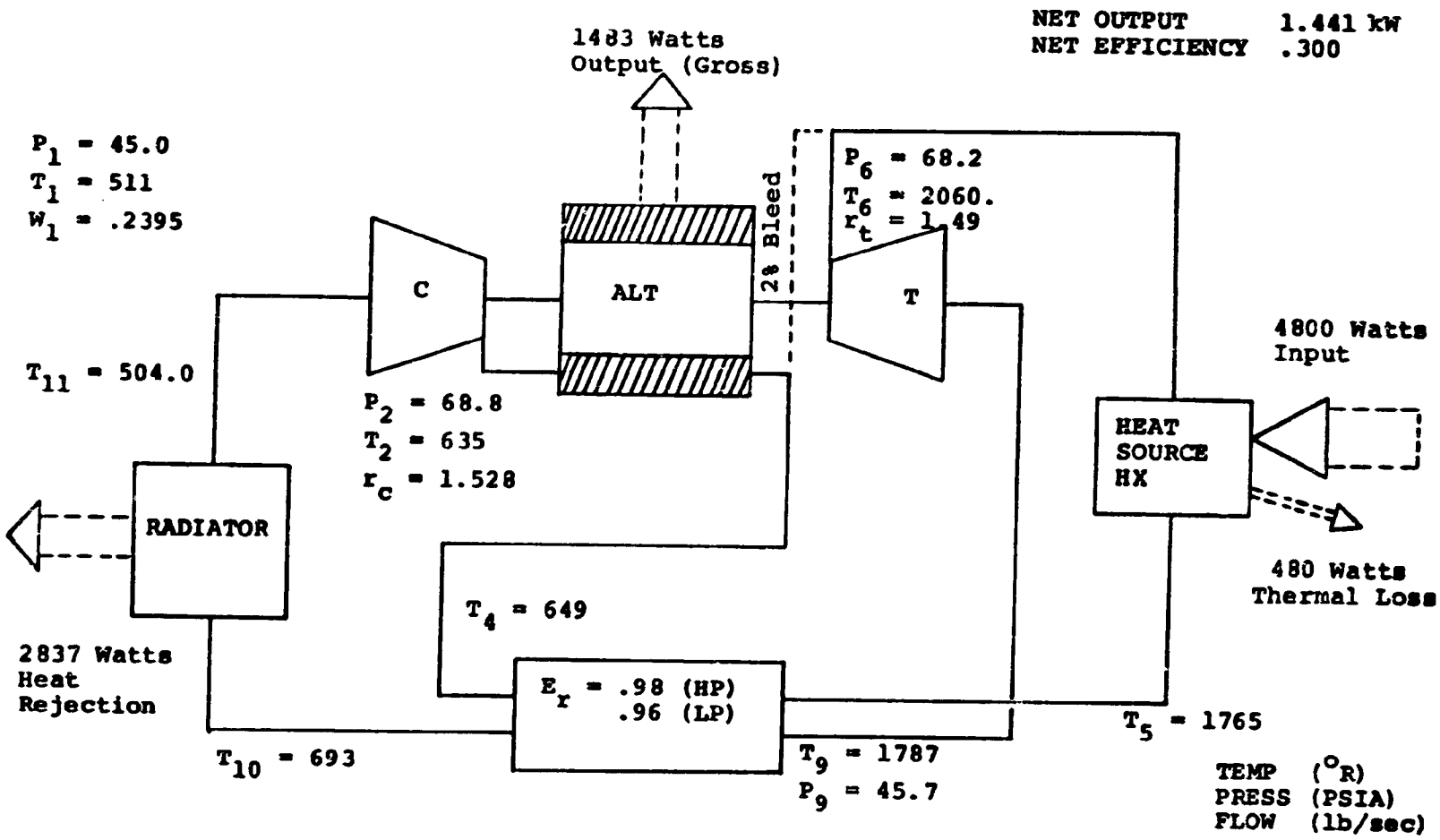

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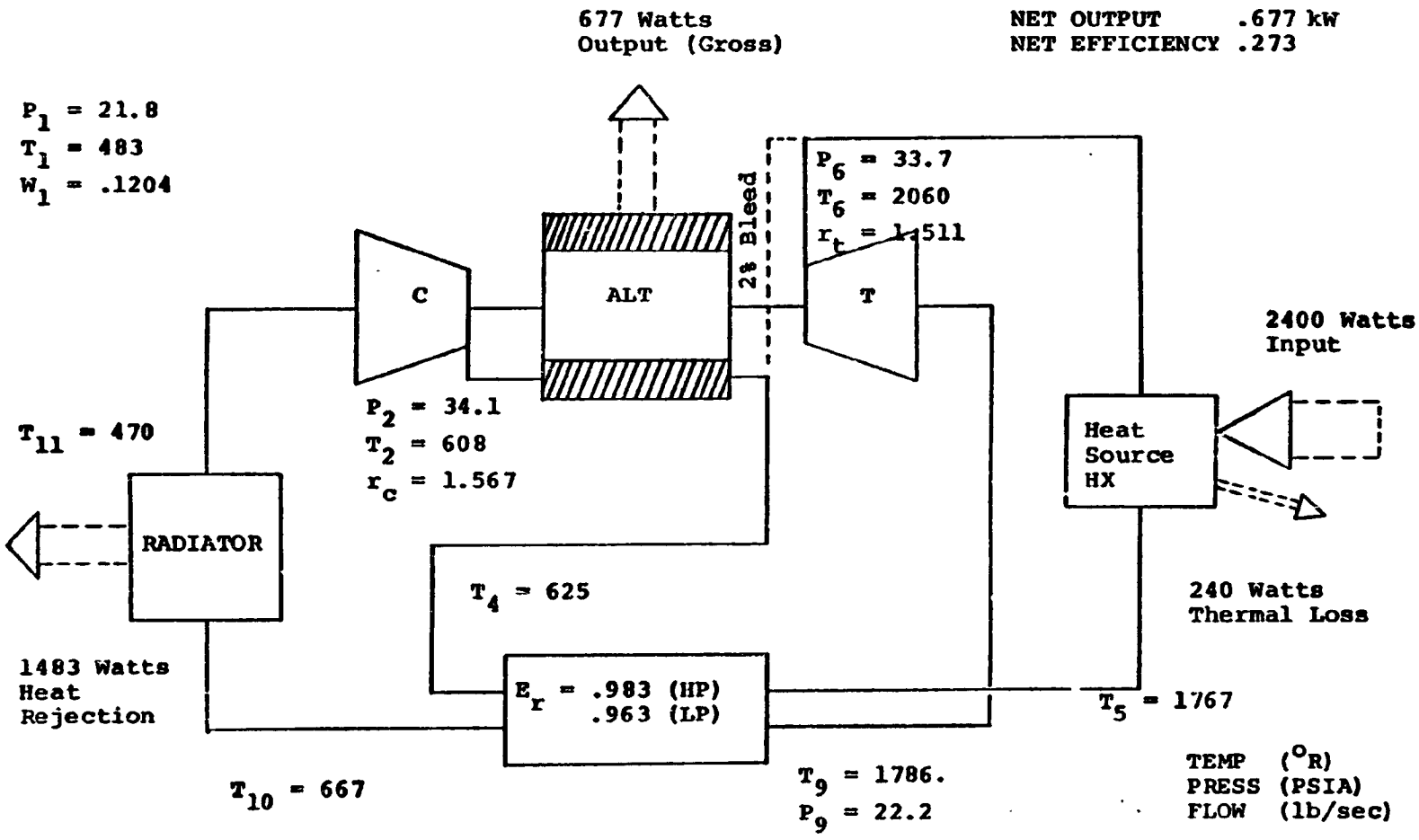

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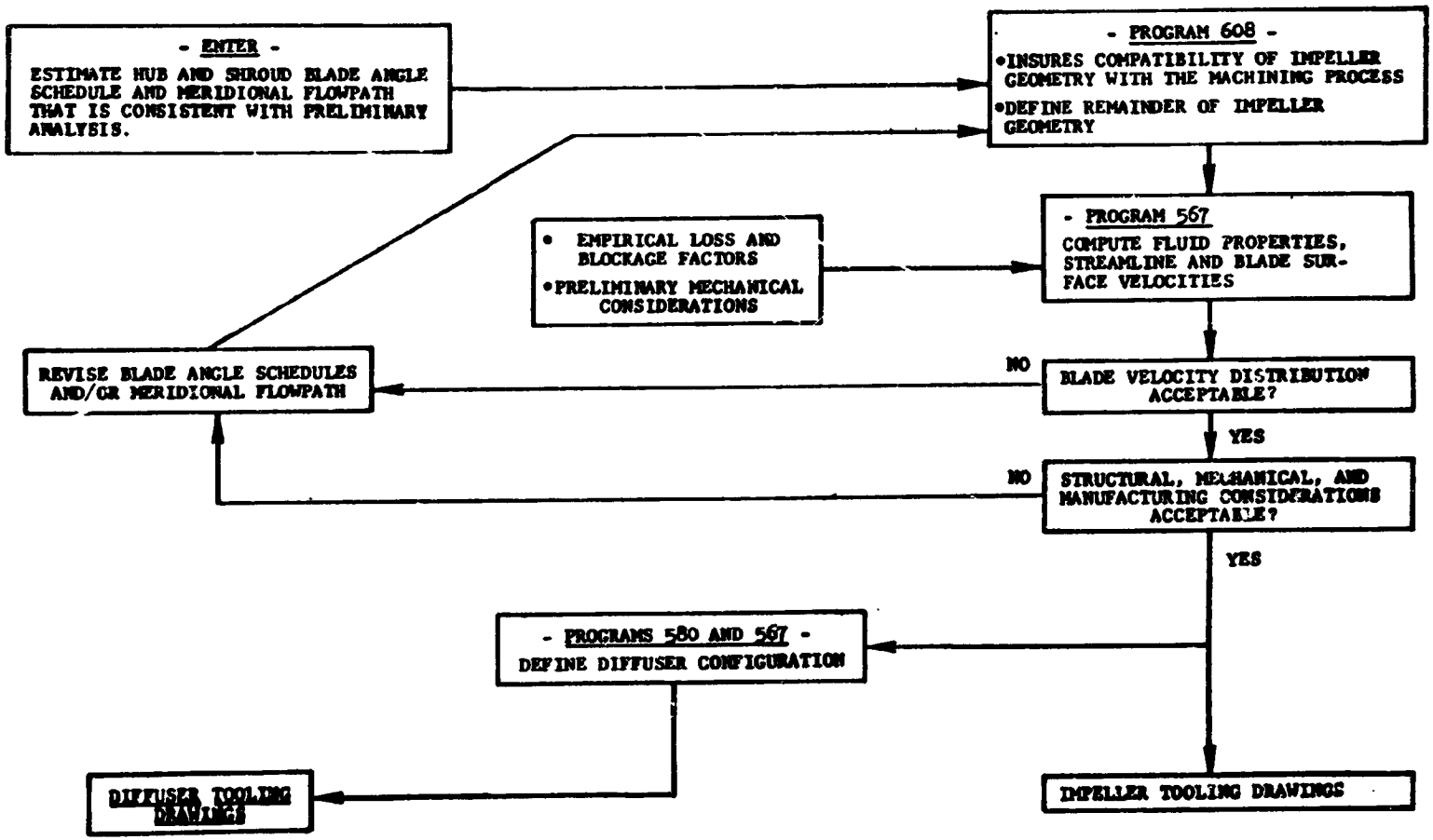

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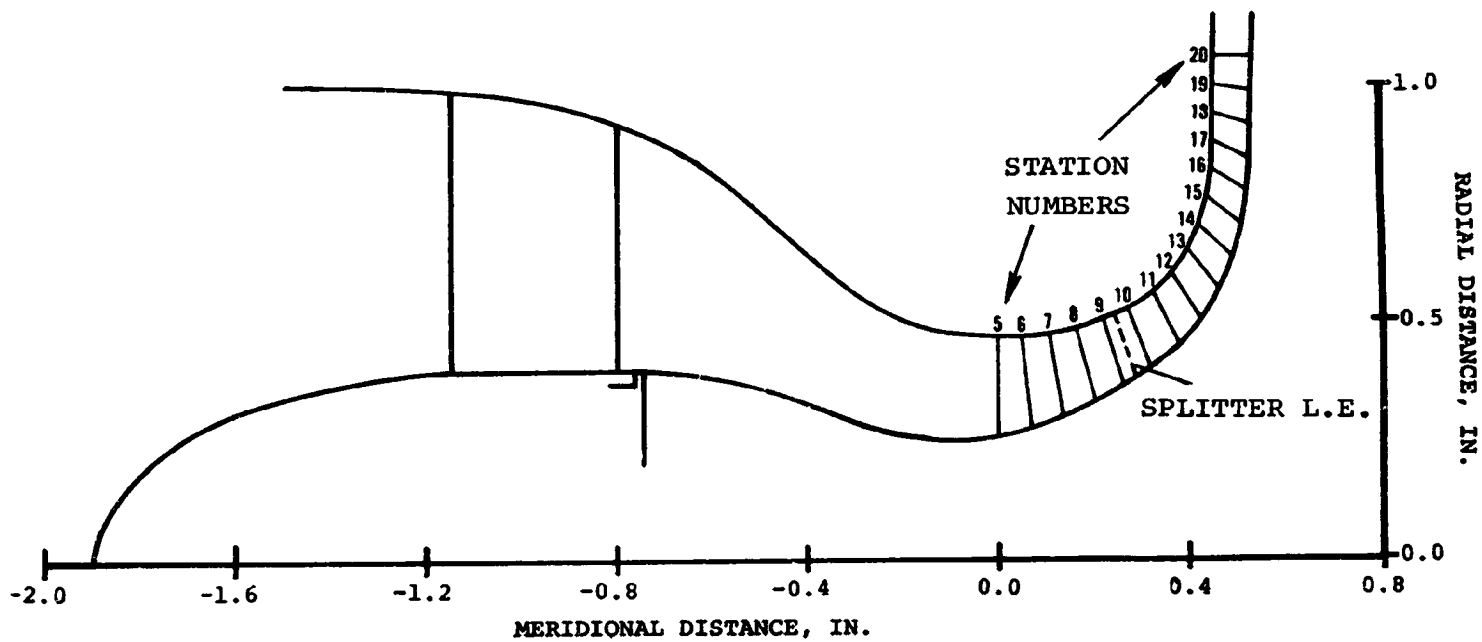

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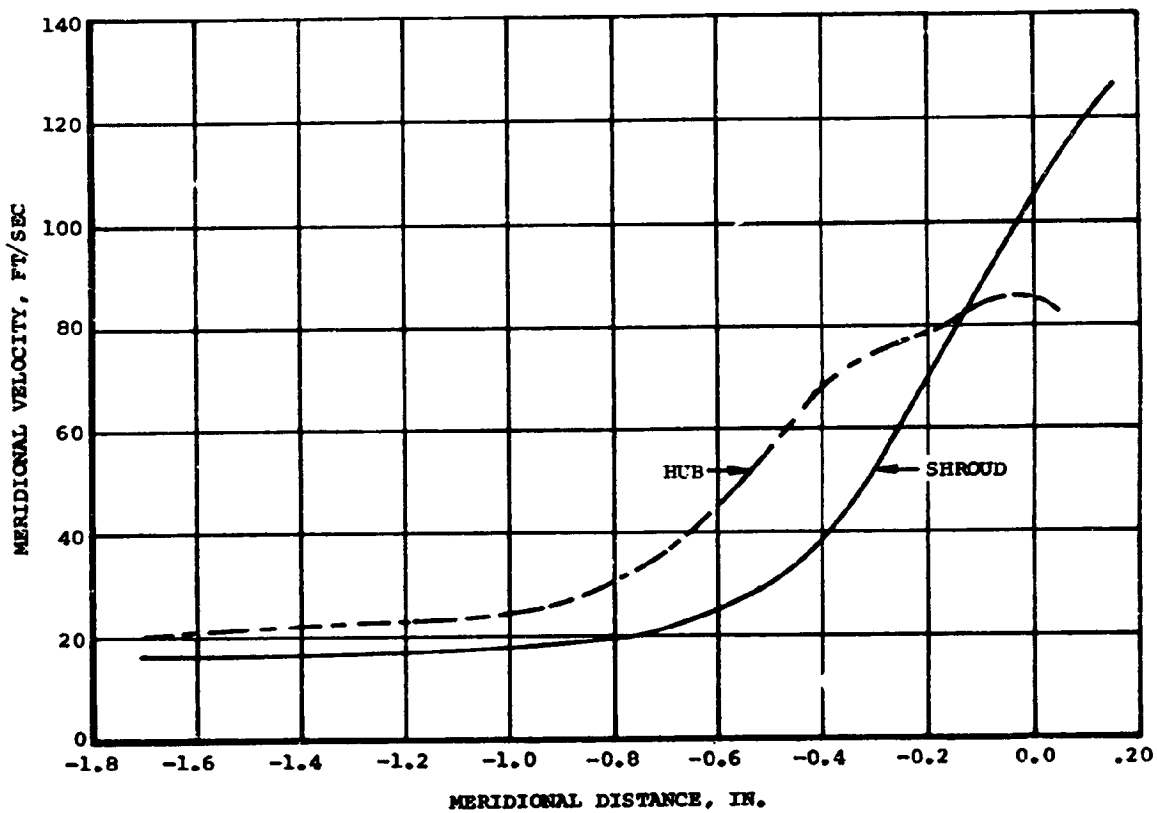

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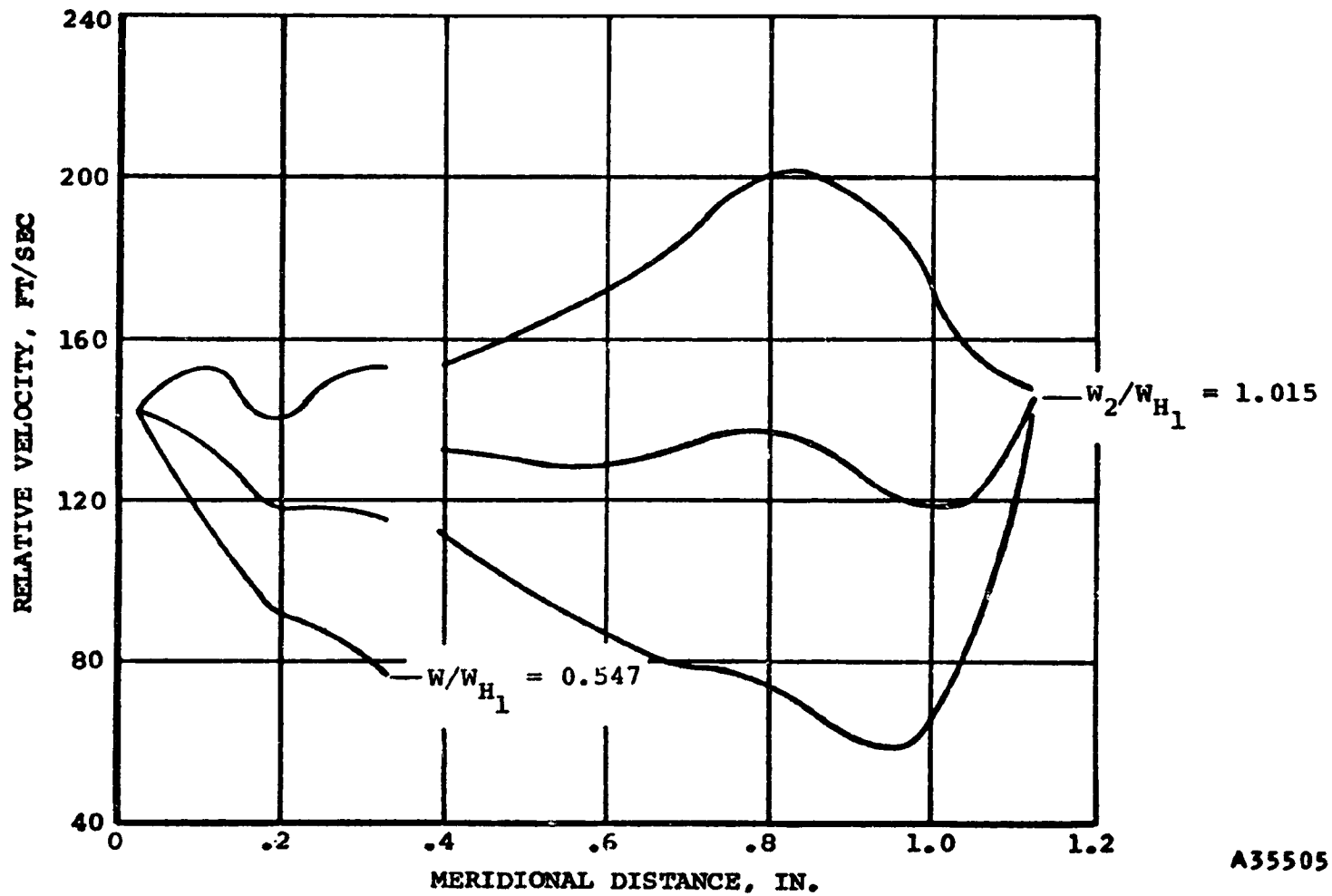

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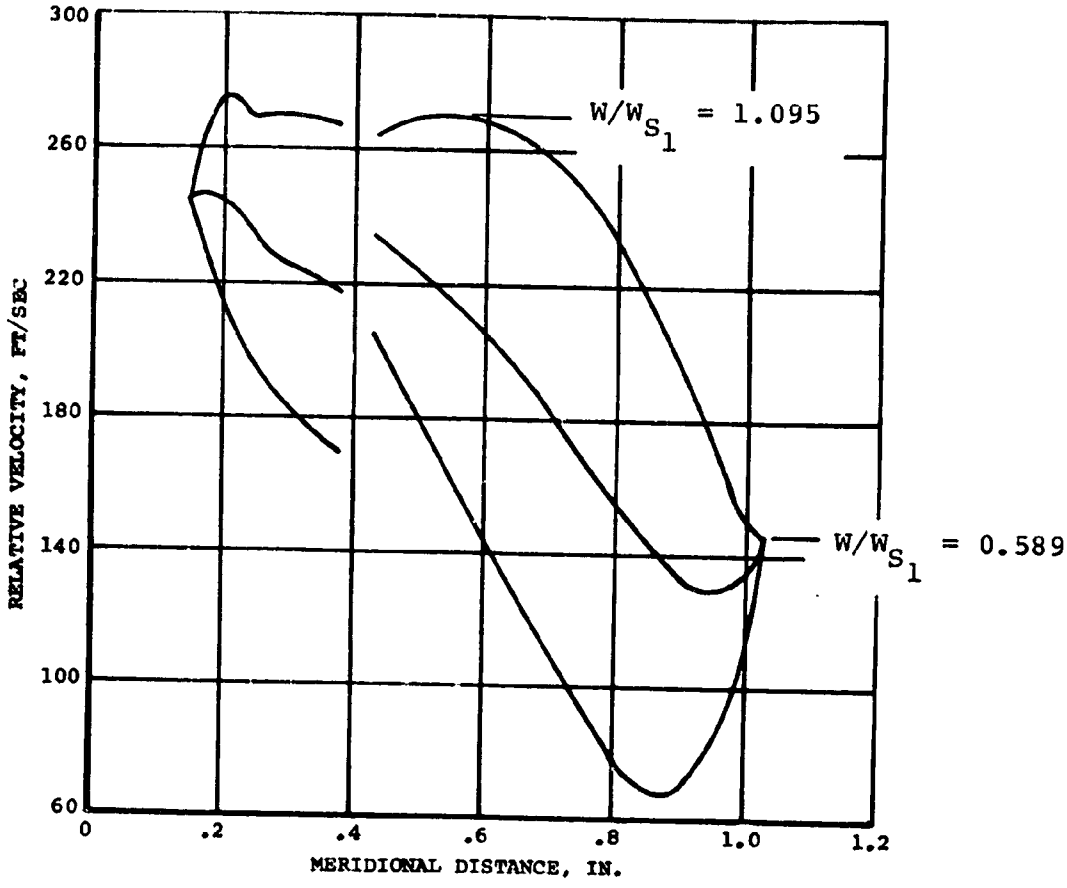

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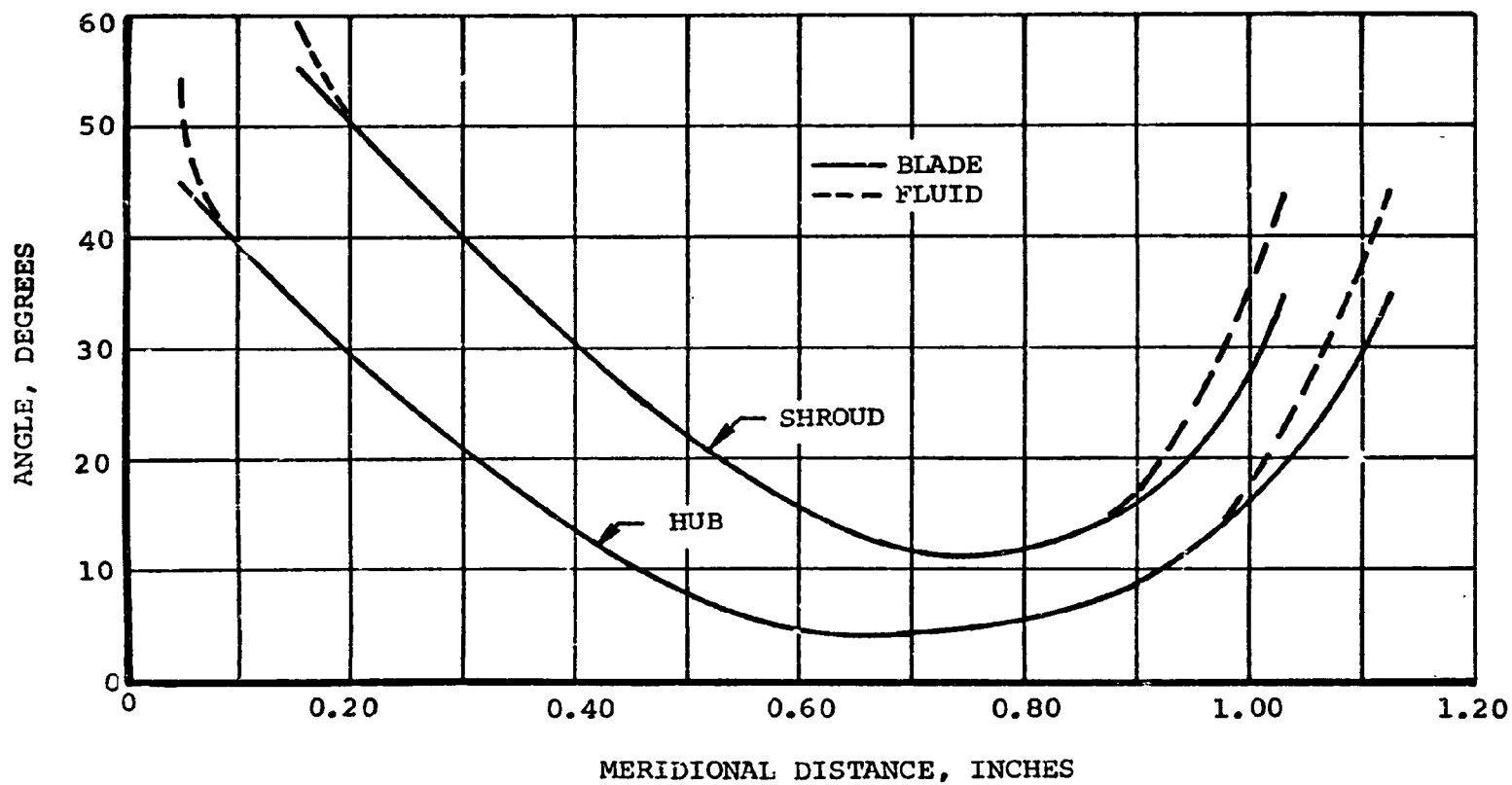
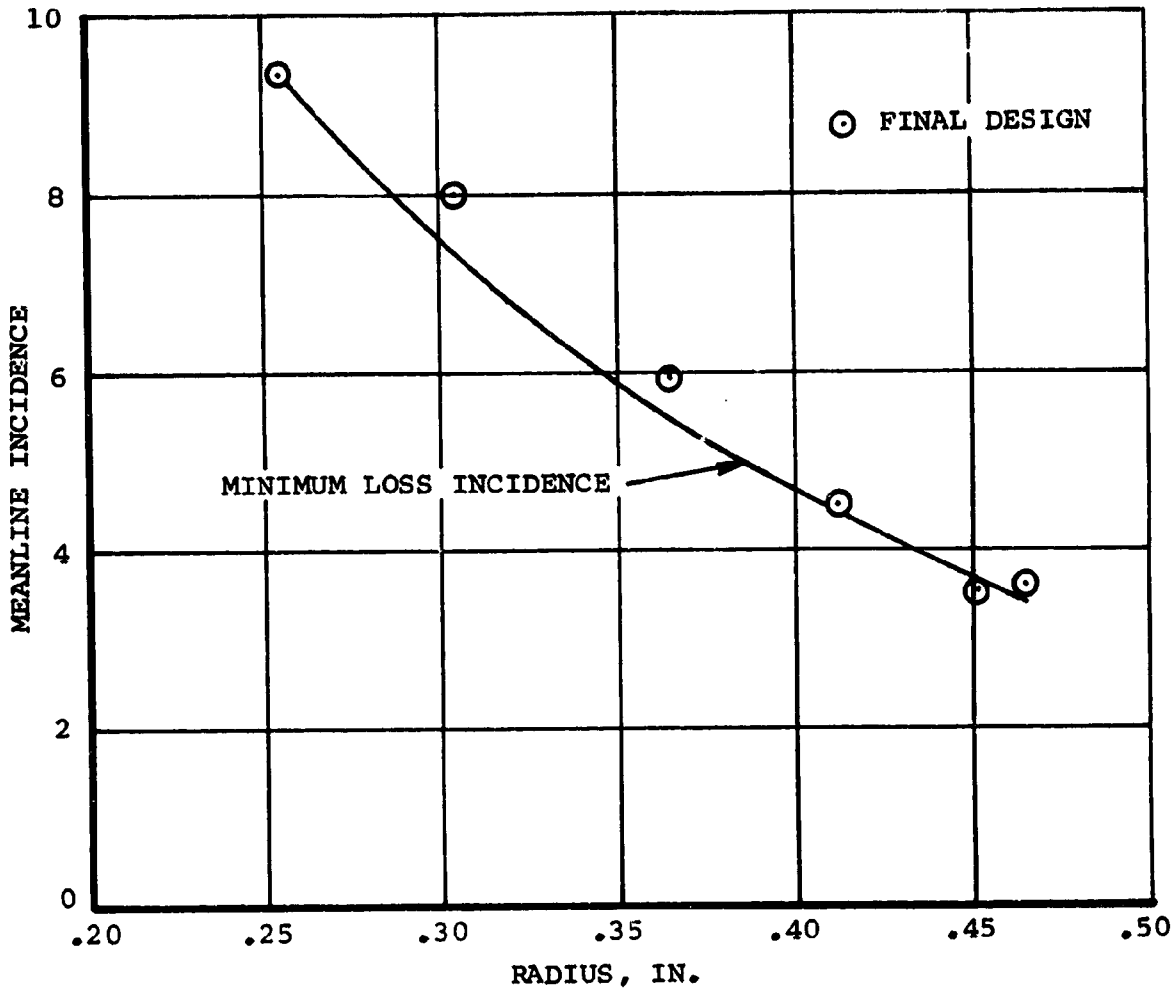


Figure 13. - Mini-BRU Compressor Blade, Air Angle Distributions.



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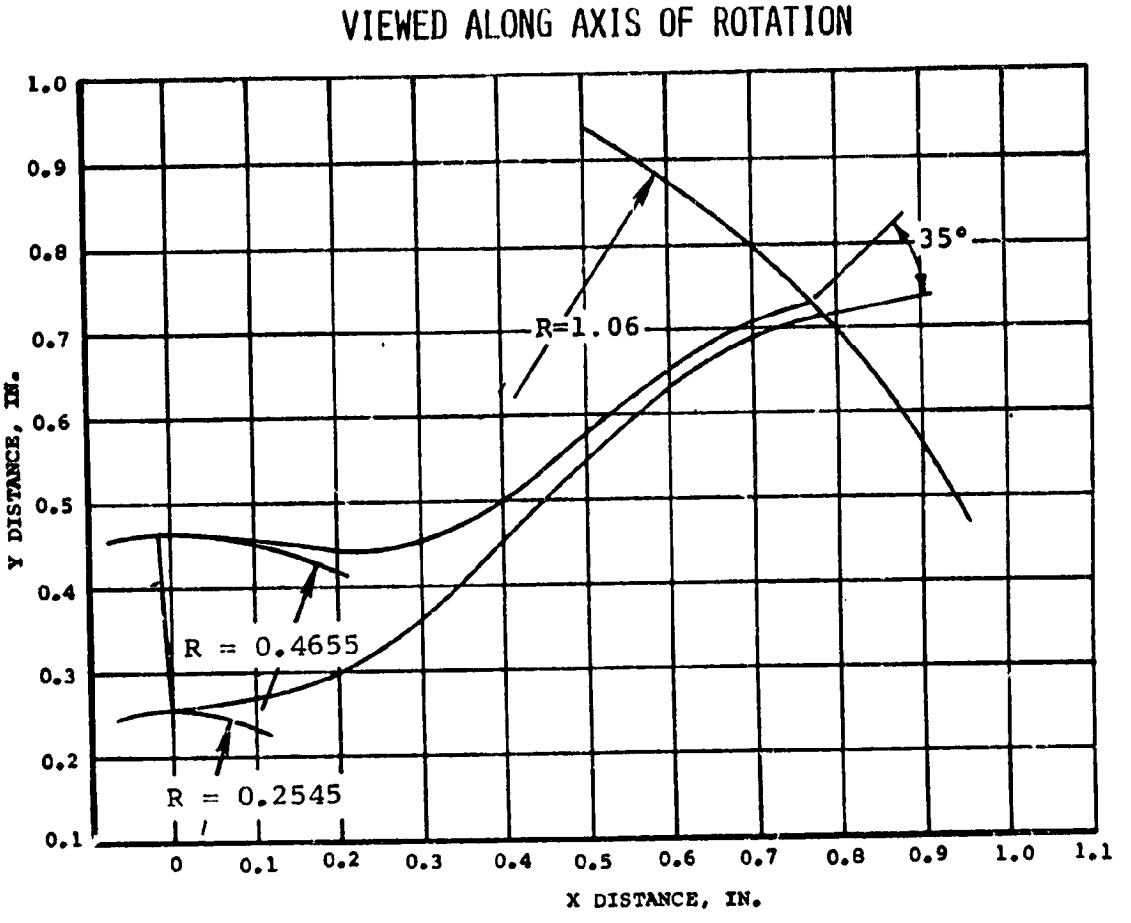


Figure 15. - Mini-BRU Impeller.

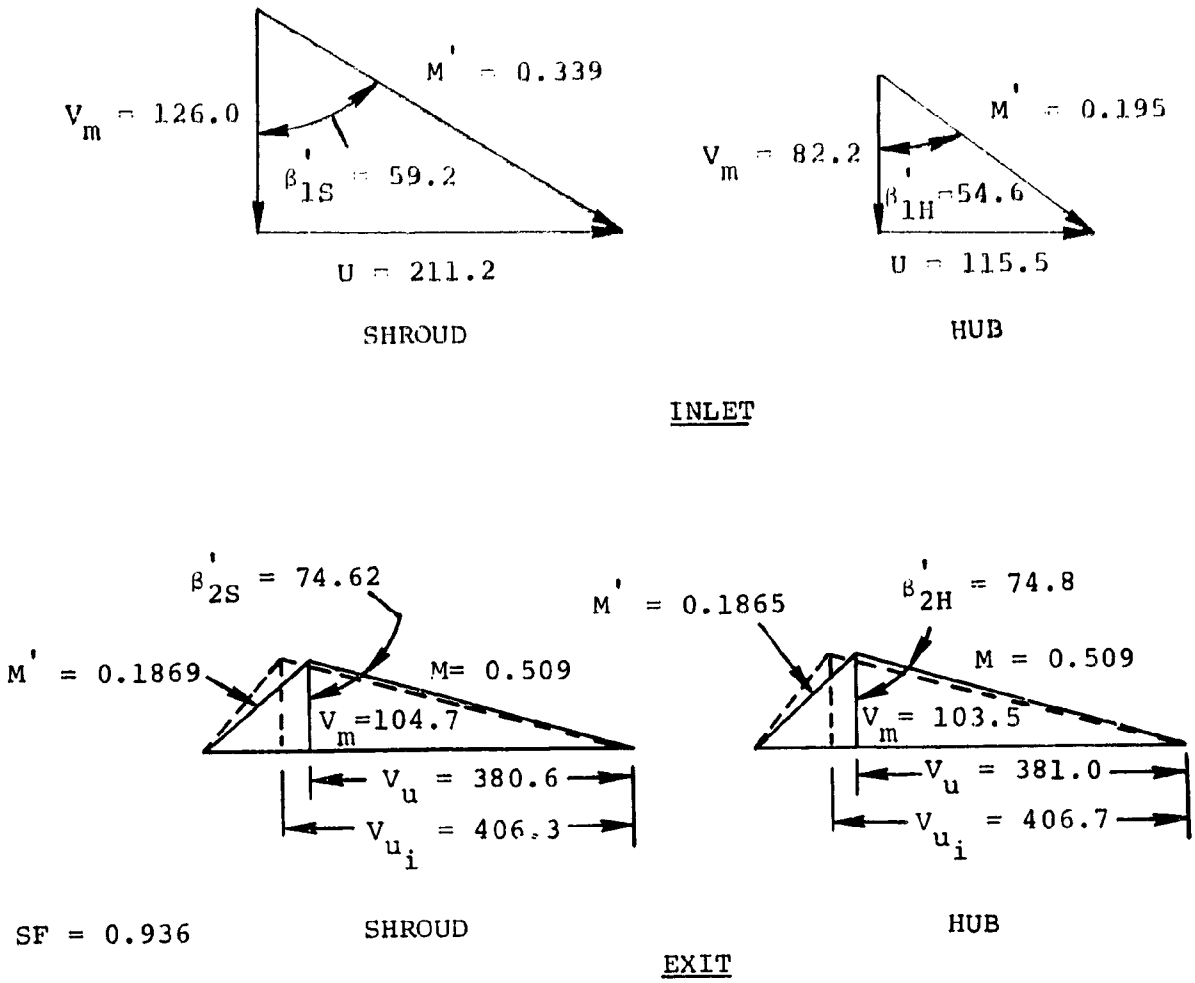


Figure 16. - Compressor Impeller Vector Diagrams.

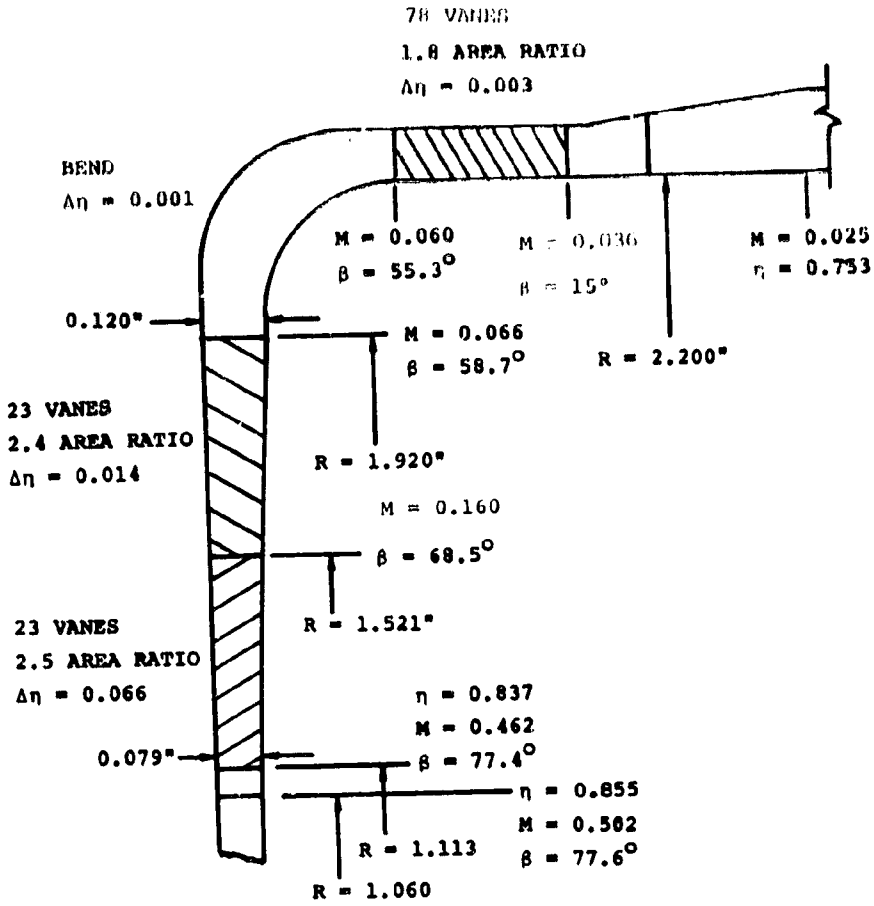
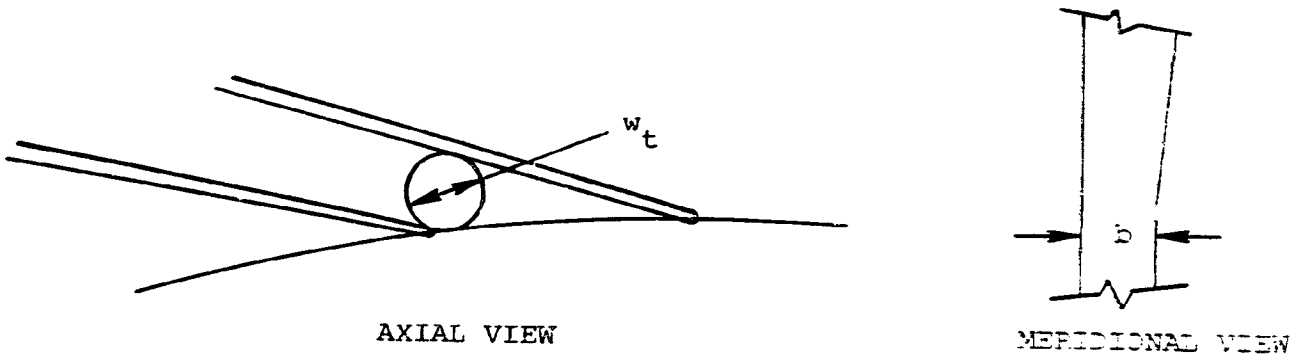


Figure 17. - Compressor Diffuser Flowpath.

$$A_s = b/w_t$$



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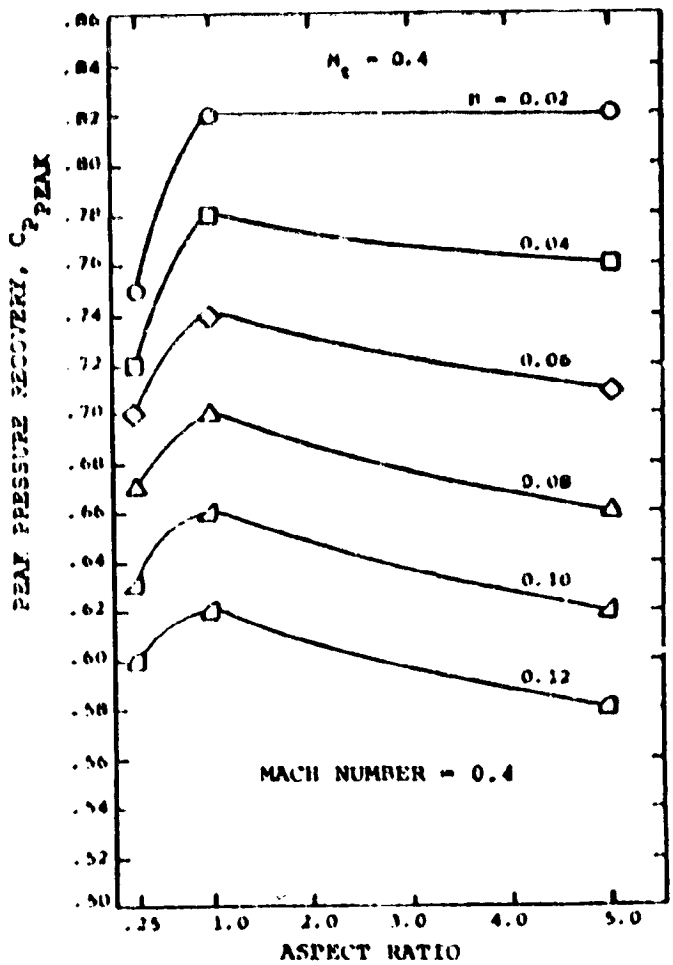


Figure 19. - Peak Pressure Recovery Versus Aspect Ratio.

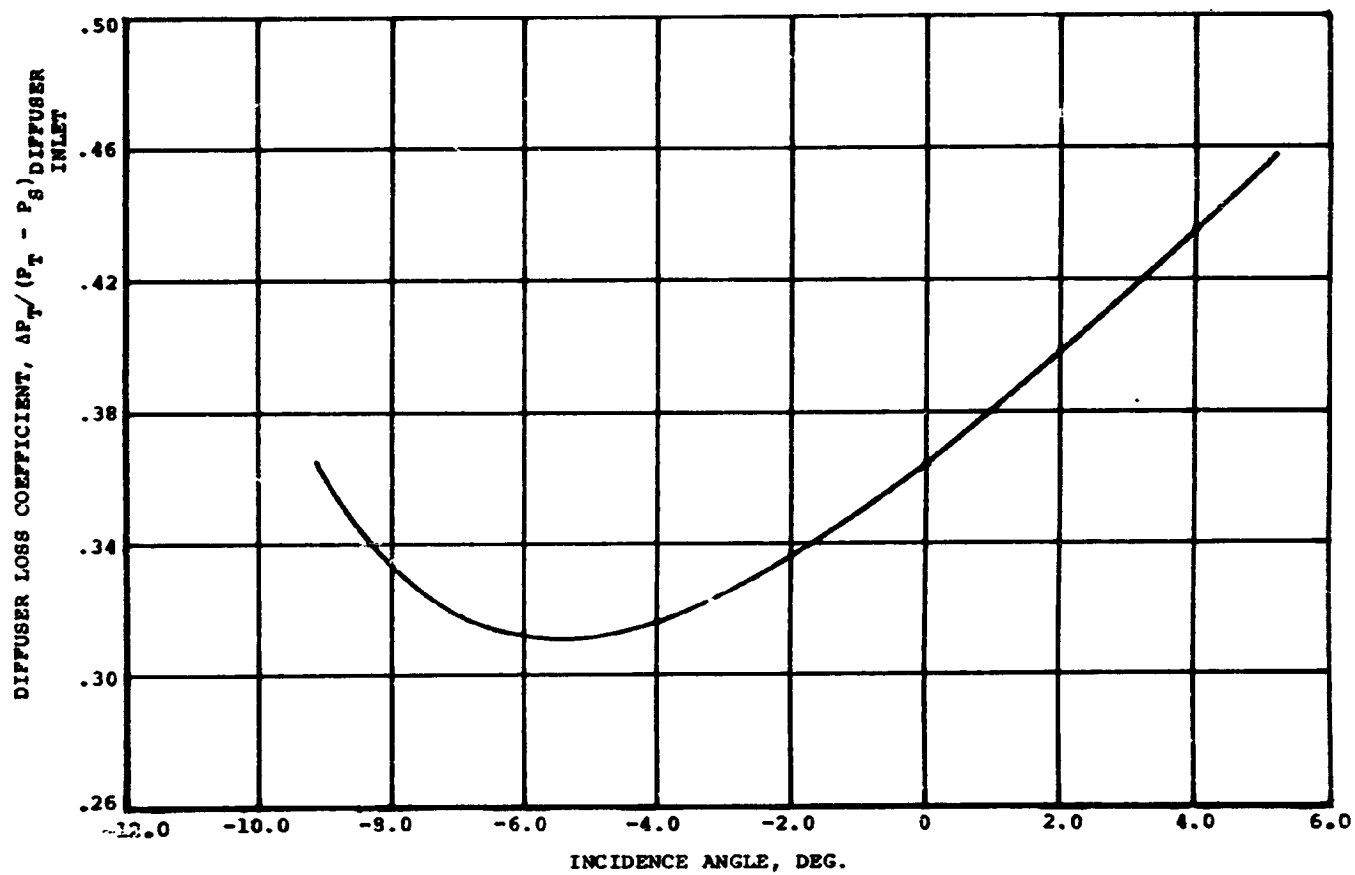


Figure 20. - Incidence Angle Versus Diffuser Loss Coefficient.

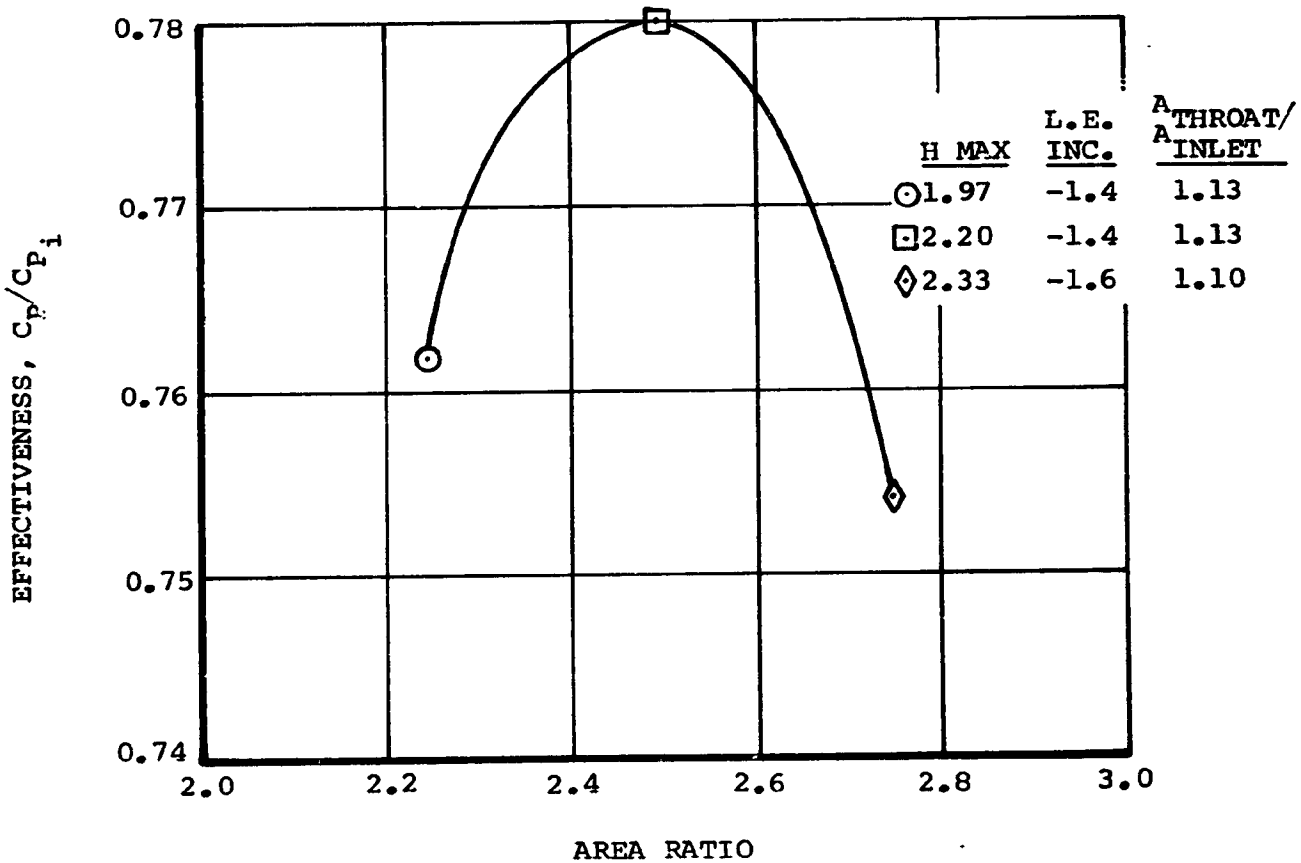


Figure 21. - Mini-BRU Compressor Diffuser Effectiveness Comparison.

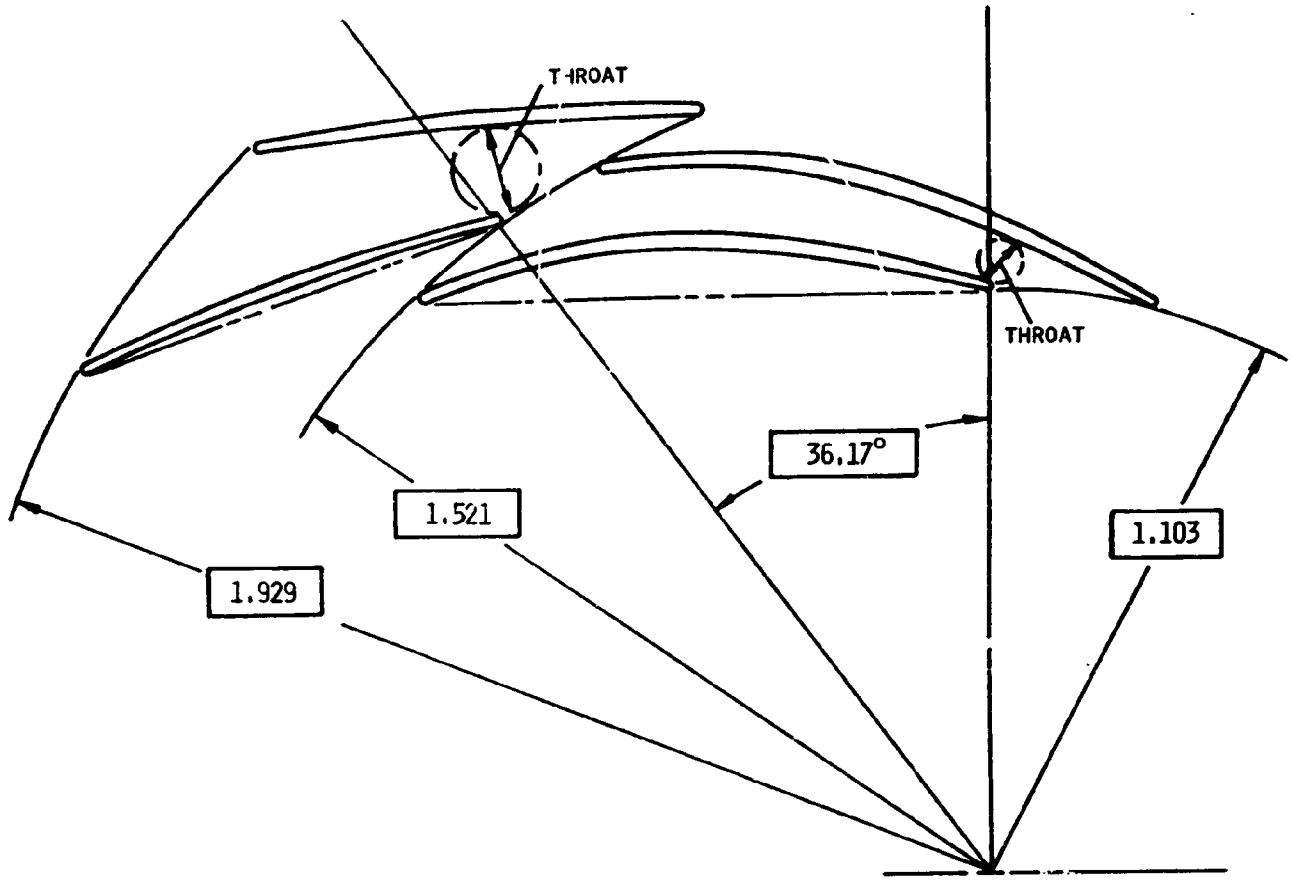


Figure 22. - Mini-BRU Compressor Tandem Diffuser Circumferential Positioning.

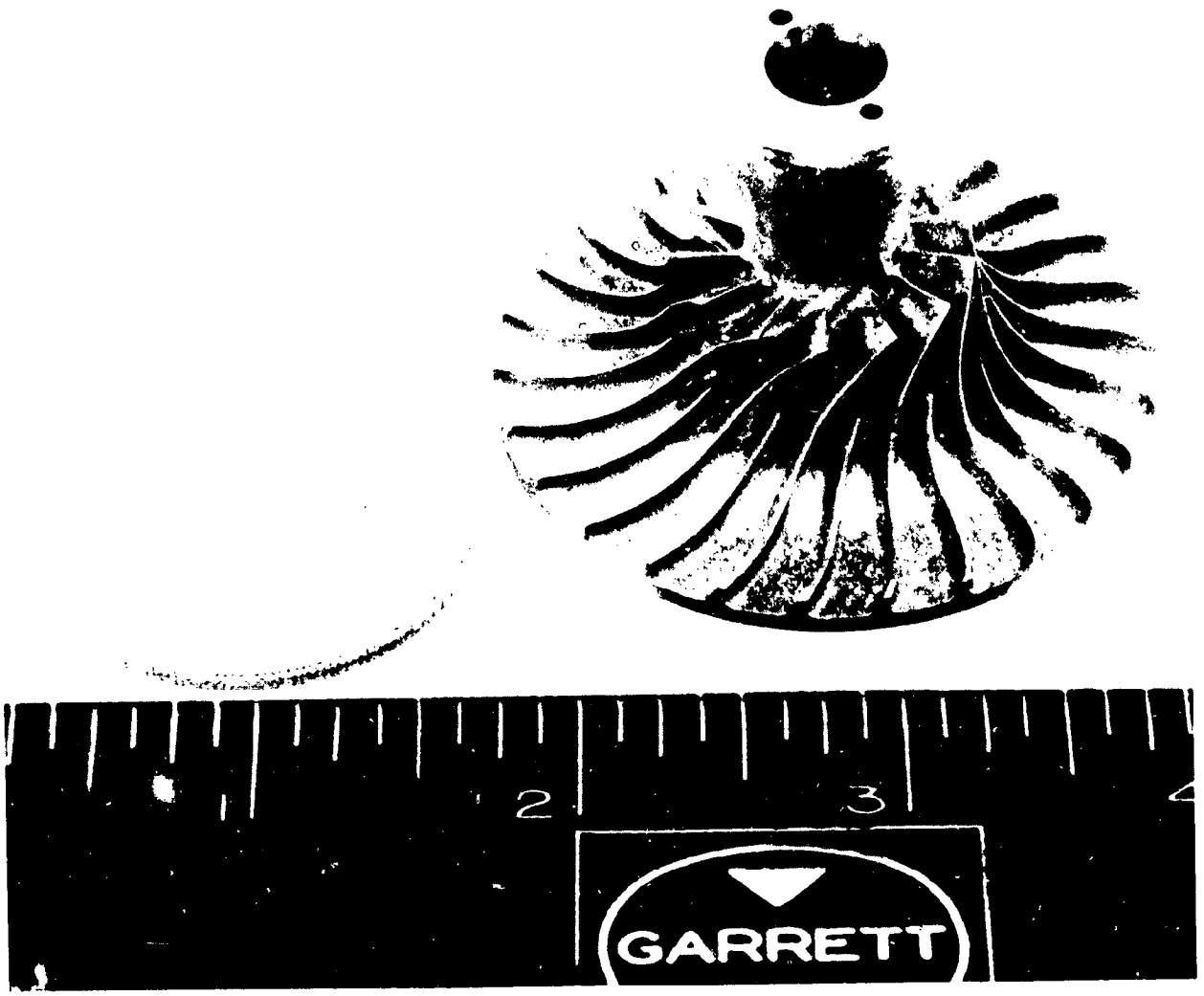


Figure 23. - Mini-BRU Compressor Impeller-Original Design.

Figure 24. - Mini-BRU Compressor 2-Stage Radial Diffuser (before assembly).

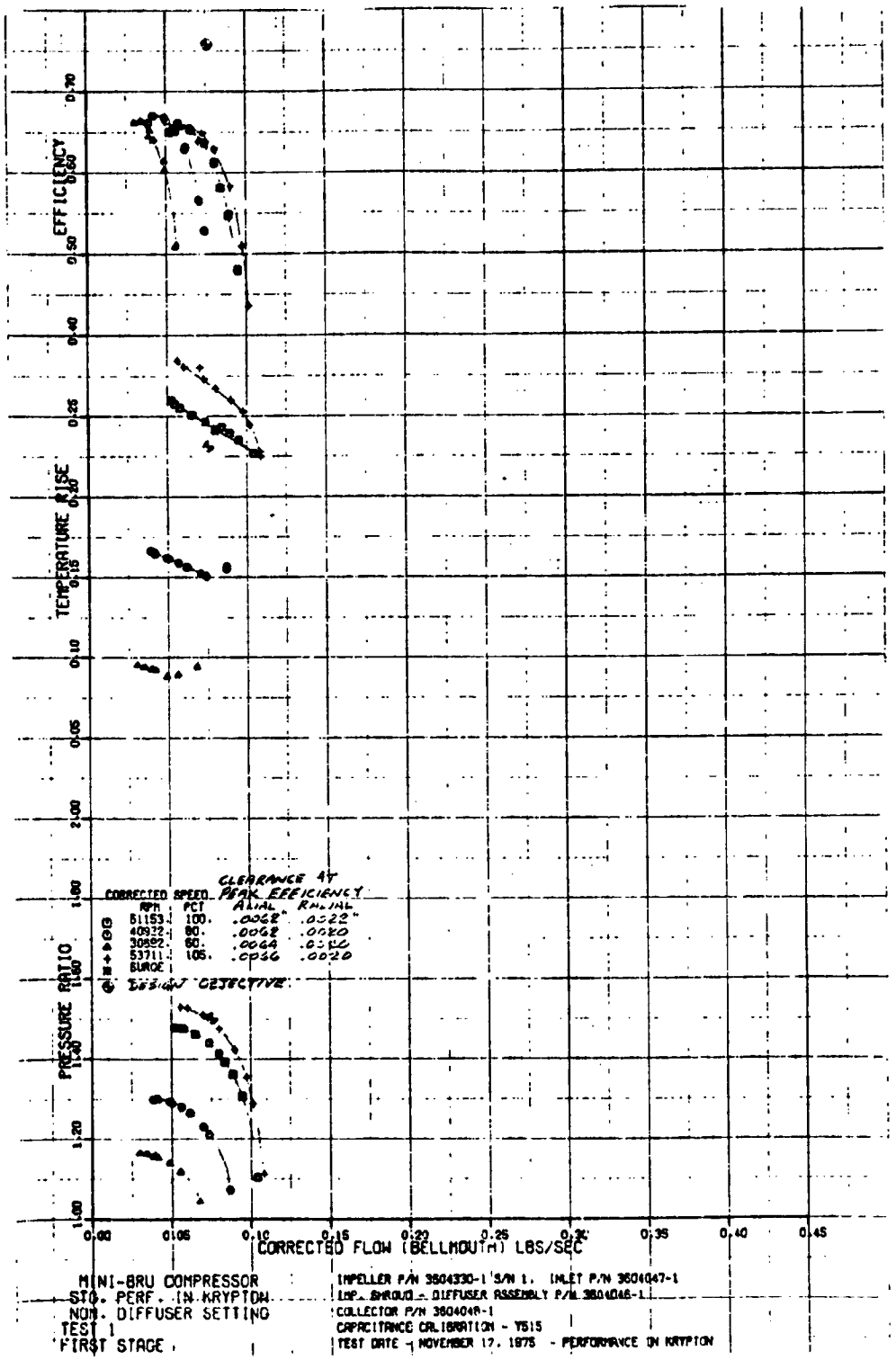


Figure 25. - Compressor Map of the Original Mini-BRU Compressor.

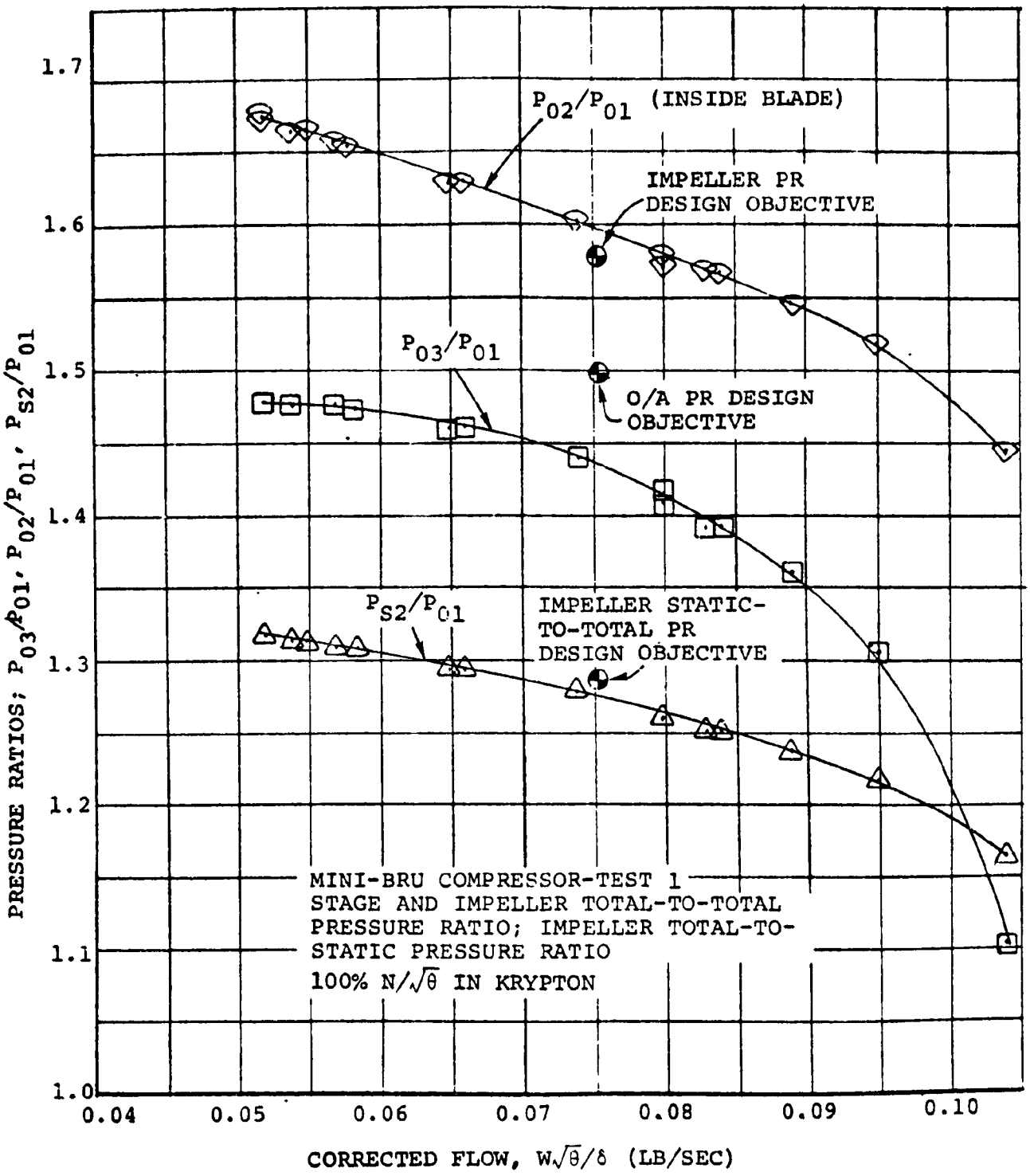


Figure 26. - Mini-BRU Compressor - Test 1, Stage and Impeller Total-to-Total Pressure Ratio; Impeller Total-to-Static Pressure Ratio, 100% $N/\sqrt{\theta}$ in Krypton.

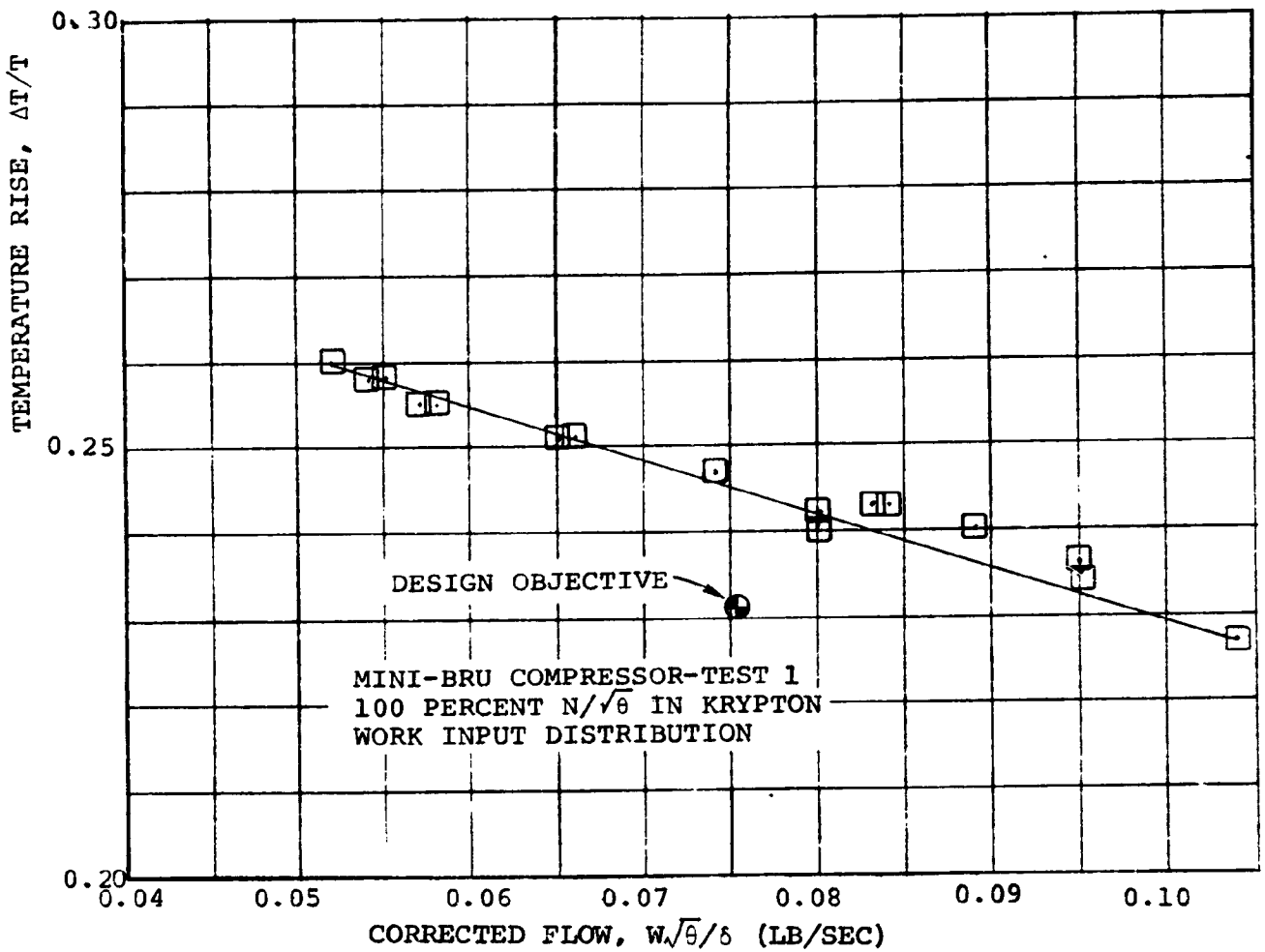


Figure 27. - Mini-BRU Compressor - Test 1, 100 Percent $N/\sqrt{\theta}$ in Krypton Work Input Distribution.

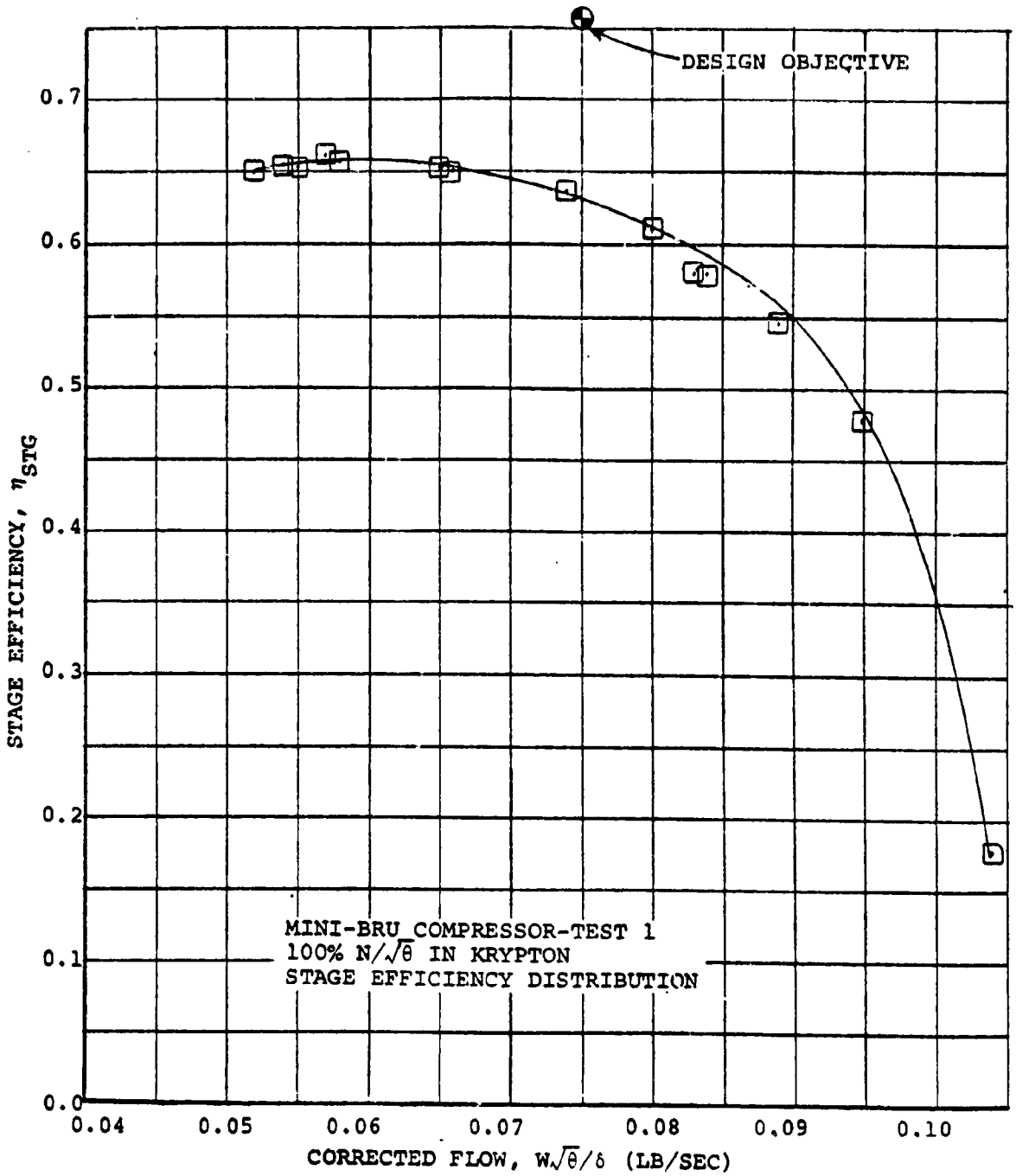


Figure 28. - Mini-BRU Compressor - Test 1 100 Percent $N/\sqrt{\theta}$ in Krypton Stage Efficiency Distribution.

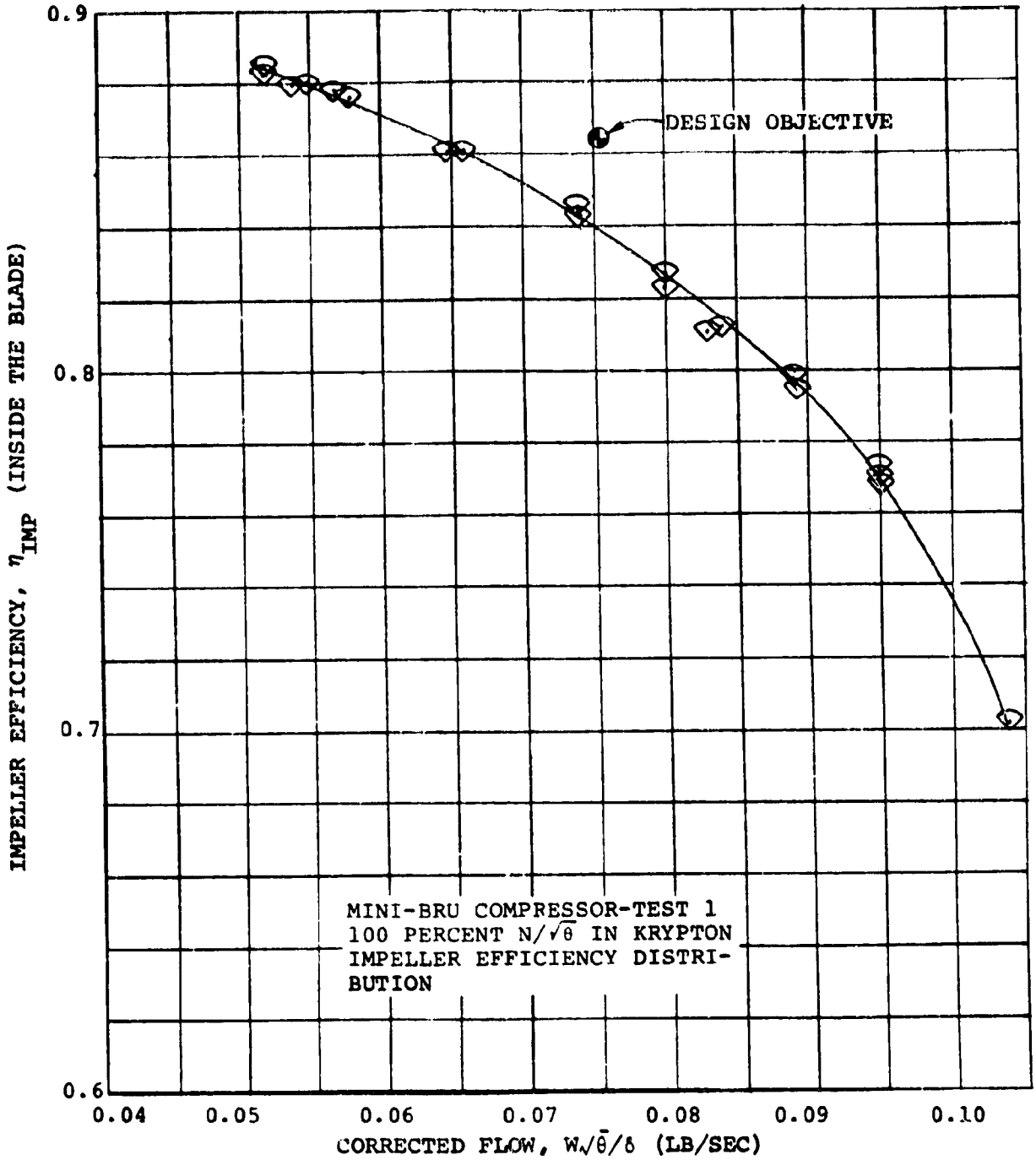


Figure 29. - Mini-BRU Compressor - Test 1, 100 Percent $N/\sqrt{\theta}$ in Krypton Impeller Efficiency Distribution.

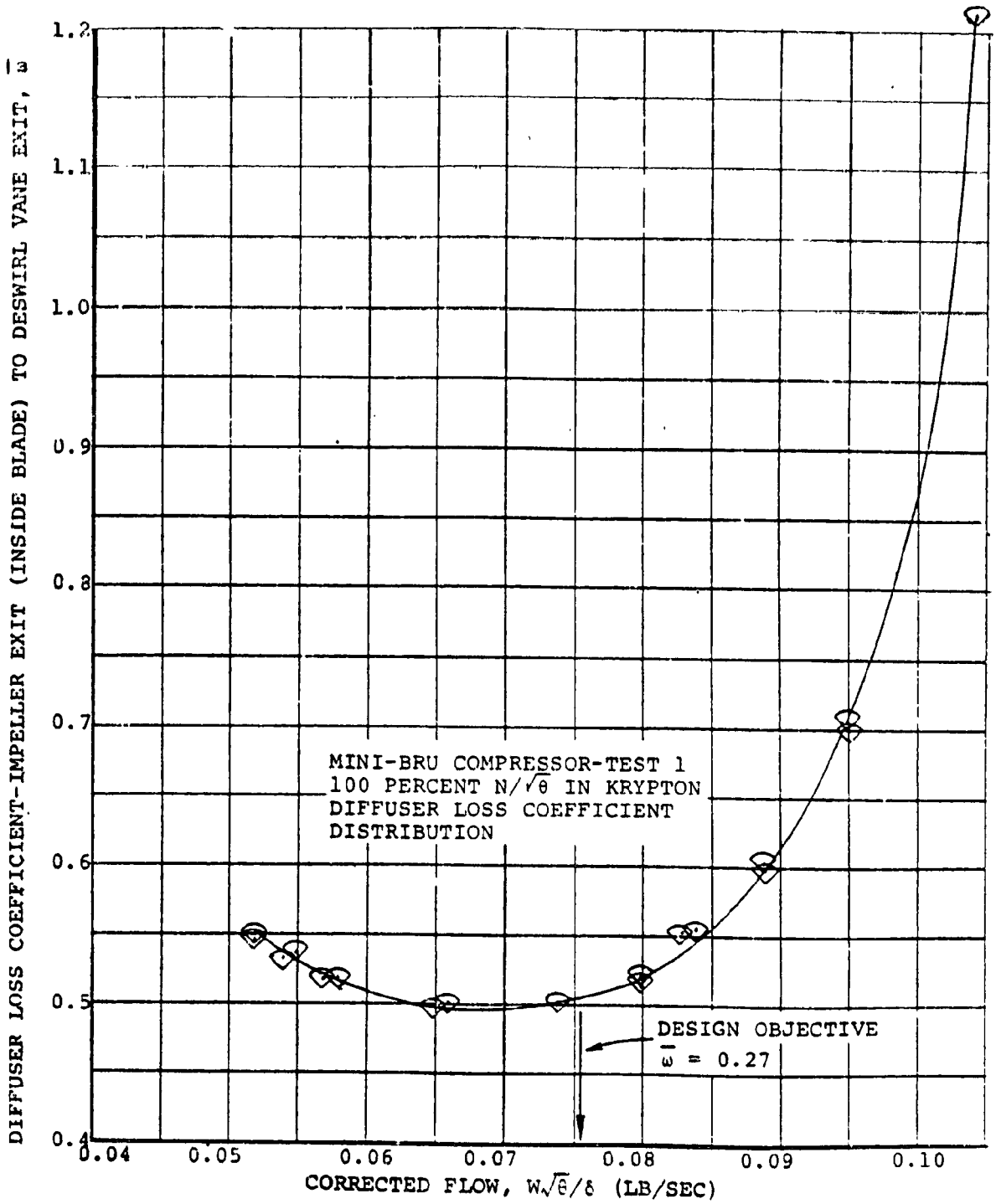


Figure 30. - Mini-BRU Compressor - Test 1, 100 Percent $N/\sqrt{\theta}$ in Krypton Diffuser Loss Coefficient Distribution.

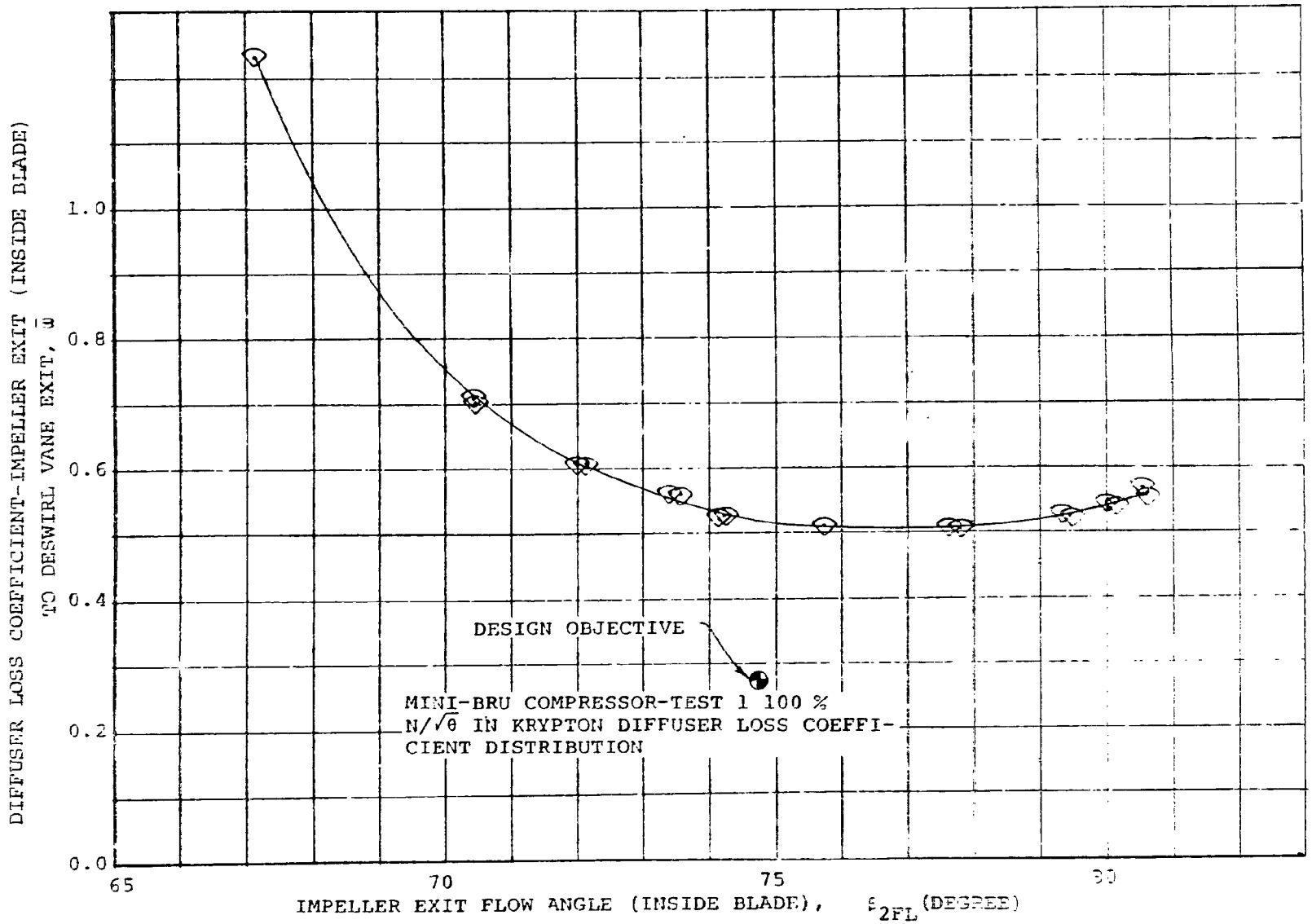


Figure 31. - Mini-BRU Compressor - Test 1, 100 Percent $N/\sqrt{\theta}$ in Krypton Diffuser Loss Coefficient Distribution.

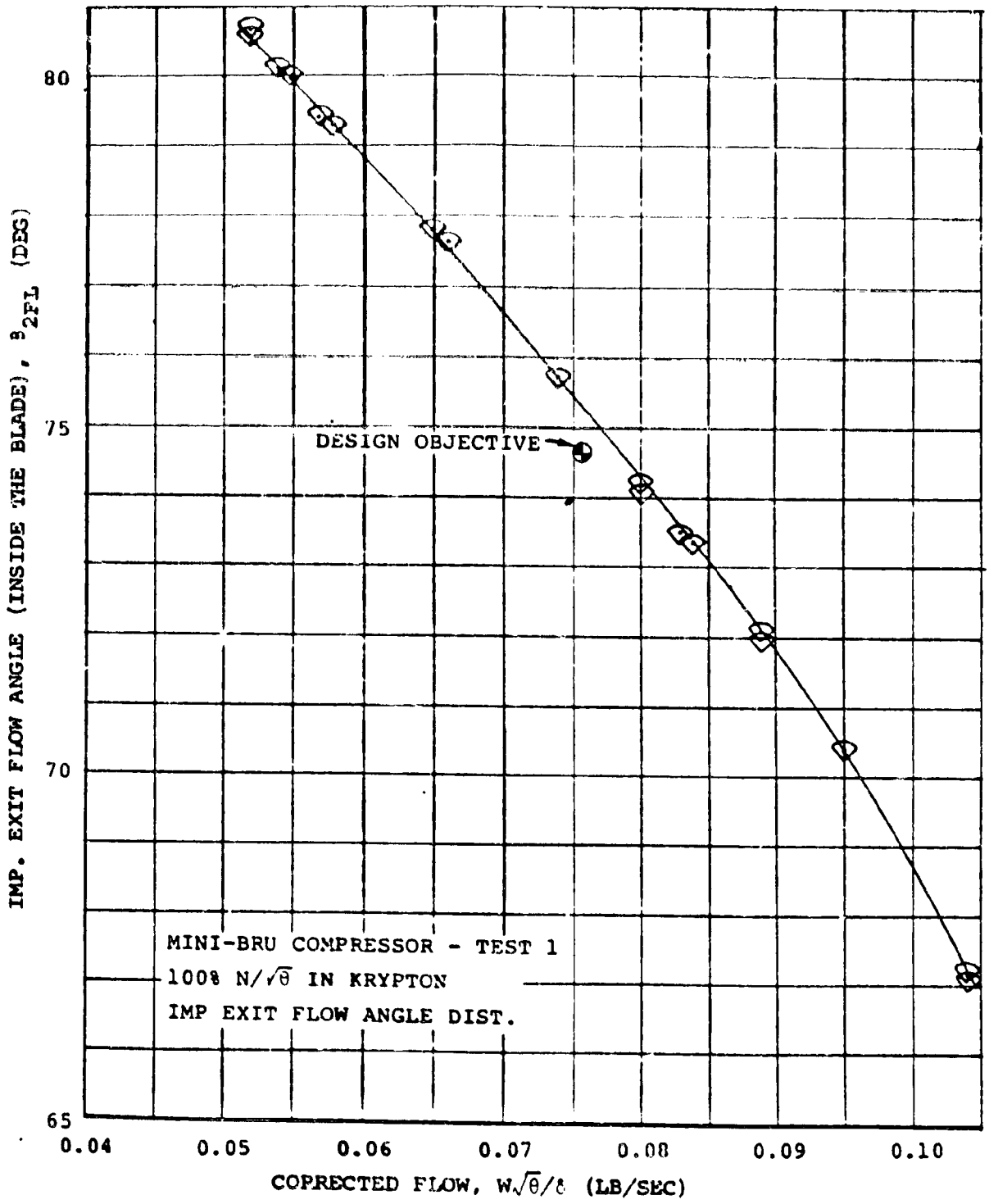
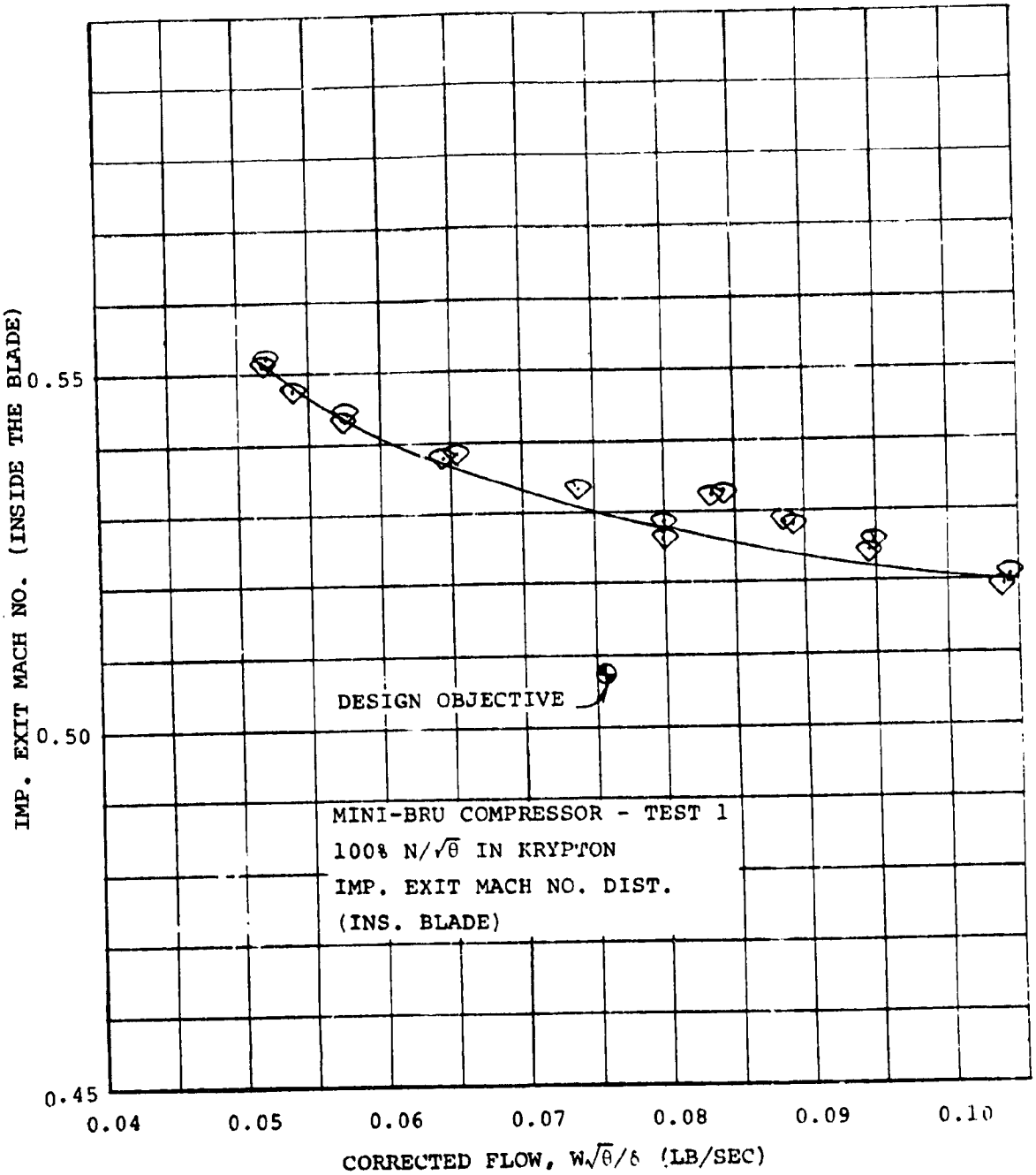


Figure 32. Mini-BRU Compressor - Test 1, 100% $N/\sqrt{\theta}$ in Krypton Impeller Exit Flow Angle Distribution.



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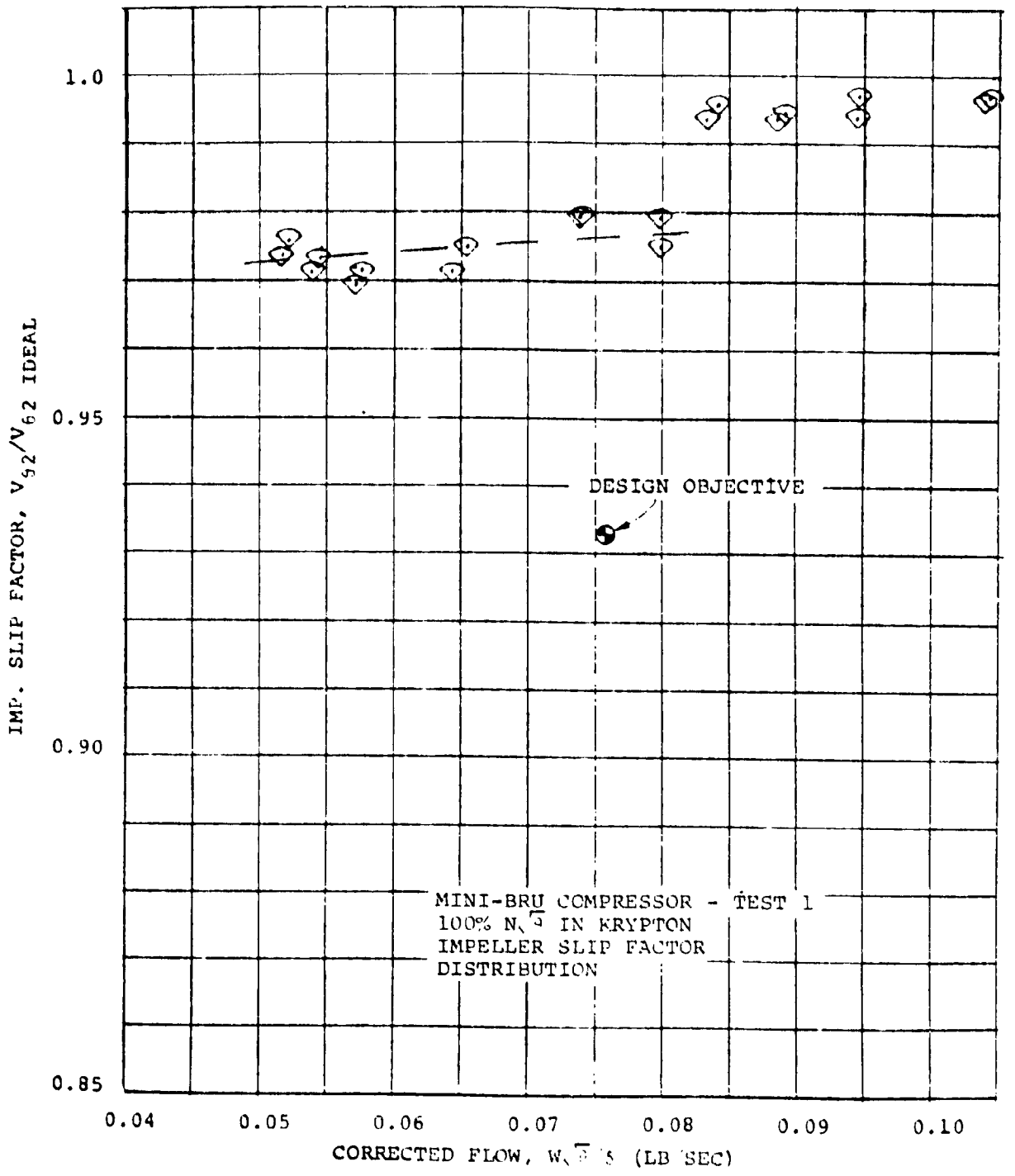


Figure 34. - Mini-BRU Compressor - Test 1, 100 Percent N/√θ in Krypton Impeller Slip Factor Distribution.

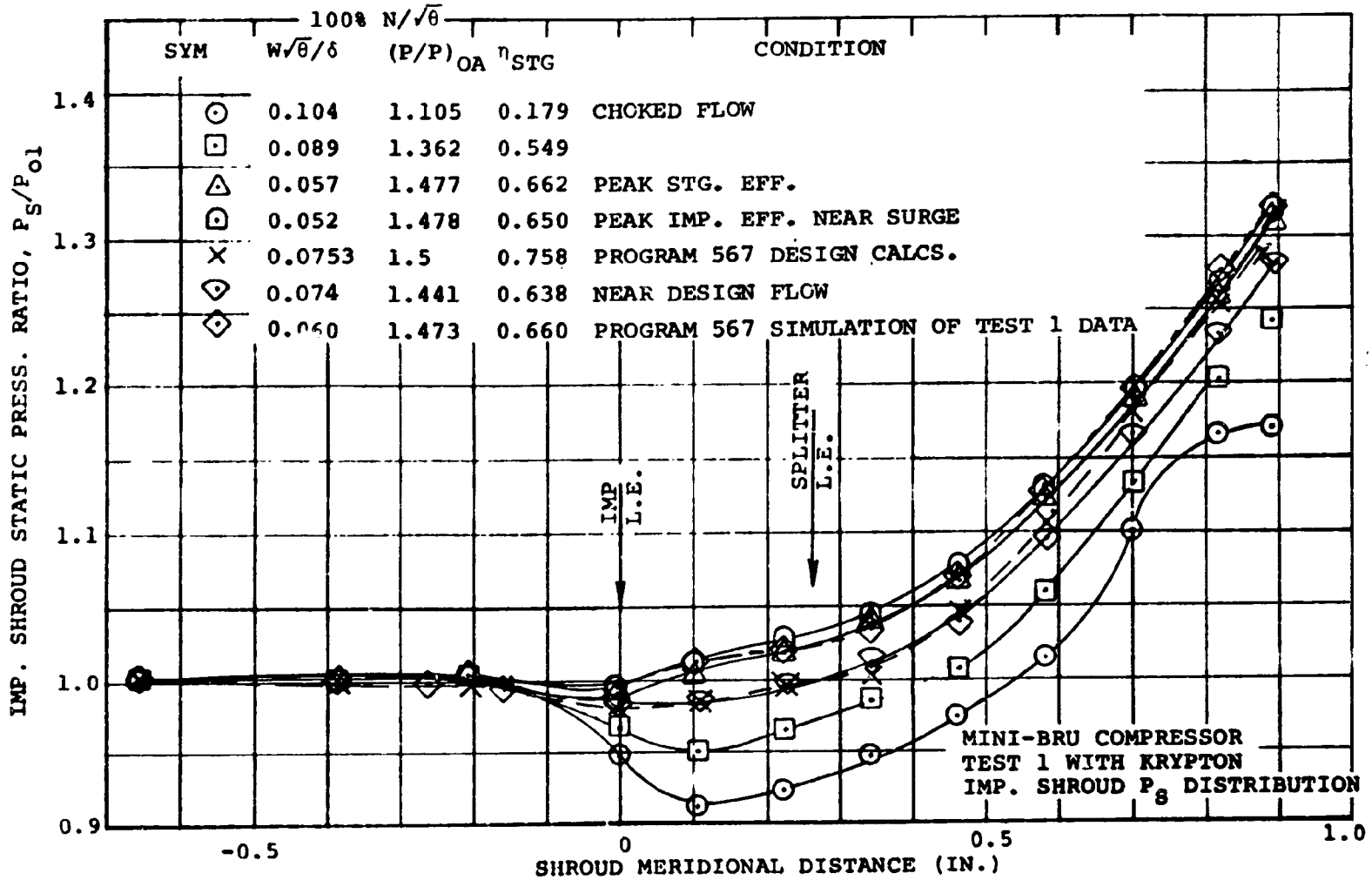


Figure 35. - Mini-BRU Compressor - Test 1 With Krypton Impeller Shroud P_S Distribution.

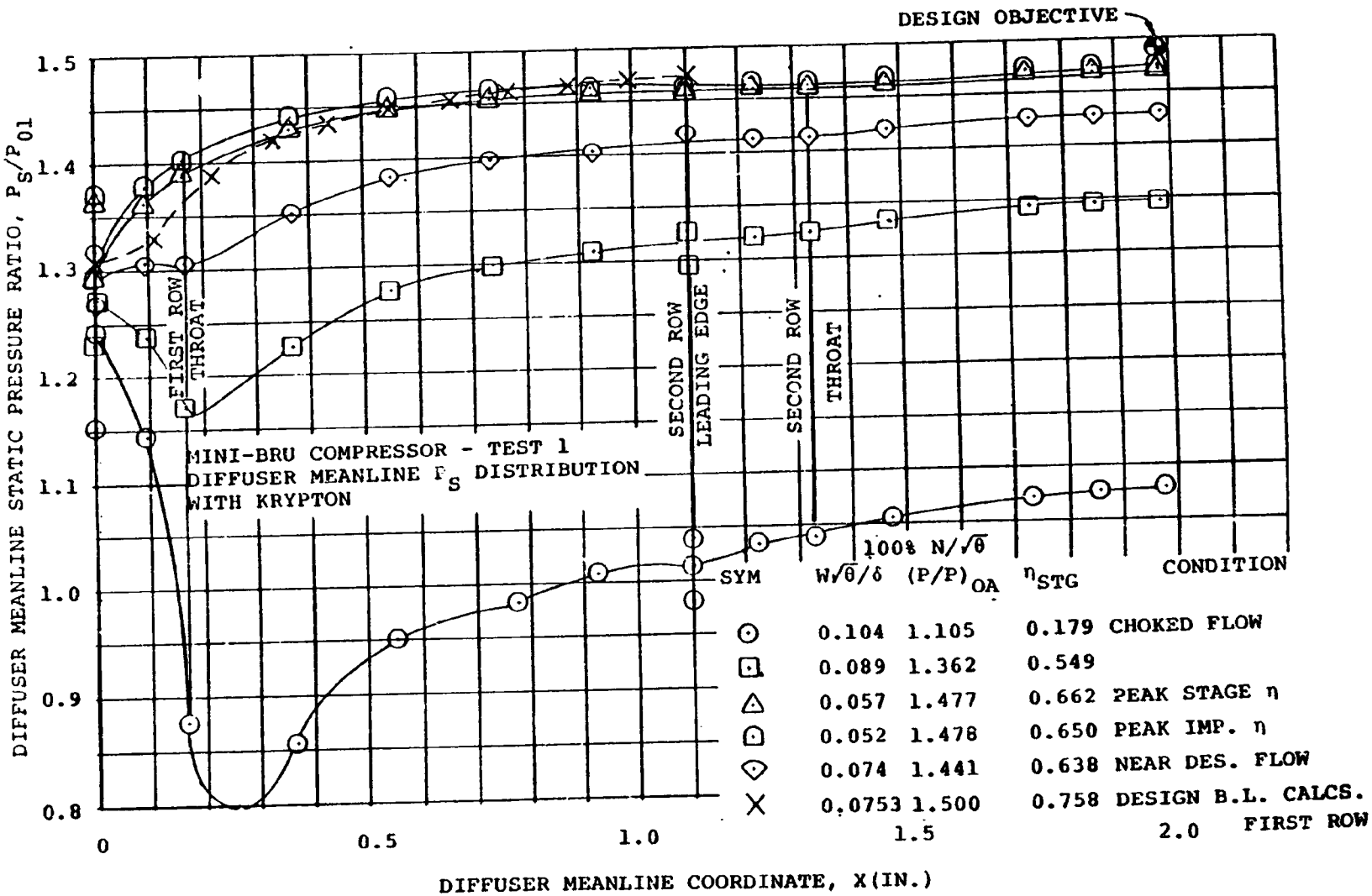


Figure 36. - Mini-BRU Compressor - Test 1, Diffuser Meanline P_S Distribution with Krypton.

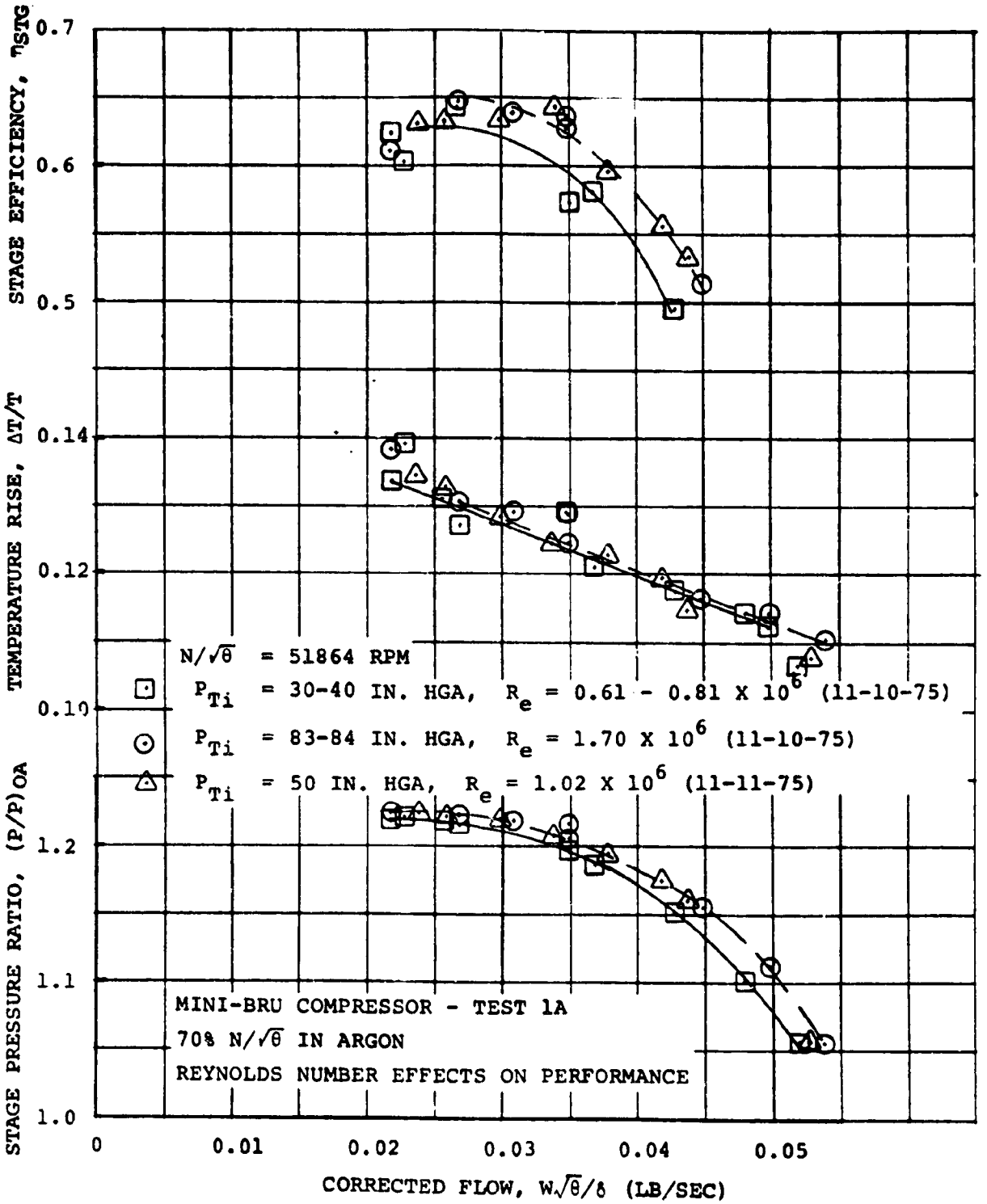


Figure 37. - Mini-BRU Compressor - Test 1A, 70% $N/\sqrt{\theta}$ in Argon, Reynolds Number Effects on Performance.

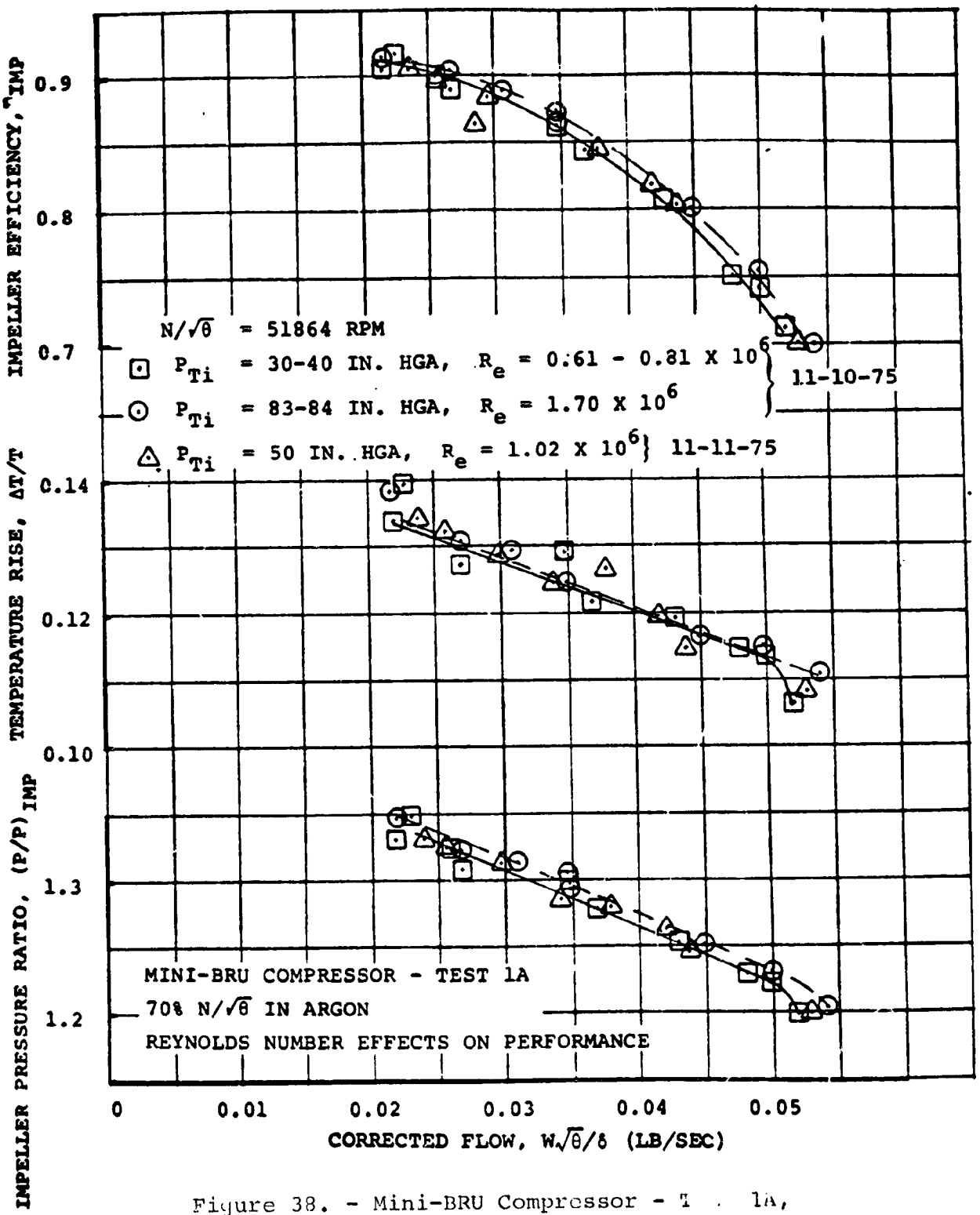


Figure 38. - Mini-BRU Compressor - T . 1A, 70% $N/\sqrt{\theta}$ in Argon, Reynolds Number Effects on Performance.

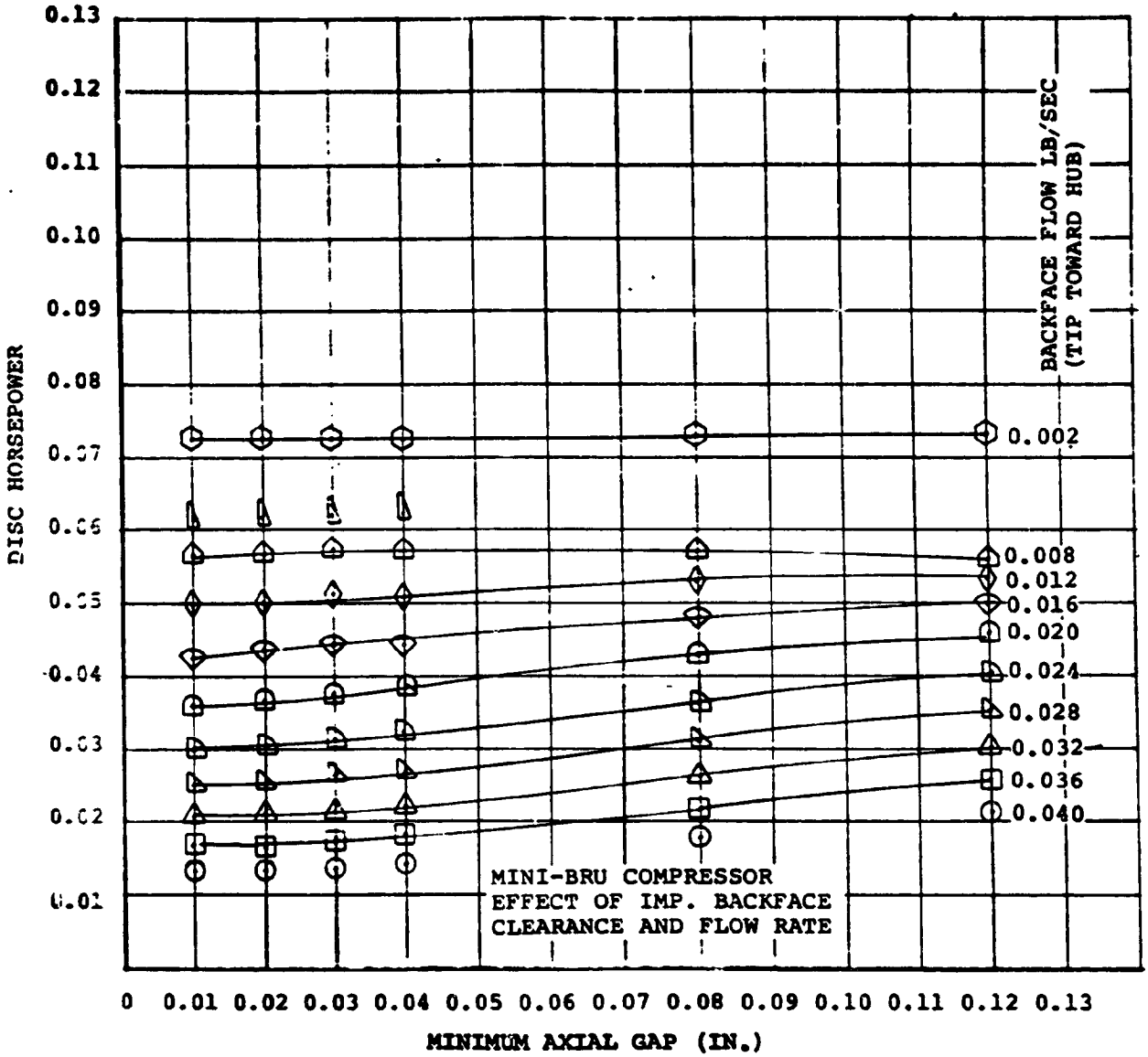


Figure 39. - Mini-BRU Compressor Effect of Impeller Backface Clearance and Flow Rate.

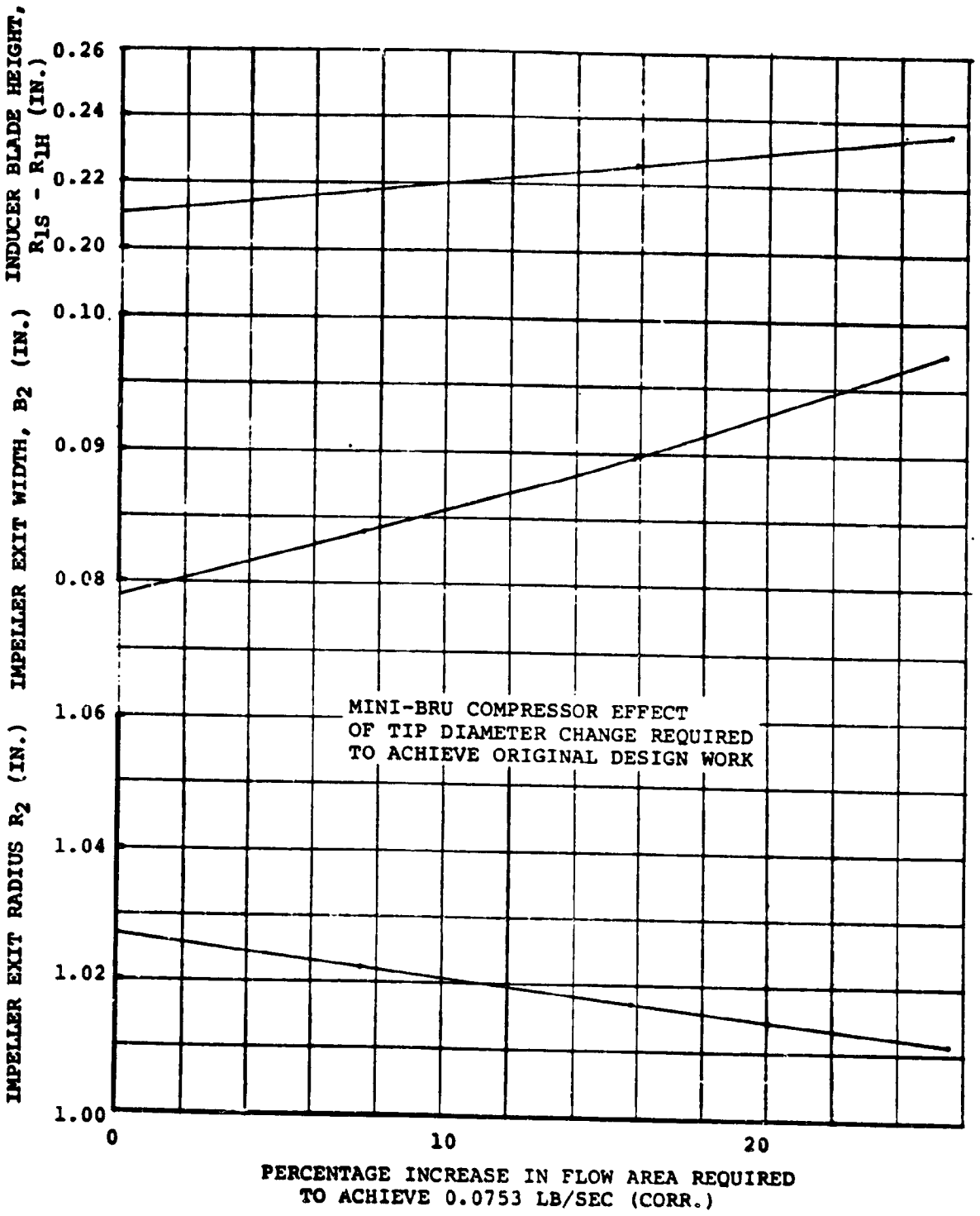


Figure 40. - Mini-BRU Compressor Effect of Tip Diameter Change Required to Achieve Original Design Work.

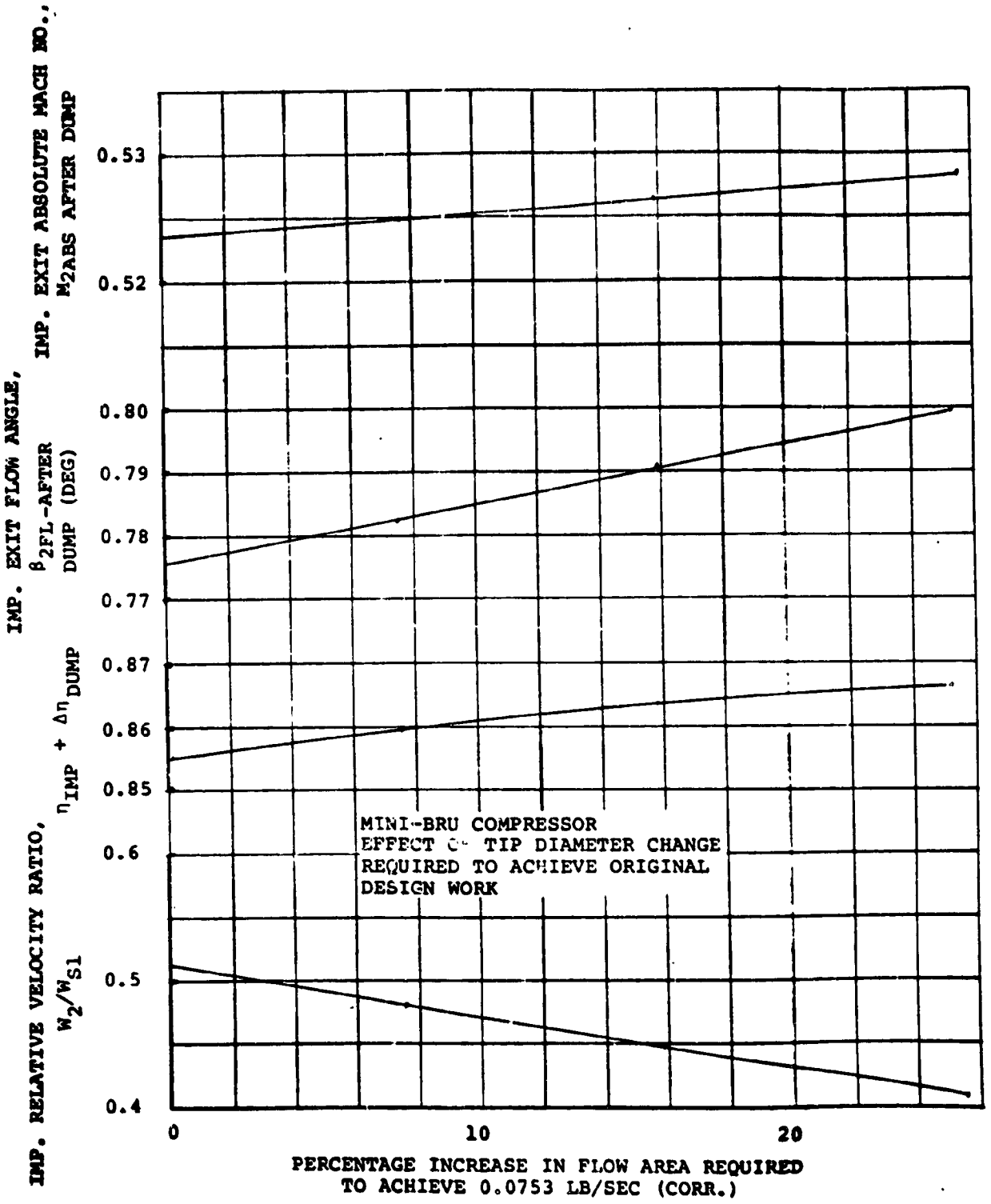


Figure 41. - Mini-BRU Compressor Effect of Tip Diameter Change Required to Achieve Original Design Work.

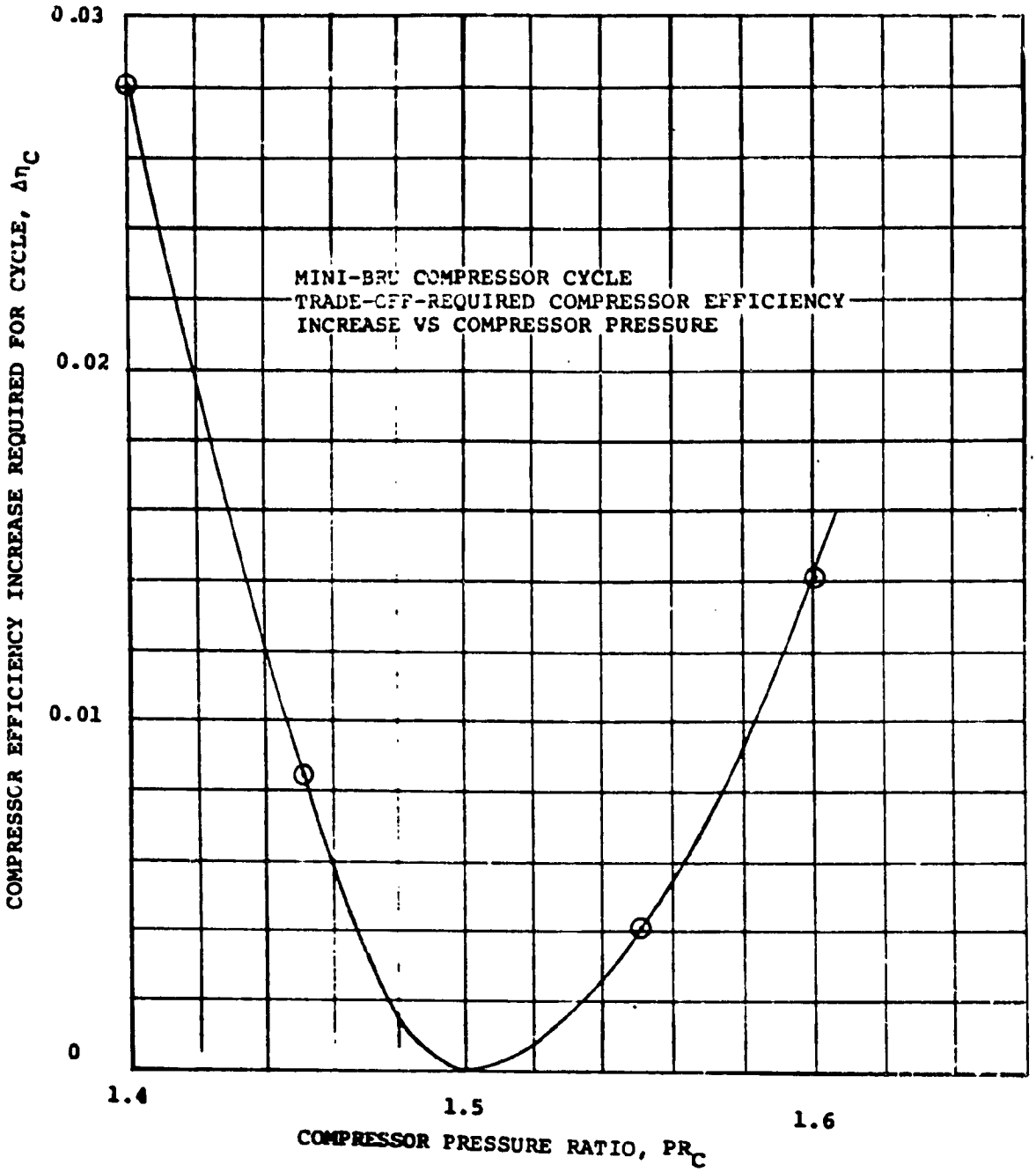


Figure 42. - Mini-BRU Compressor Cycle Trade-Off-Required Compressor Efficiency Increase vs Compressor Pressure.

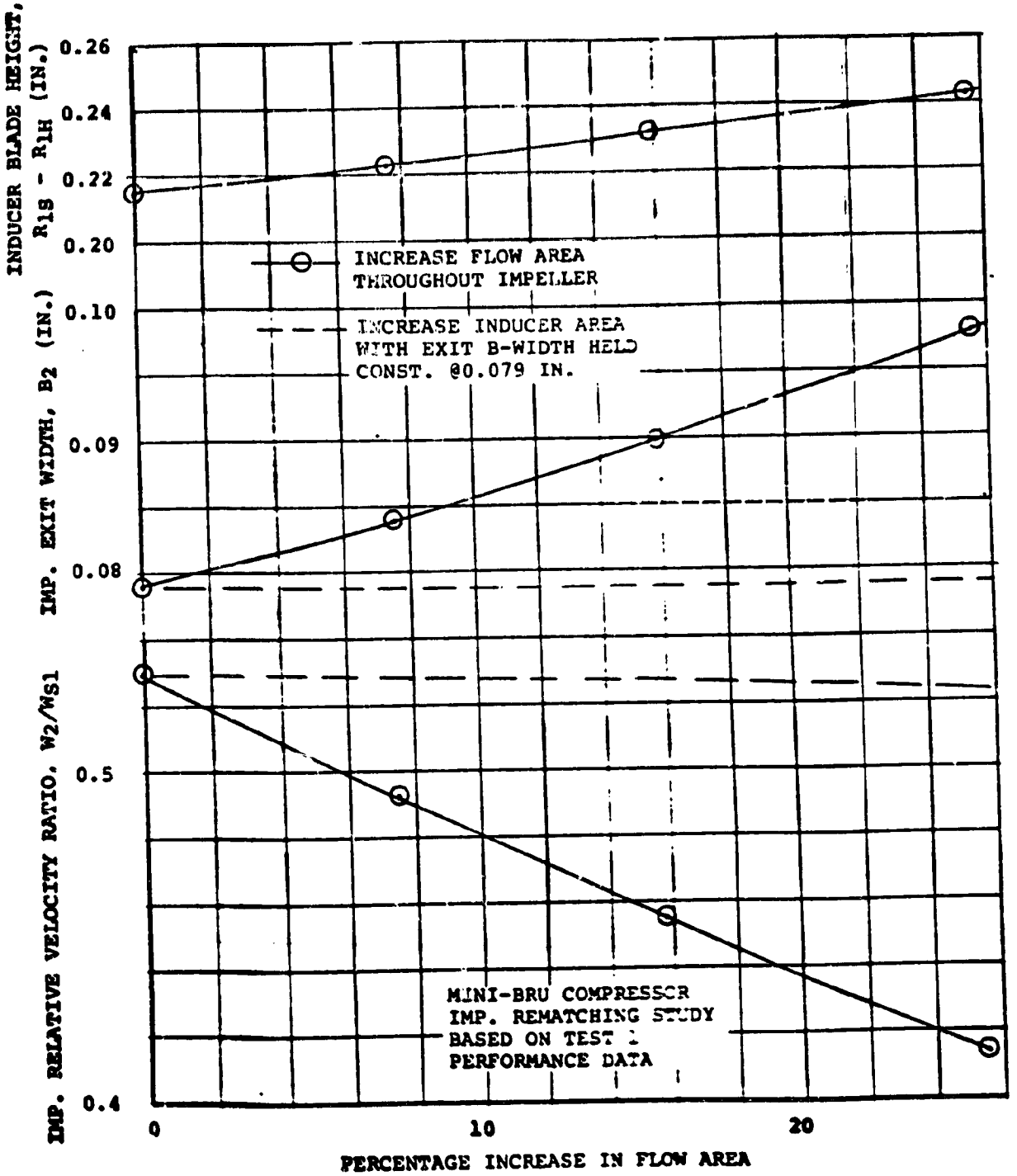


Figure 43. - Mini-BRU Compressor Impeller Rematching Study Based on Test 1 Performance Data.

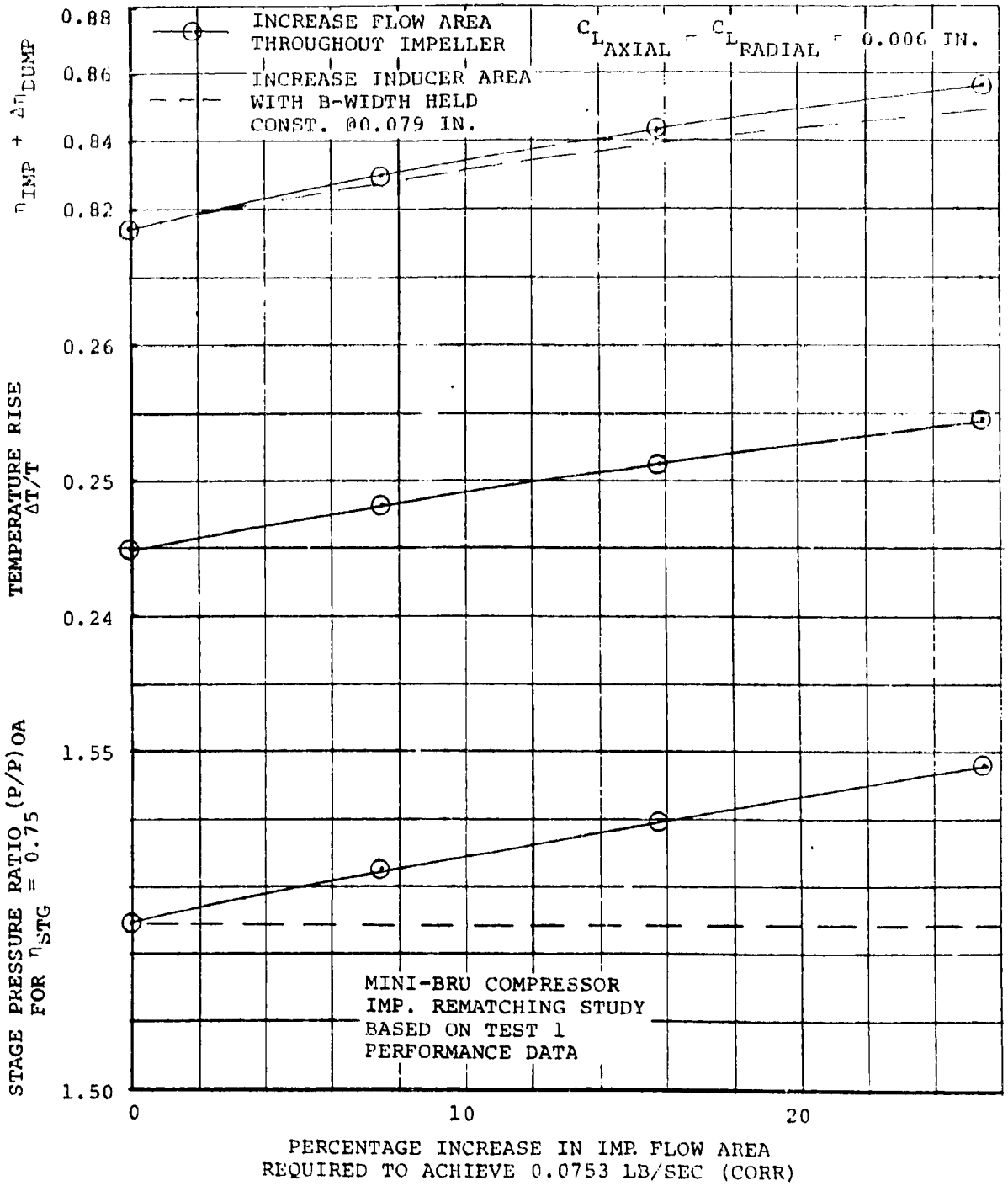


Figure 44. - Mini-BRU Compressor Impeller Rematching Study Based on Test 1, Performance Data.

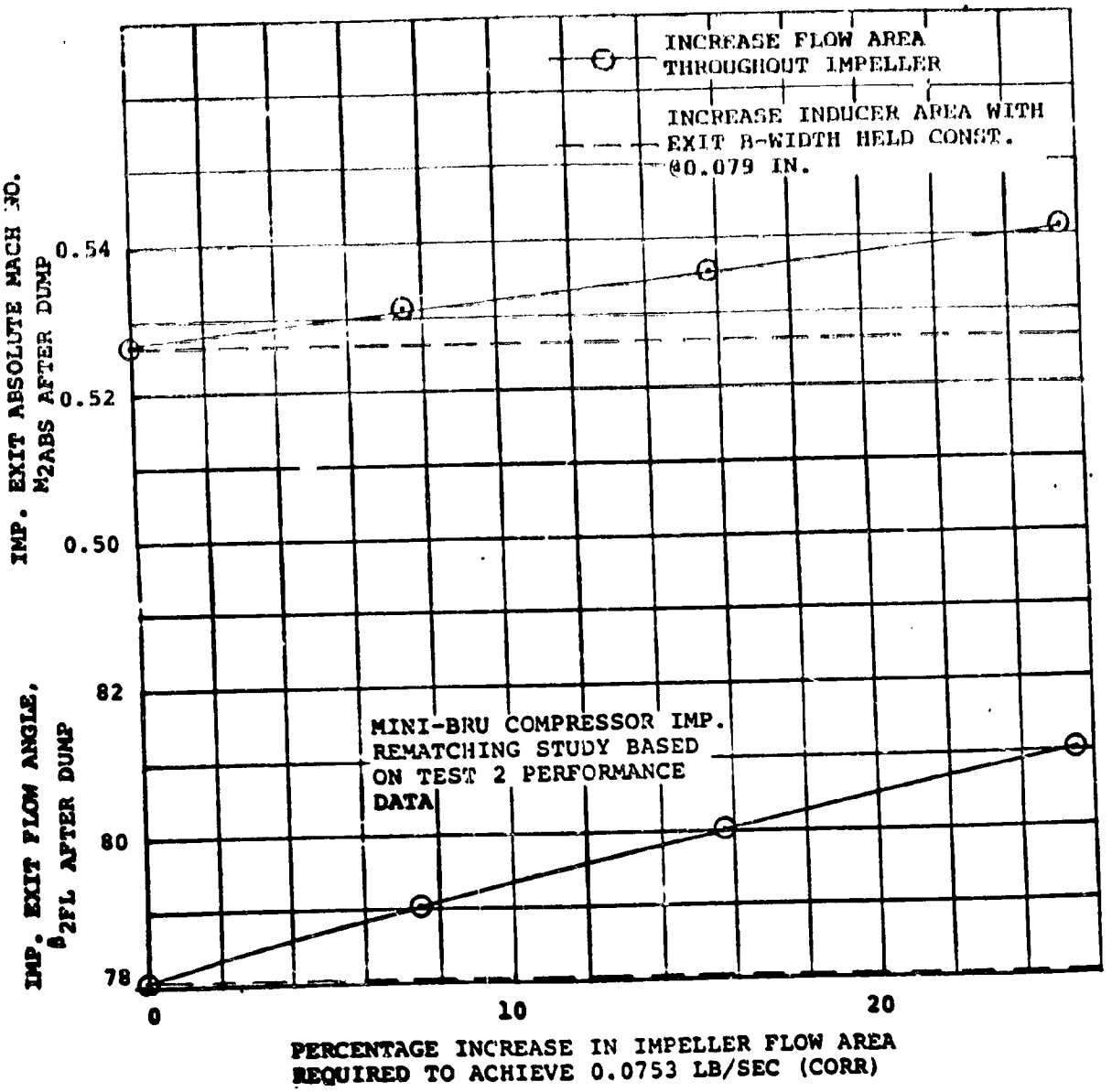


Figure 45. - Mini-BRU Compressor Impeller Rematching Study Based on Test 2 Performance Data.

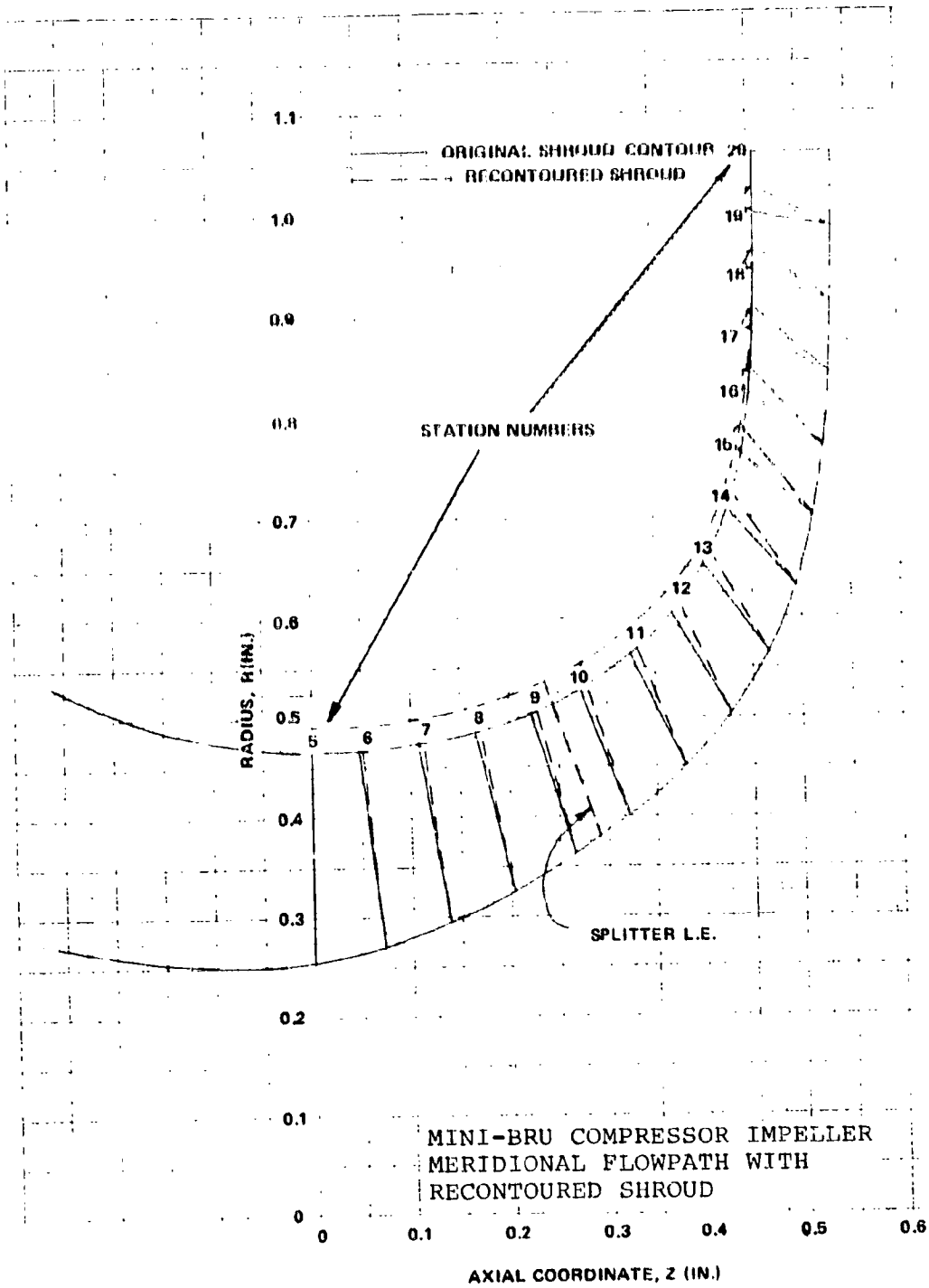


Figure 46. - Mini-BRU Compressor Impeller Meridional Flowpath With Recontoured Shroud.

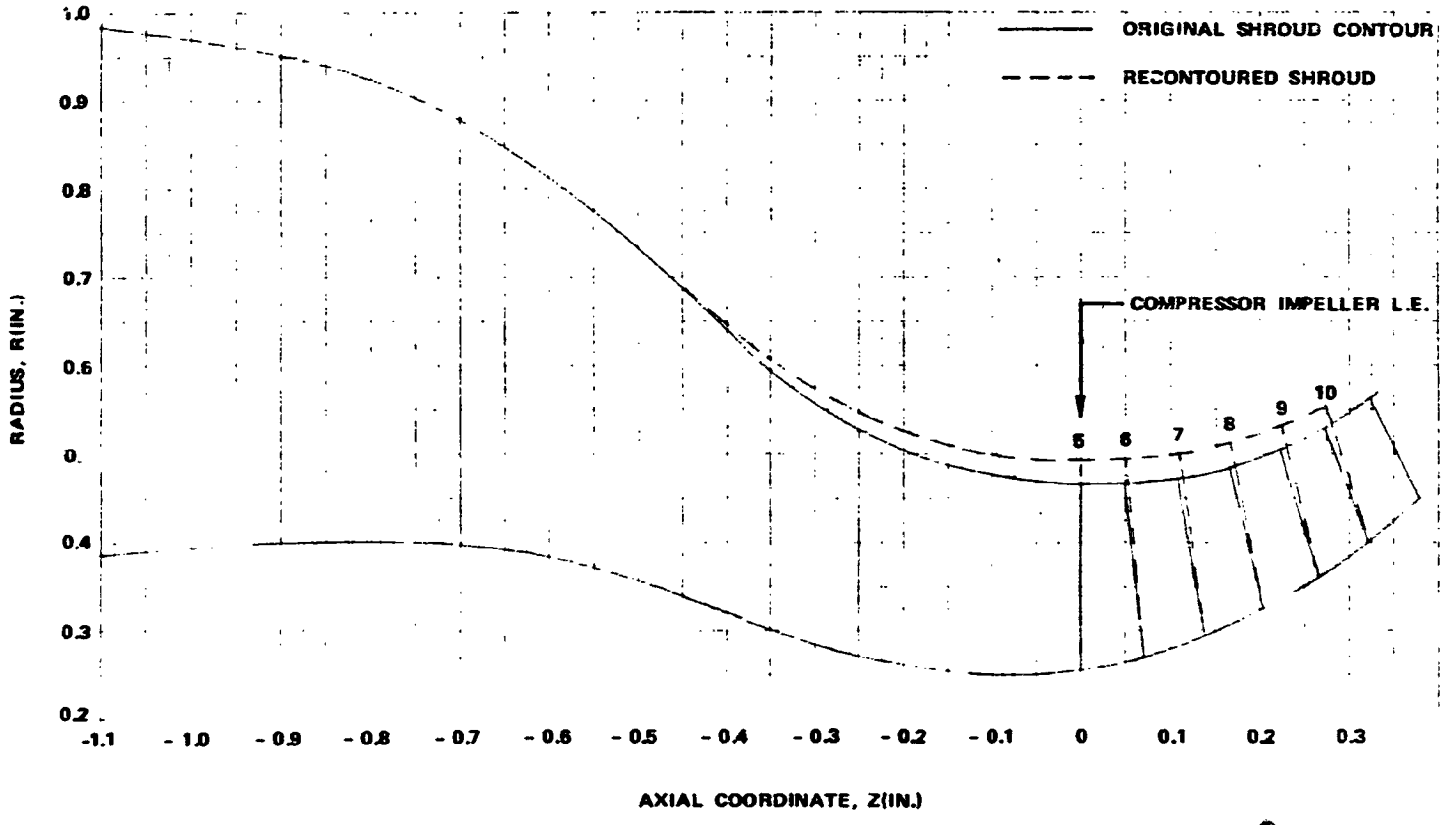


Figure 47. - Mini-BRU Compressor Inlet Meridional Flowpath With Recontoured Shroud.

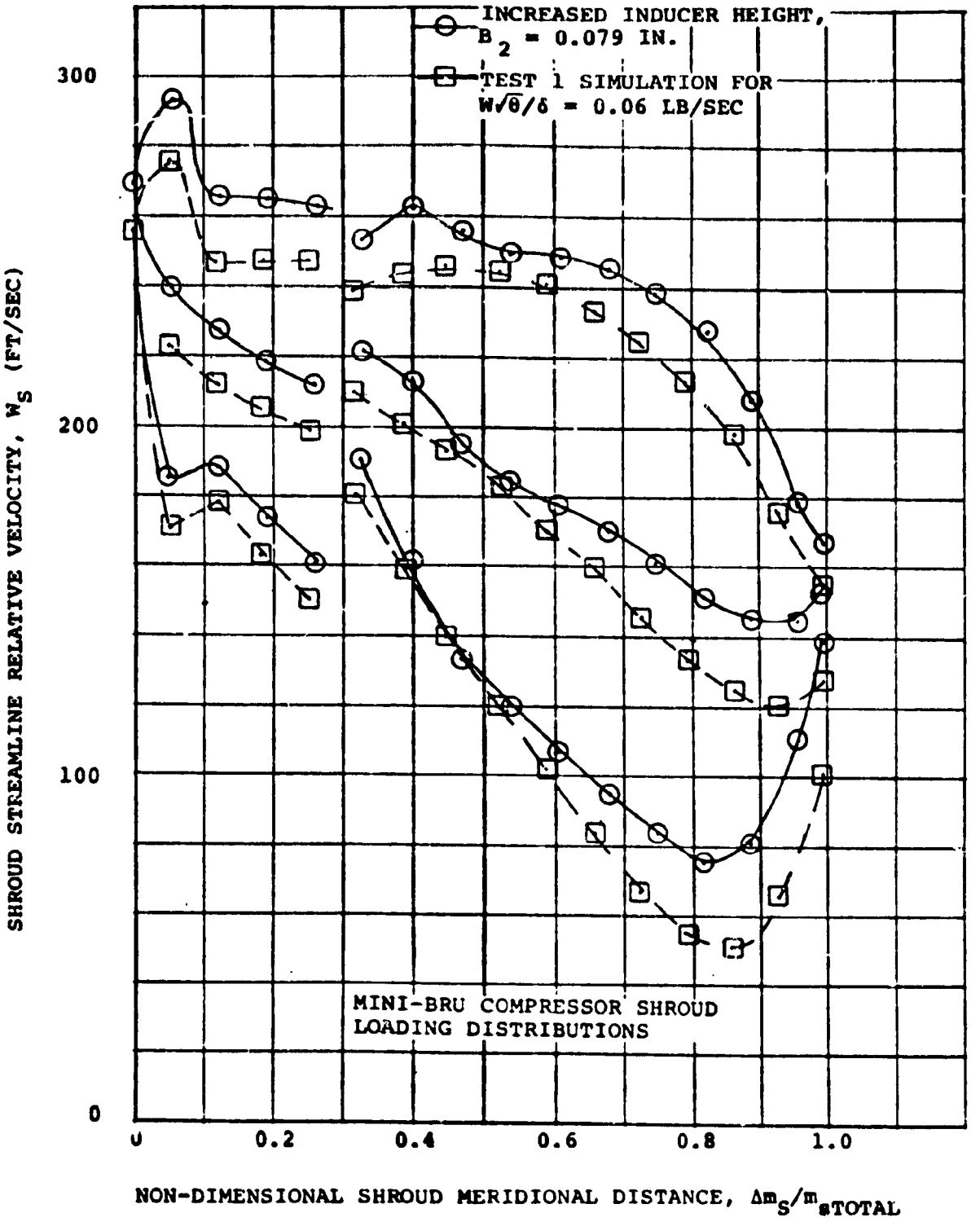


Figure 48. - Mini-BRU Compressor Shroud Loading Distributions.

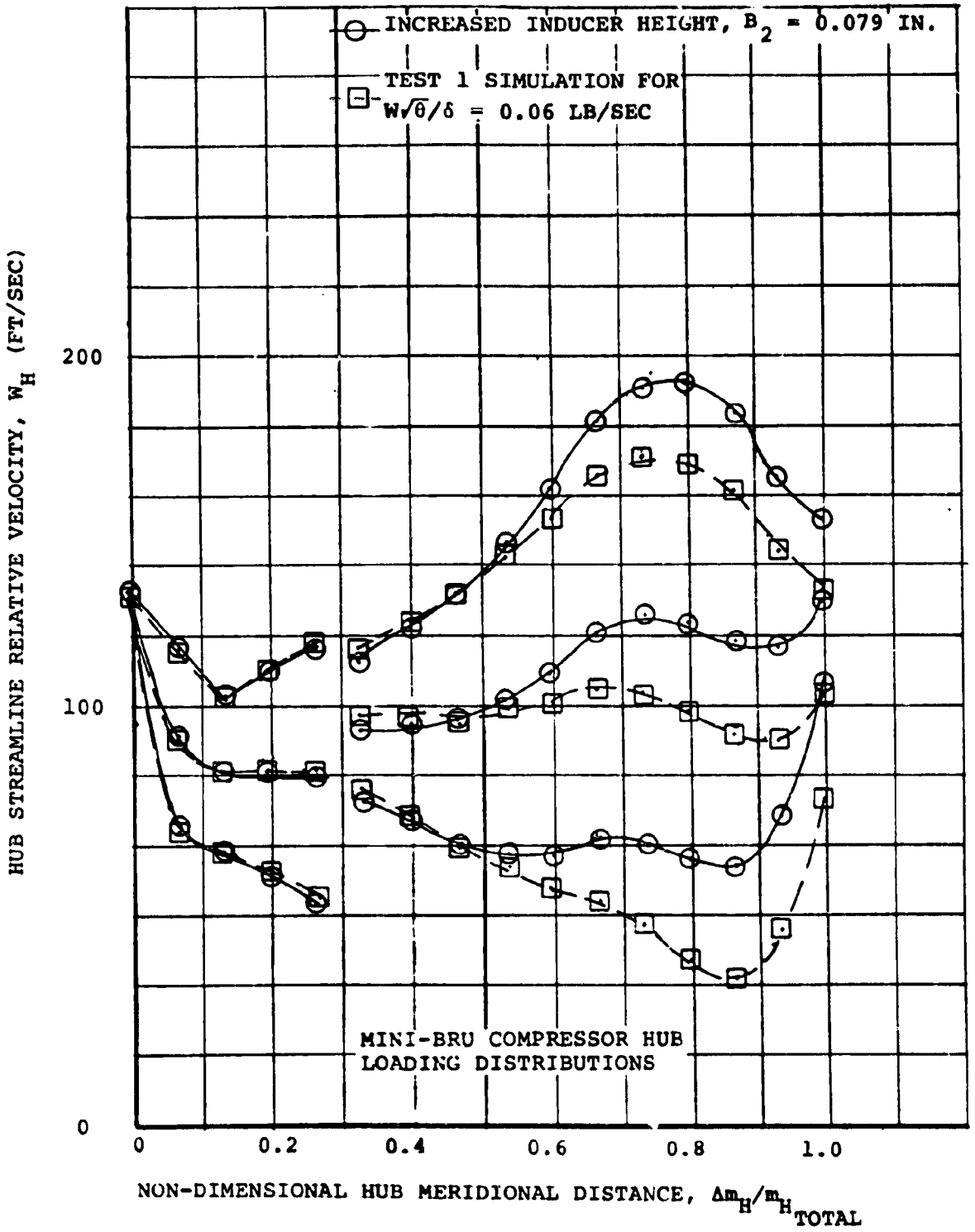


Figure 49. - Mini-BRU Compressor Hub Loading Distributions.

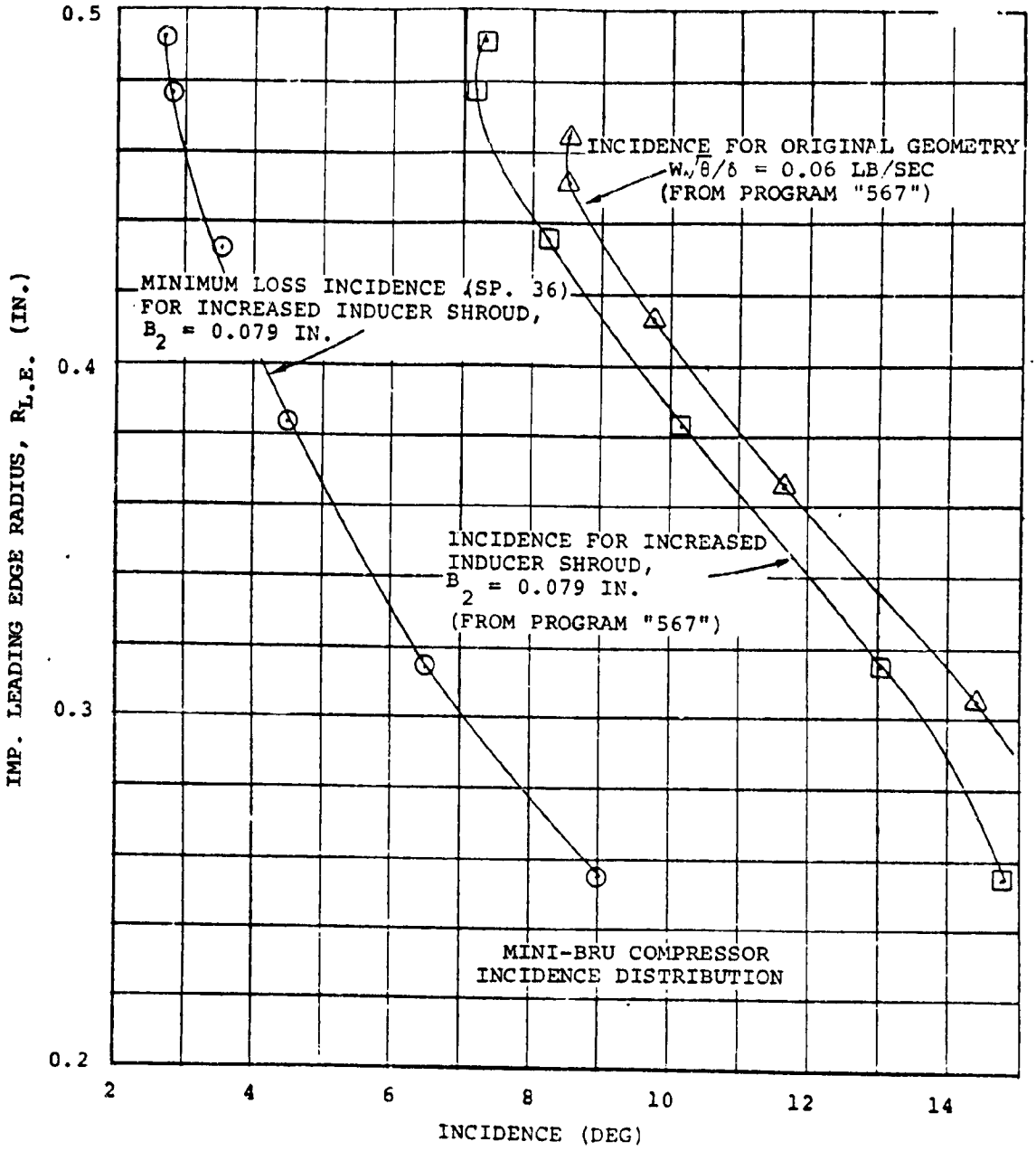


Figure 50. - Mini-BRU Compressor Incidence Distribution.

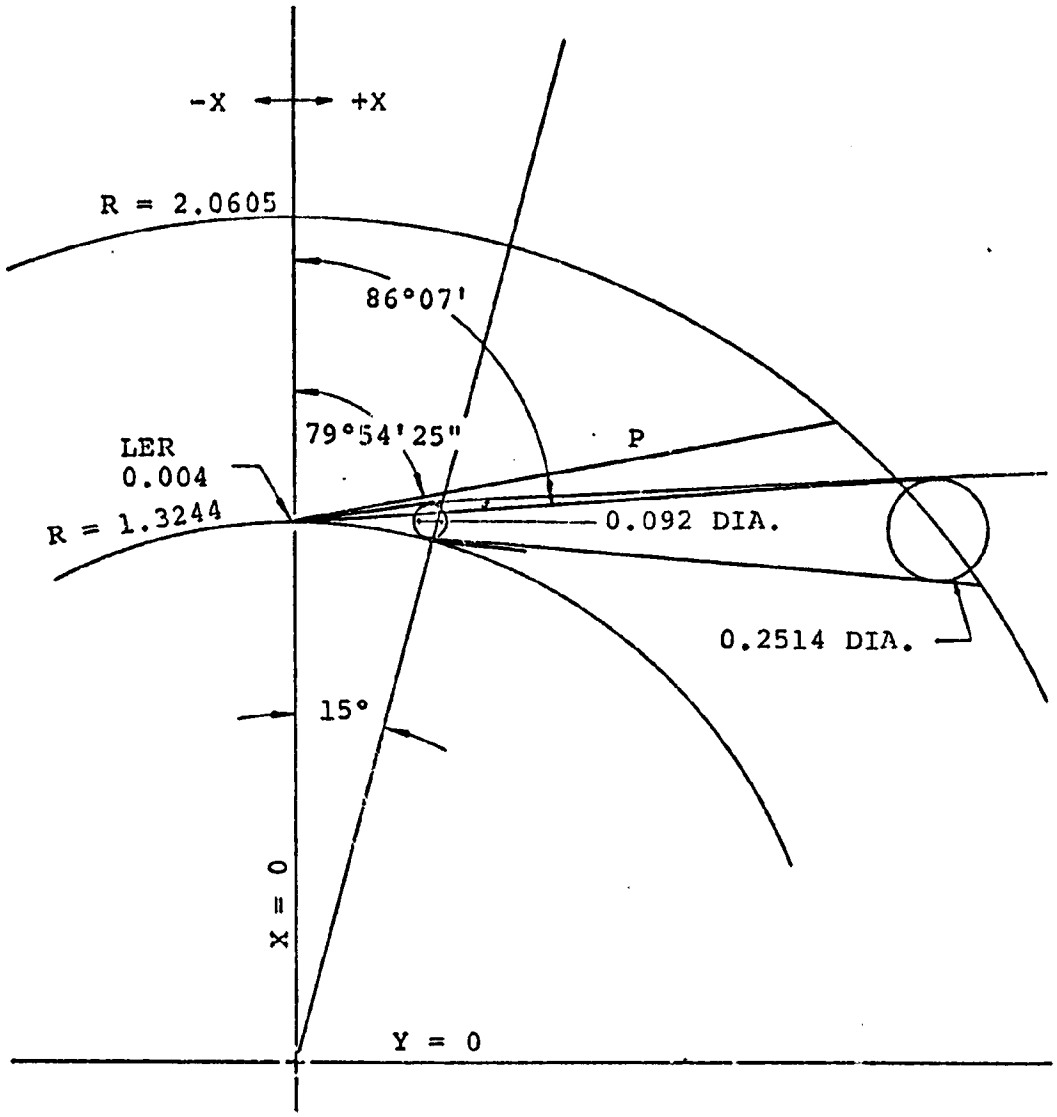


Figure 51. - 1.5/3 KW Test Rig Diffuser Vane.

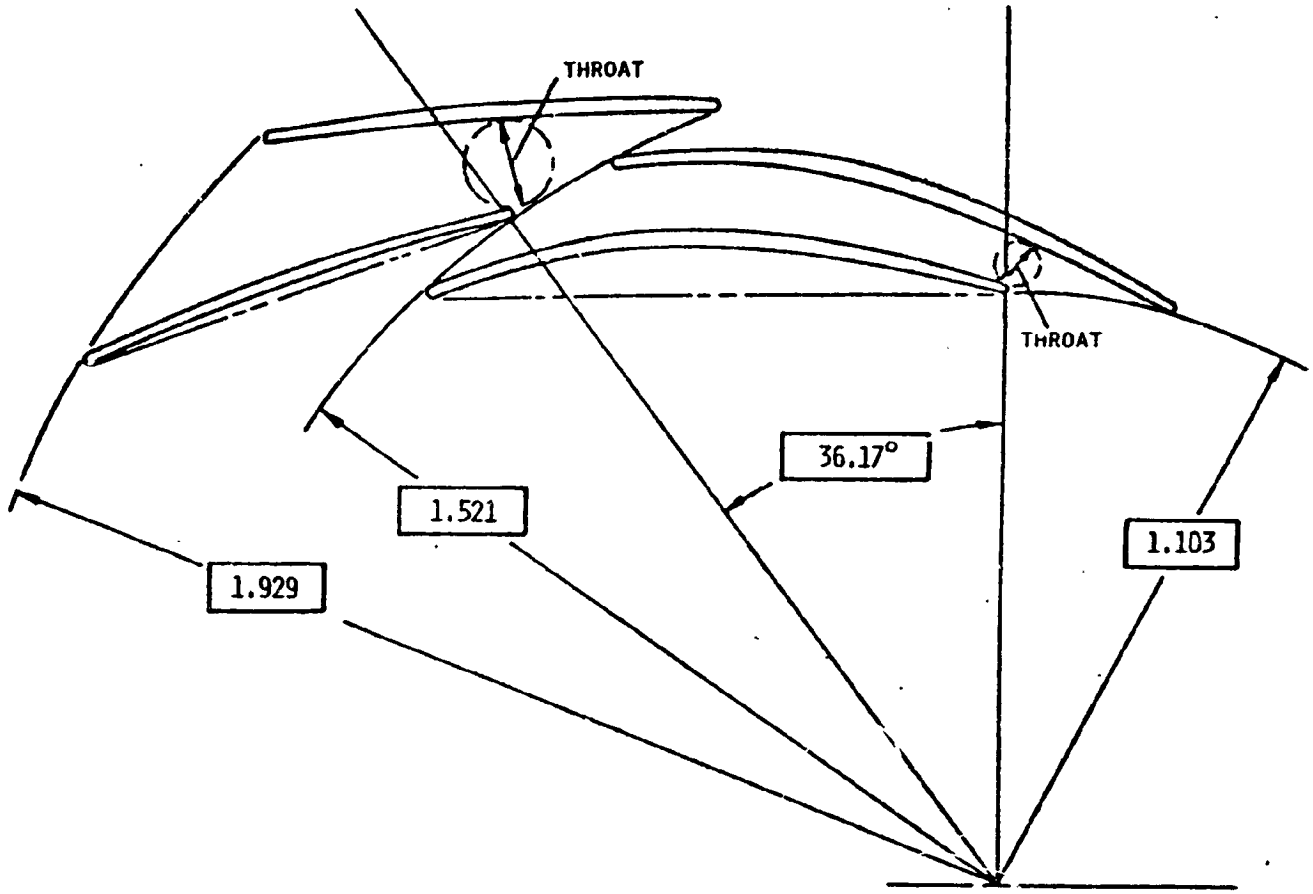


Figure 52. - Mini-BRU Compressor Tandem Diffuser Circumferential Positioning.

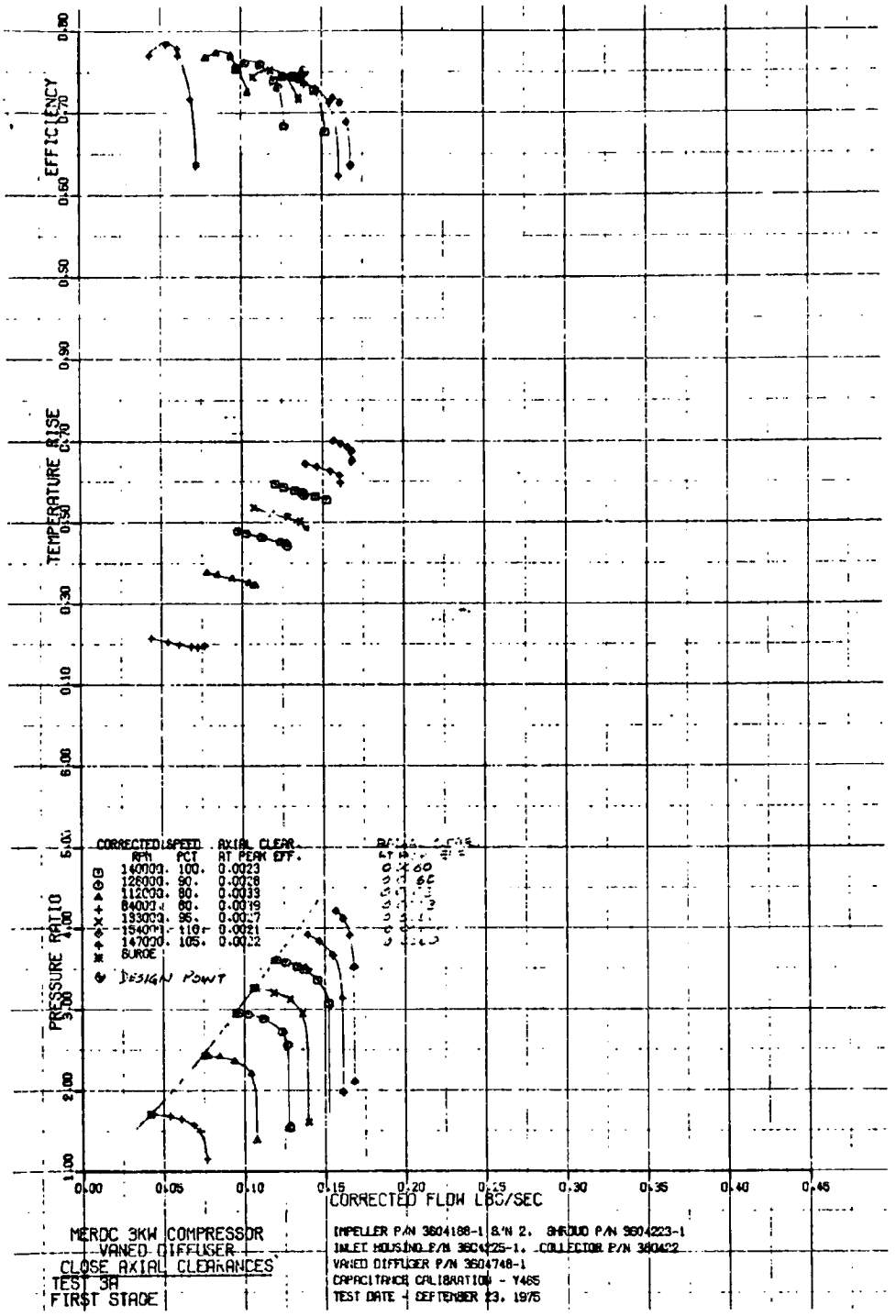


Figure 53. - MERDC 3 KW Vaned Diffuser Test Results (Test 1A).

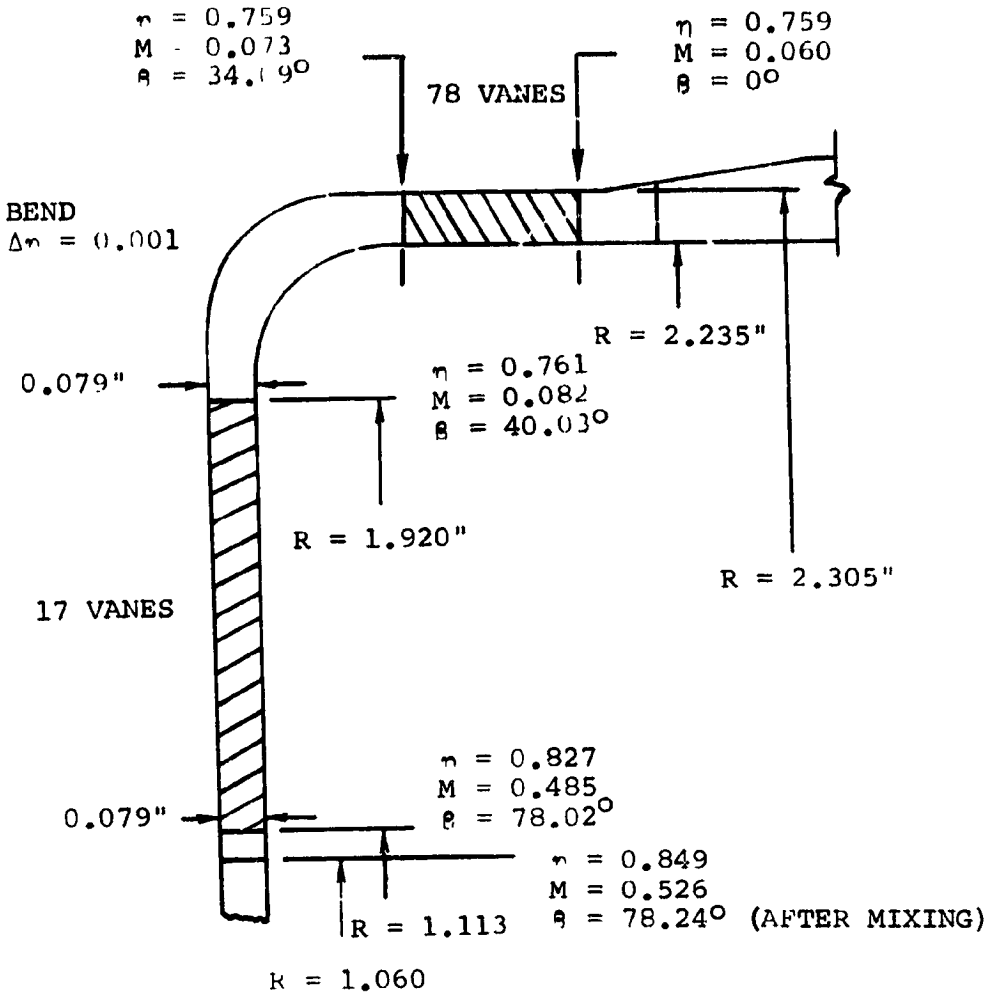


Figure 54. - Compressor Diffuser Flowpath.

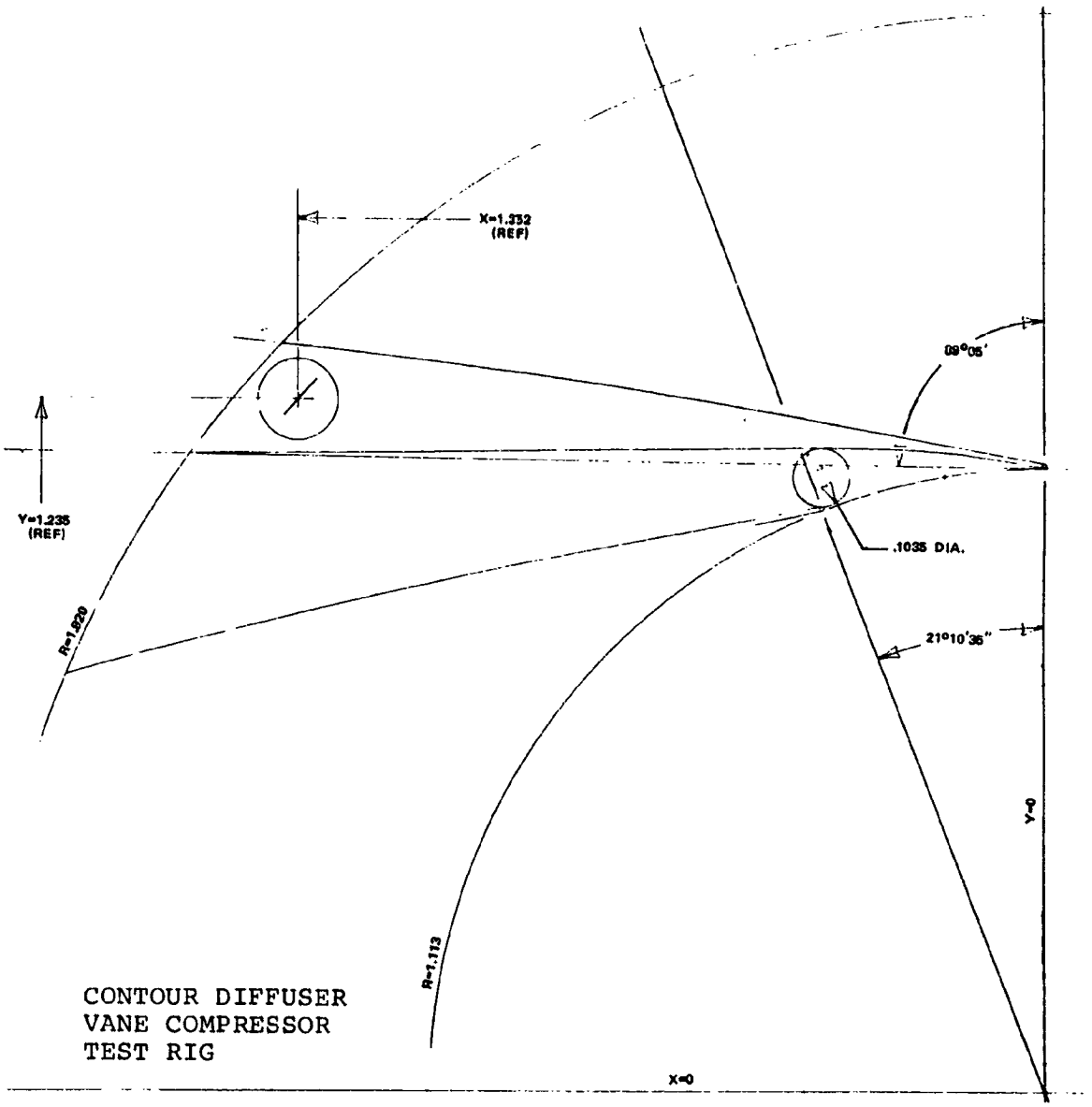


Figure 55. - Contour Diffuser Vane Compressor Test Rig.

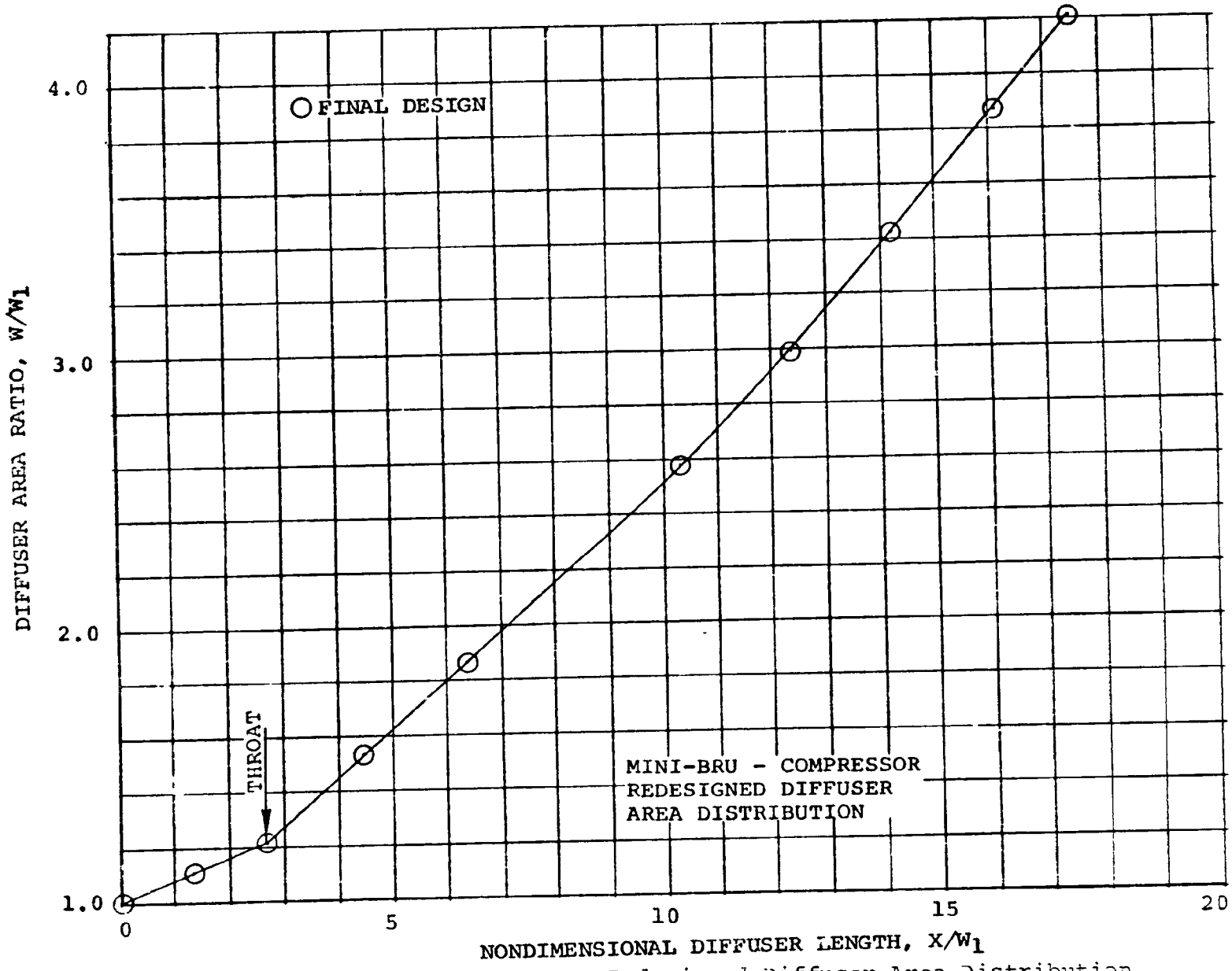


Figure 56. - Mini-BRU Compressor Redesigned Diffuser Area Distribution.

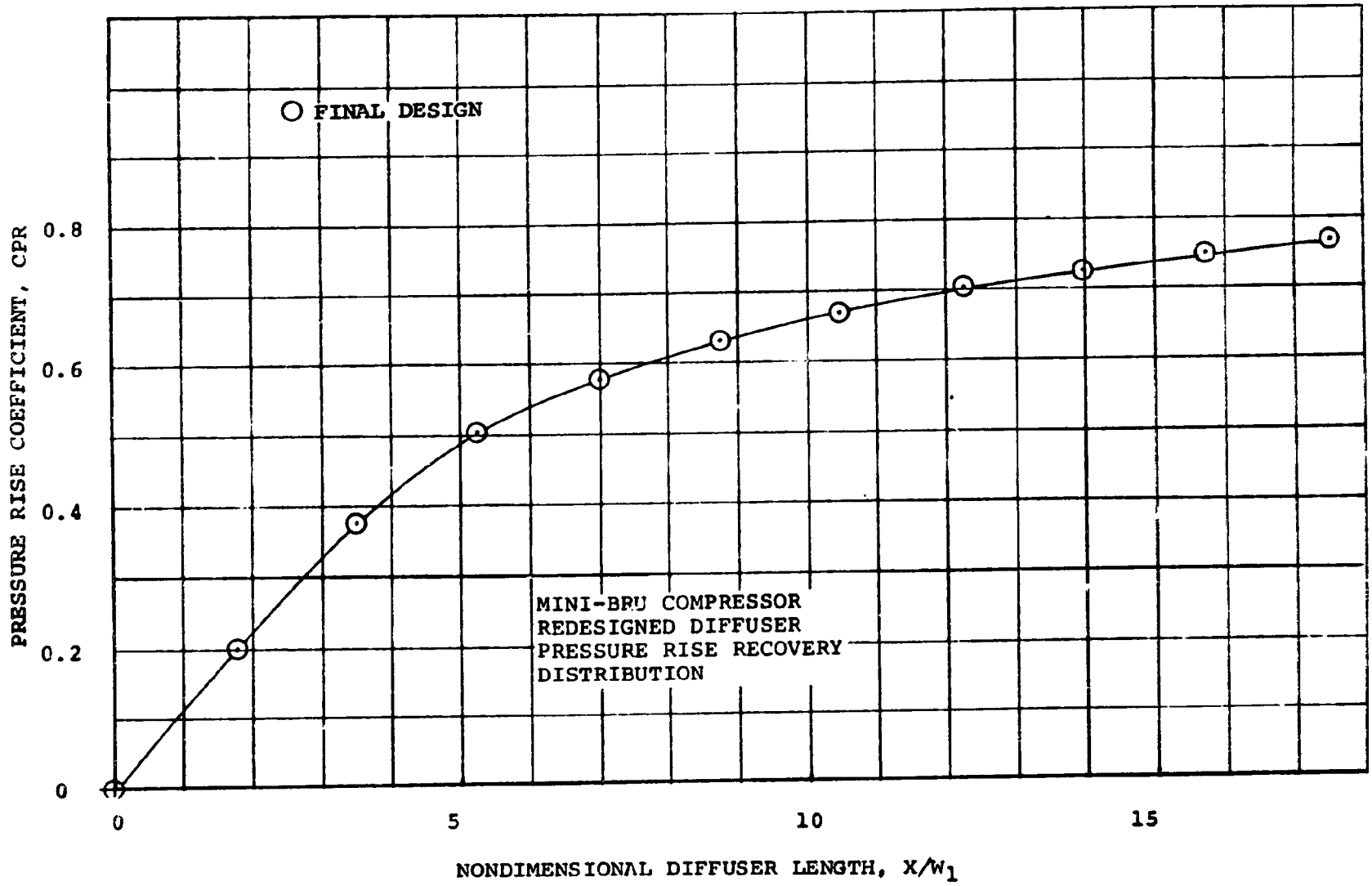


Figure 57. - Mini-BRU Compressor Redesigned Diffuser Pressure Rise Recovery Distribution.

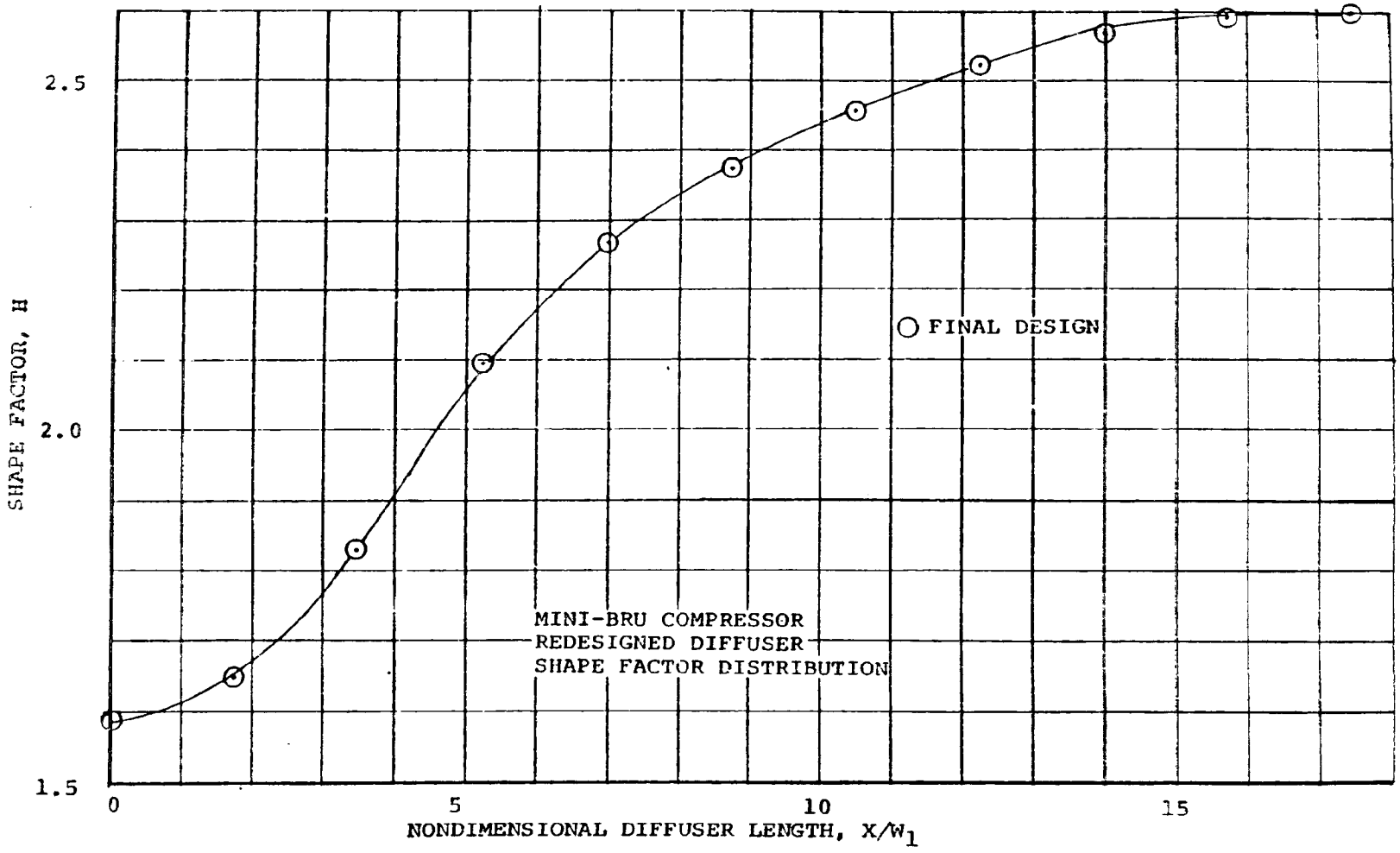


Figure 58. - Mini-BRU Compressor Redesigned Diffuser Shape Factor Distribution.

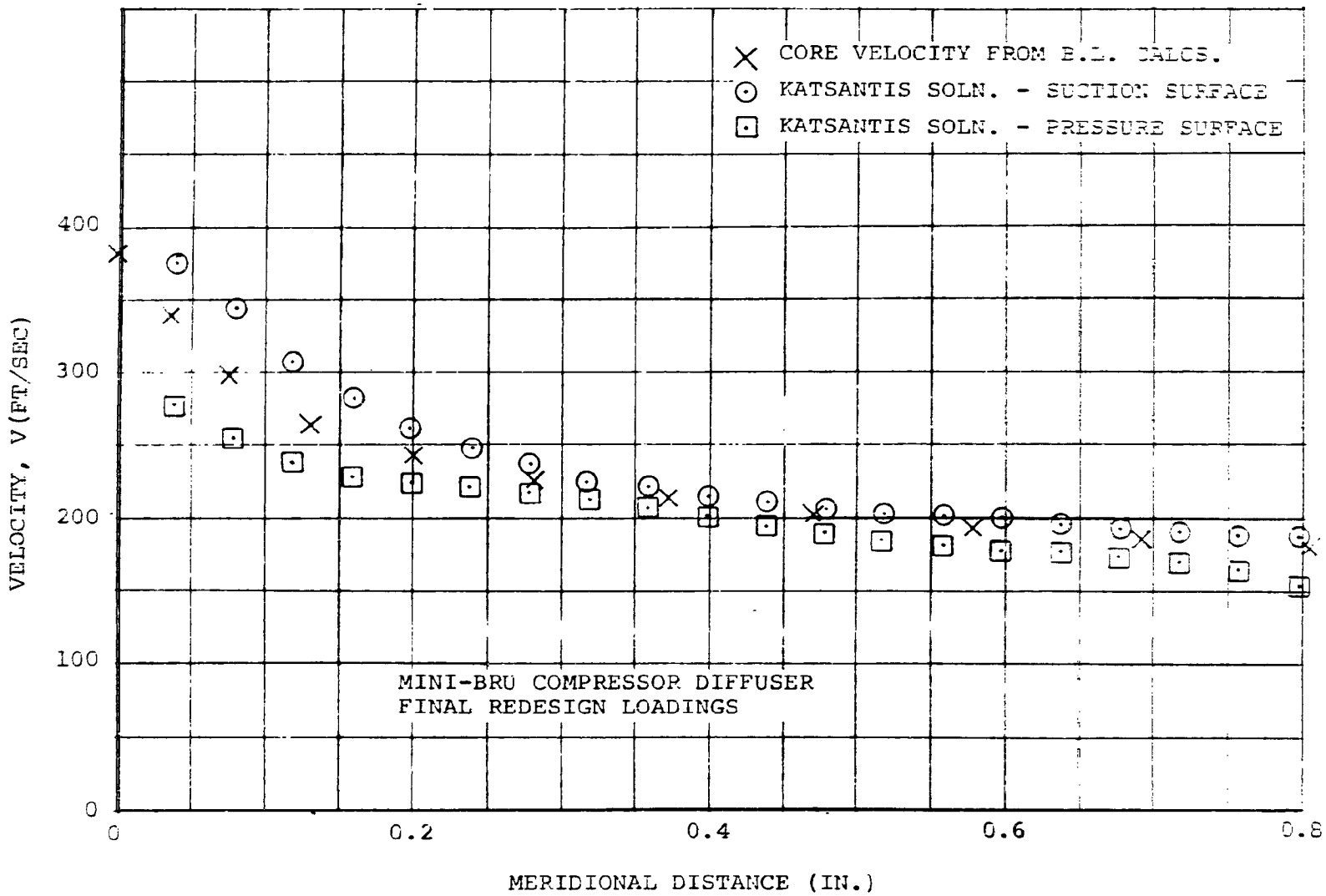


Figure 59. - Mini-BRU Compressor Diffuser Final Redesign Loadings.

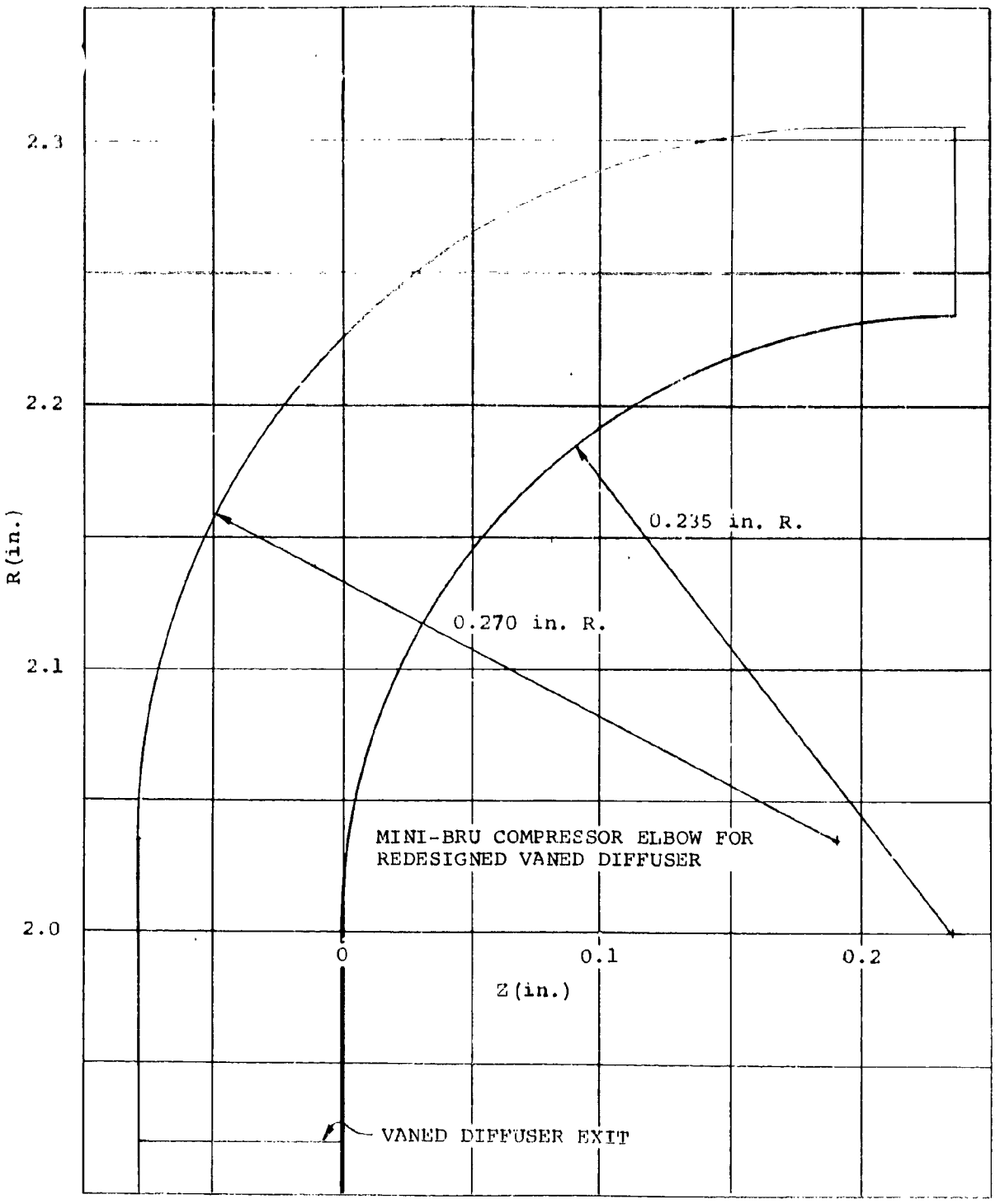


Figure 60. - Mini-BRU Compressor Elbow for Redesigned Vaned Diffuser.

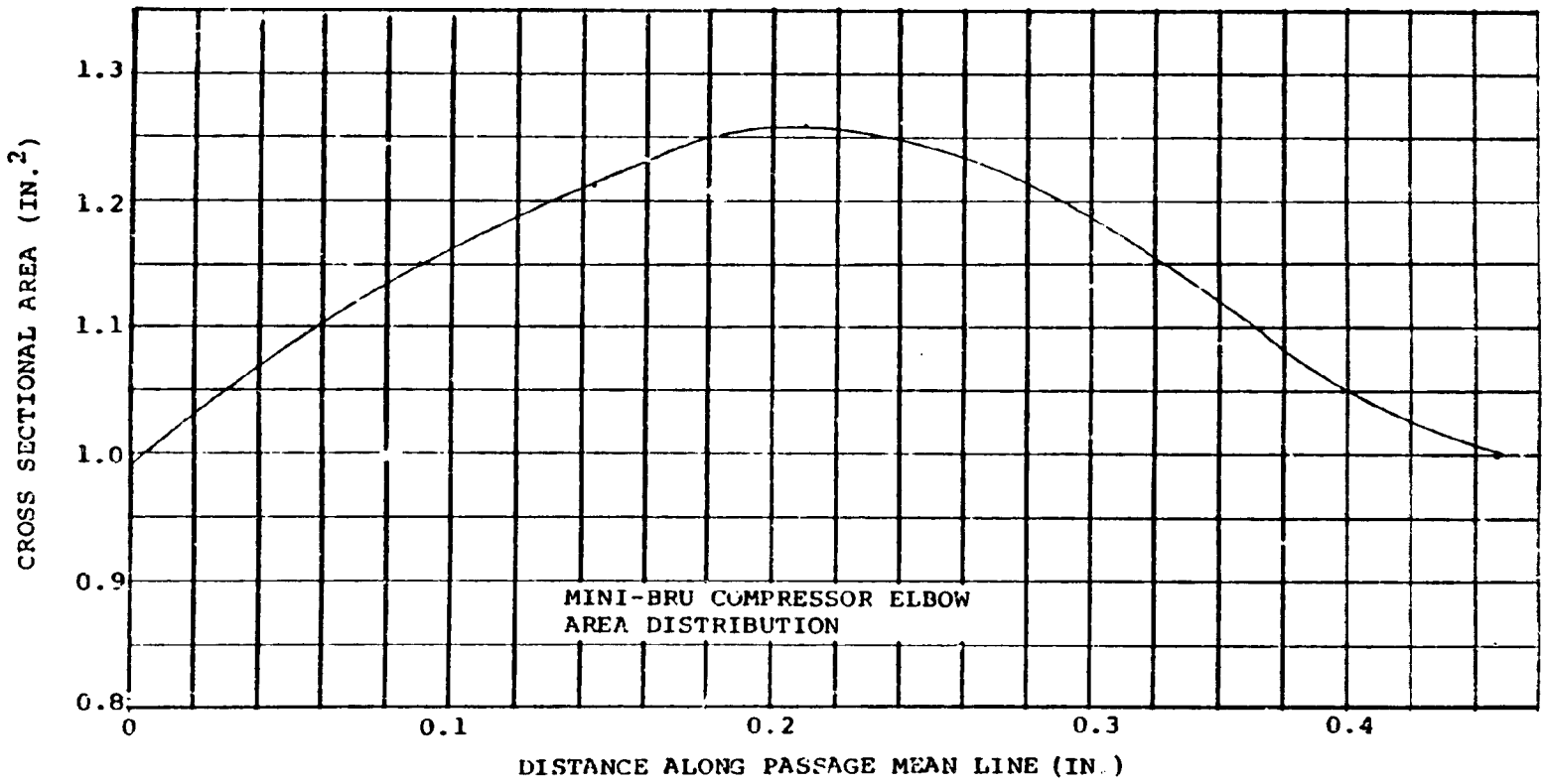
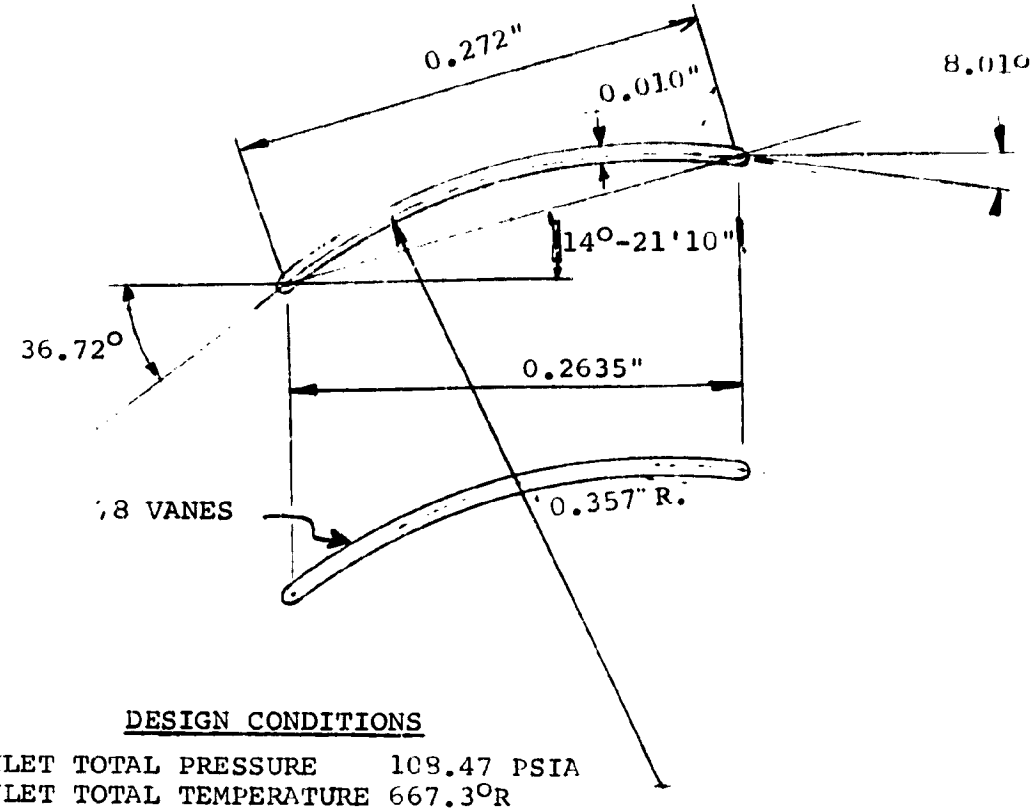


Figure 61. - Mini-BRU Compressor Elbow Area Distribution.



DESIGN CONDITIONS

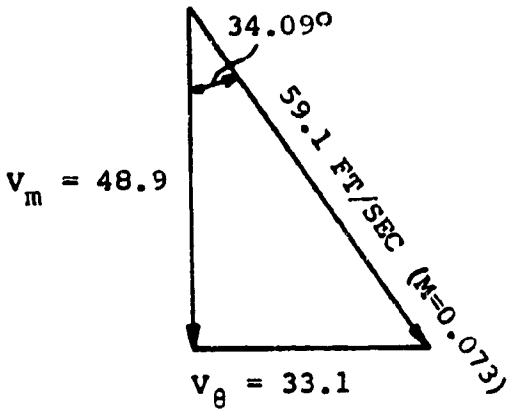
INLET TOTAL PRESSURE	108.47 PSIA
INLET TOTAL TEMPERATURE	667.3°R
INLET MEAN MACH NO.	0.073
INLET FLOW ANGLE	34.09°
INCIDENCE	-2.63°
EXIT MEAN MACH NO.	0.06
EXIT FLOW ANGLE	0°
DEVIATION	8.01°
EXIT TOTAL PRESSURE	108.46 PSIA
DIFFUSION FACTOR	0.360
LOSS COEFFICIENT, $\bar{\omega}$	0.033

GEOMETRY

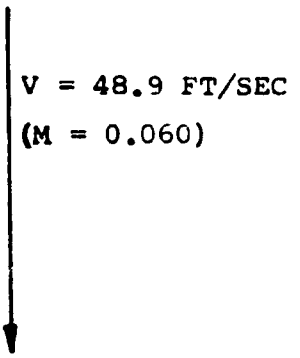
3.7% CIRCULAR ARC VANE

NO. OF VANES	78
CHORD LENGTH	0.272 IN.
SOLIDITY	1.5
STAGGER	14.35°
BLADE CAMBER	44.73°
INLET BLADE ANGLE	36.72°
EXIT BLADE ANGLE	-8.01°
CONSTANT NORMAL THICKNESS	0.010"

Figure 62. - Deswirl Vanes for Redesigned Diffuser.



DESWIRL VANE INLET



DESWIRL VANE EXIT

Figure 63. - Mini-BRU Compressor Deswirl Vane Velocity Triangles for Redesigned Vaned Diffuser.

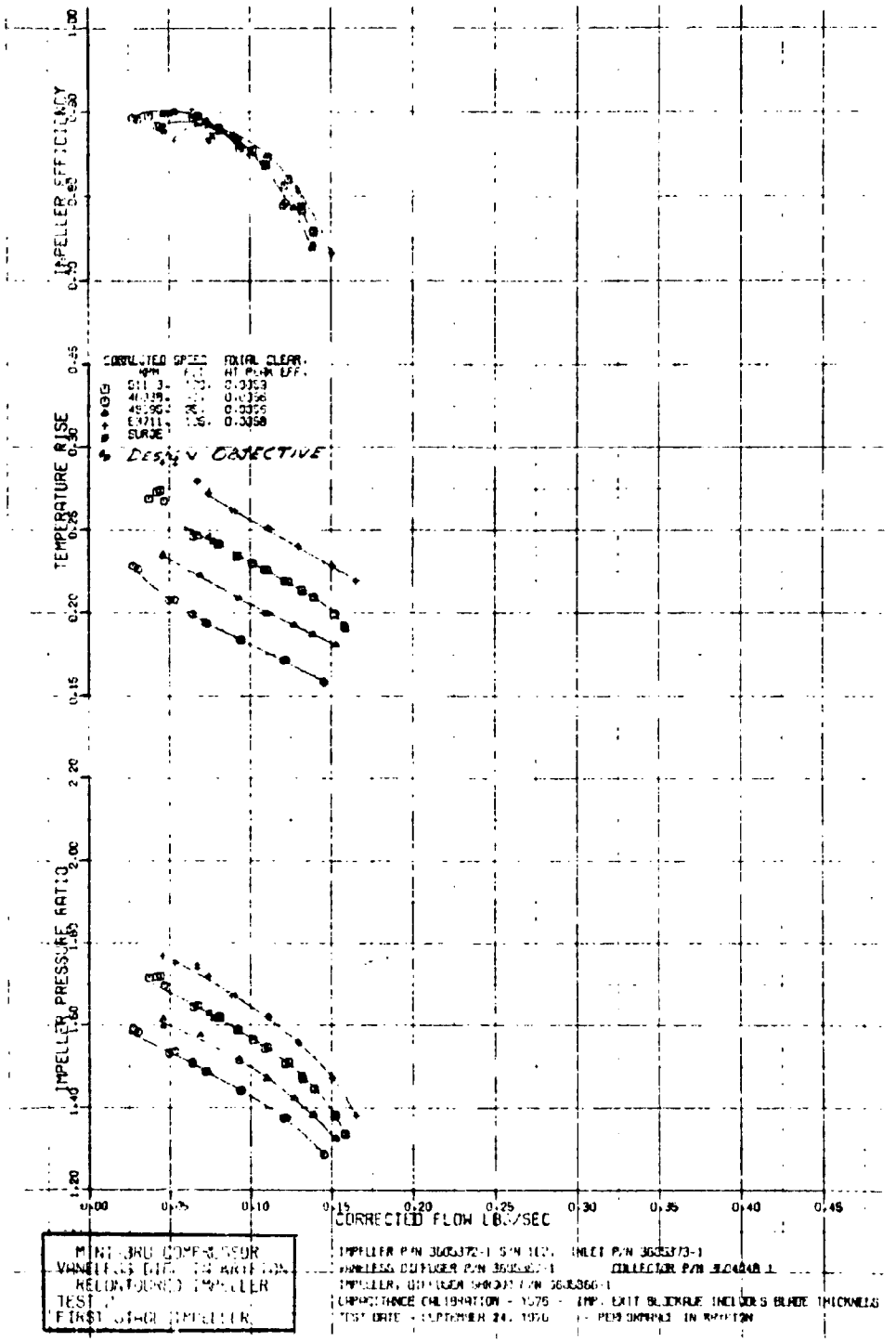


Figure 64. - Mini-BRU Compressor Vaneless Diffuser in Krypton Recontoured Impeller, Test 2, First-Stage Impeller.

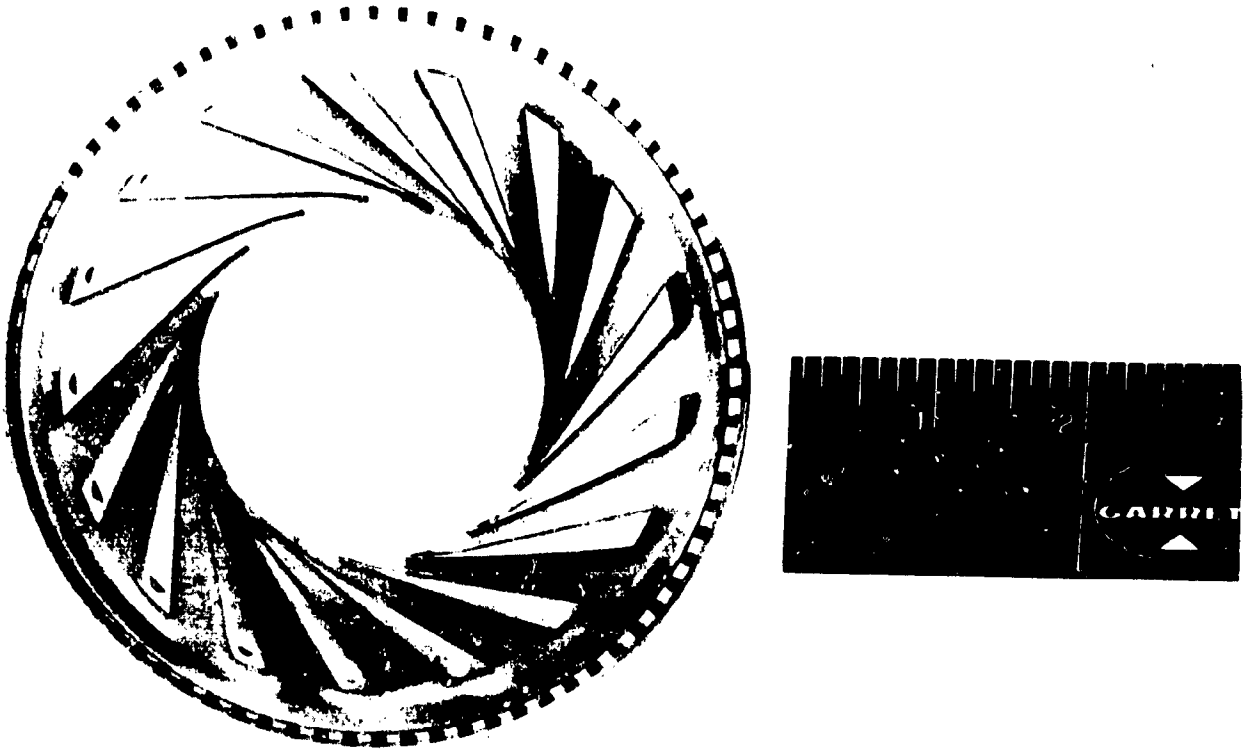


Figure 65. - Redesigned Radial Diffuser.

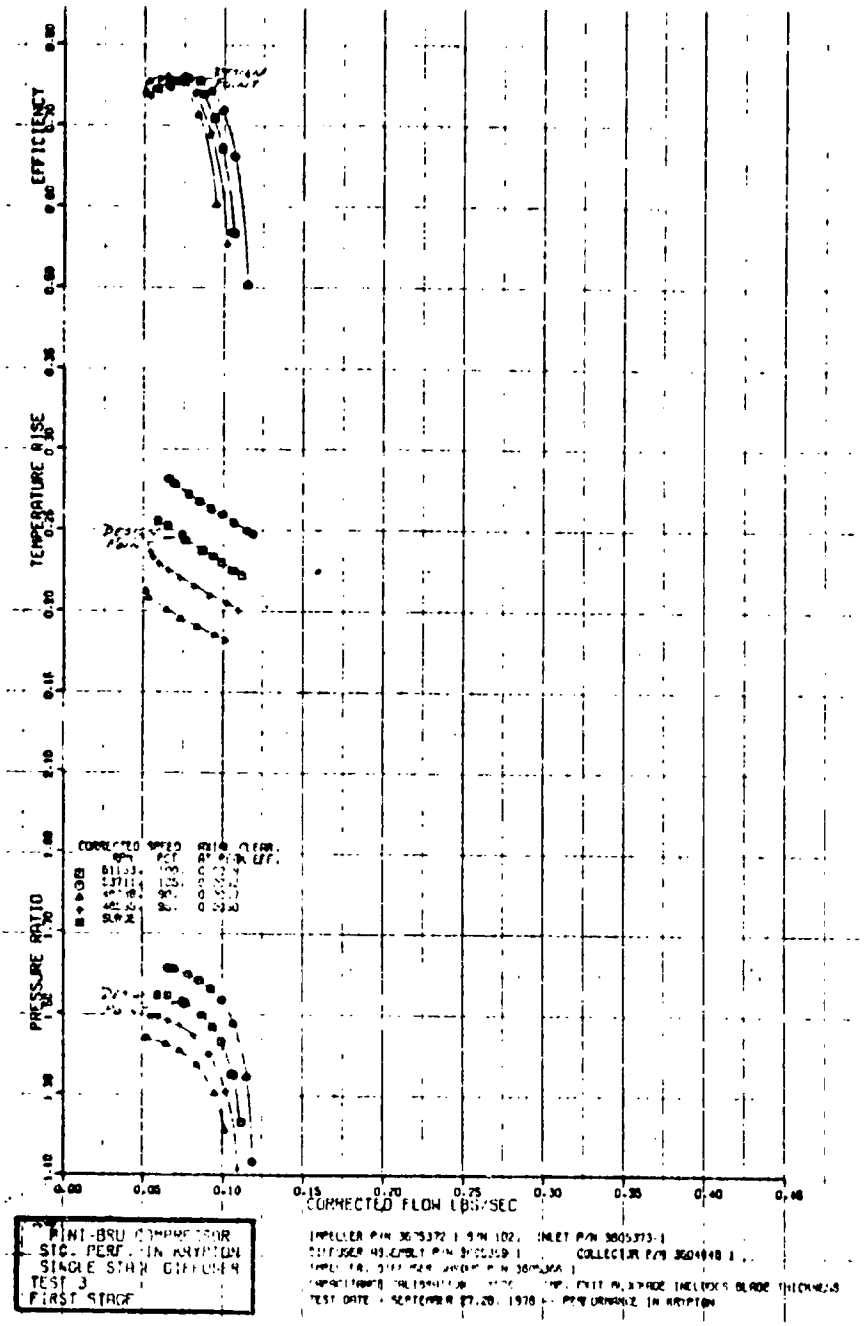


Figure 66. - Mini-BRU Compressor Stage Performance in Krypton, Single-Stage Diffuser, Test 3, First Stage.

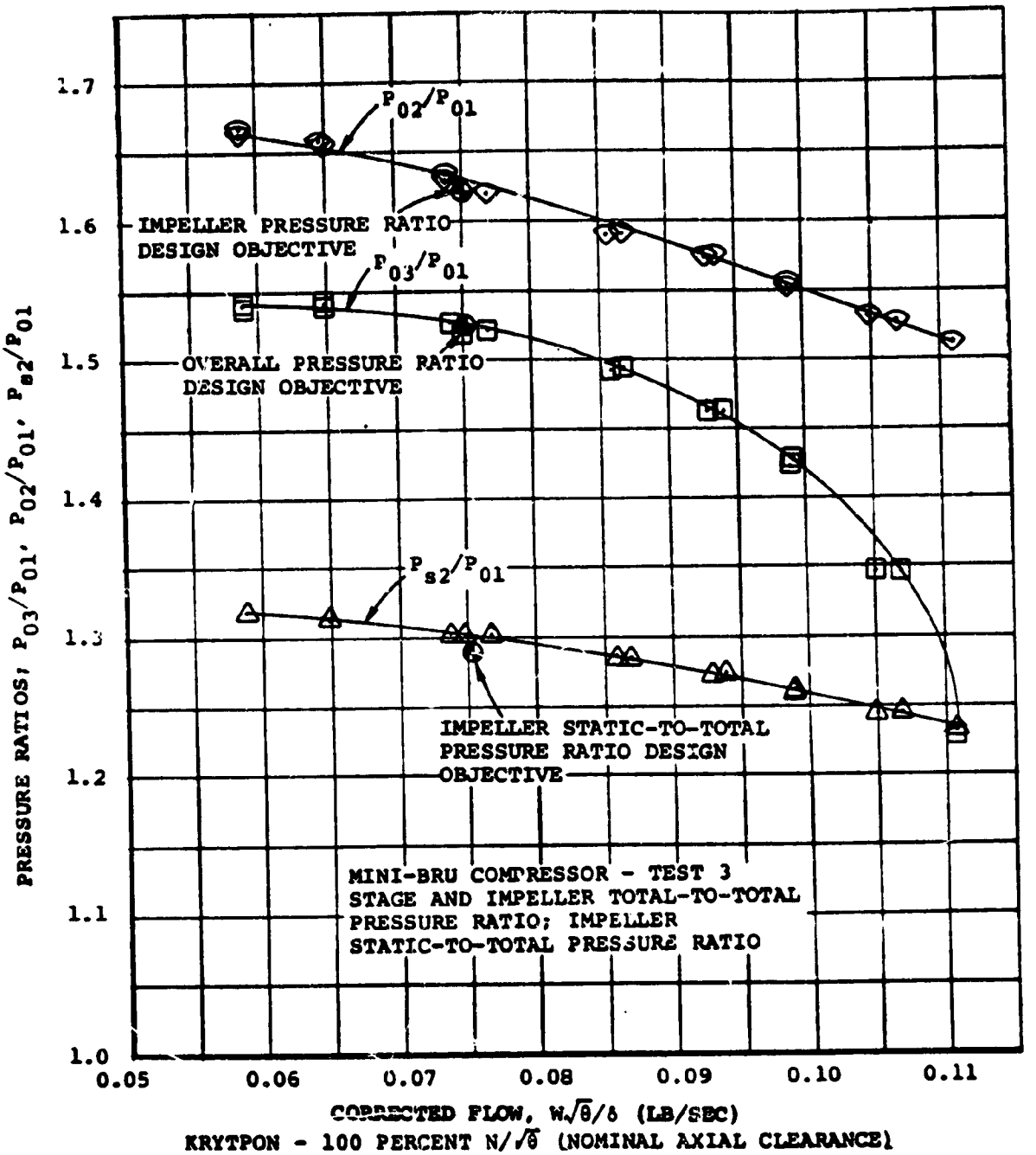


Figure 67. - Mini-BRU Compressor, Test 3, Stage and Impeller Total-to-Total Pressure Ratio; Impeller Static-to-Total Pressure Ratio.

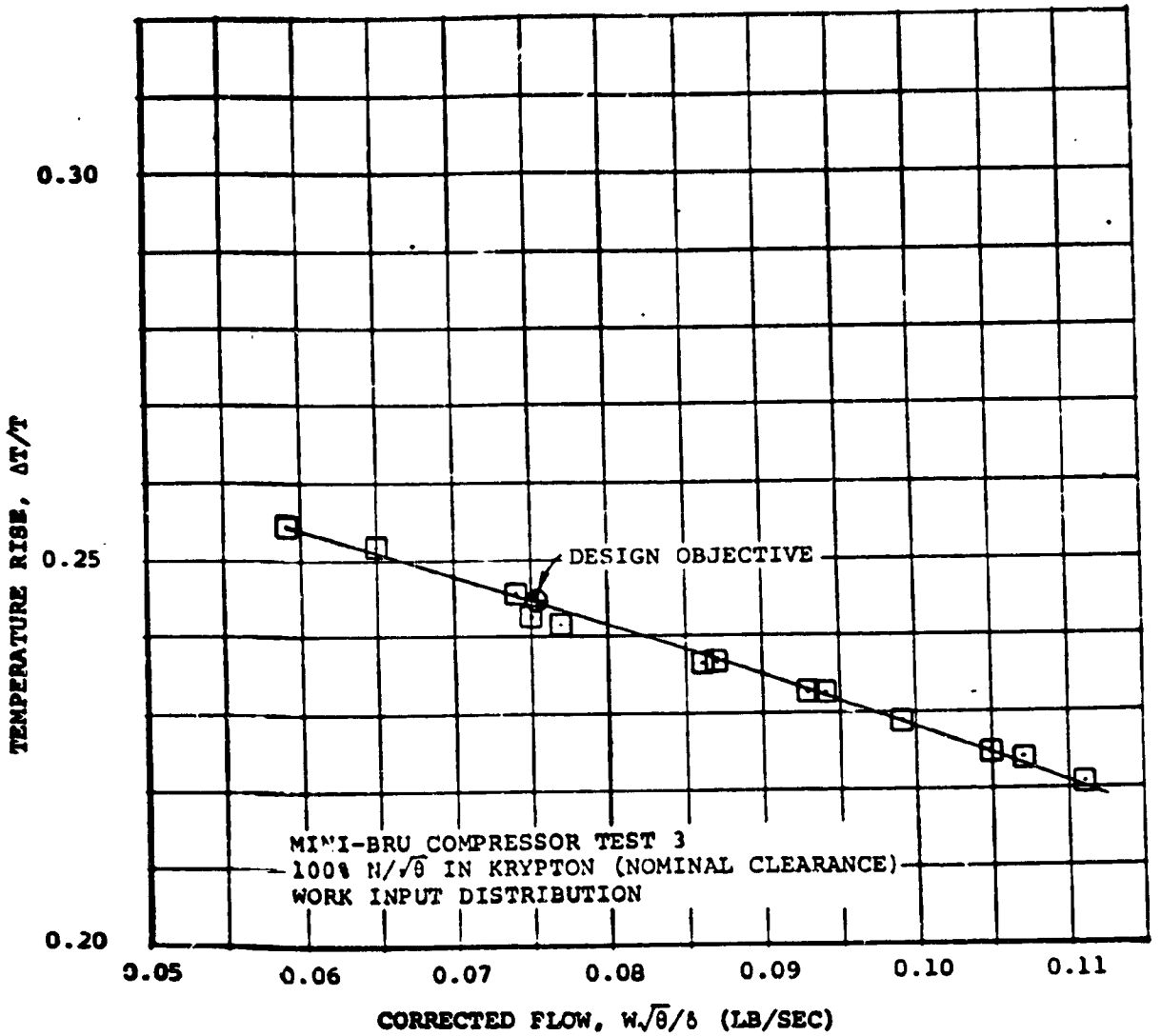


Figure 68. - Mini-BRU Compressor, Test 3, 100% $N/\sqrt{\theta}$ in Krypton (Nominal Clearance) Work Input Distribution.

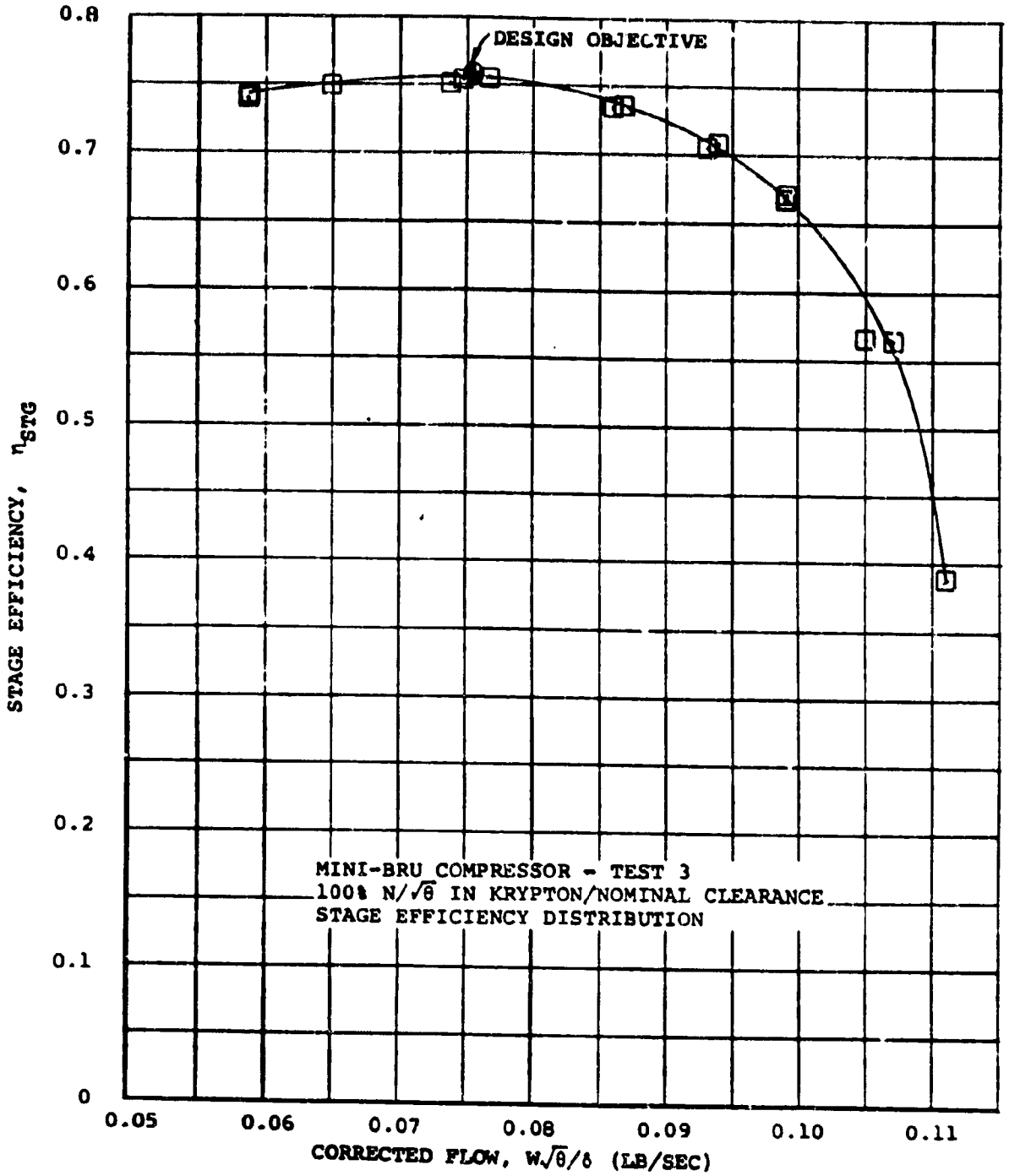


Figure 69. - Mini-BRU Compressor, Test 3, 100% N/$\sqrt{\theta}$ in Krypton (Nominal Clearance) Stage Efficiency Distribution.

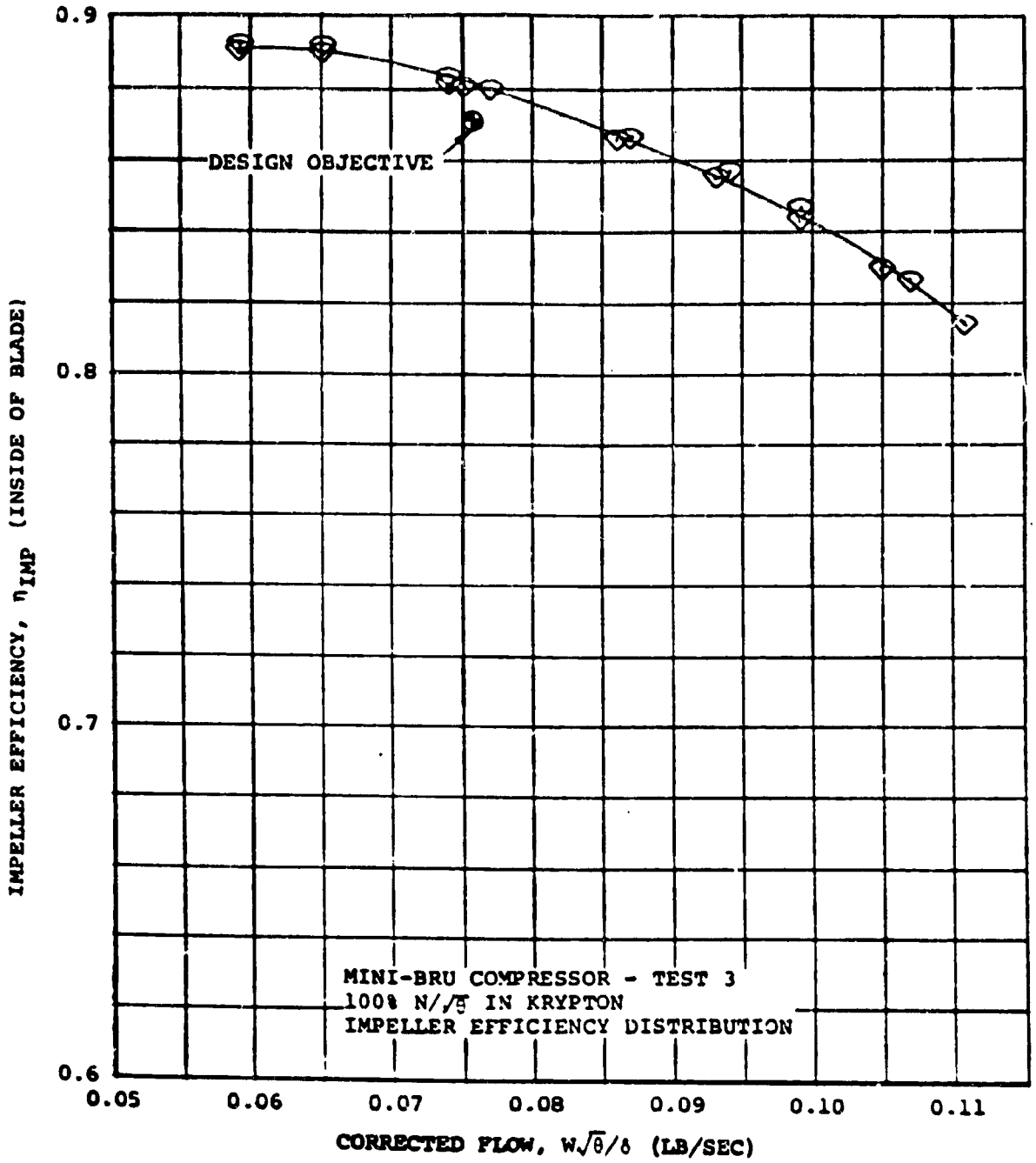


Figure 70. - Mini-BRU Compressor, Test 3, 100% $N/\sqrt{\theta}$ in Krypton Impeller Efficiency Distribution.

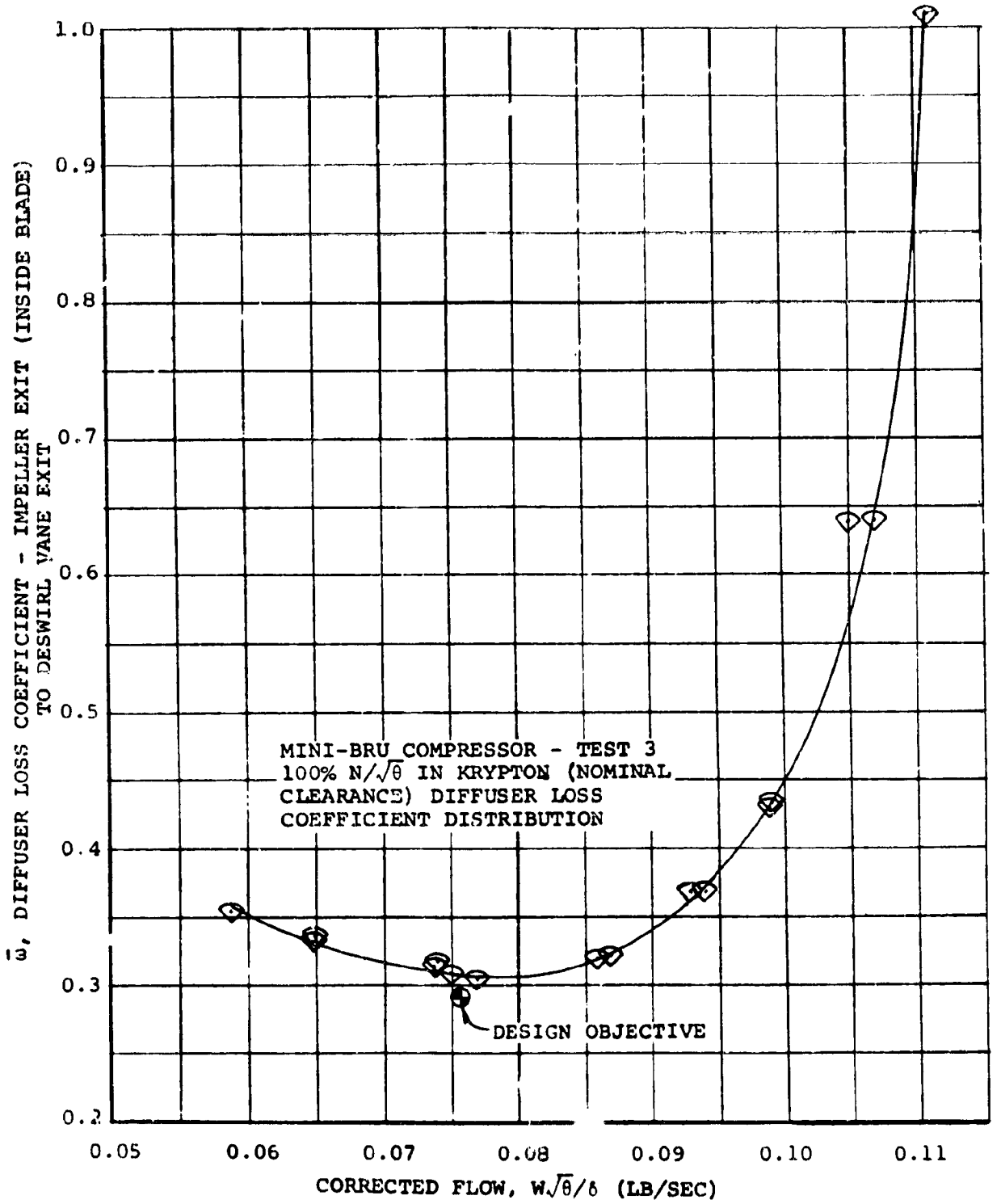


Figure 71. - Mini-BRU Compressor, Test 3, 100% N/$\sqrt{\theta}$ in Krypton (Nominal Clearance) Diffuser Loss Coefficient Distribution.

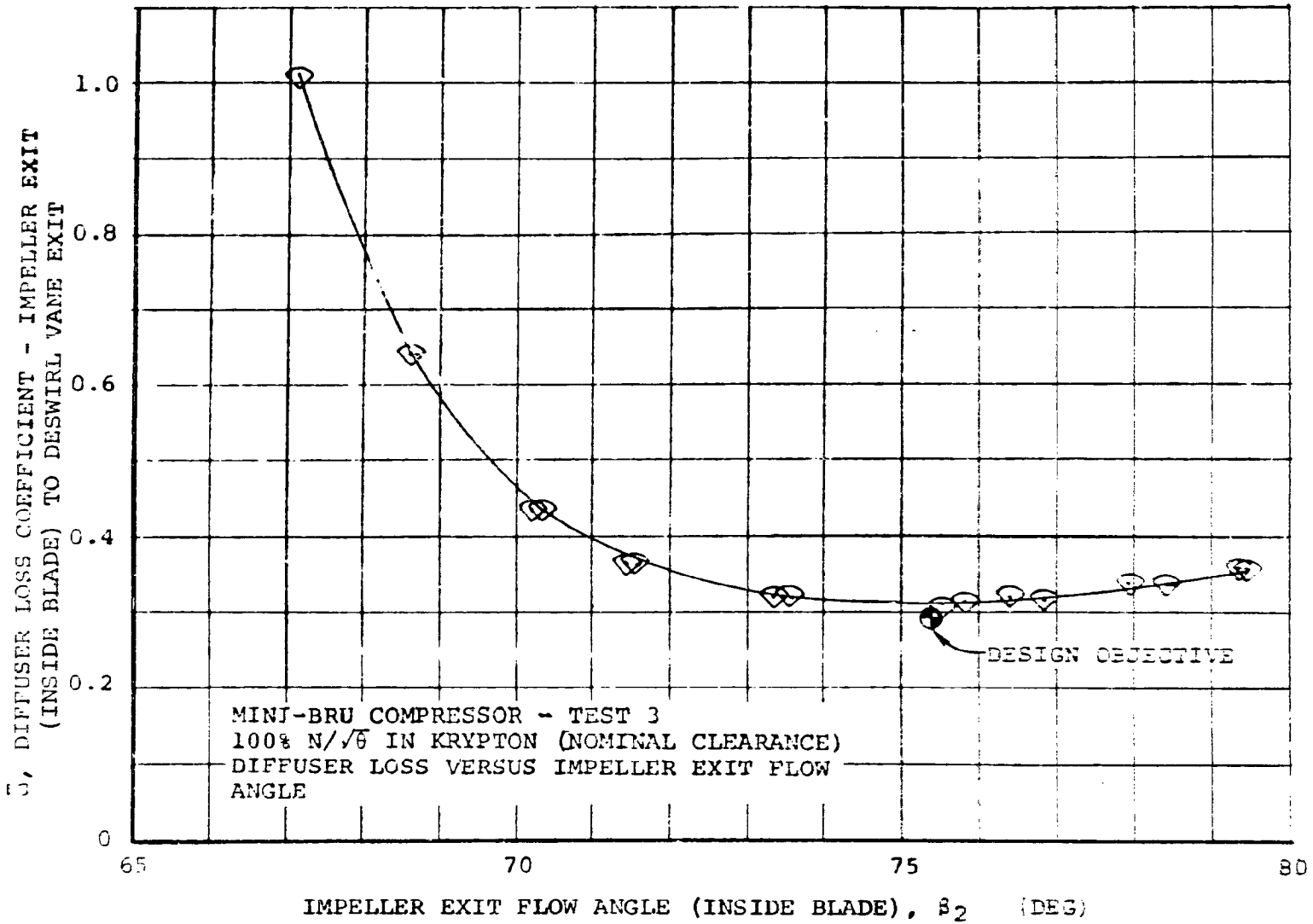


Figure 72. - Mini-BRU Compressor, Test 3, 100% N/√θ in Krypton (Nominal Clearance) Diffuser Loss Versus Impeller Exit Flow Angle.

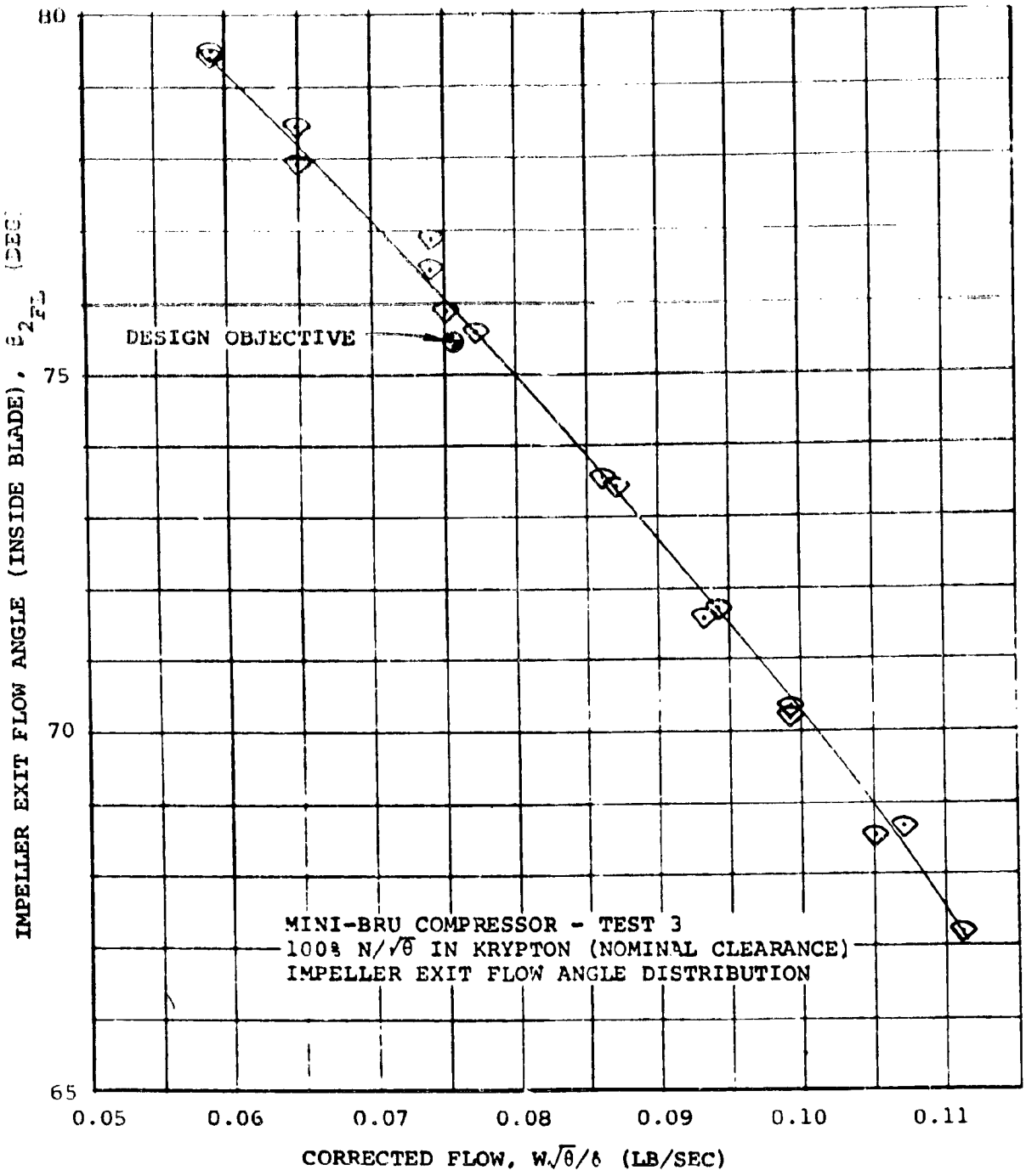


Figure 73. - Mini-BRU Compressor, Test 3, 100% $N/\sqrt{\theta}$ in Krypton (Nominal Clearance) Impeller Exit Flow Angle Distribution.

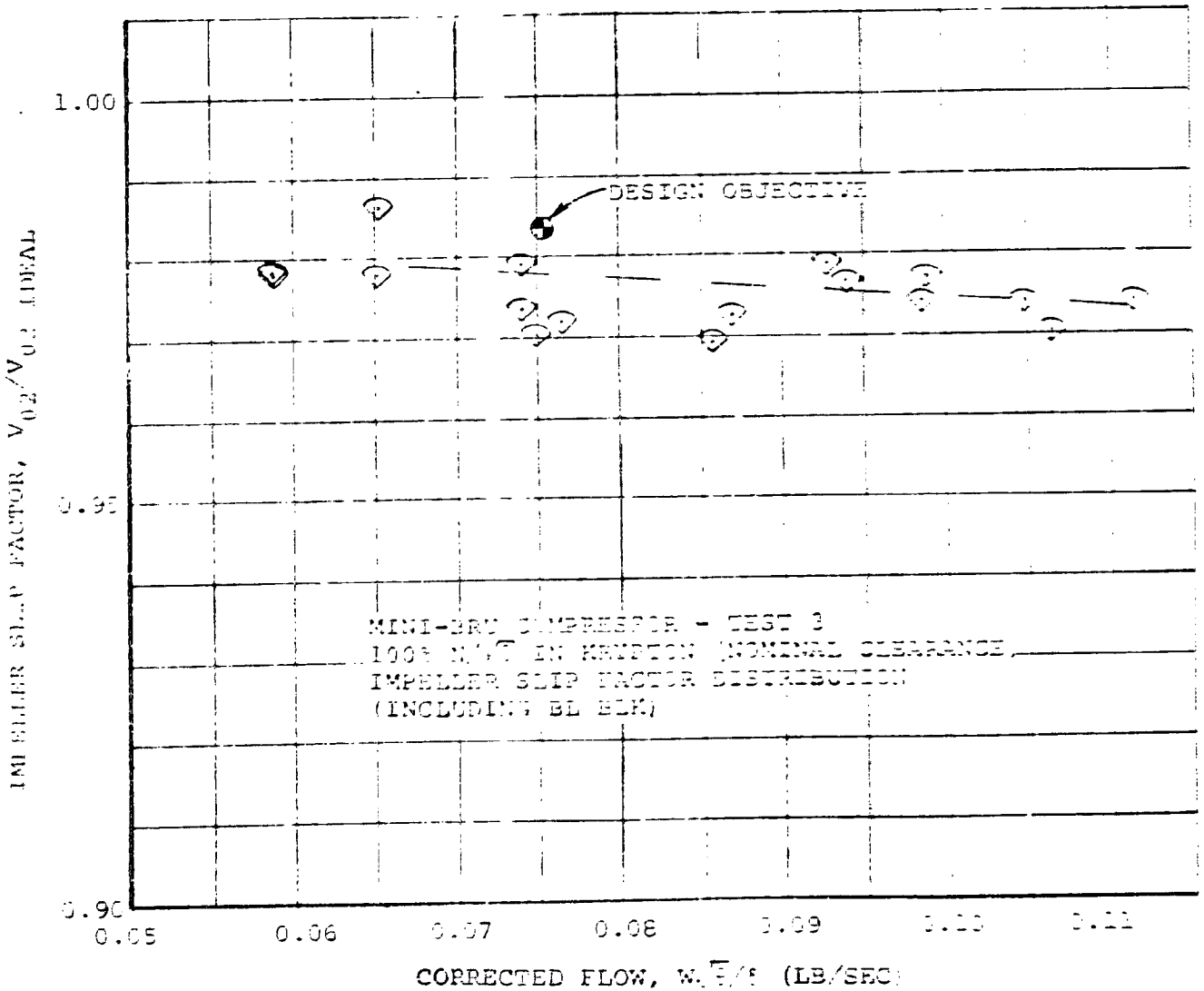


Figure 74. - Mini-BRU Compressor, Test 3, 100% N/√T in Krypton (Nominal Clearance), Impeller Slip Factor Distribution (Including BL BLK).

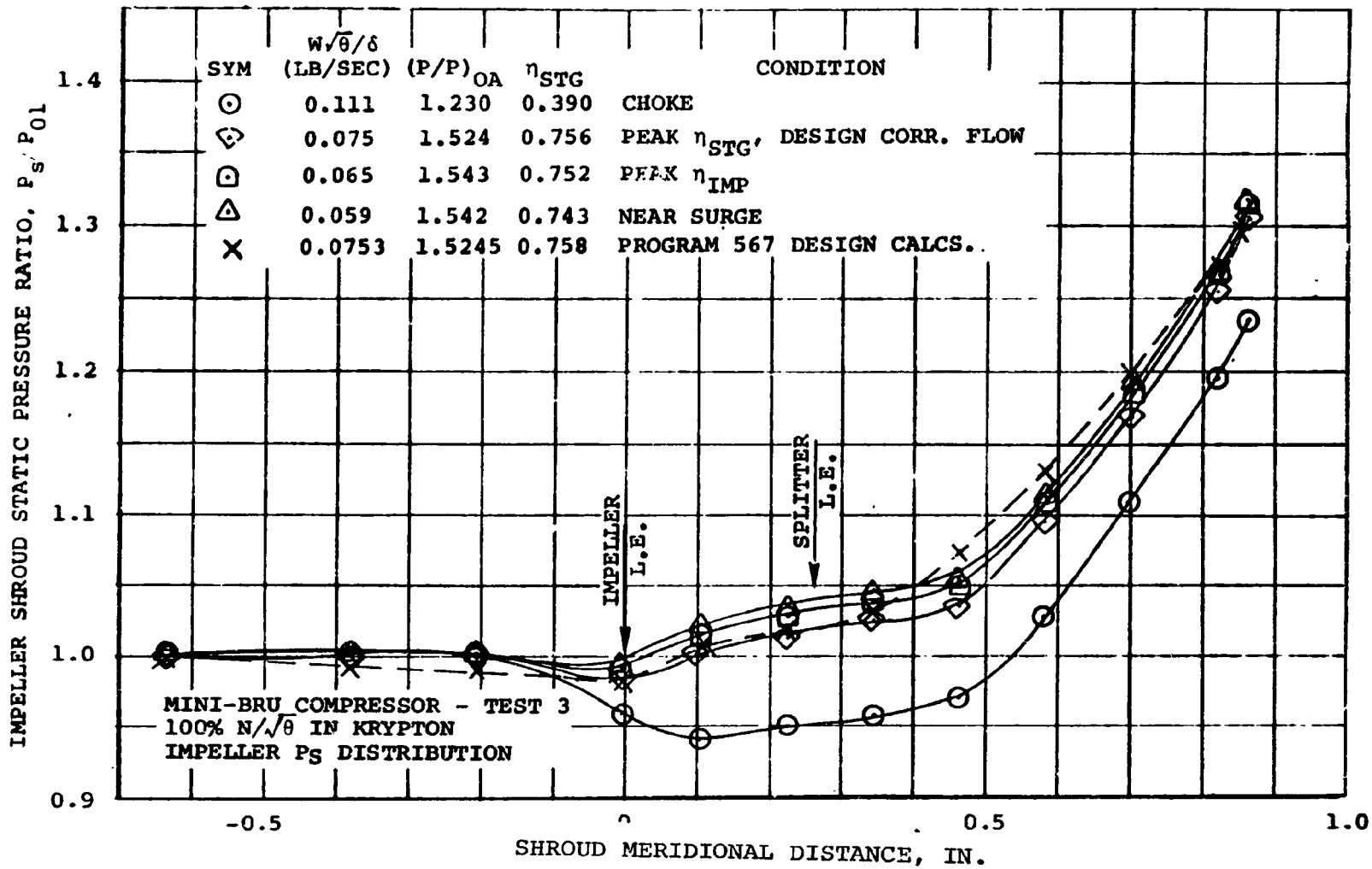


Figure 75. - Mini-BRU Compressor, Test 3, 100% $N/\sqrt{\theta}$ in Krypton Impeller P_S Distribution.

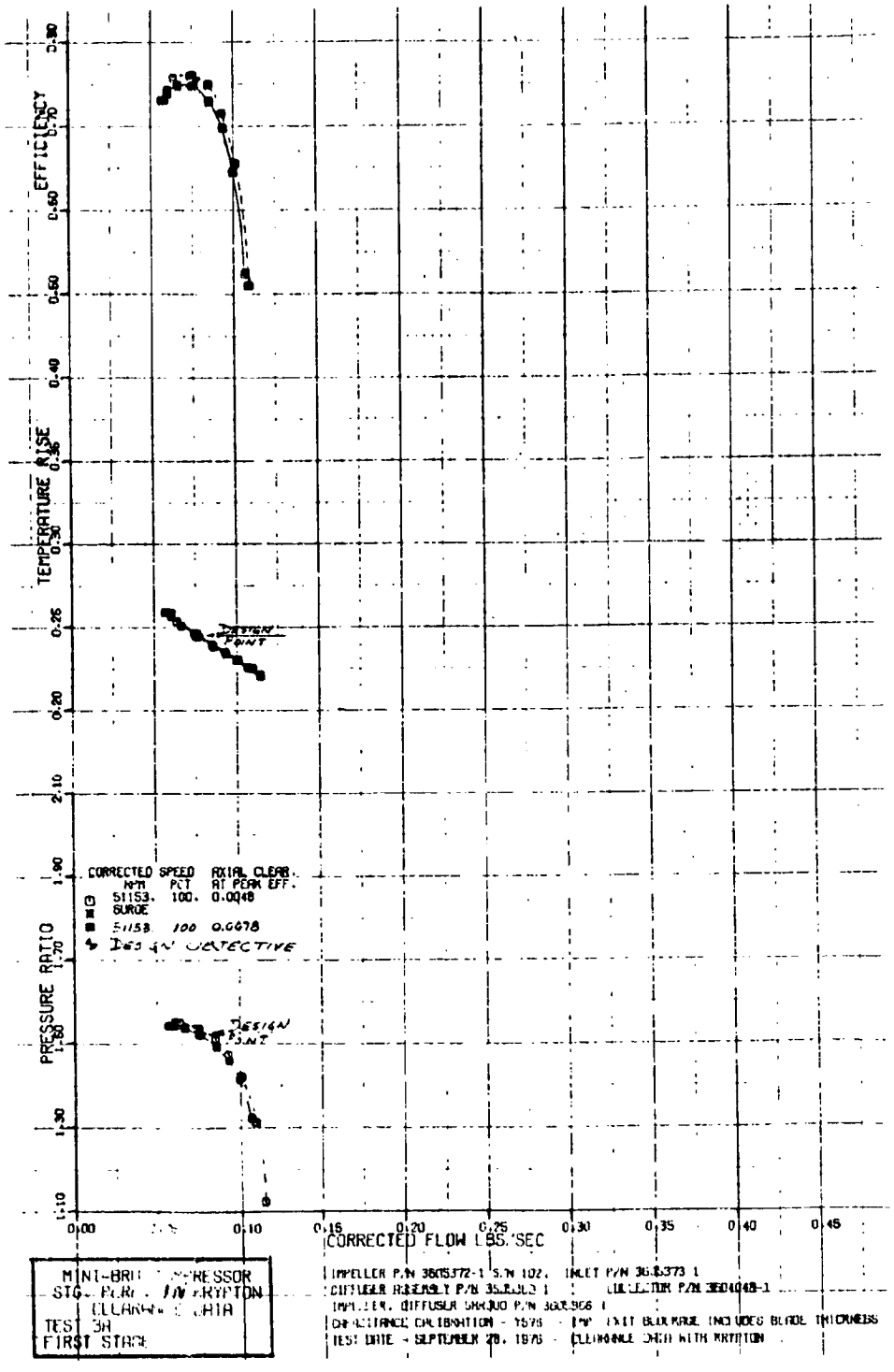


Figure 76. - Mini-BRU Compressor Stage Performance in Krypton Clearance Data, Test 3A, First Stage.

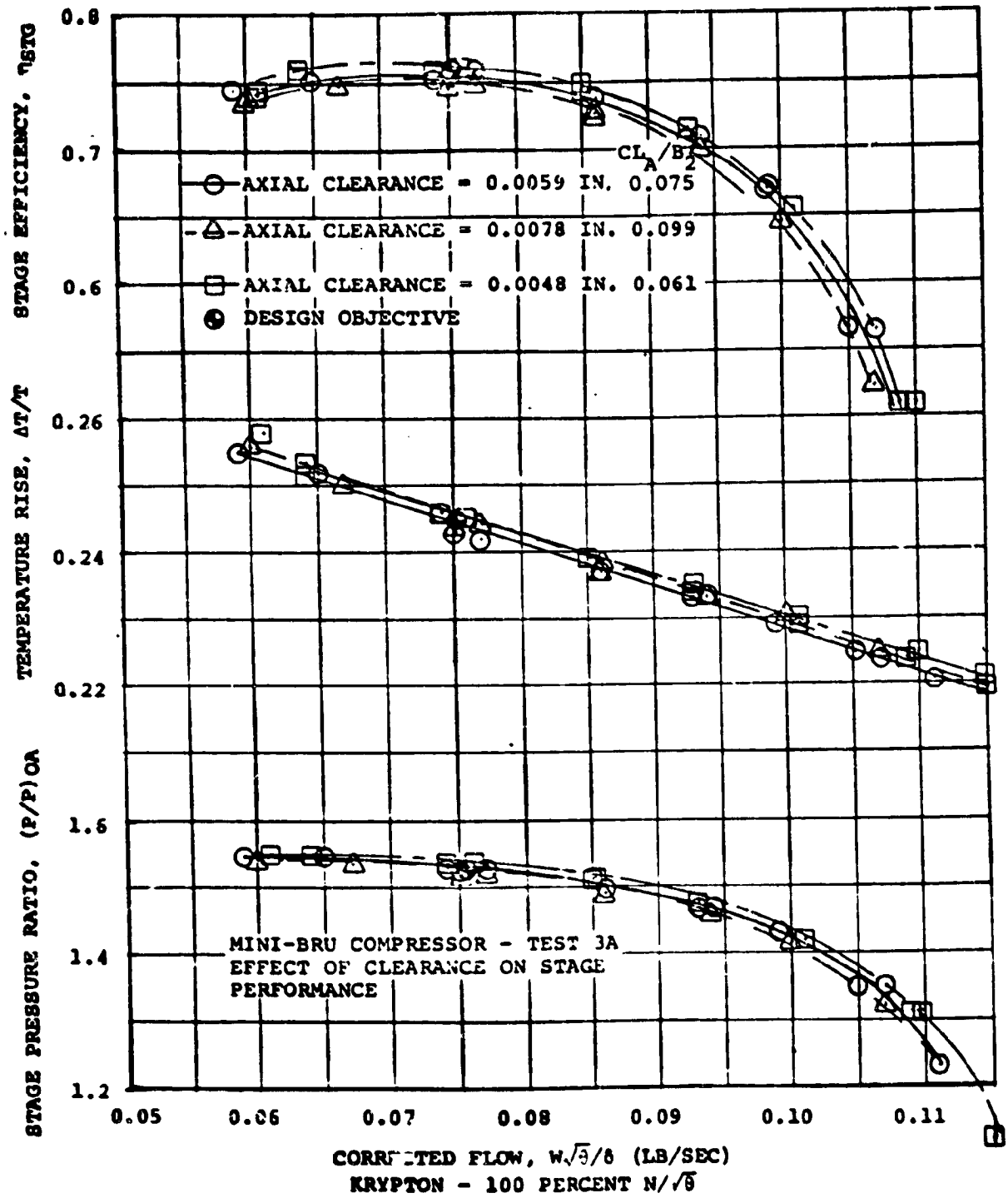


Figure 77. - Mini-BRU Compressor, Test 3A, Effect of Clearance on Stage Performance.

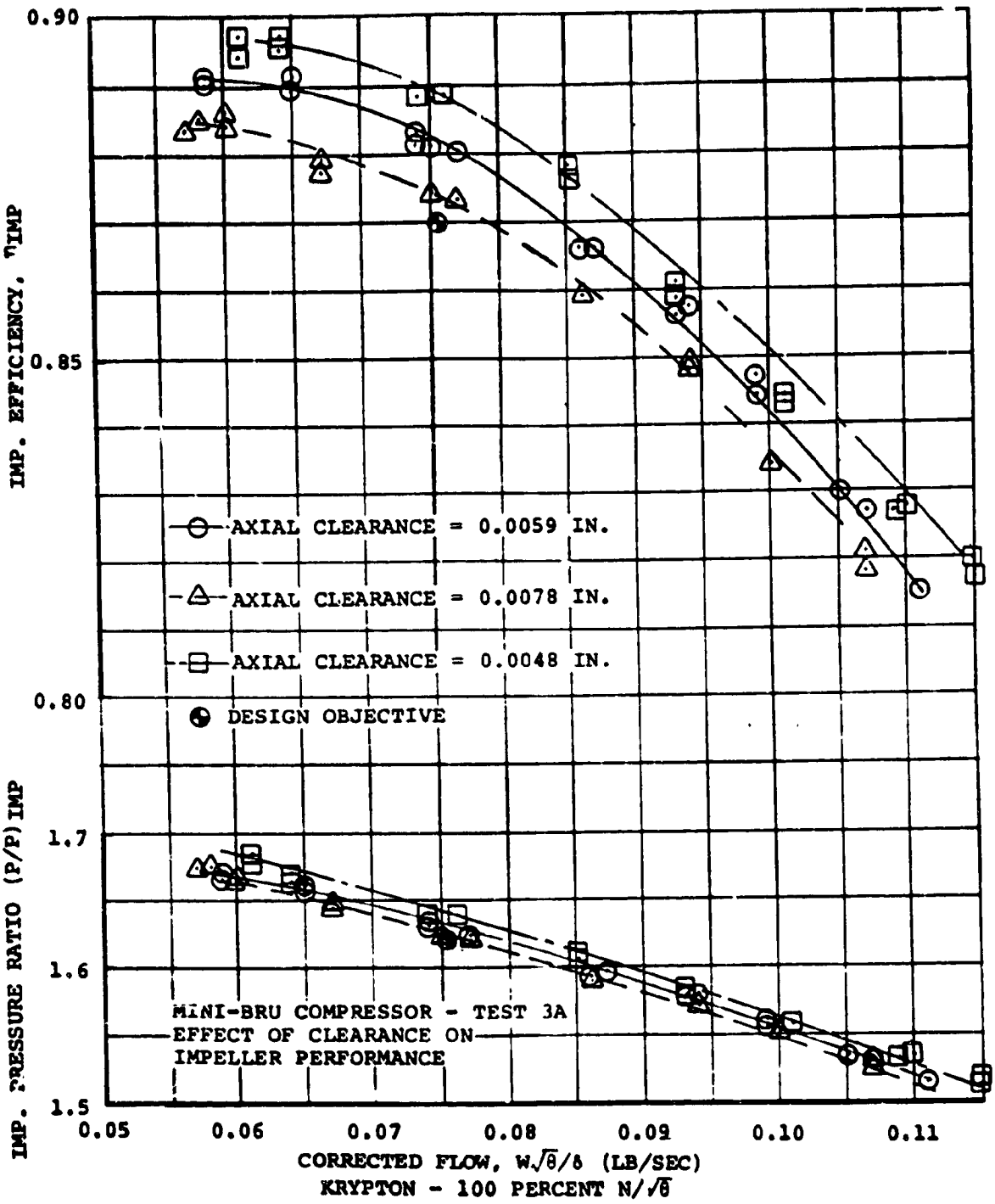


Figure 78. - Mini-BRU Compressor, Test 3A, Effect of Clearance on Impeller Performance.

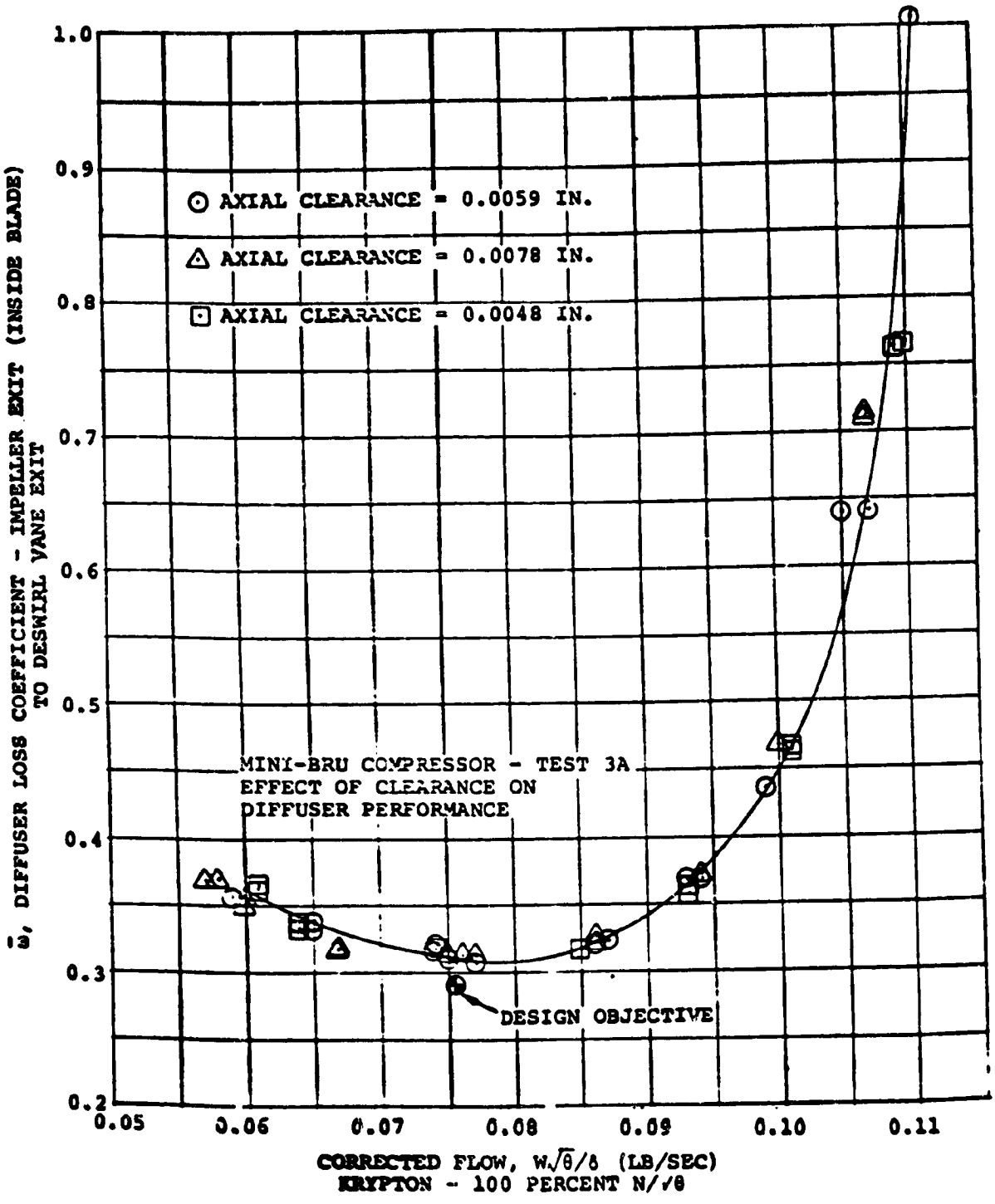


Figure 79. - Mini-BRU Compressor, Test 3A, Effect of Clearance on Diffuser Performance.

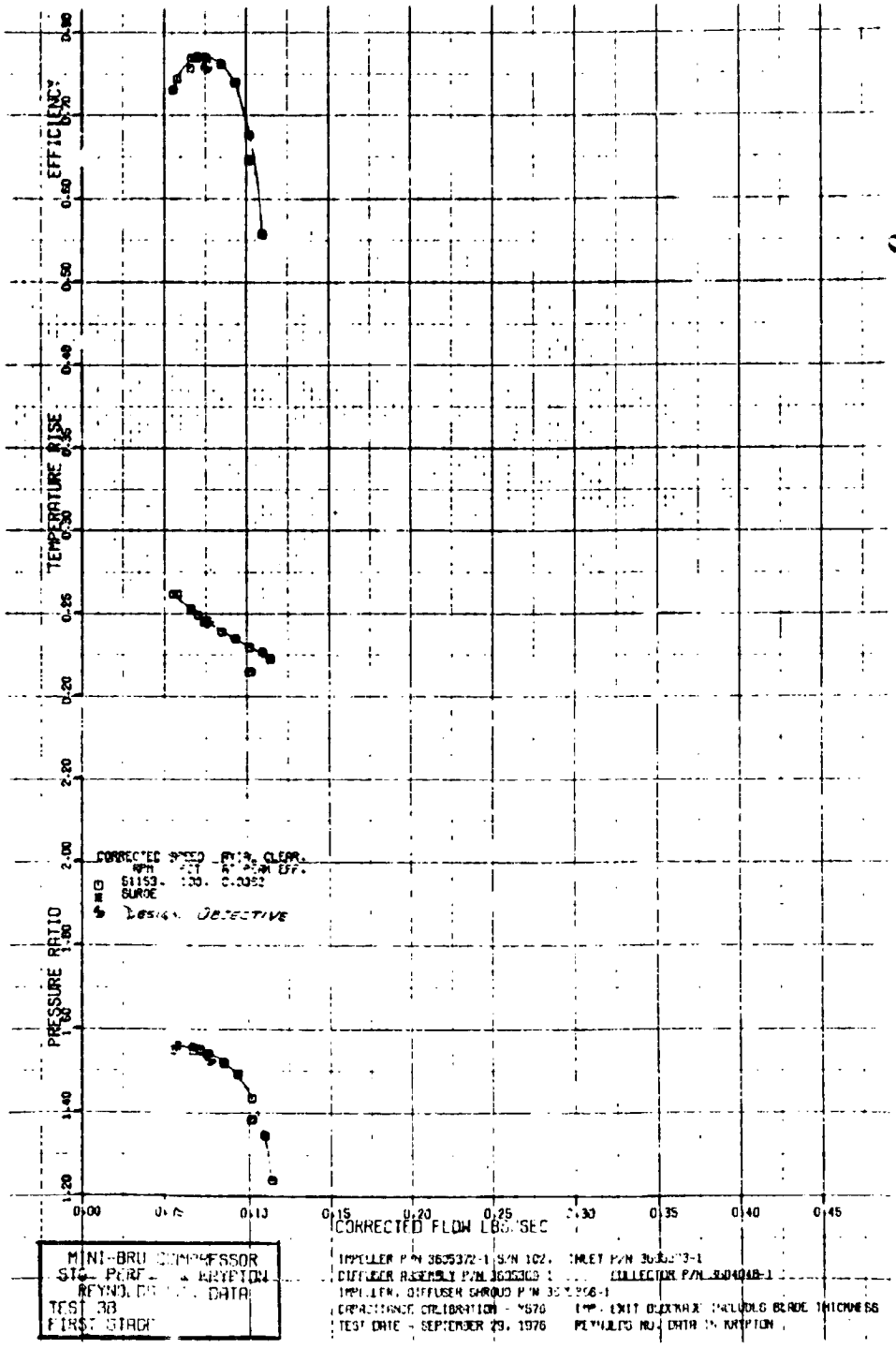


Figure 80. - Mini-BRU Compressor Stage Performance in Krypton, Reynolds Number Data, Test 3B, First Stage.

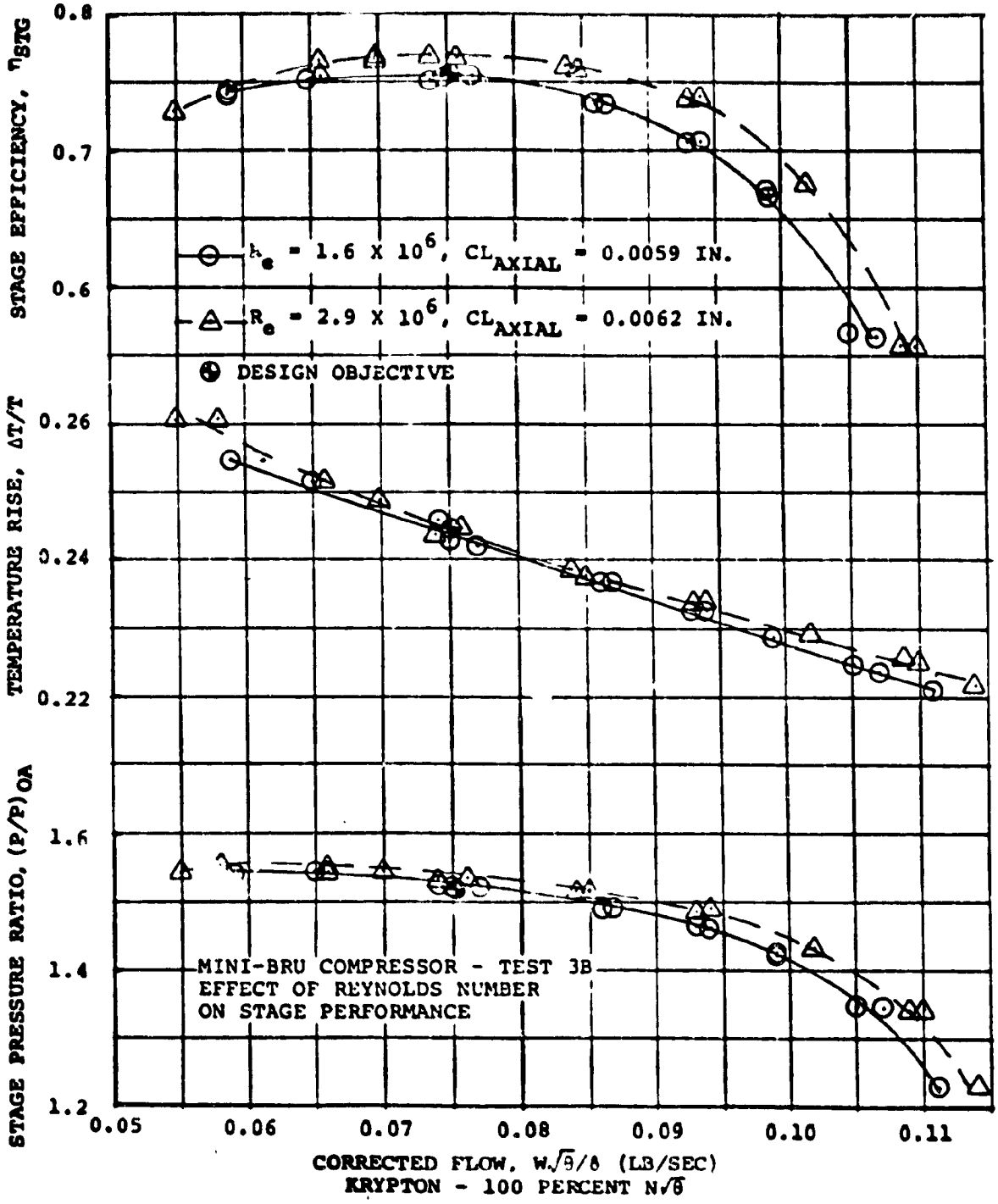


Figure 81. - Mini-BRU Compressor, Test 3B, Effect of Reynolds Number on Stage Performance.

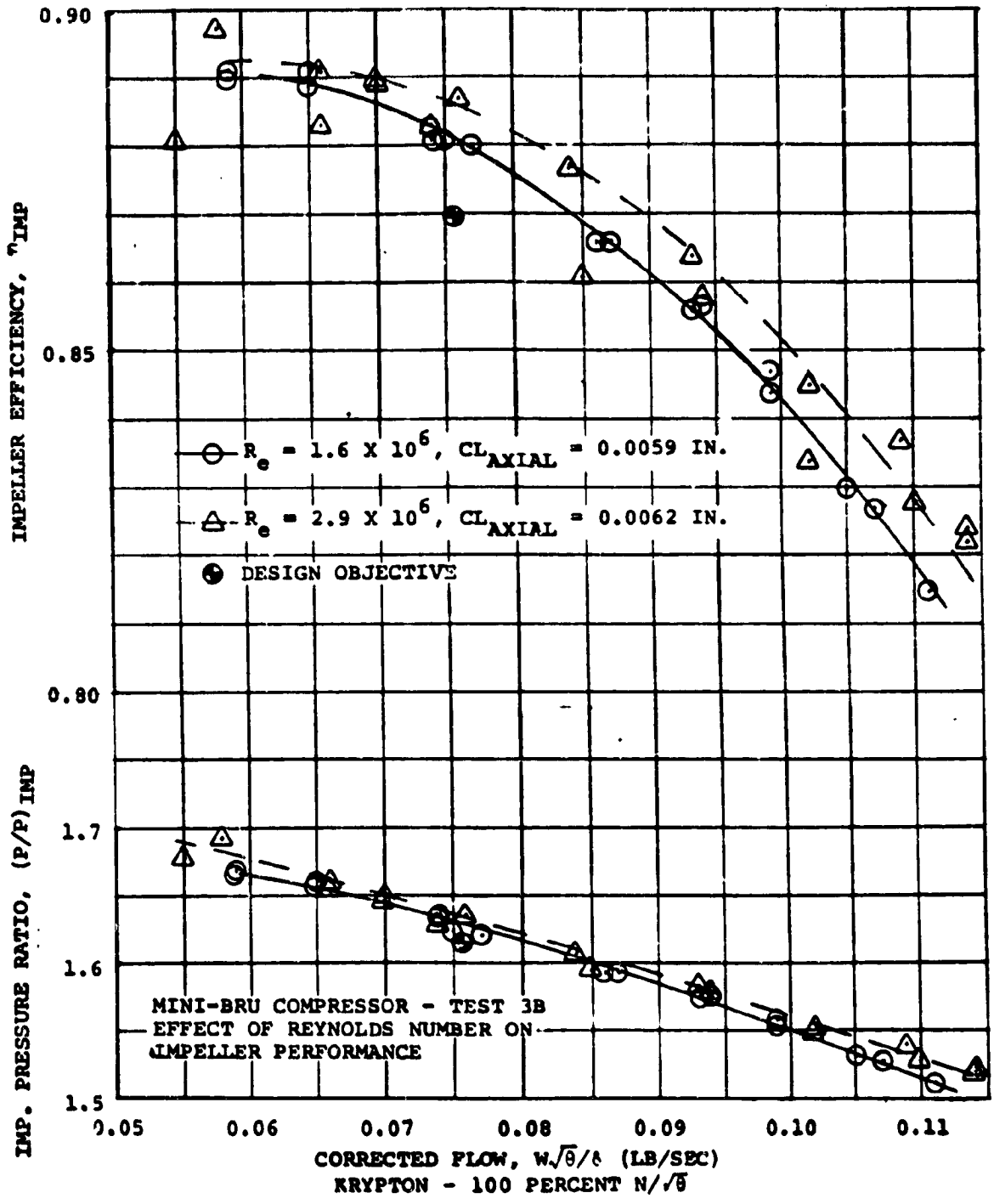


Figure 82. - Mini-BRU Compressor, Test 3B, Effect of Reynolds Number on Impeller Performance.

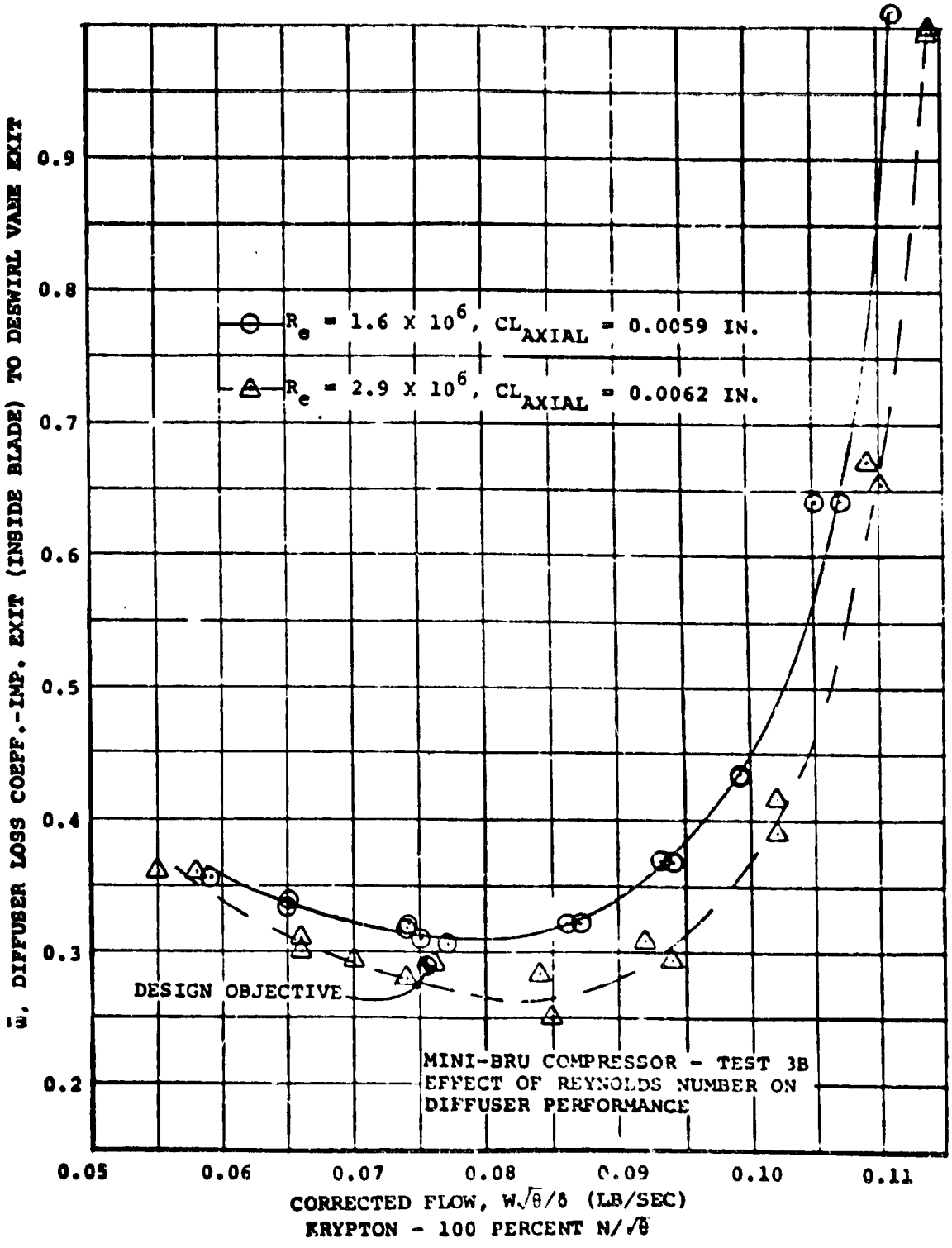


Figure 53. - Mini-BRU Compressor, Test 3B, Effect of Reynolds Number on Diffuser Performance.

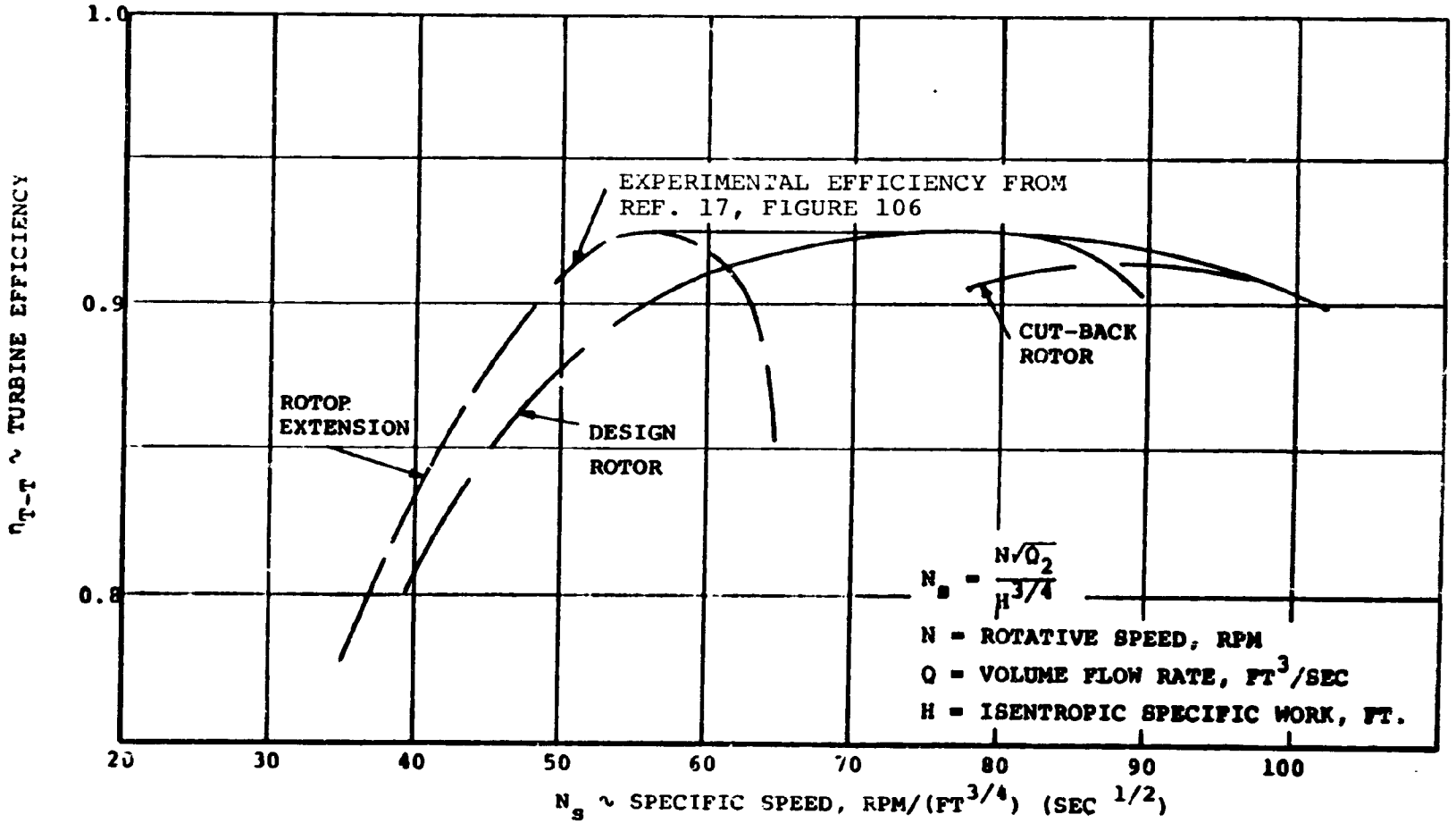


Figure 84. - Composite Turbine Performance.

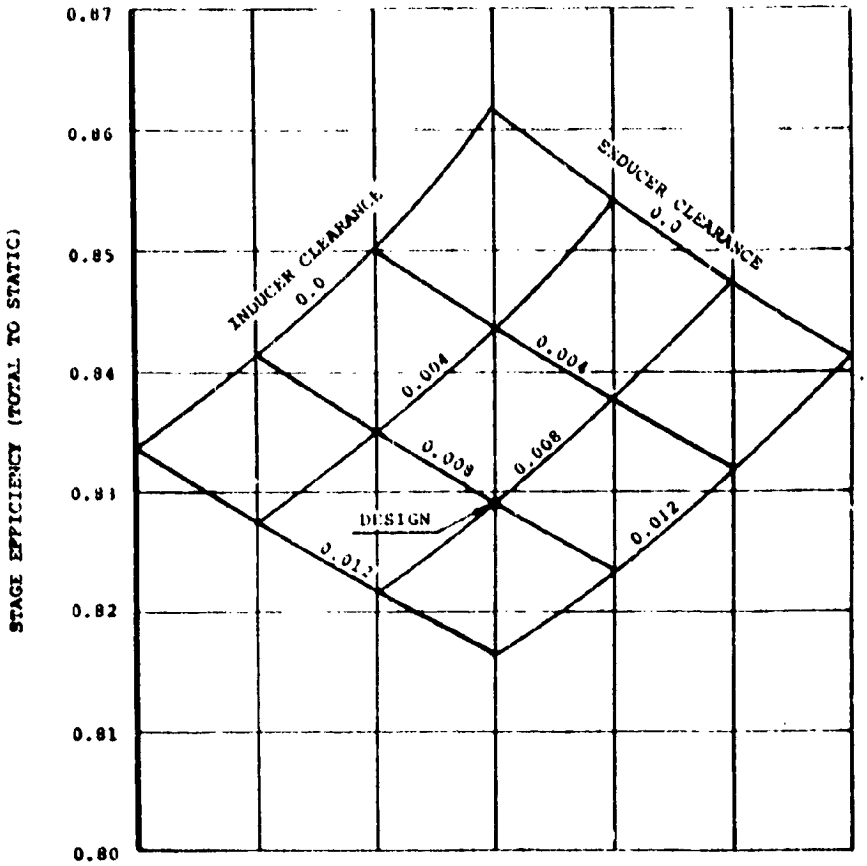


Figure 35. - Turbine Clearance Effects on Stage Performance.

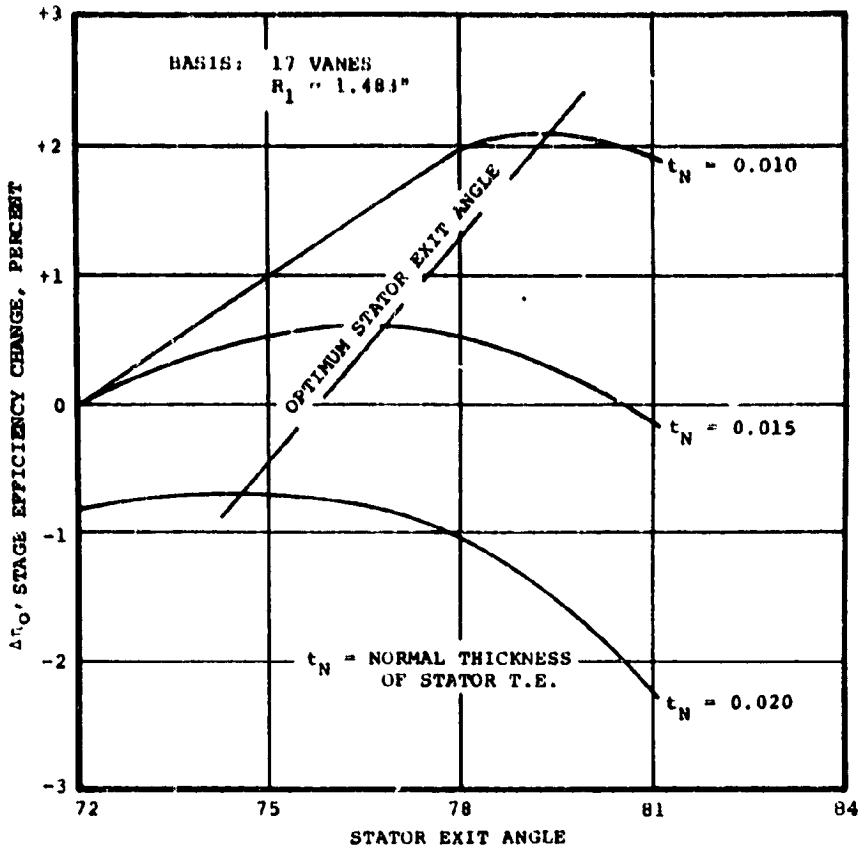


Figure 86. - Mini-BRU Turbine Stator Exit Angle Selection Criteria.

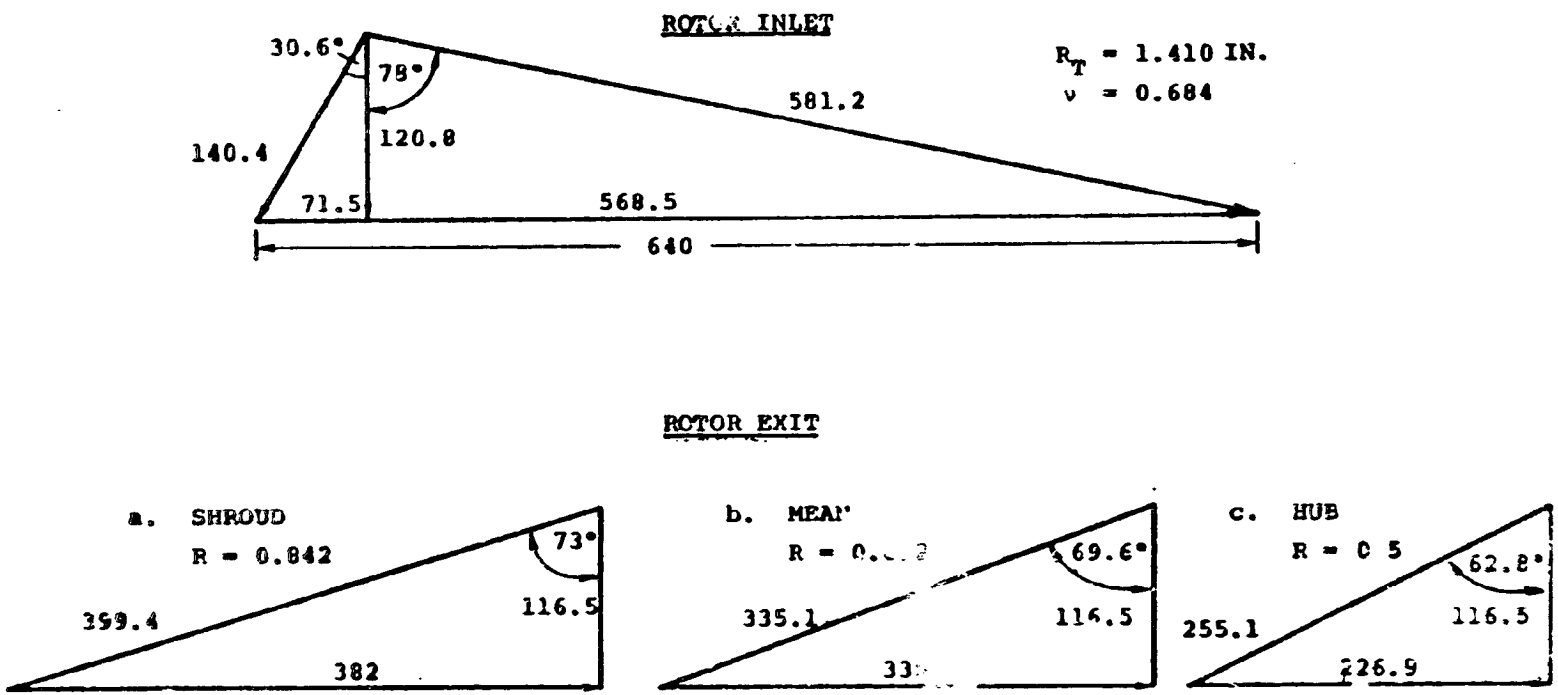


Figure 87. - Preliminary Turbine Rotor Triangles.

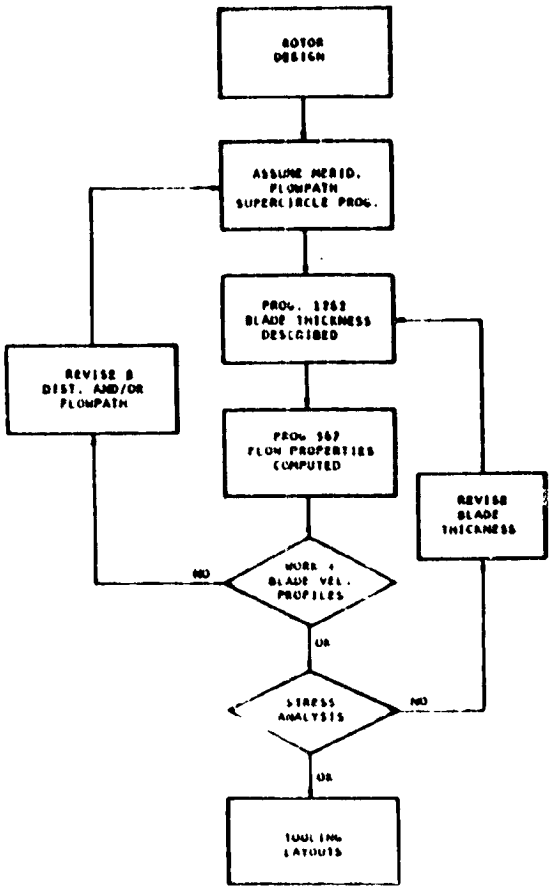


Figure 88. - Rotor Design Logic.

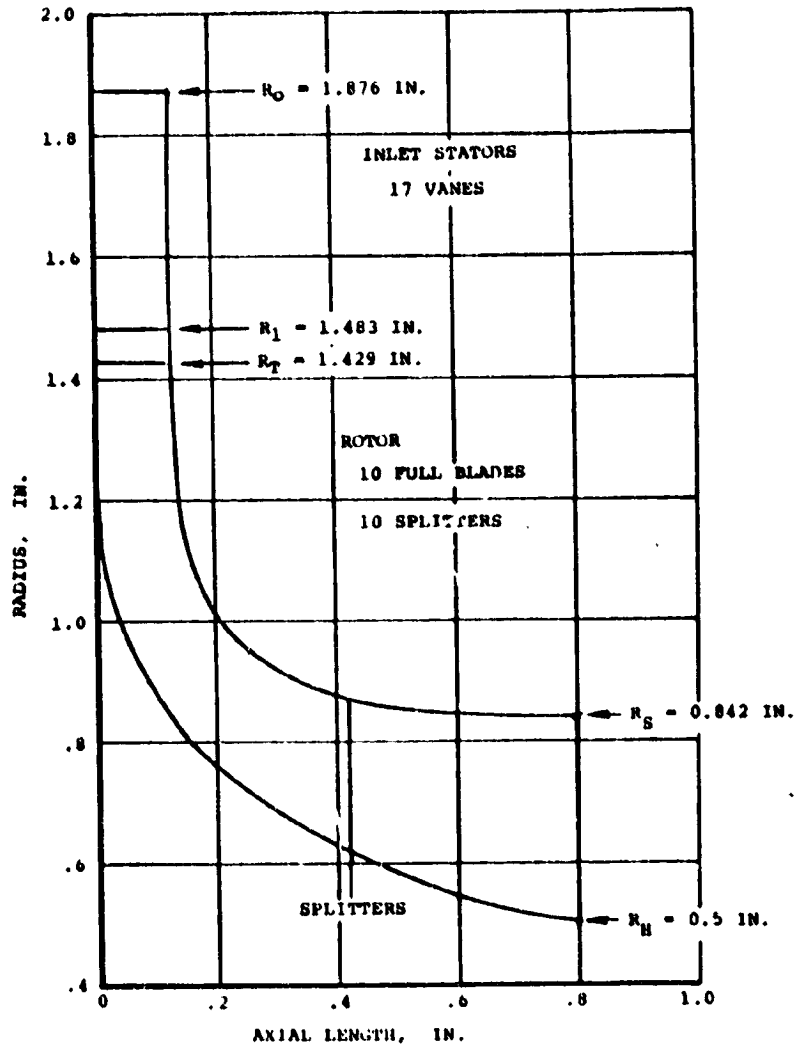


Figure 89. - Mini-BRU Turbine Final Flowpath Description.

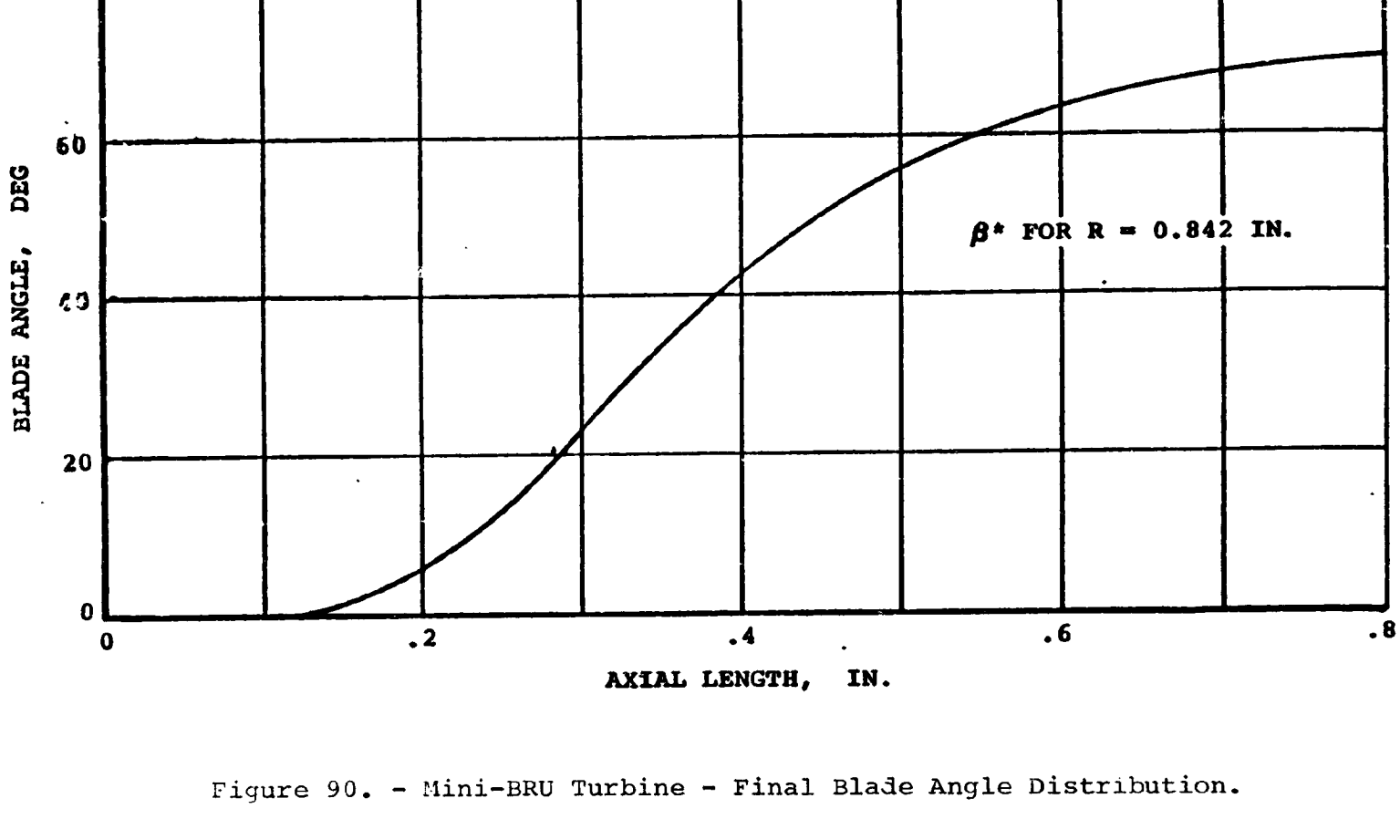


Figure 90. - Mini-BRU Turbine - Final Blade Angle Distribution.

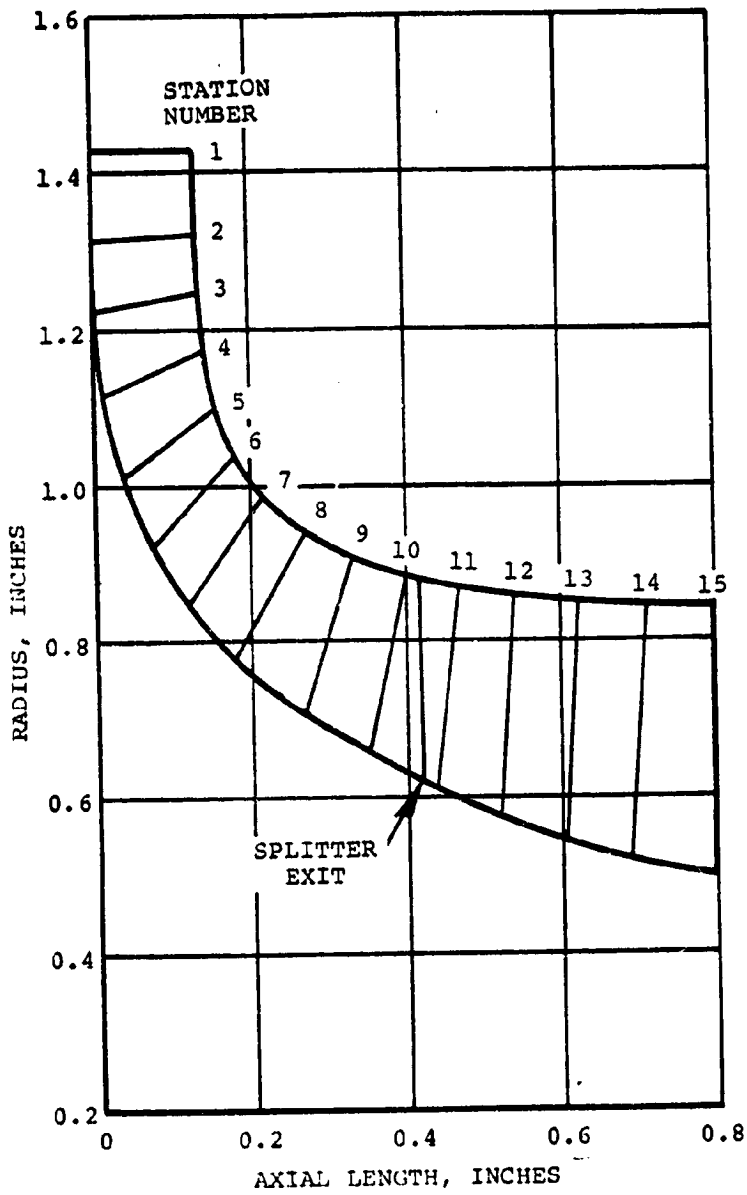


Figure 91. - Calculation Stations Within the Turbine Rotor.

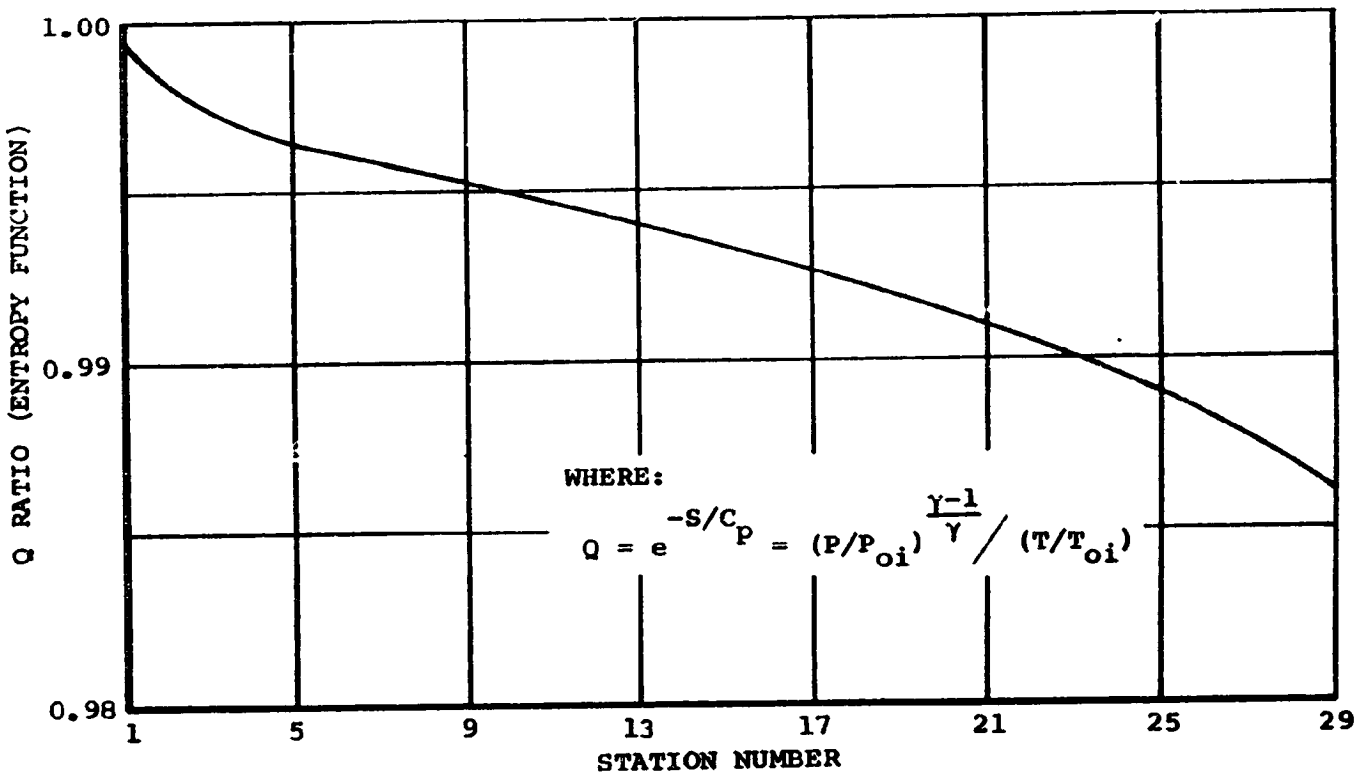


Figure 92. - Loss Distribution for Turbine Rotor.

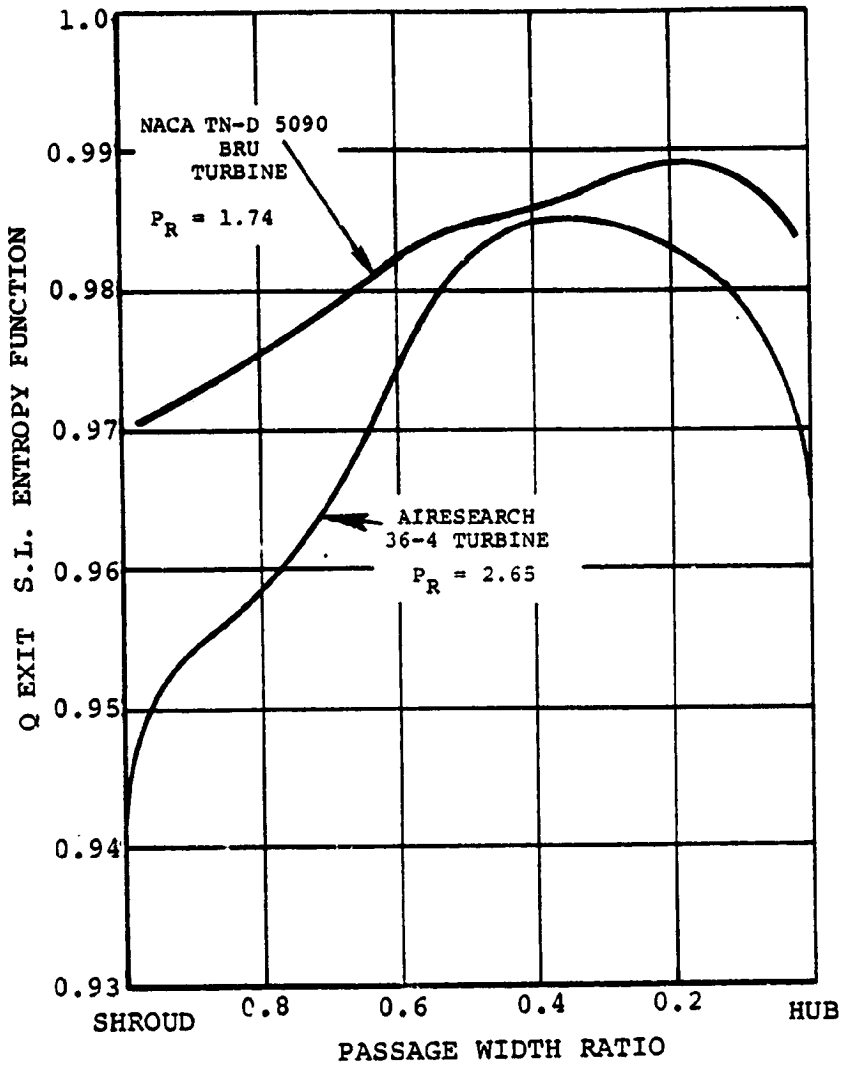


Figure 93. - Pressure Ratio Effects on the Radial Loss Distribution.

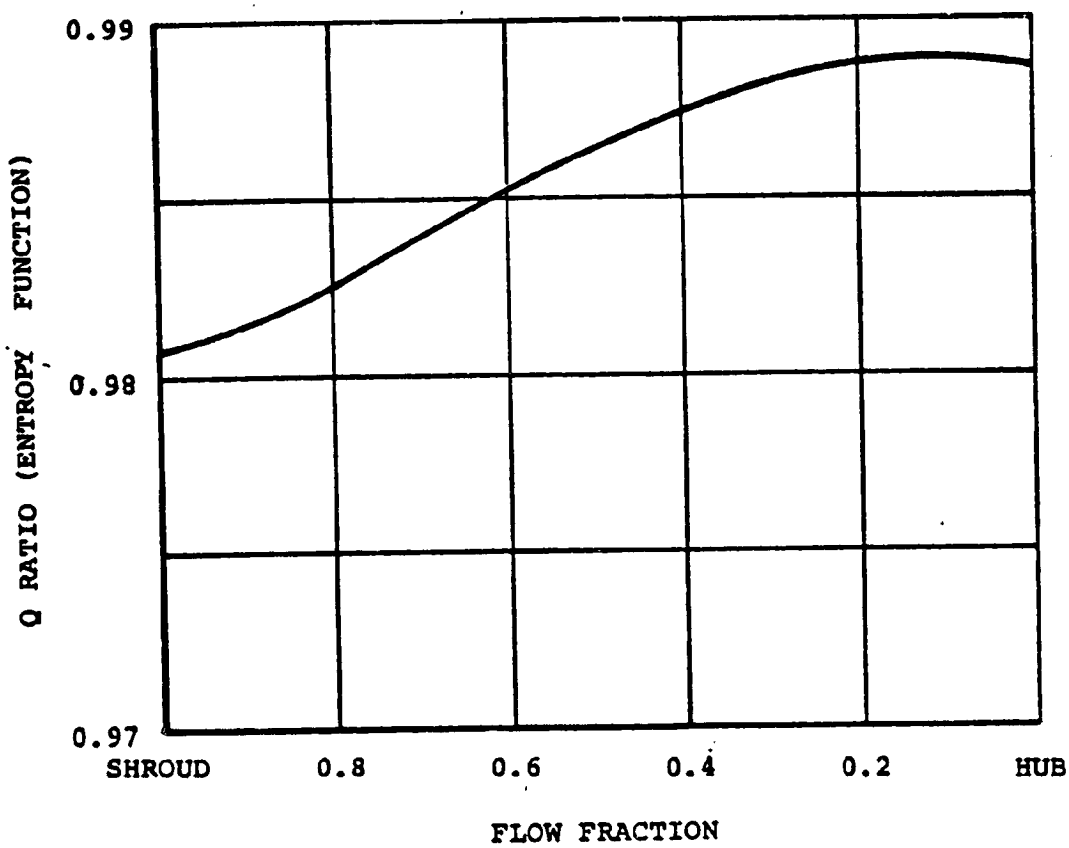


Figure 94. - Overall Loss at the Rotor Exit Station.

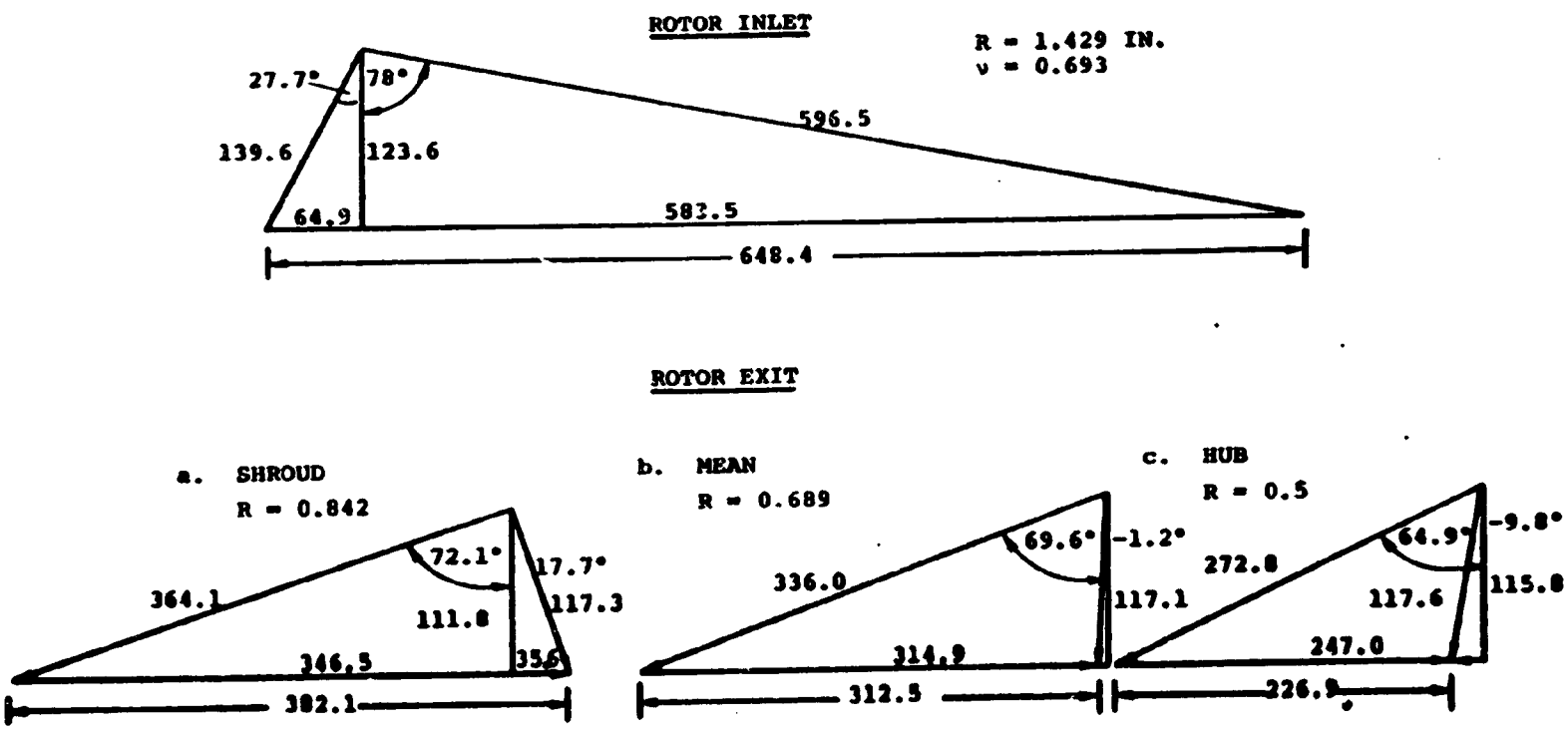


Figure 95. - Final Turbine Vector Triangles.

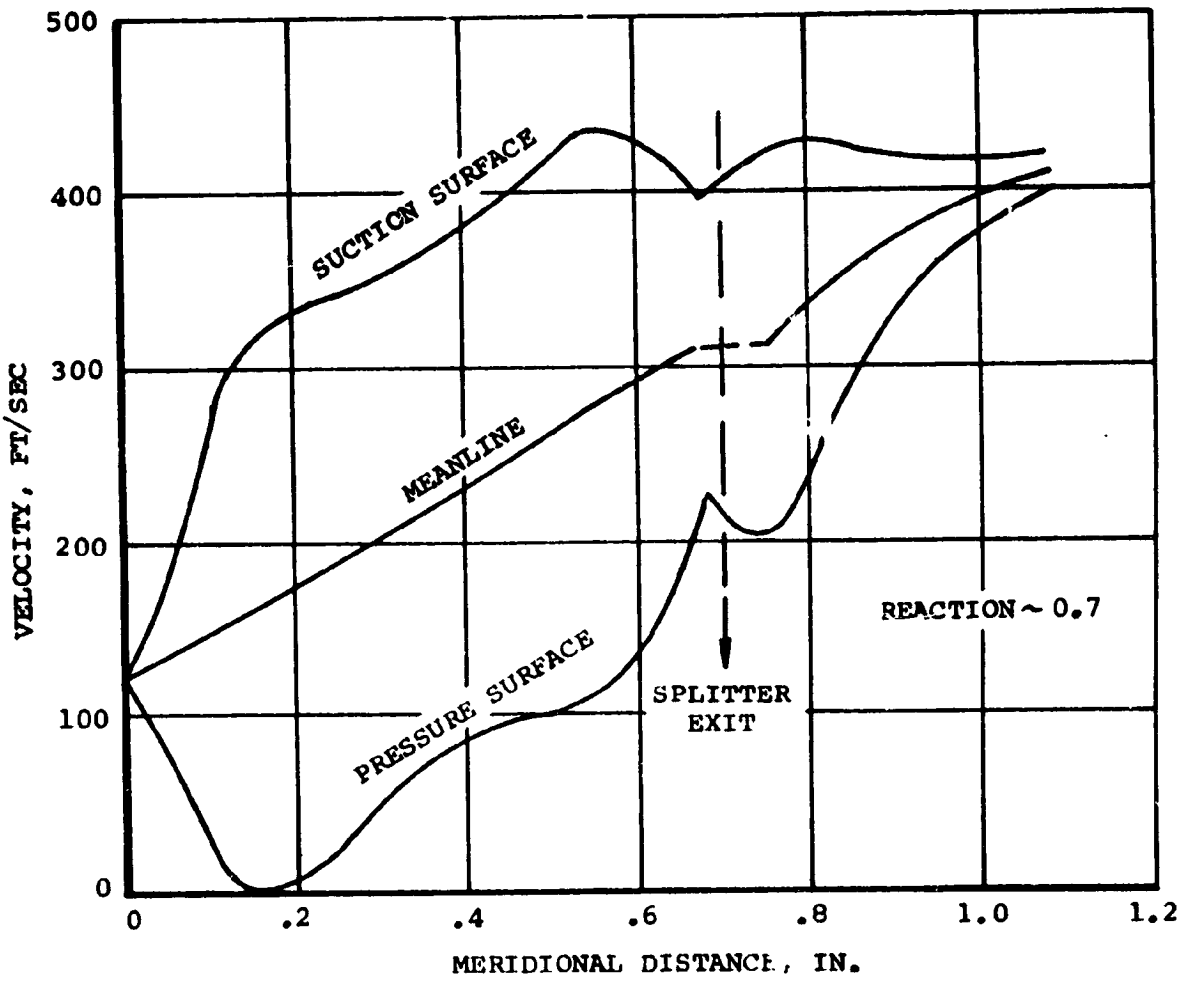


Figure 96. - Mini-BRU Rotor Shroud Streamline Loading.

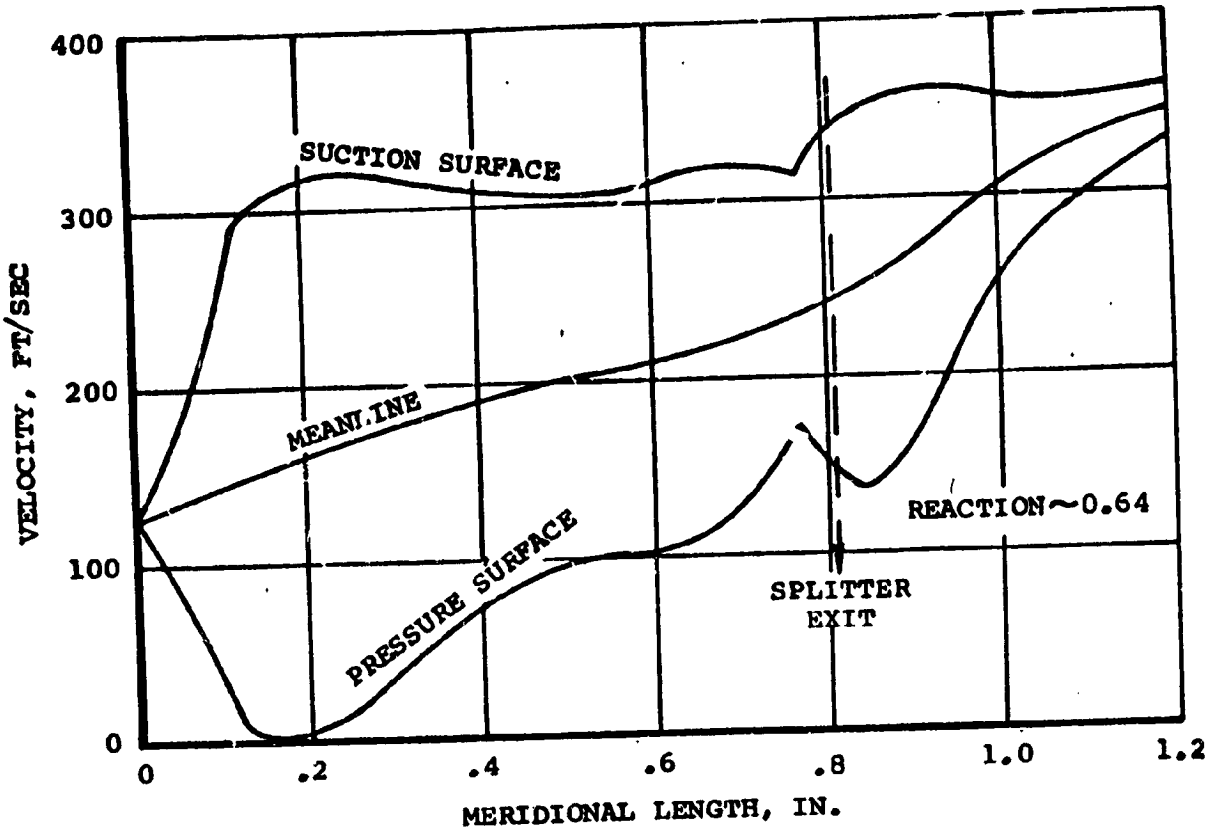


Figure 97. - Mini-BRU Rotor - 50 Percent Streamline Loading.

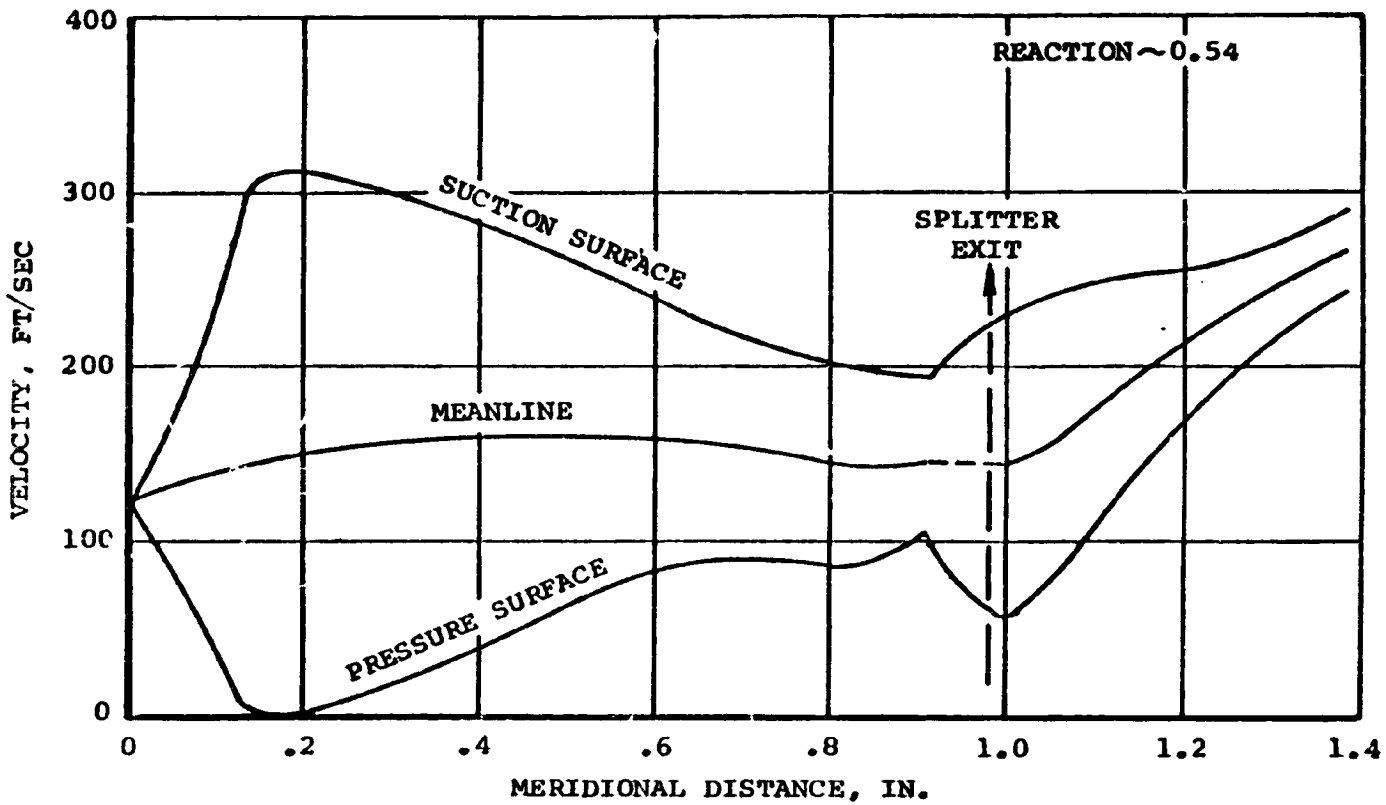


Figure 98. - Mini-LRU Rotor-Hub Streamline Loading.

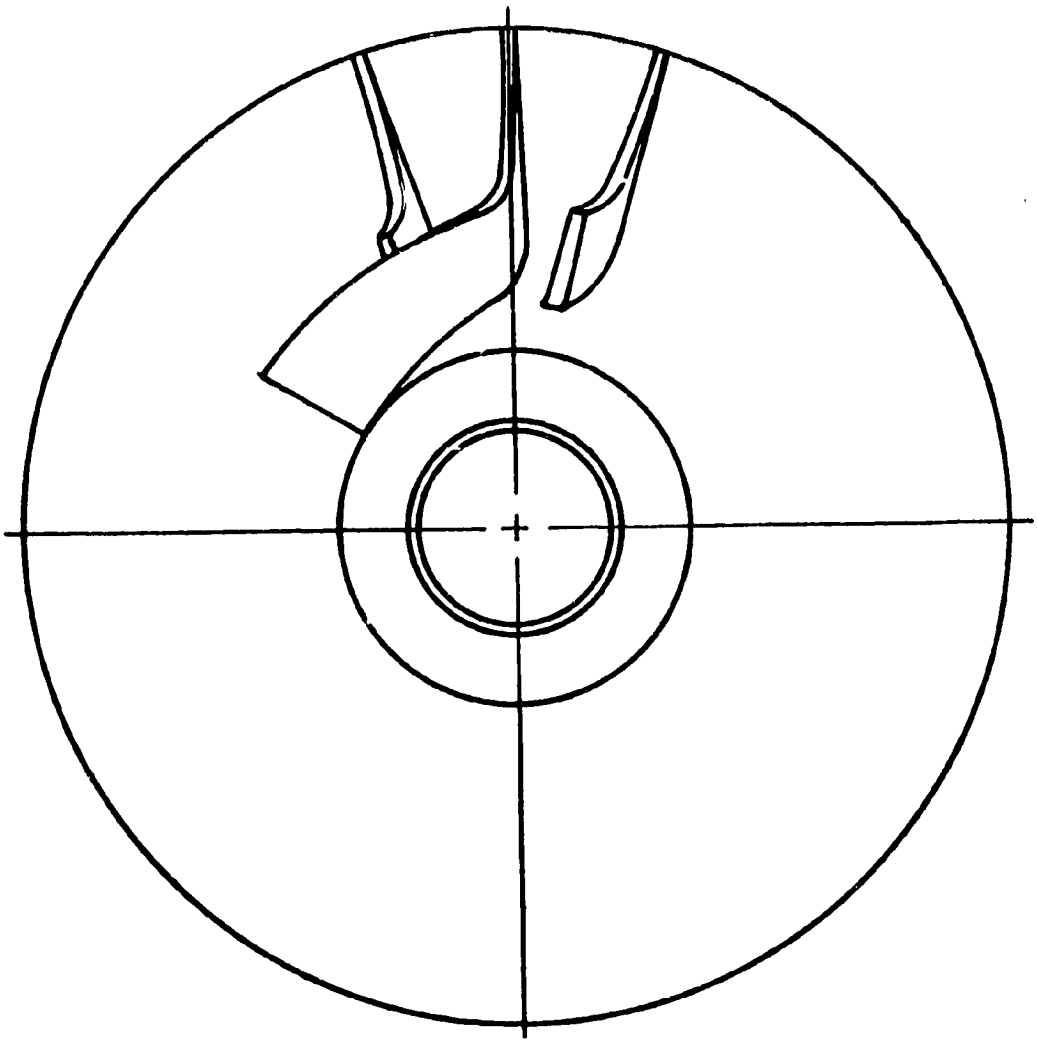


Figure 99. - Front View of Turbine.

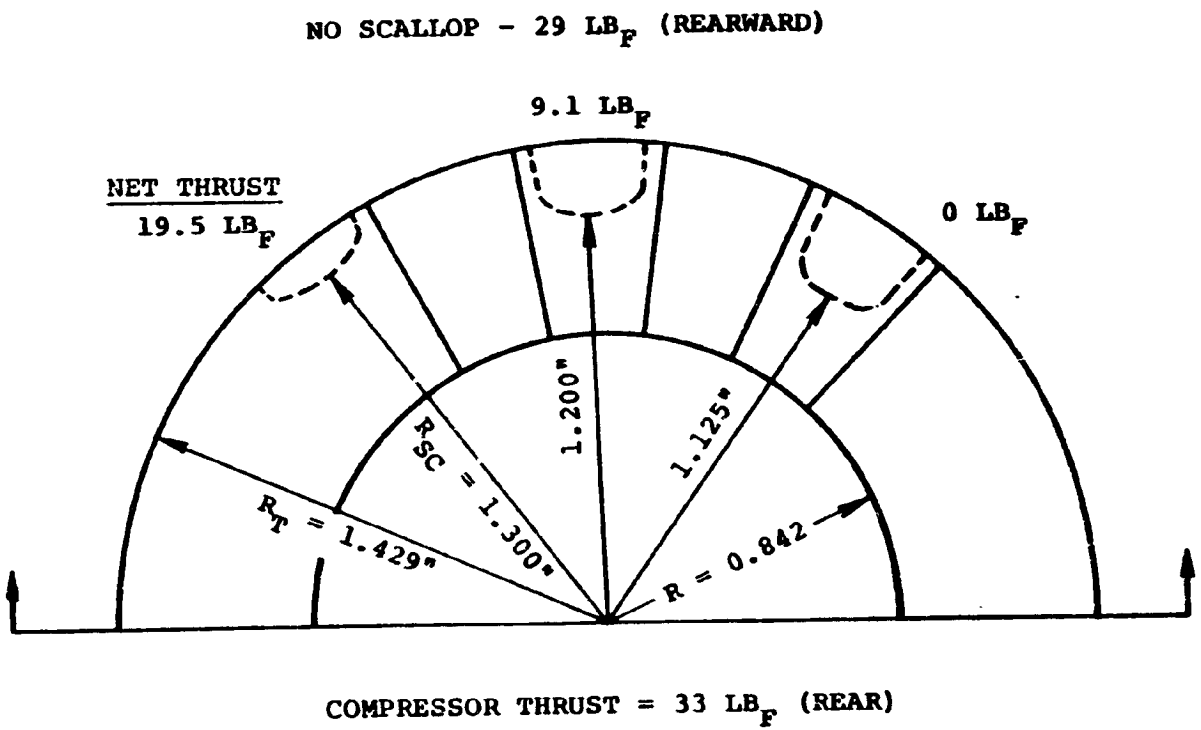


Figure 100. - Net Thrust With Scalloping.

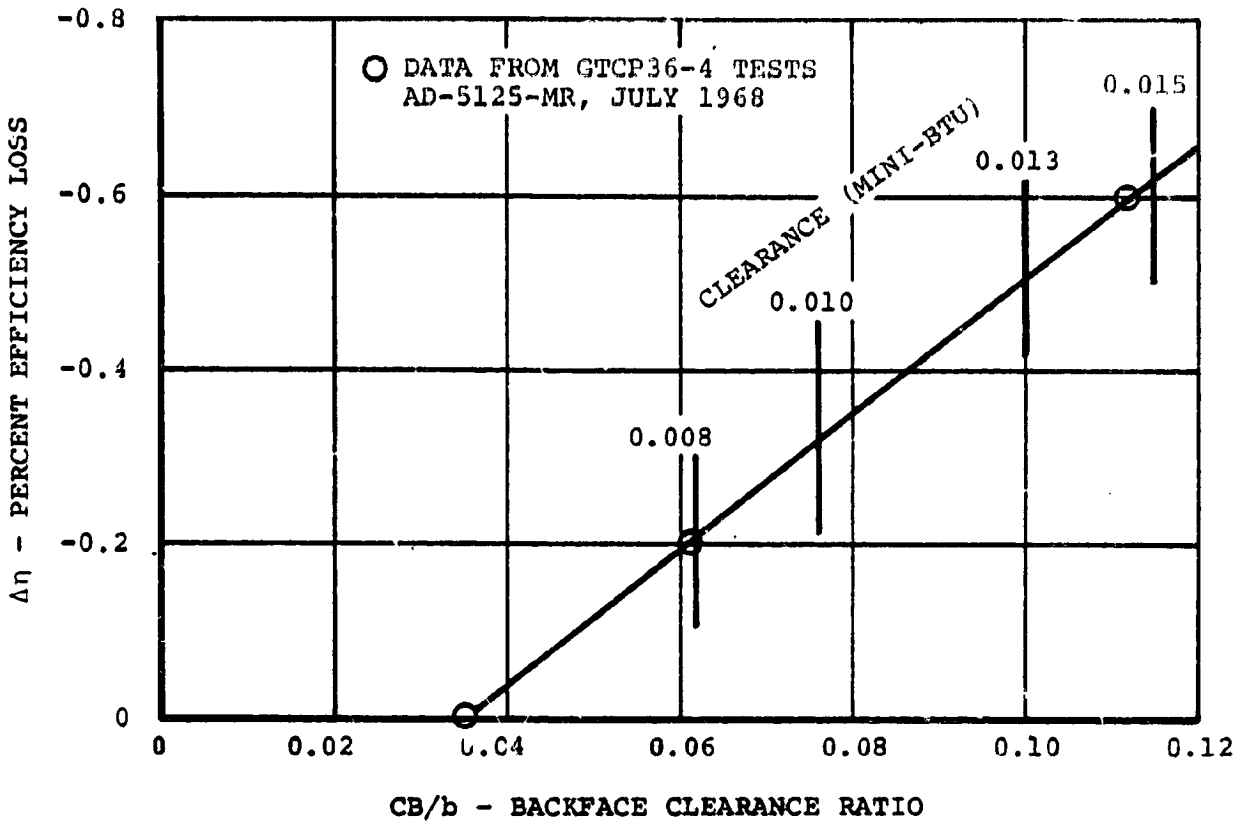


Figure 101. - Effects of Backface Clearance on Scalloped Rotor Performance.

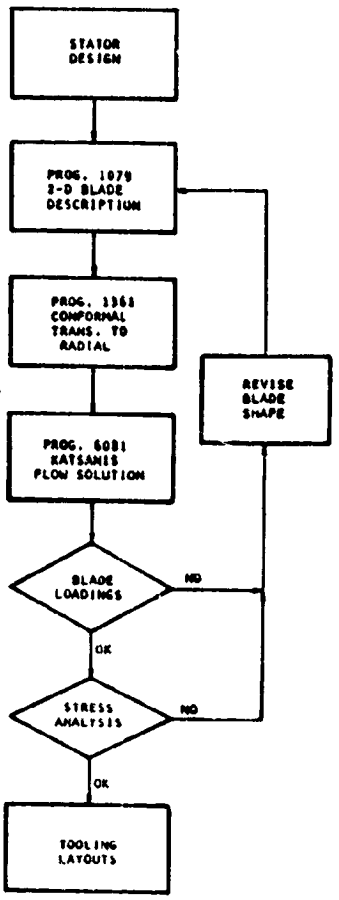


Figure 102. - Design Logic for Inlet Stators.

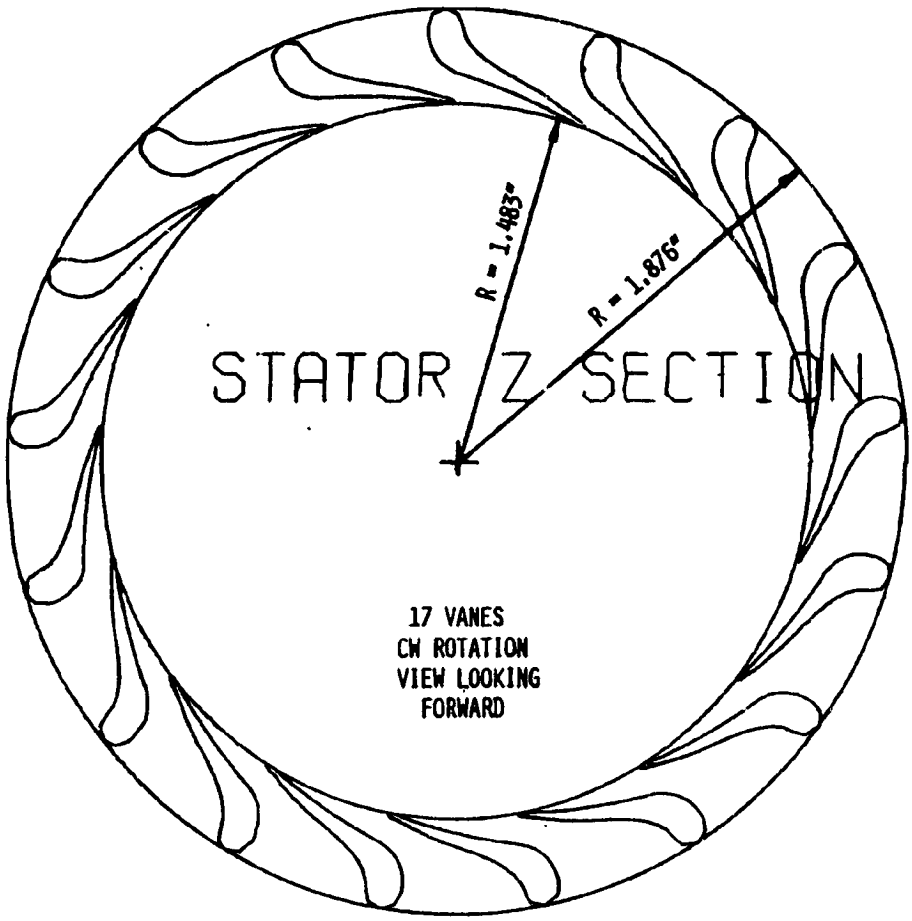


Figure 103. - Mini-BRU Stator Assembly.

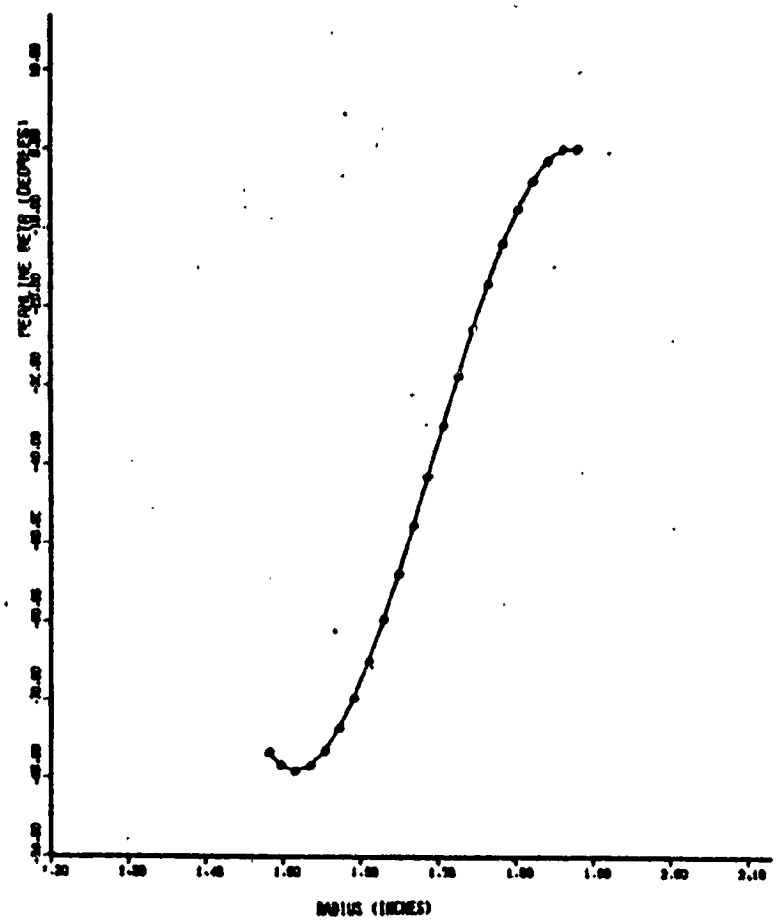


Figure 104. - Beta Distribution for Mini-BRU Stators.

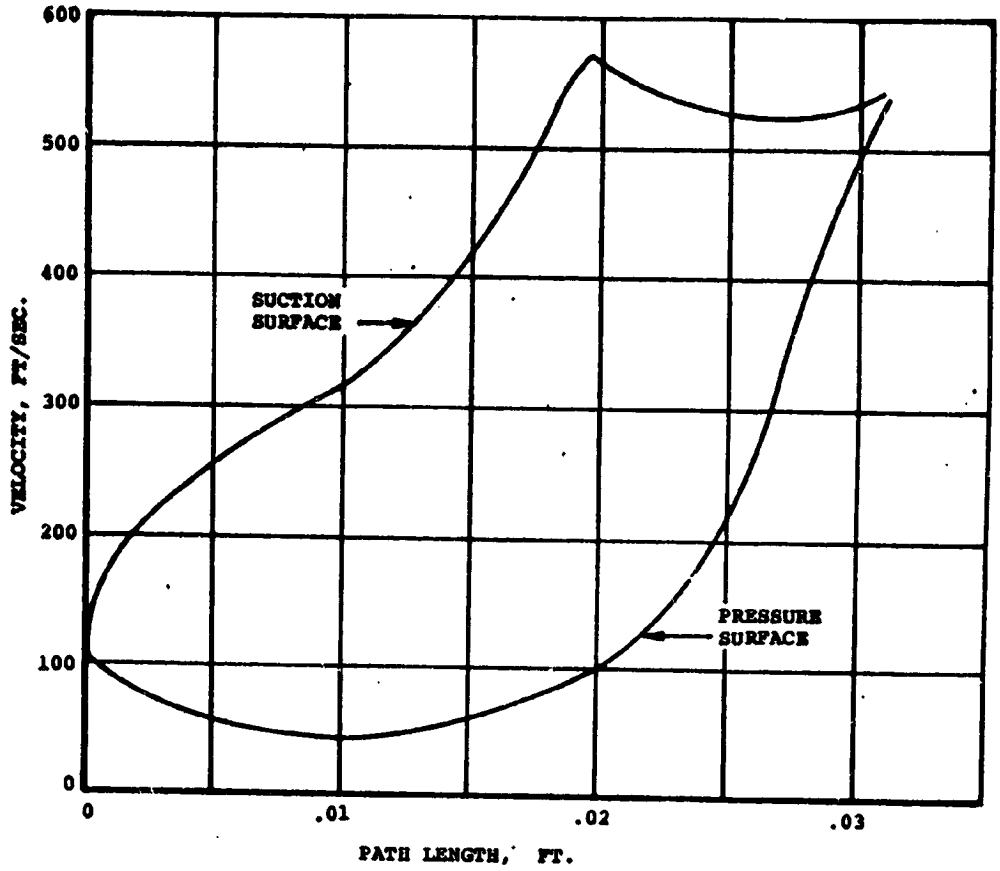


Figure 105. - Inlet Stator Loading.

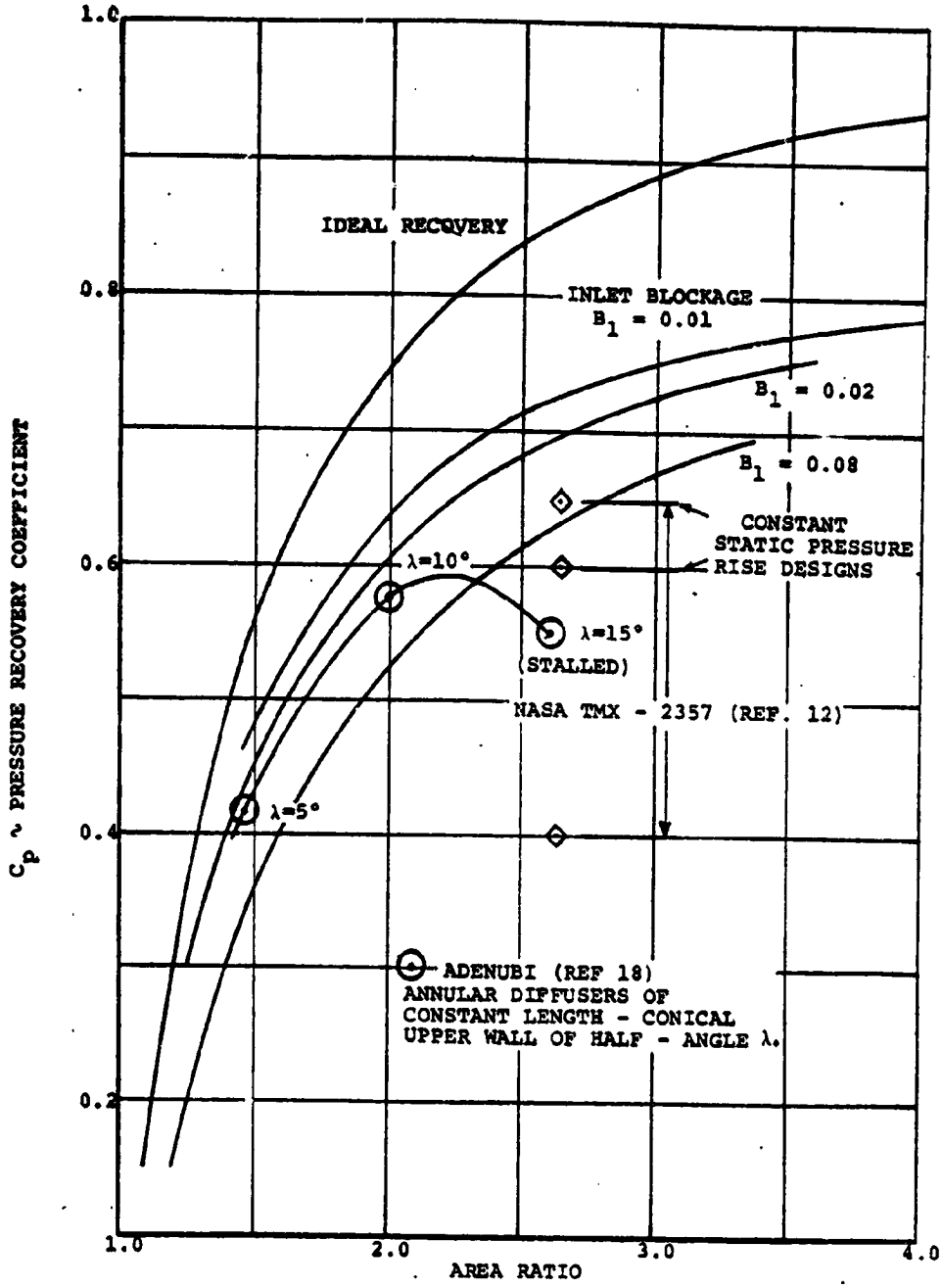


Figure 106. - Annular Diffuser Performance Opt. Area Ratio for Fixed Length.

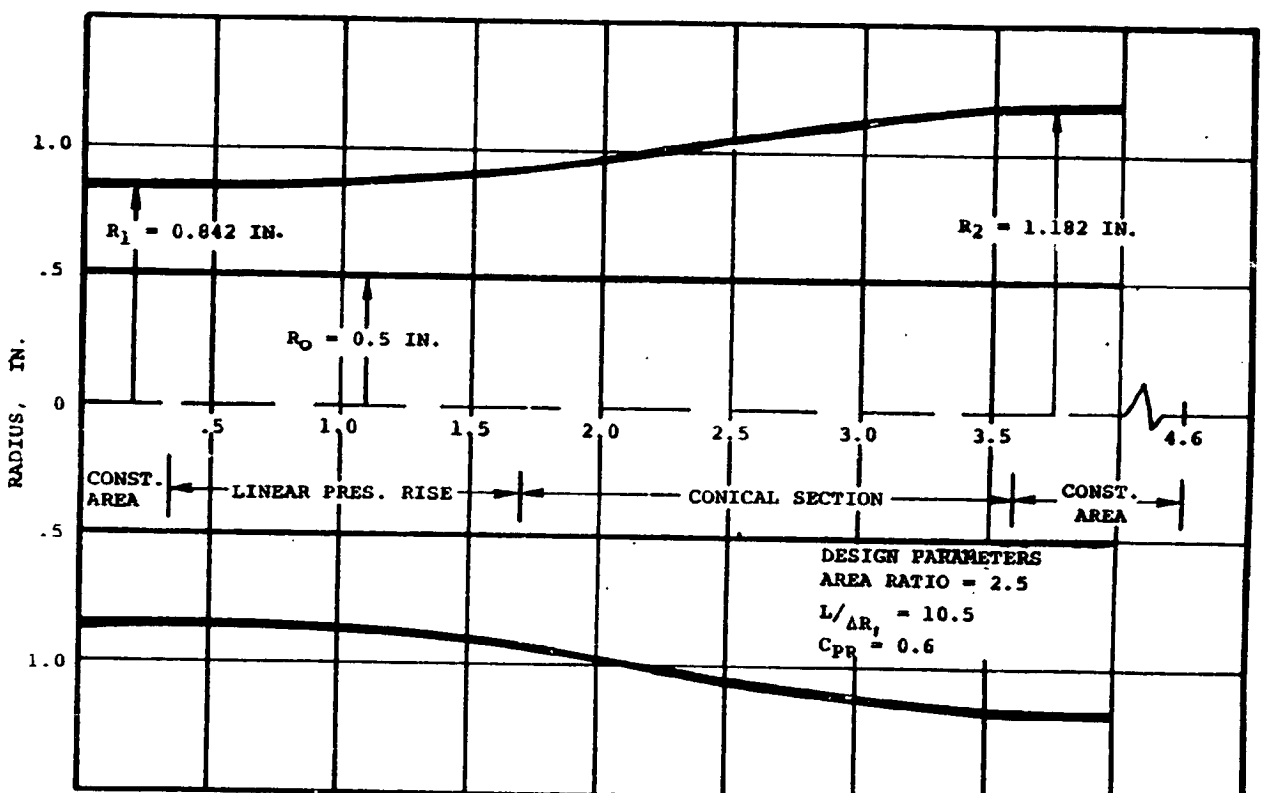


Figure 107. - Mini-BRU Diffuser.

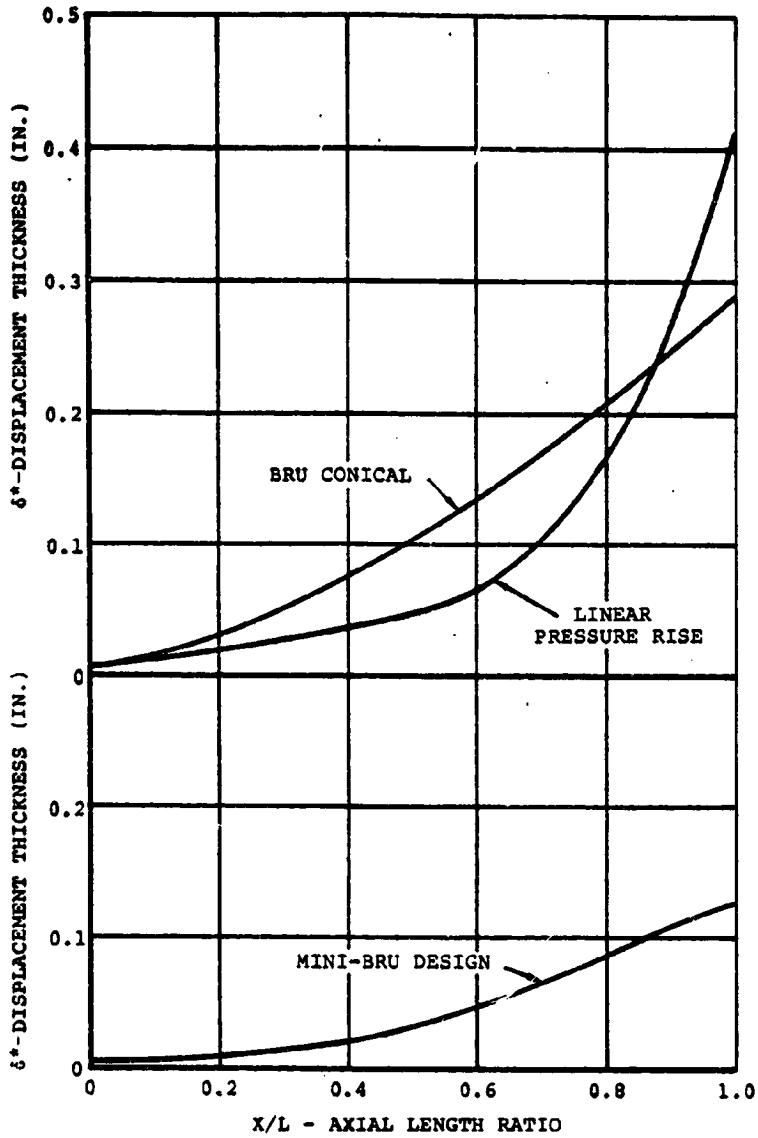


Figure 108. - Comparison of Calculated Displacement Thicknesses.

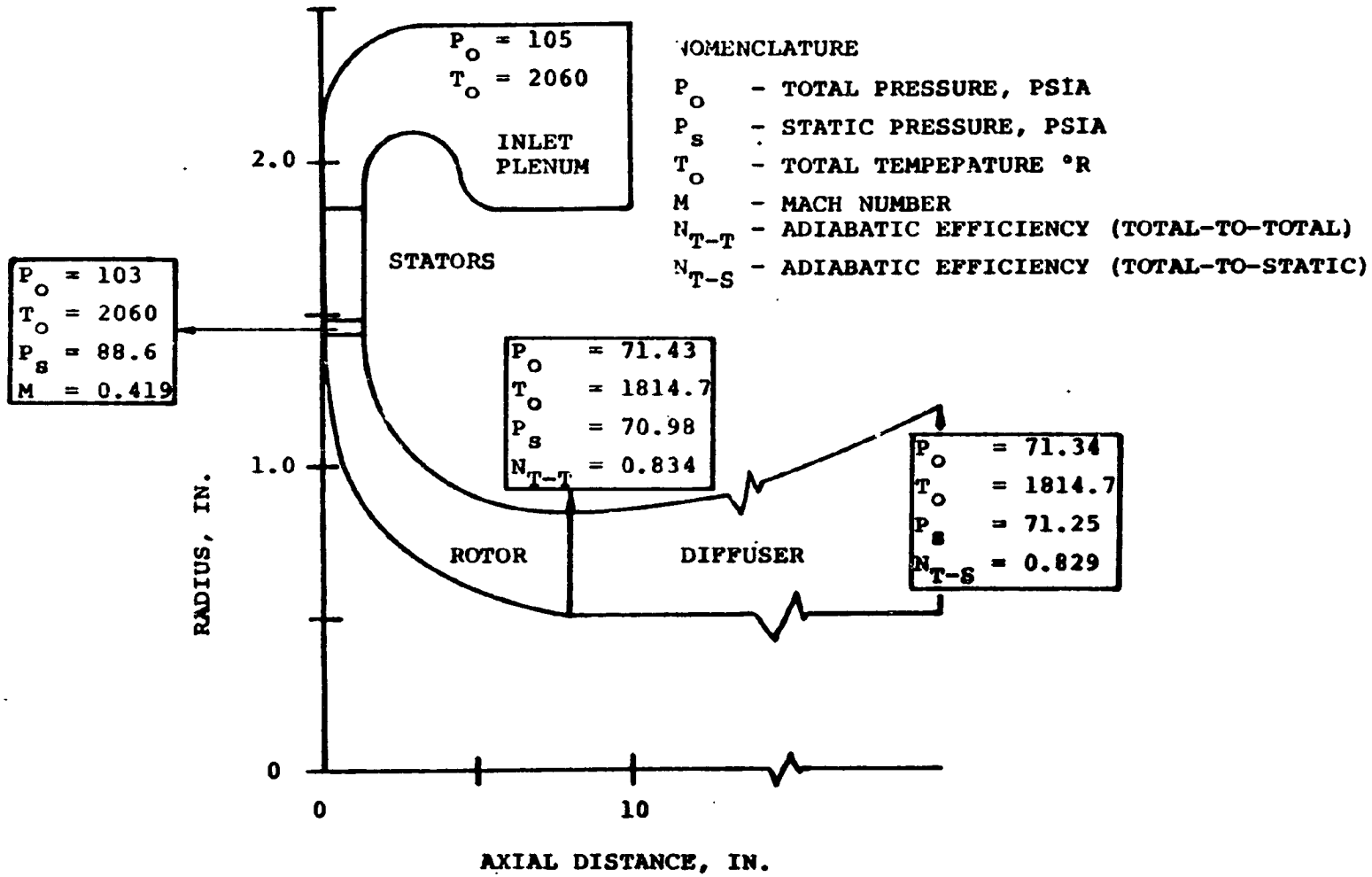


Figure 109. - Mean Gas Conditions at Several Turbine Locations.

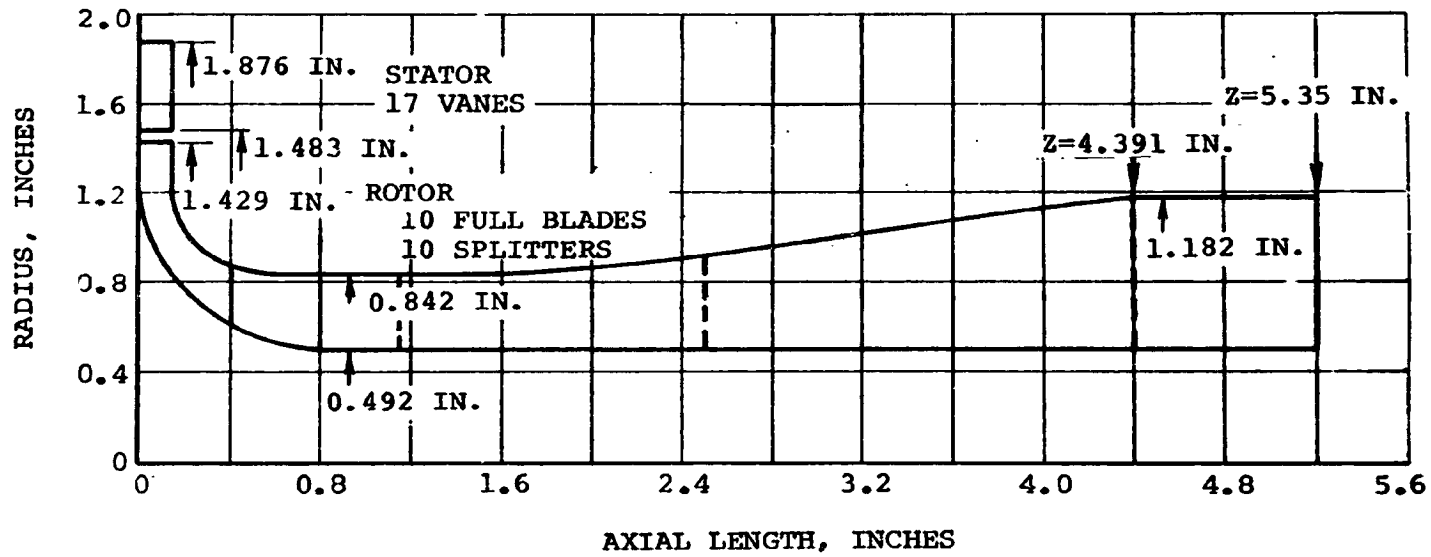


Figure 110. - Mini-BRU Turbine, Final Flow Path Description.

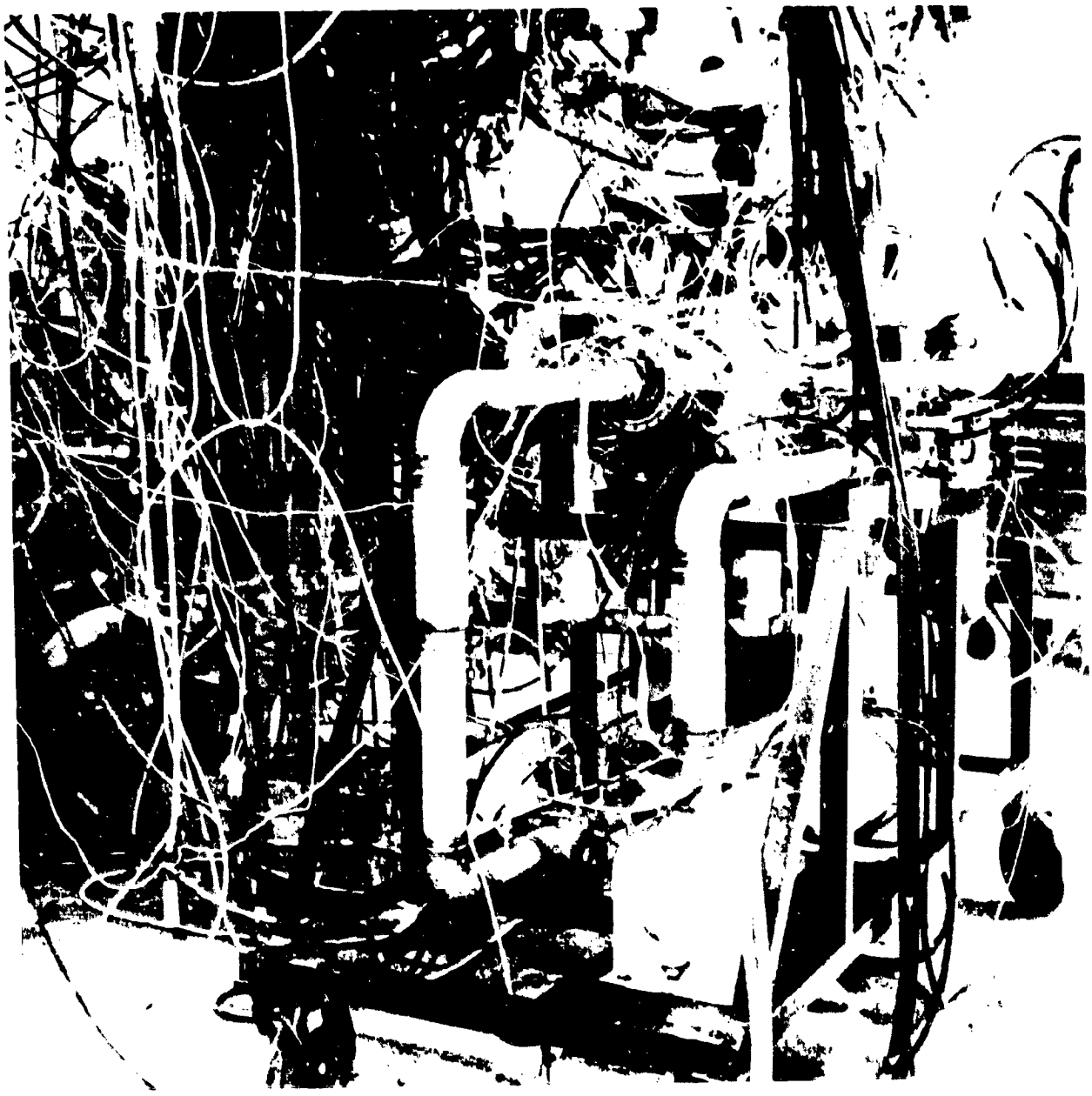


Figure 111. - Turbine Test Rig Installation and Instrumentation Configuration.

Figure 112. - Fully Instrumented Turbine Plenum Nozzle Shroud Assembly.

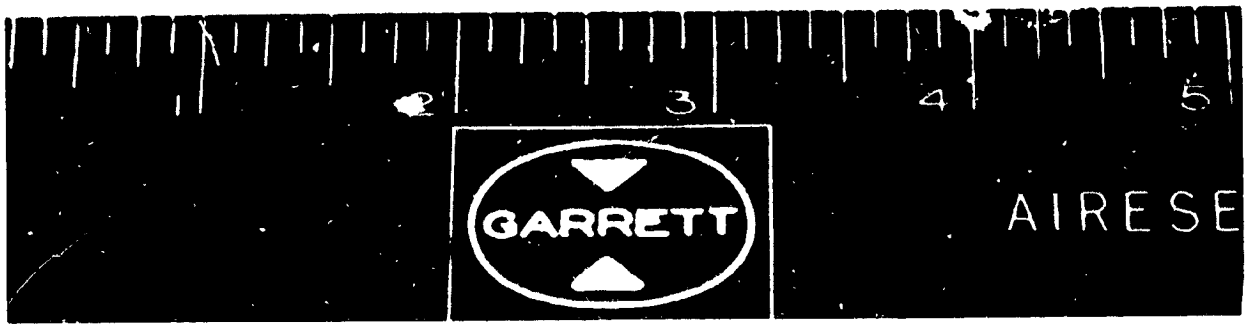


Figure 113. - Mini-BRU Astroloy Turbine Wheel (machined).

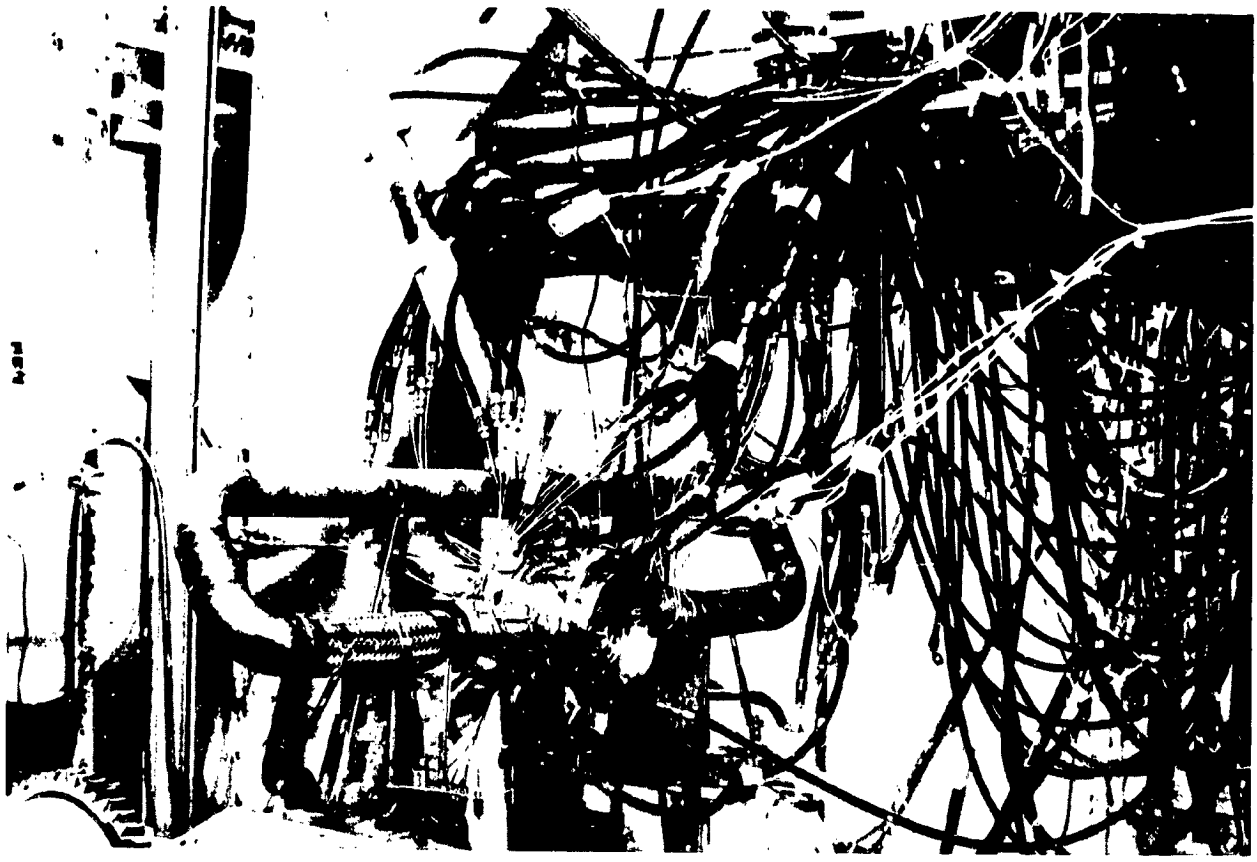


Figure 114. - Mini-BRU Turbine Test Rig Complete with 180° Bifurcated Inlet Ducts.

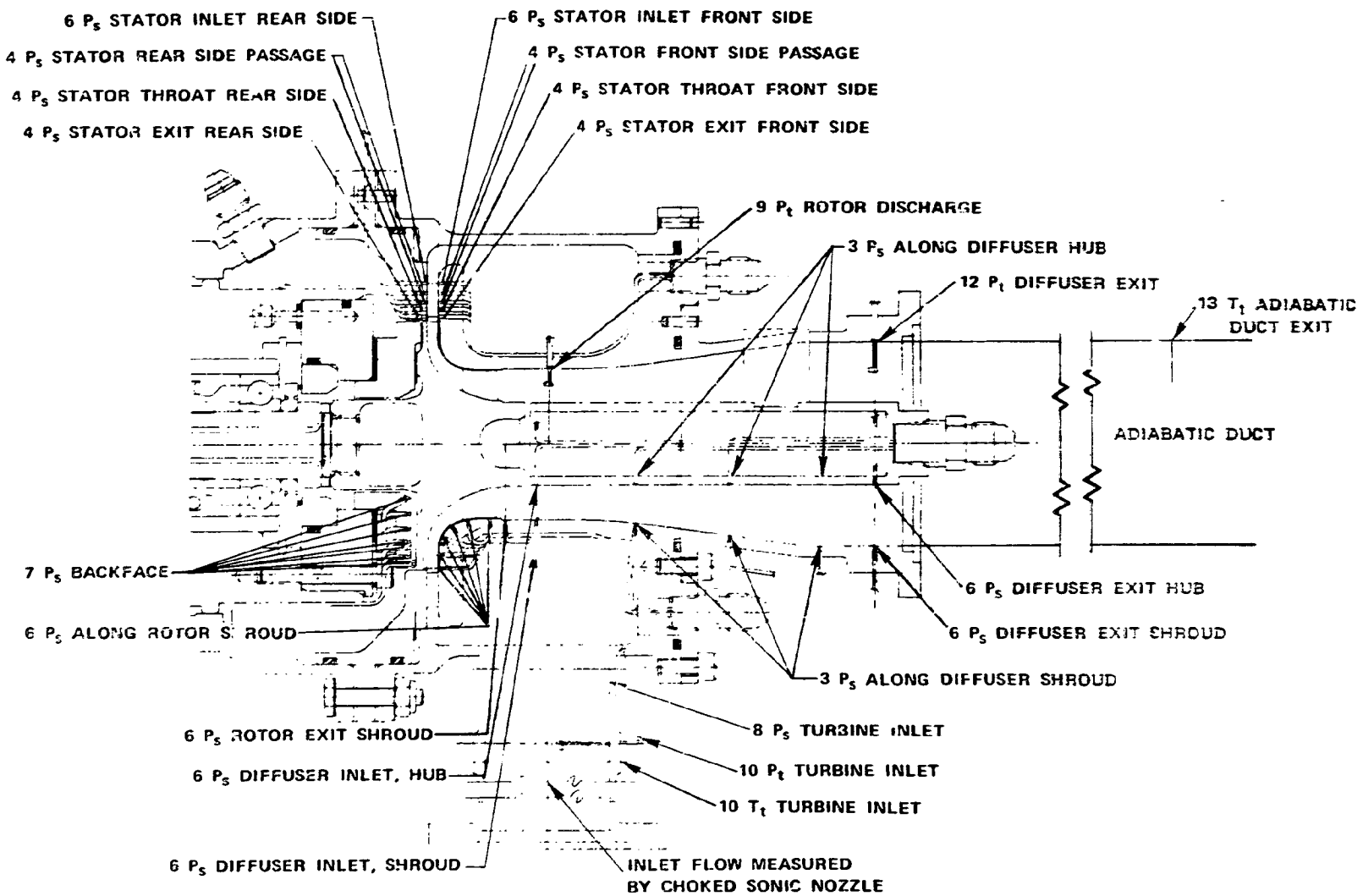


Figure 115. - Mini-BRU Turbine Component Instrumentation Layout.

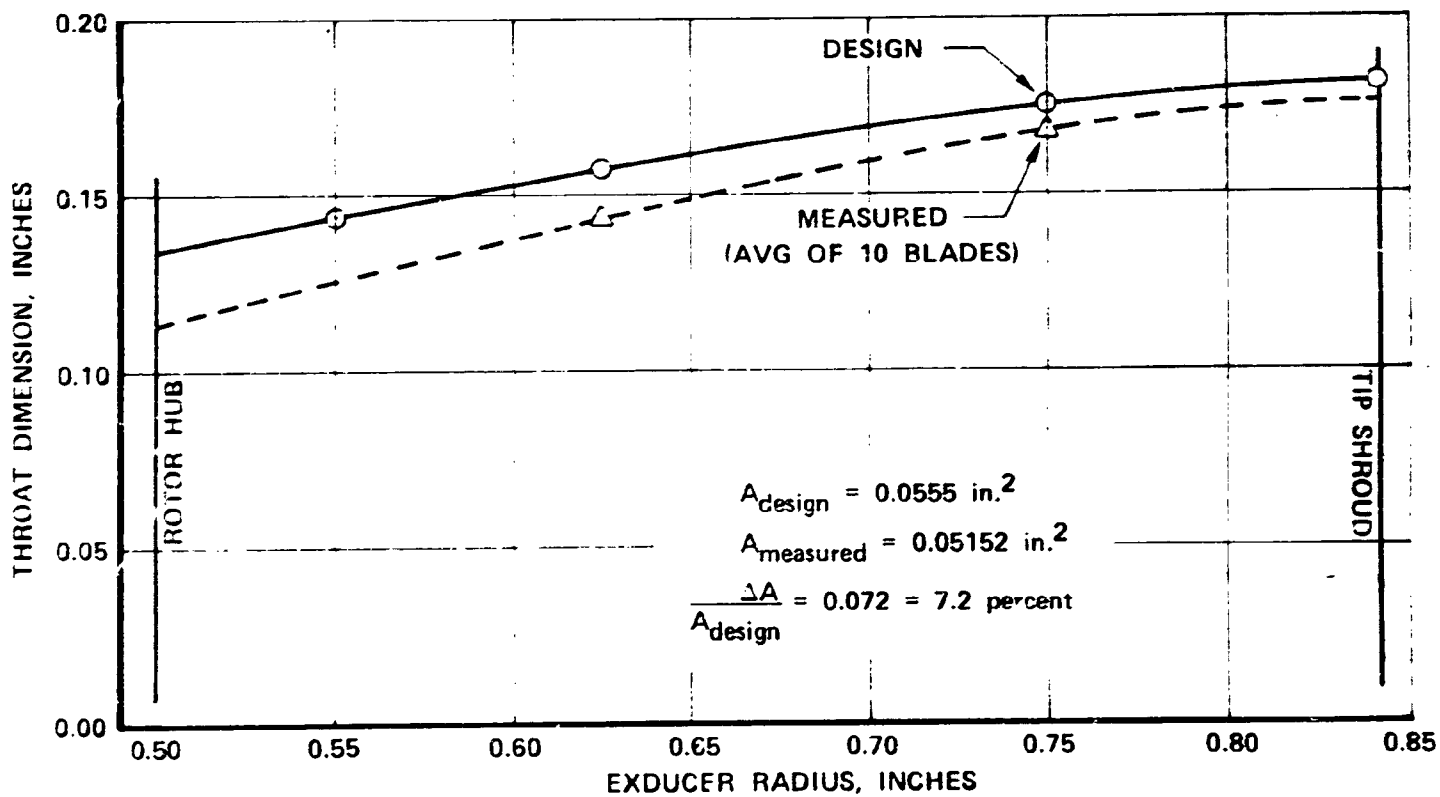


Figure 116. - Rotor Throat Dimensions.

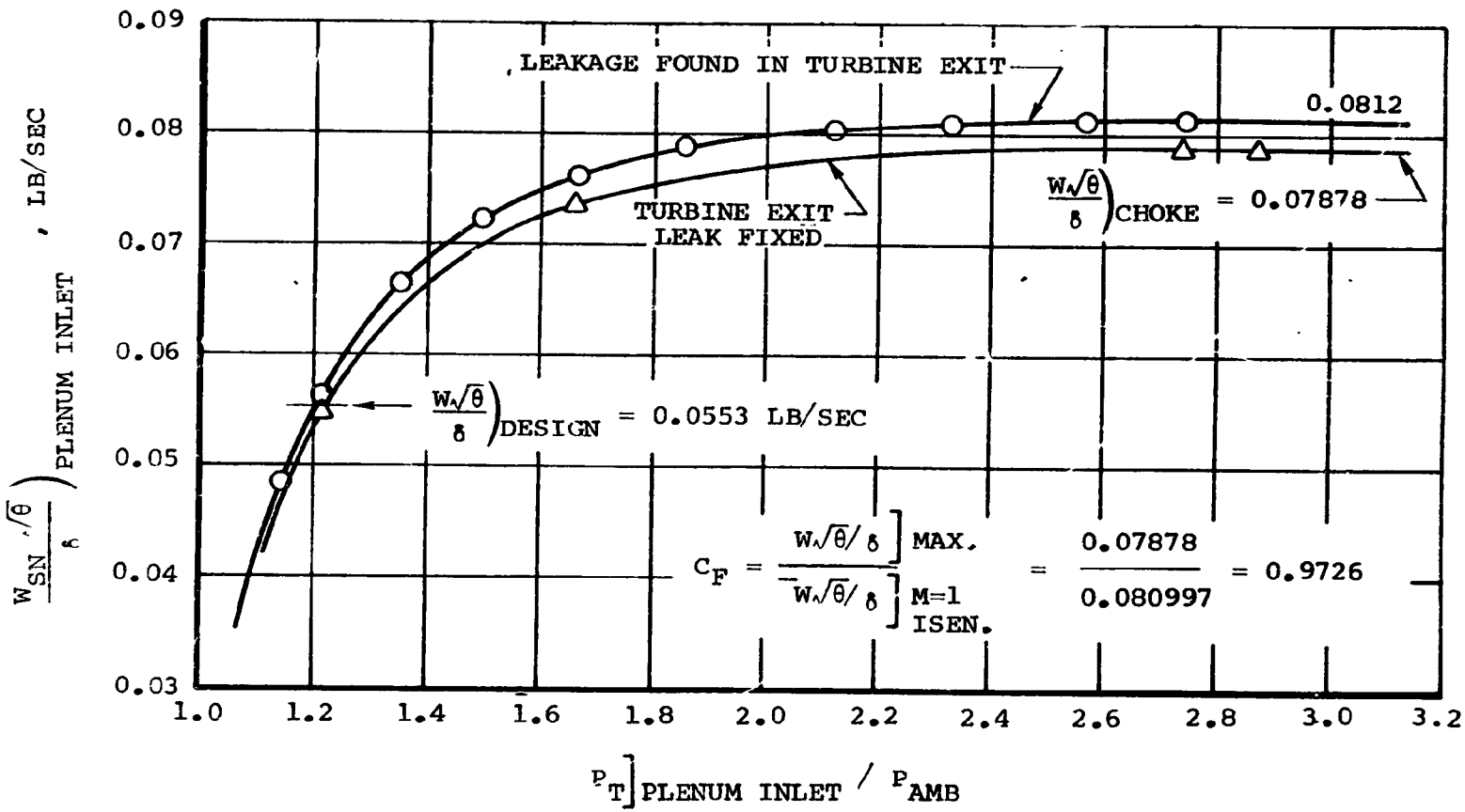


Figure 117. - Mini-BRU Turbine Stator Flow Test.

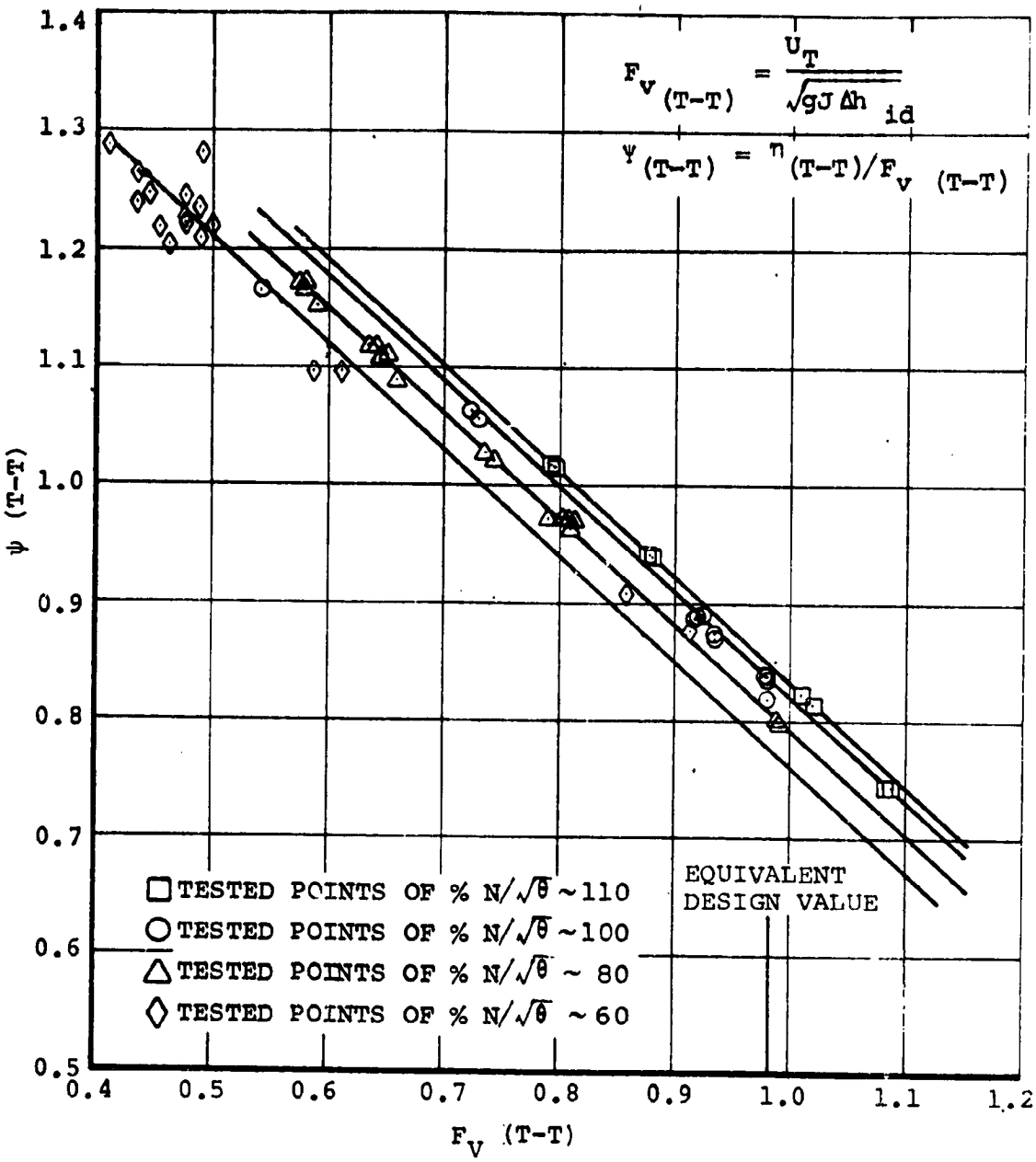


Figure 118. - Mini-BRU Turbine Cold Air Test ψ Versus F_v (Total-Total).

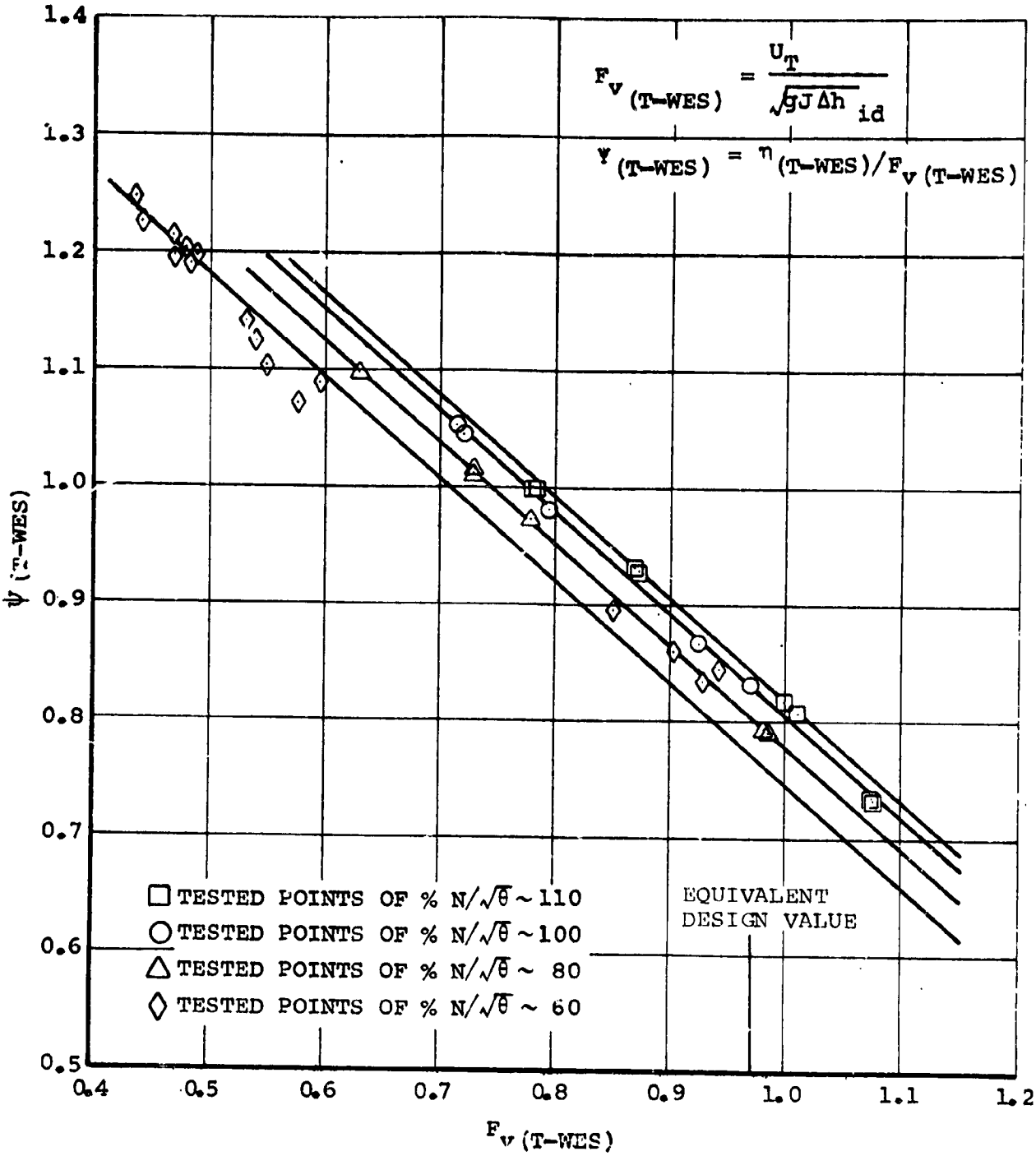


Figure 119. - Mini-BRU Turbine Cold Air Test
Ψ Versus F_v (Total-Wheel Exit Static).

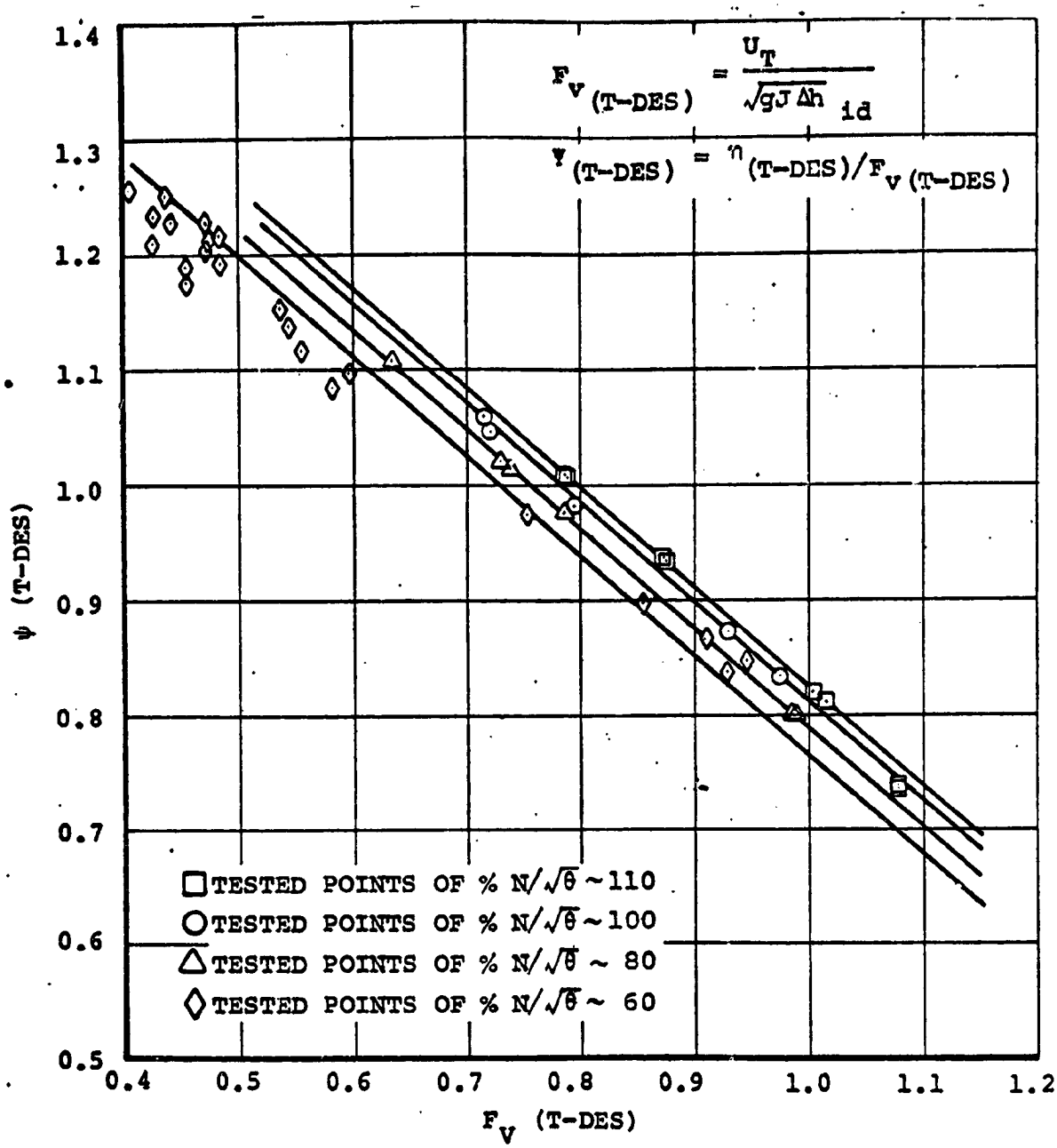


Figure 120. - Mini-BRU Turbine Cold Air Test
ψ Versus F_V (Total-Diffuser Exit Static).

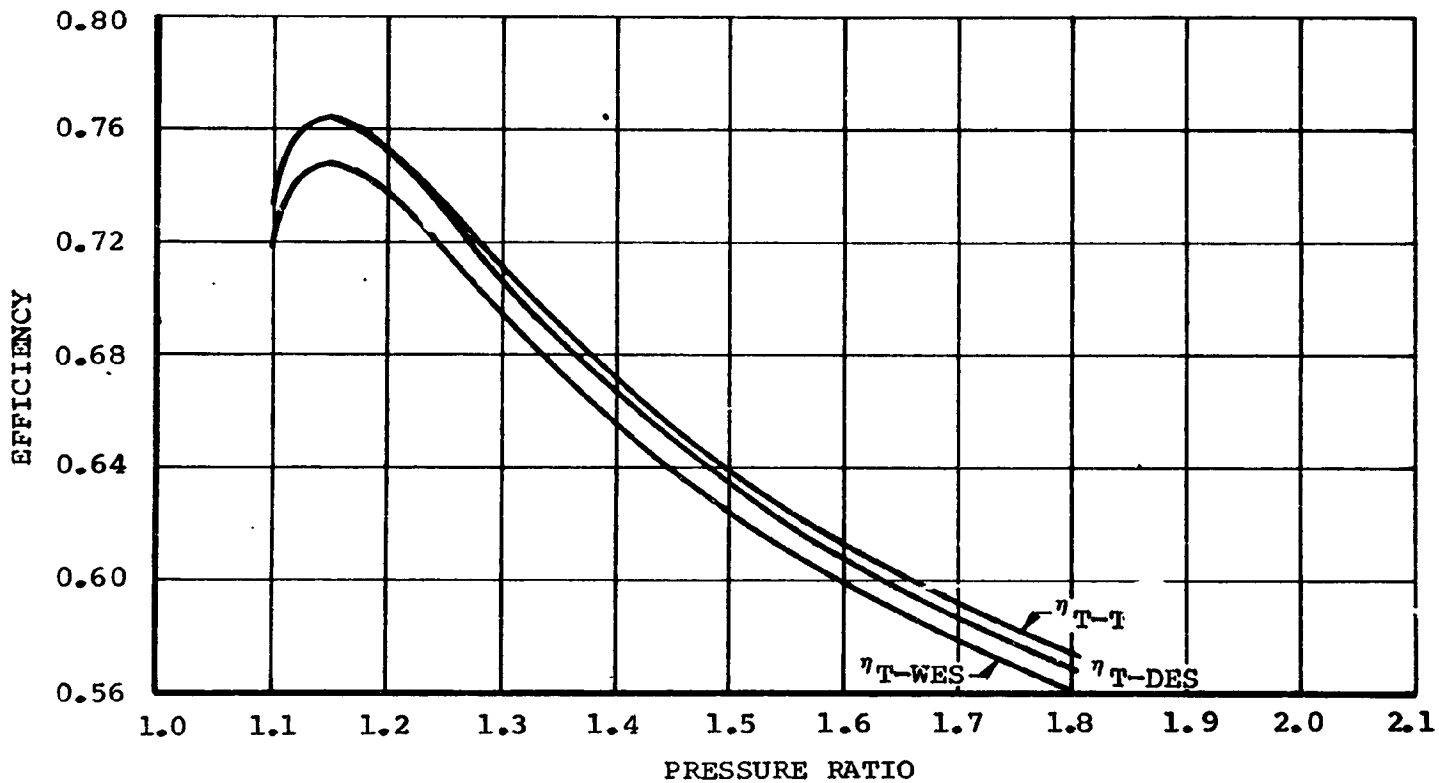


Figure 121. - Mini-BRU Turbine Cold Air Test Efficiency Versus Pressure Ratio for % $N/\sqrt{\theta}$ = 60.

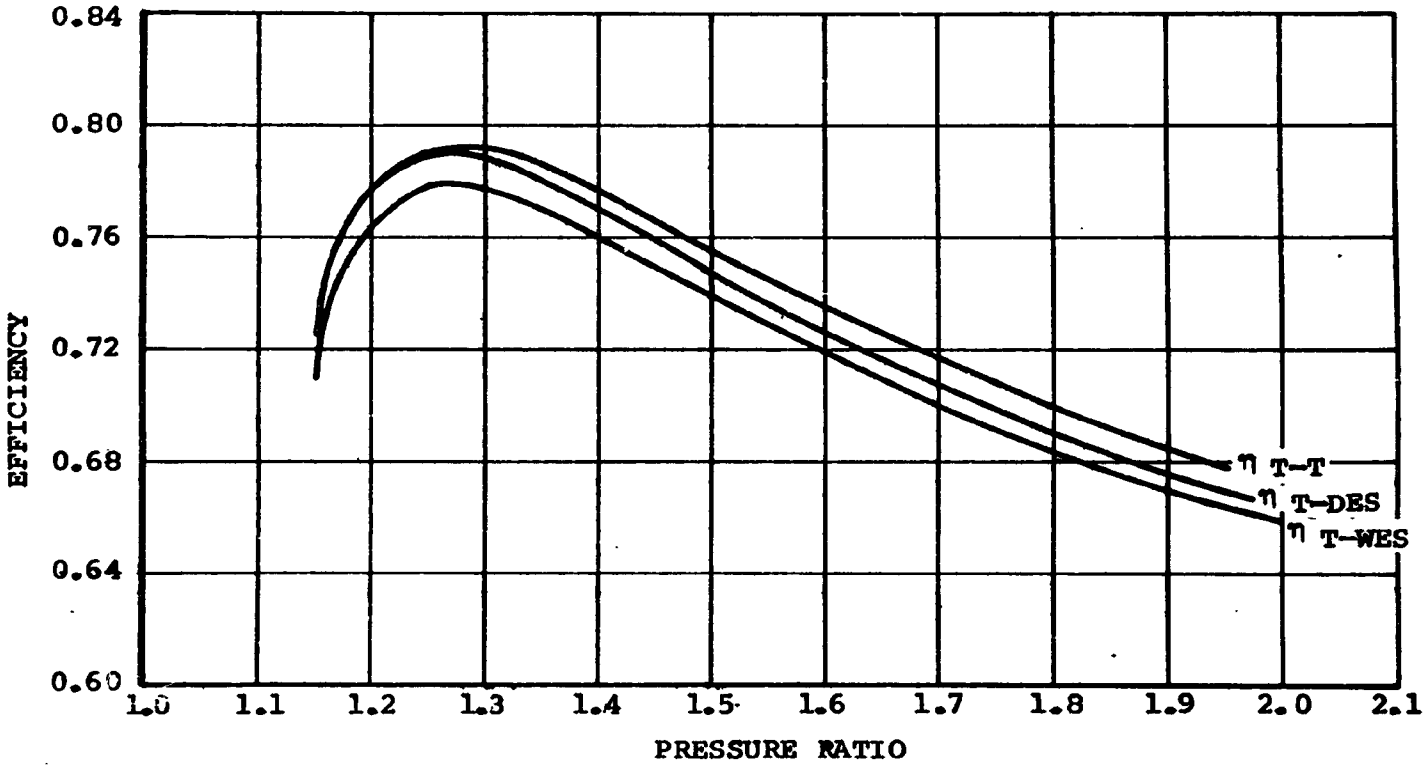


Figure 122. - Mini-BRU Turbine Cold Air Test Efficiency Versus Pressure Ratio for % $N/\sqrt{\theta}$ = 80.

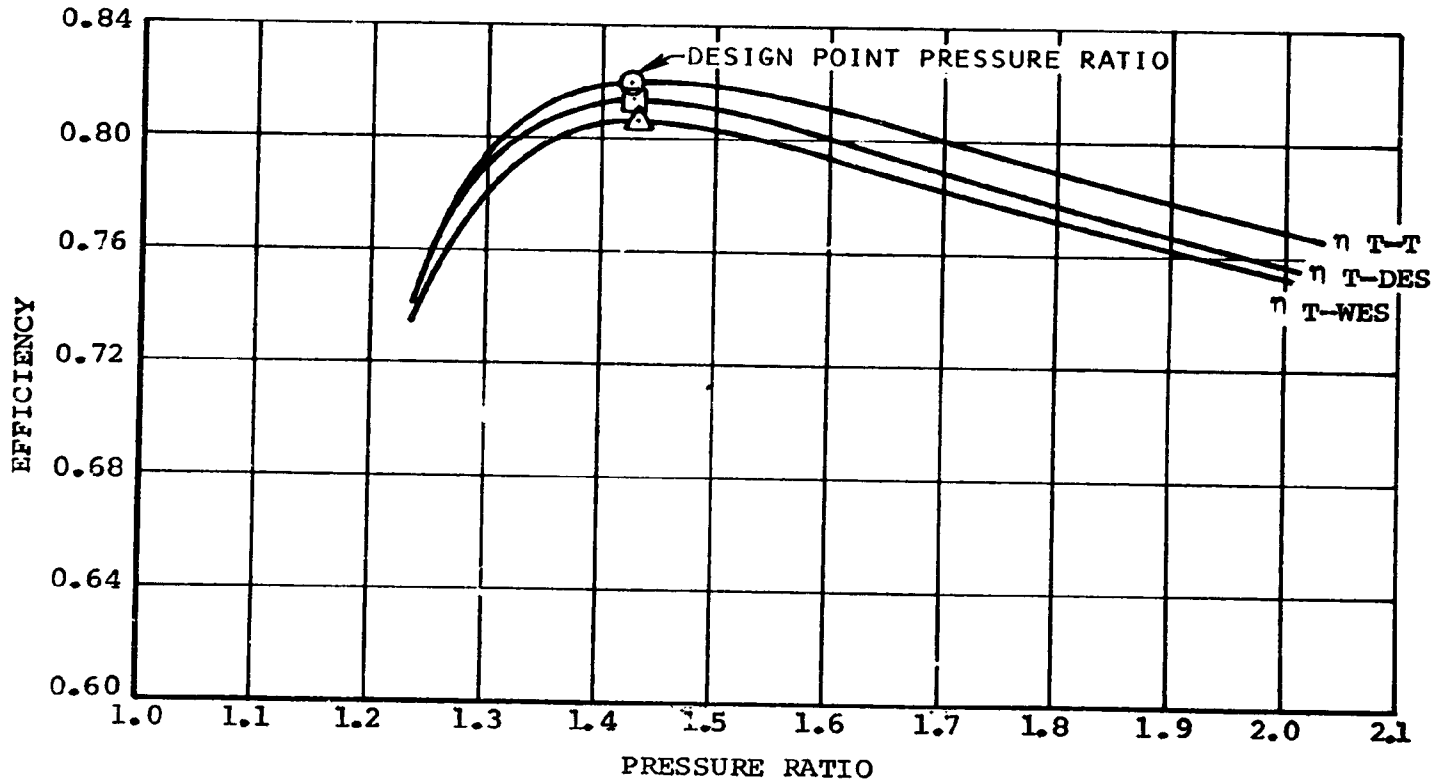


Figure 123. - Mini-BRU Turbine Cold Air Test Efficiency Versus Pressure Ratio for % $N/\sqrt{\theta}$ = 100.

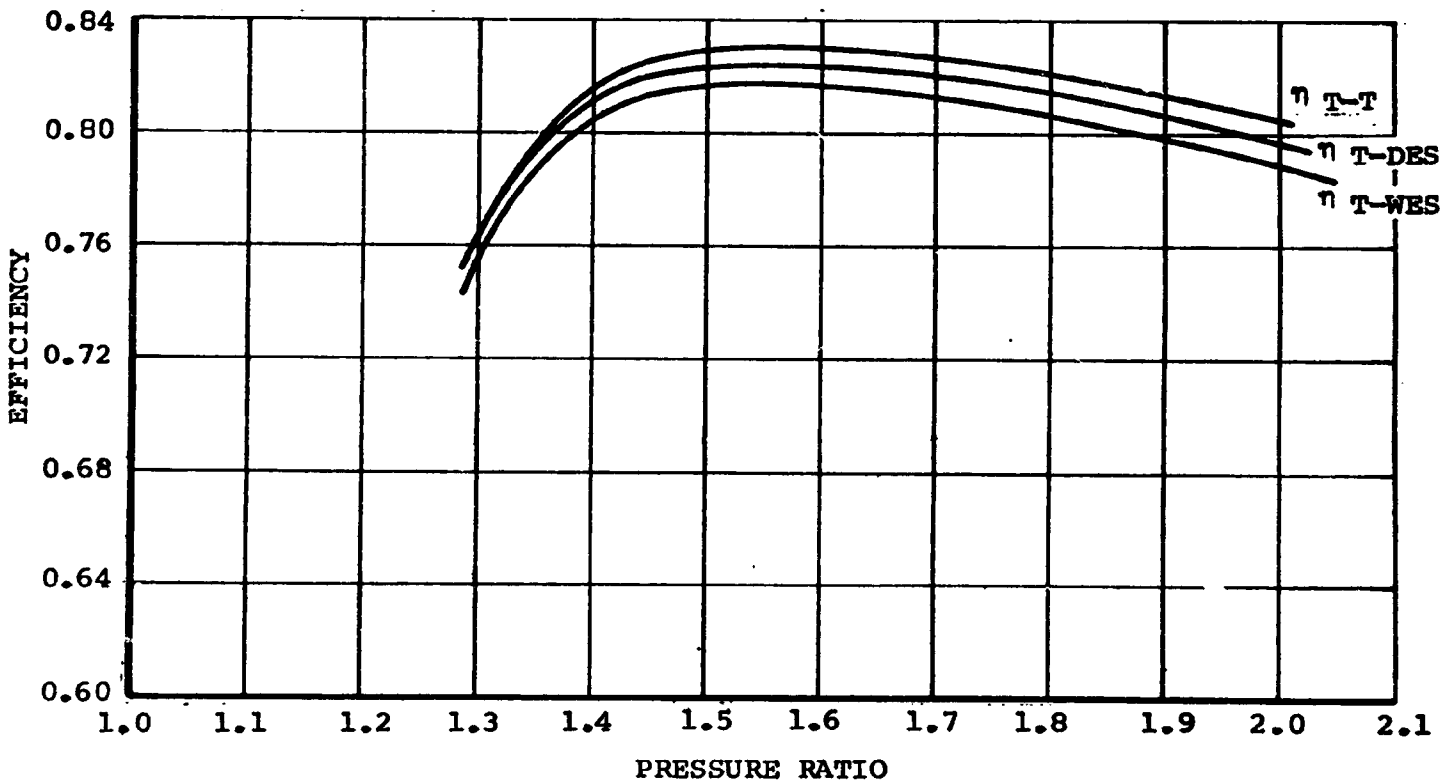


Figure 124. - Mini-BRU Turbine Cold Air Test Efficiency Versus Pressure Ratio for % $N/\sqrt{\theta}$ = 110.

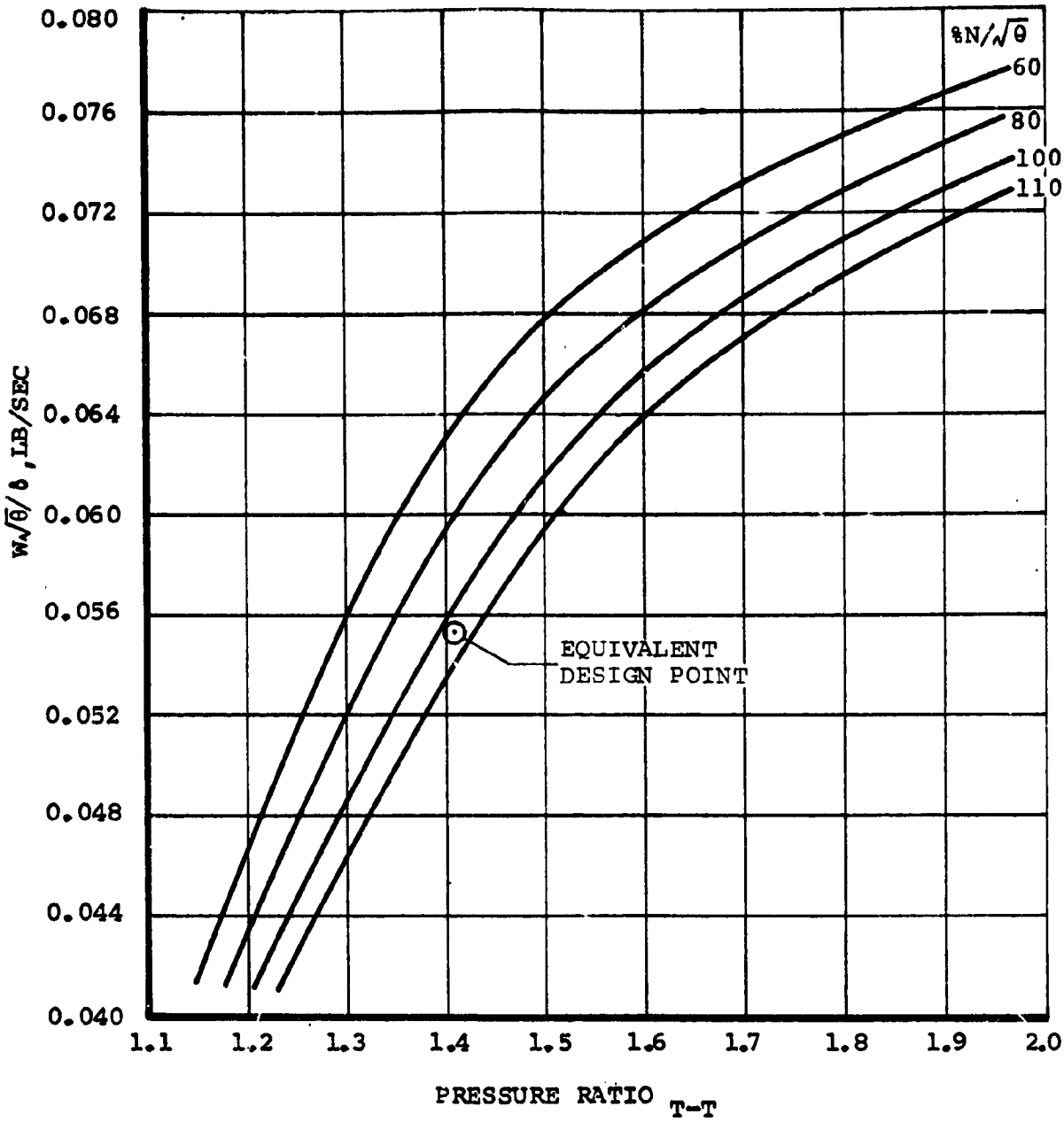


Figure 125. - Mini-BRU Turbine Cold Air Test Corrected Flow Versus Pressure Ratio.

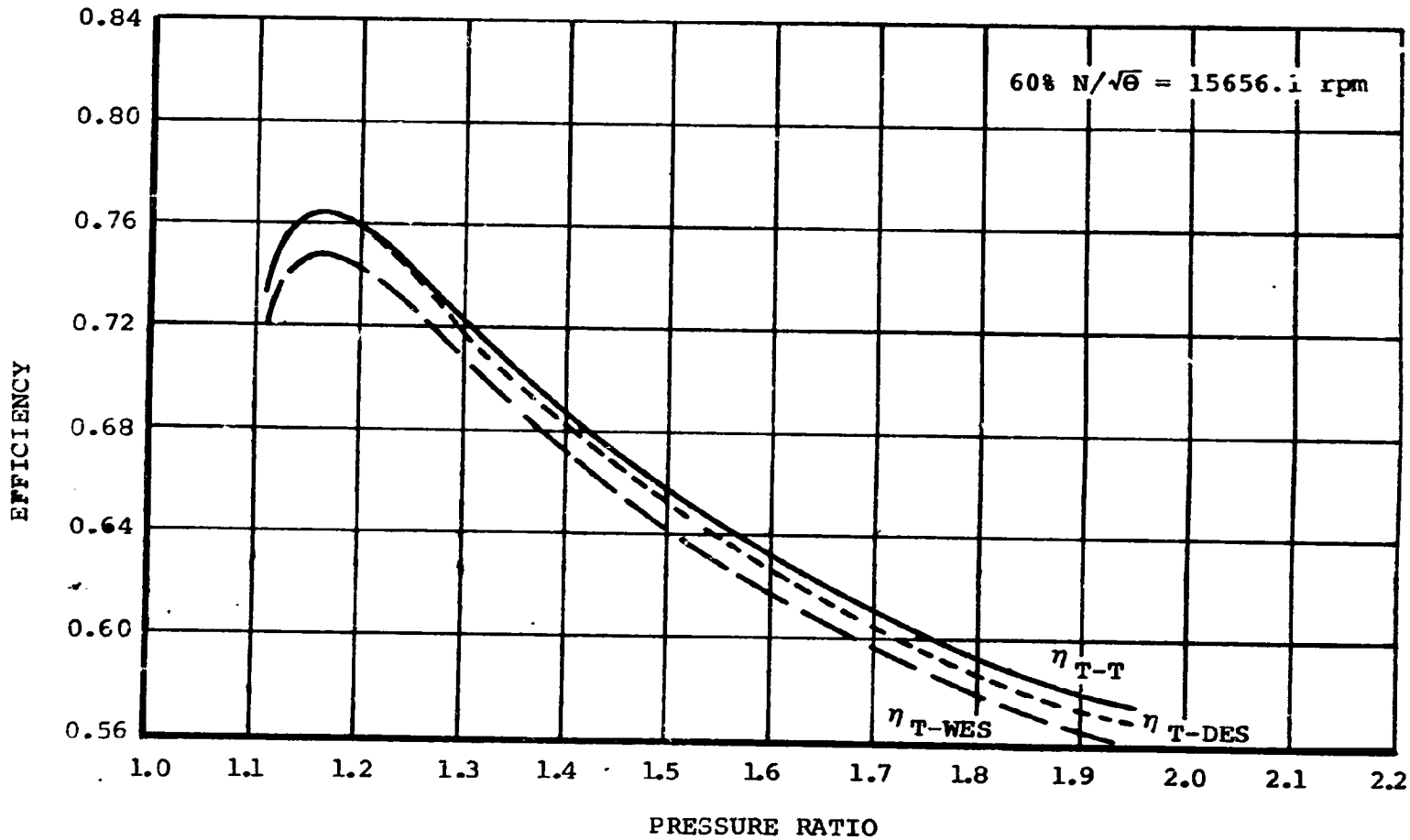


Figure 126. - Turbine Performance in HeXe.

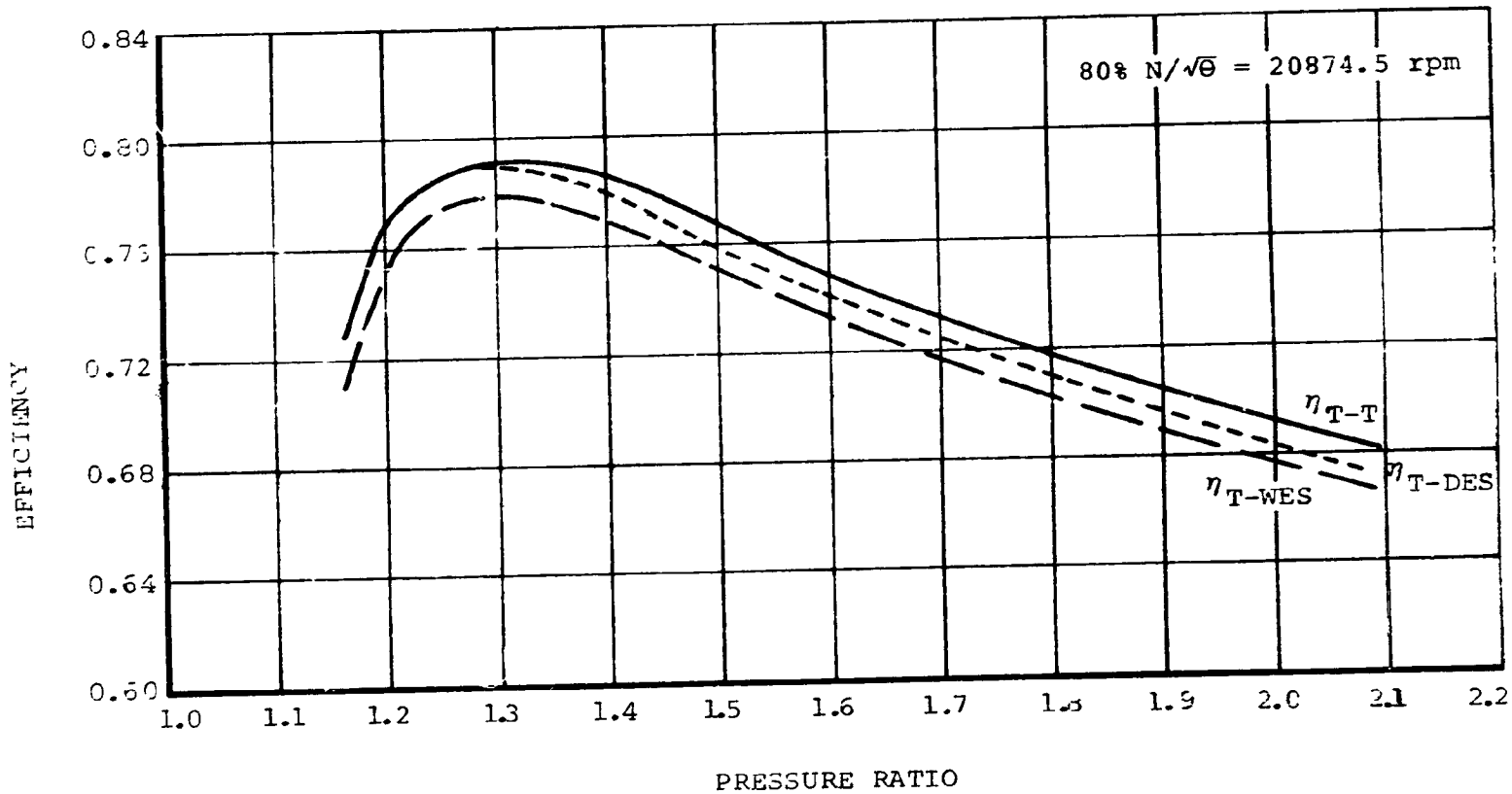


Figure 127. - Turbine Performance in HeXe.

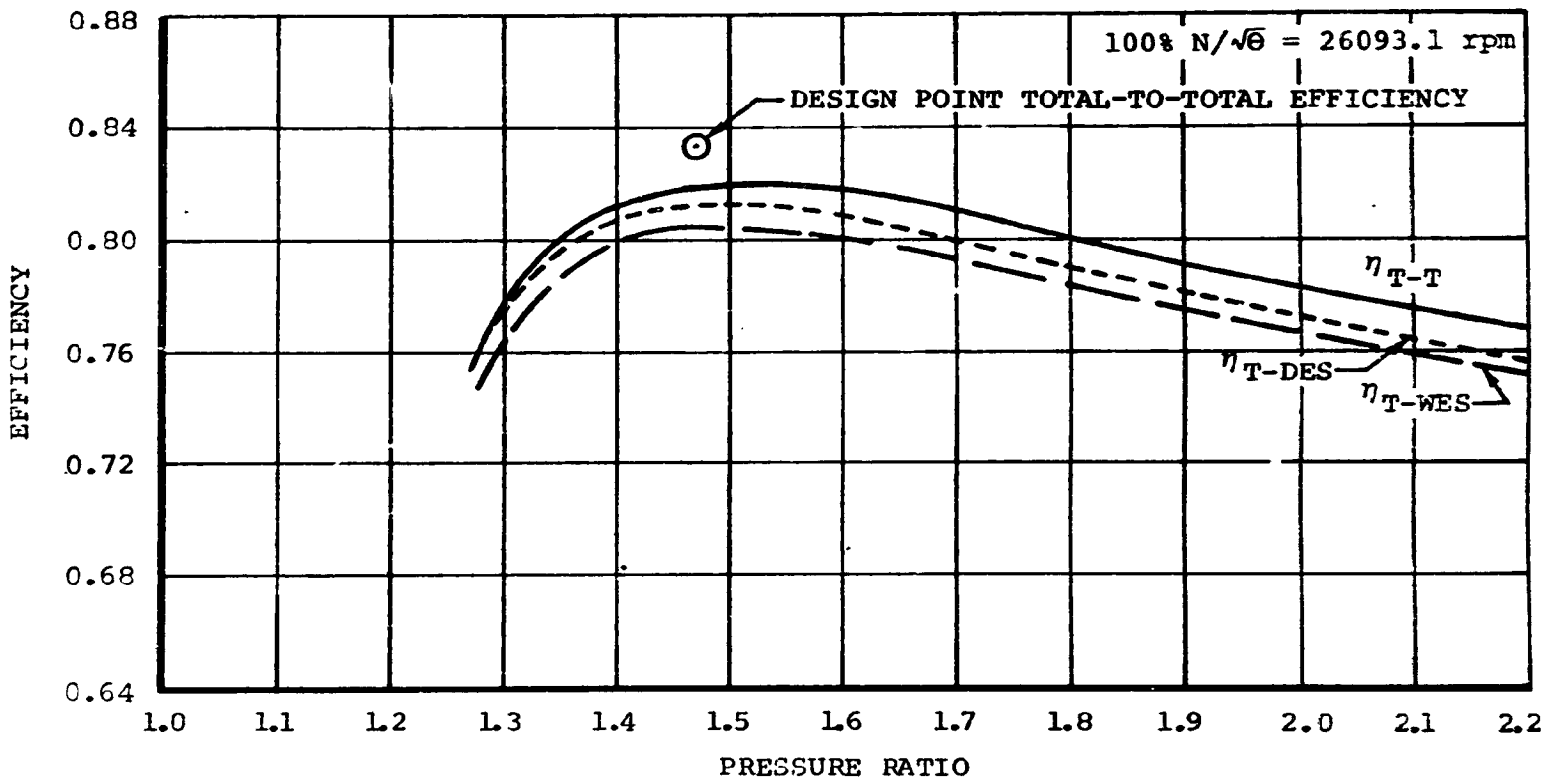


Figure 128. - Turbine Performance in HeXe.

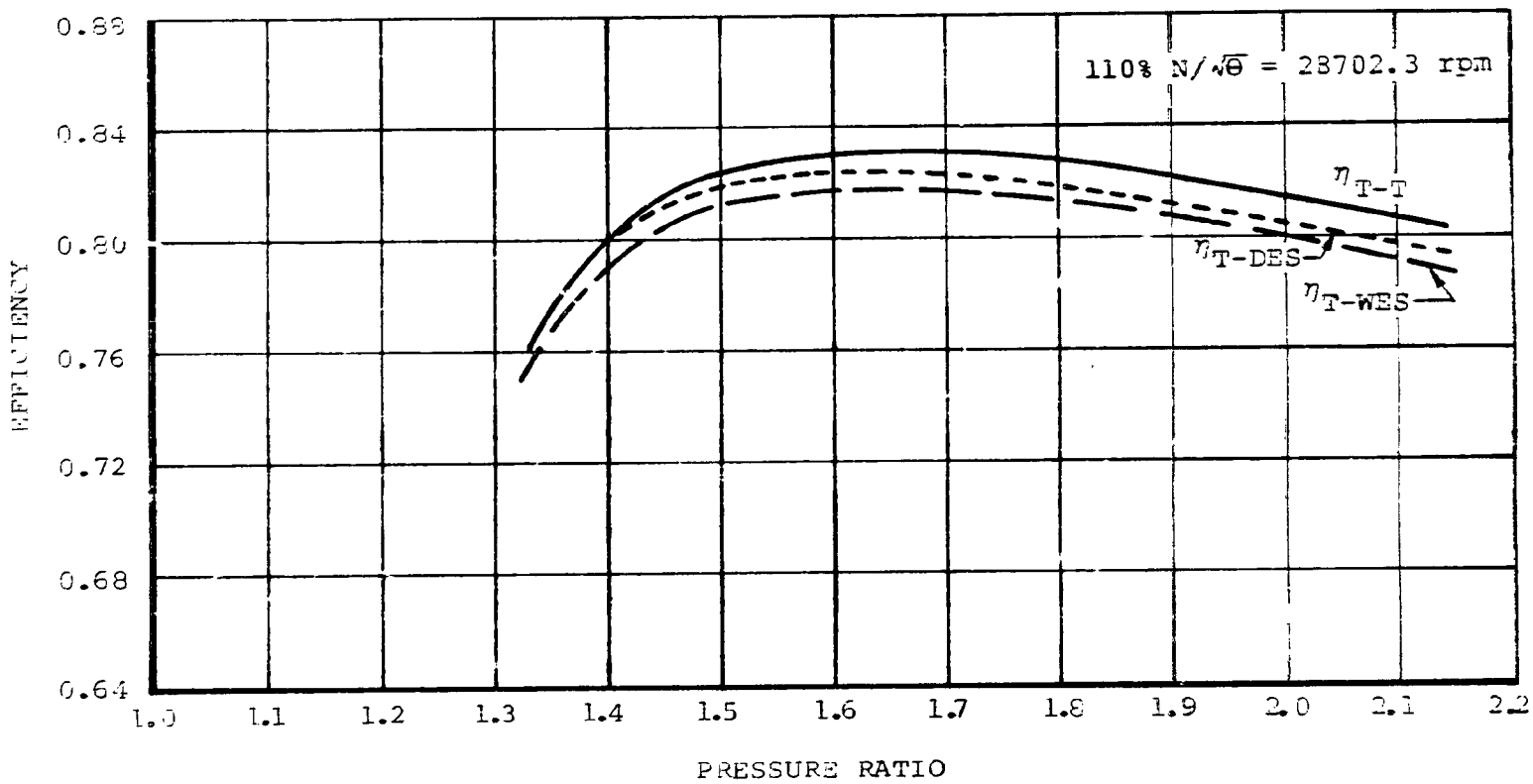


Figure 129. - Turbine Performance in HeXe.

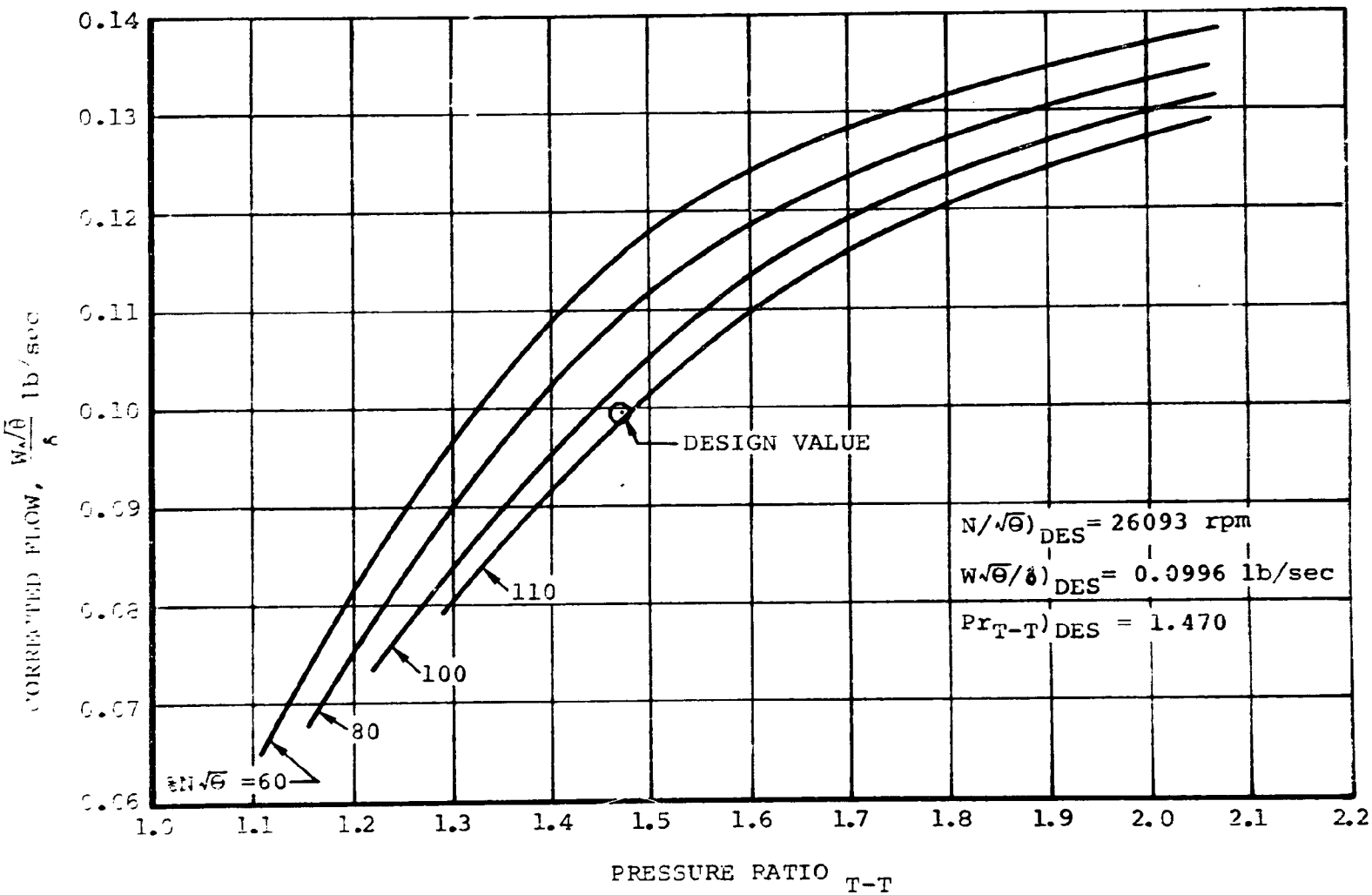


Figure 130. - Turbine Performance in HeXe.

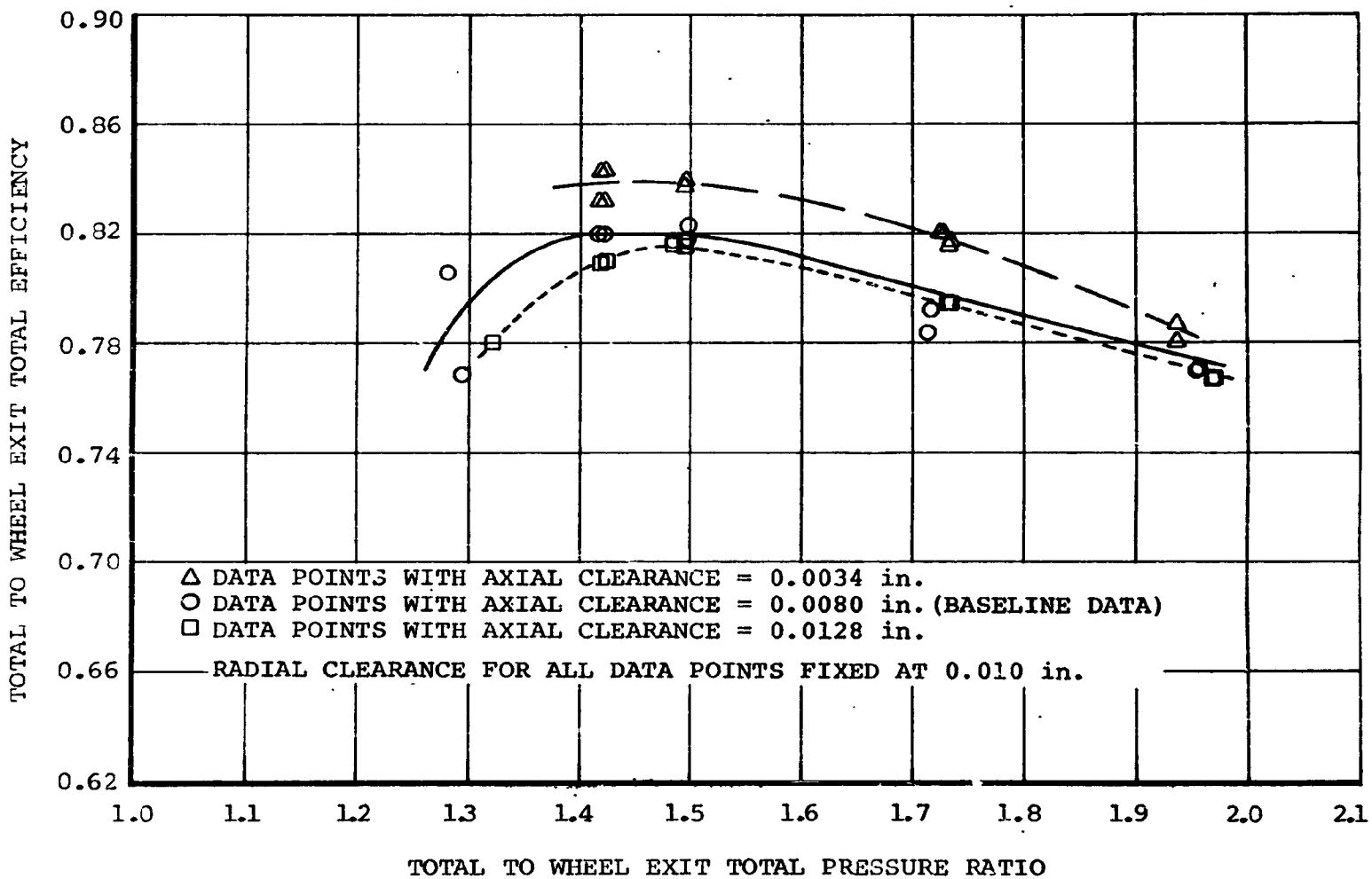


Figure 131. - Effect of Axial Clearance for 100 Percent Speed.

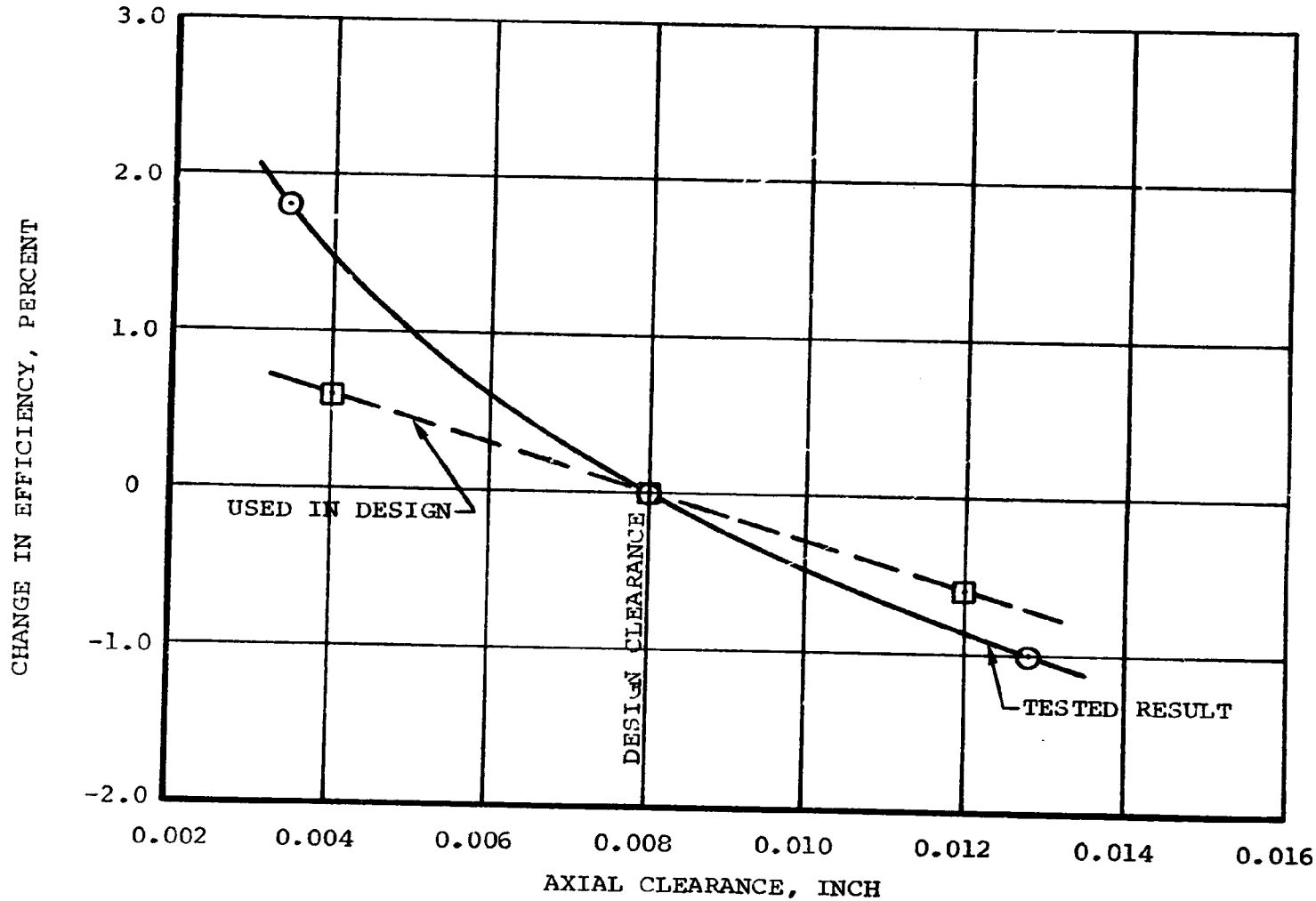
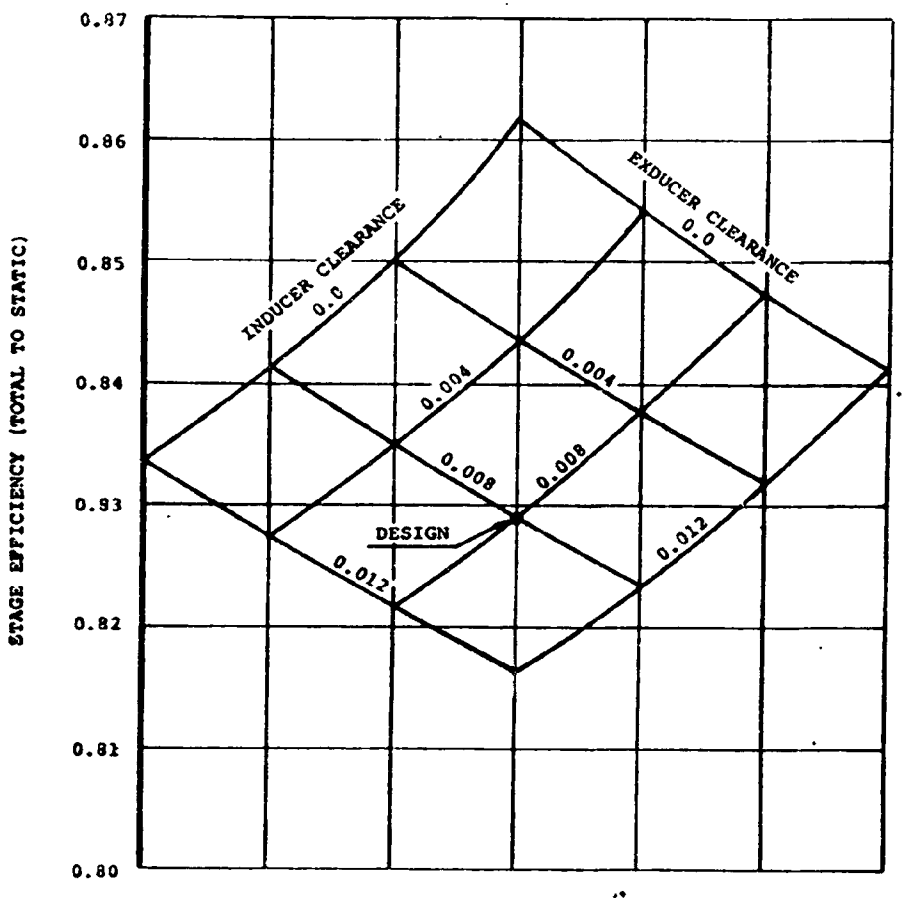


Figure 132. - Effect of Axial Clearance on Efficiency.



NOTE:

THIS FIGURE REPRODUCED FROM REFERENCE 1, AND REPRESENTS AXIAL AND RADIAL CLEARANCE EFFECT USED IN DESIGN PHASE.

Figure 133. - Turbine Clearance Effects on Stage Performance.

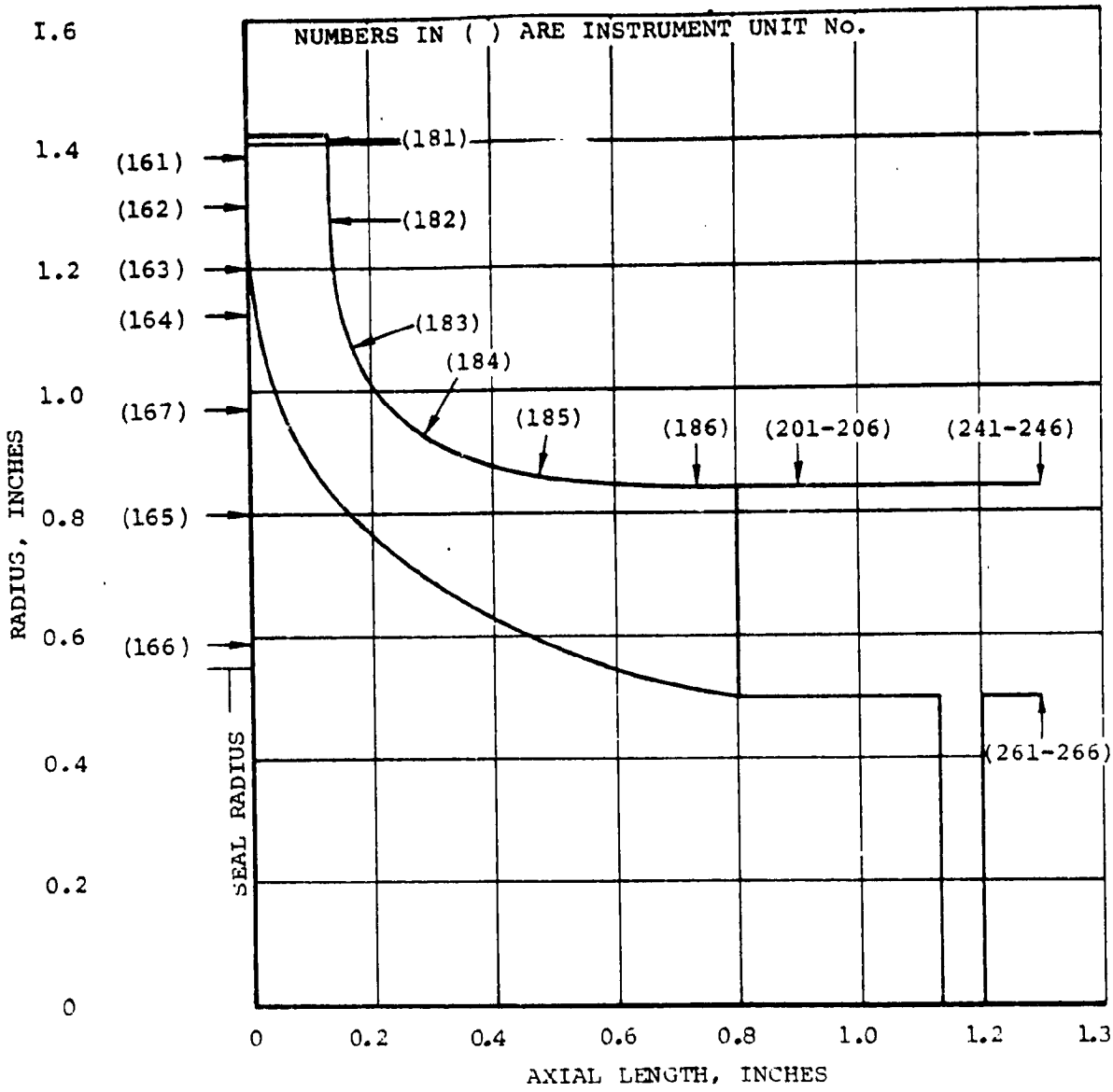


Figure 134. - Static Pressure Measurements.

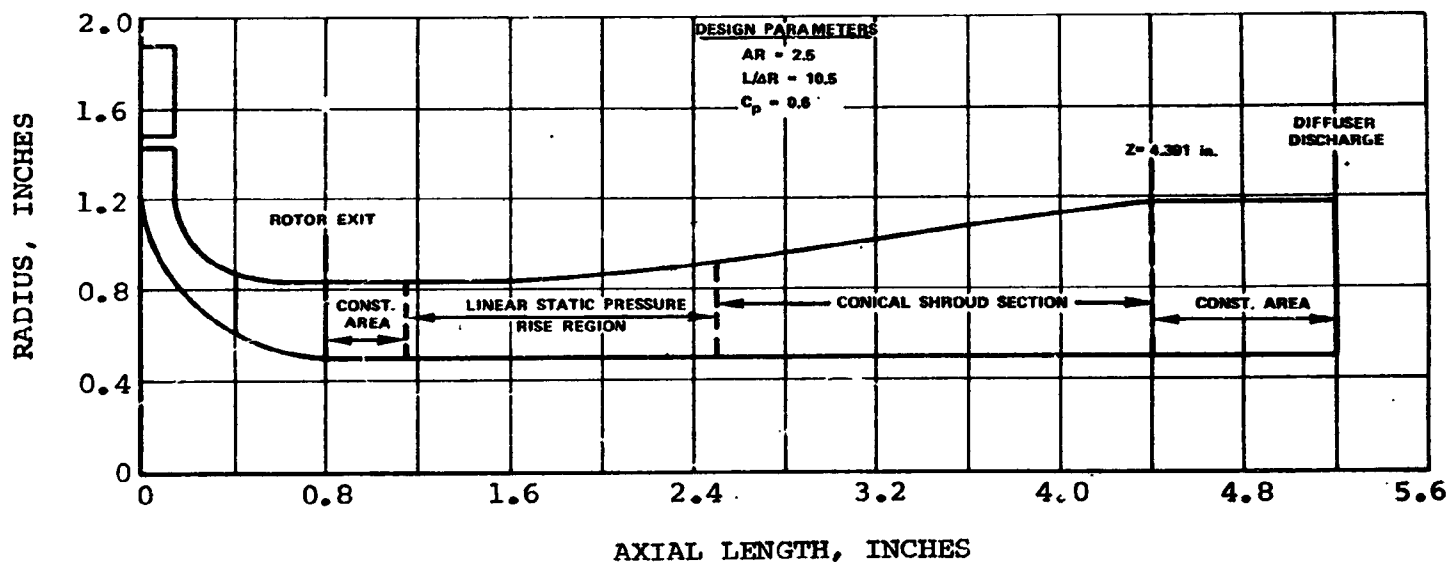


Figure 135. - Mini-BRU Diffuser.

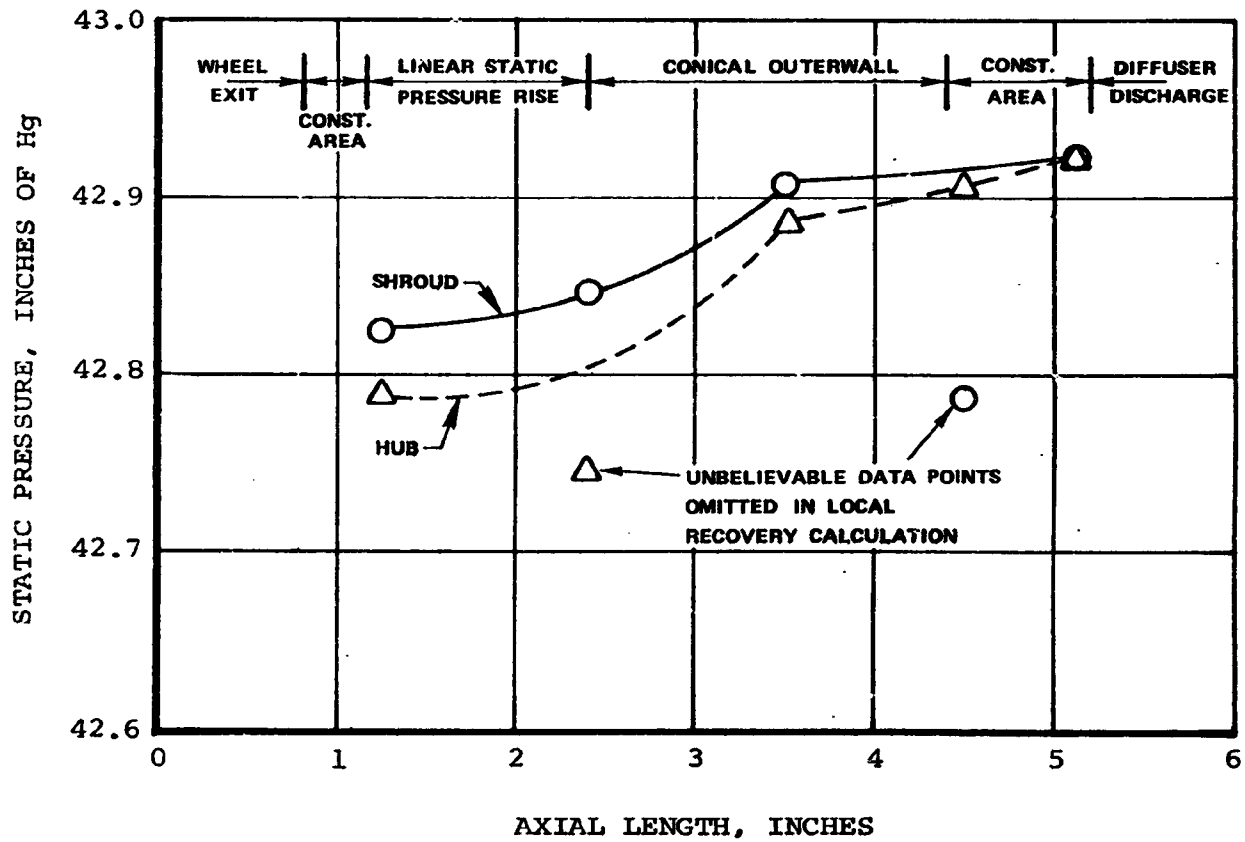


Figure 136. - Local Static Pressure Distribution in the Diffuser.

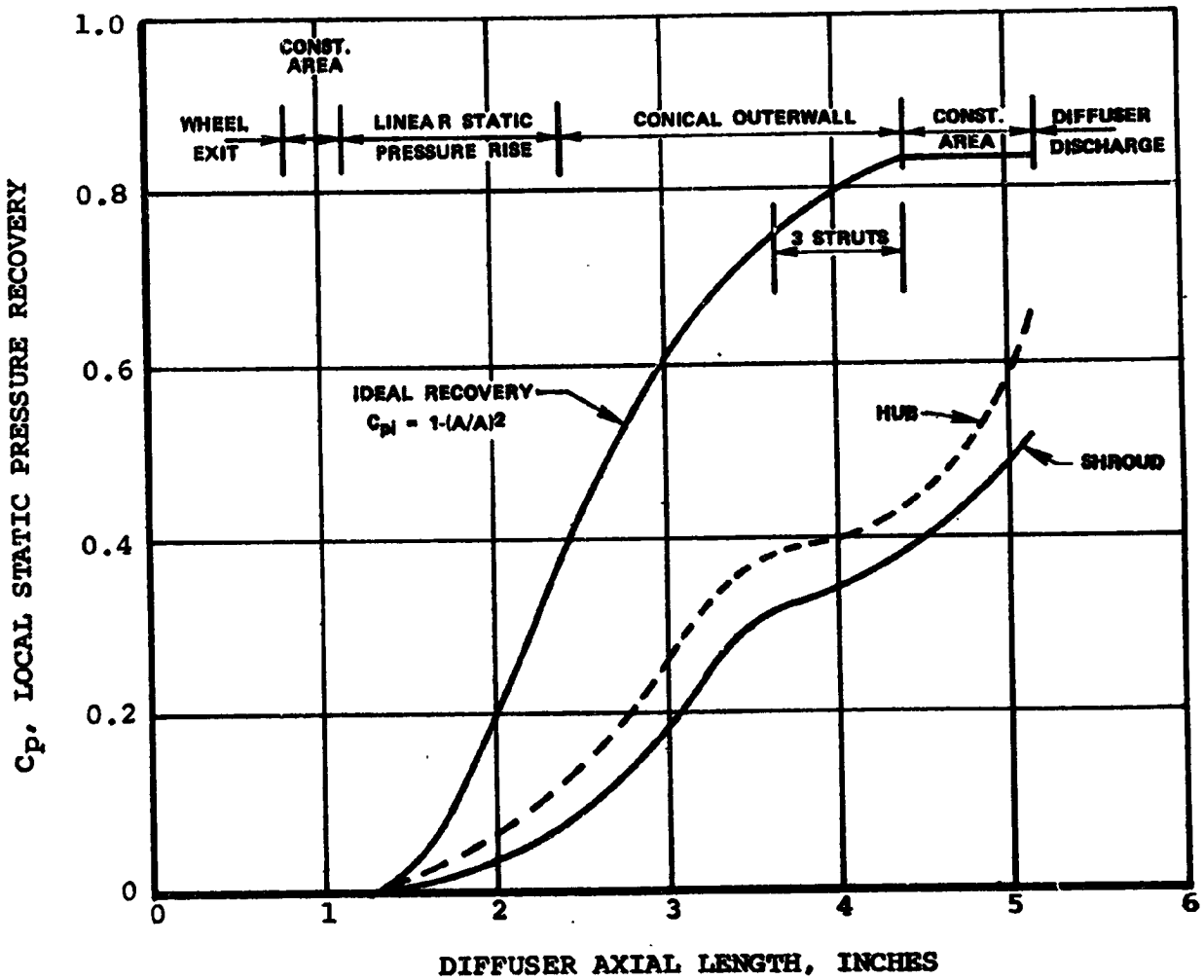
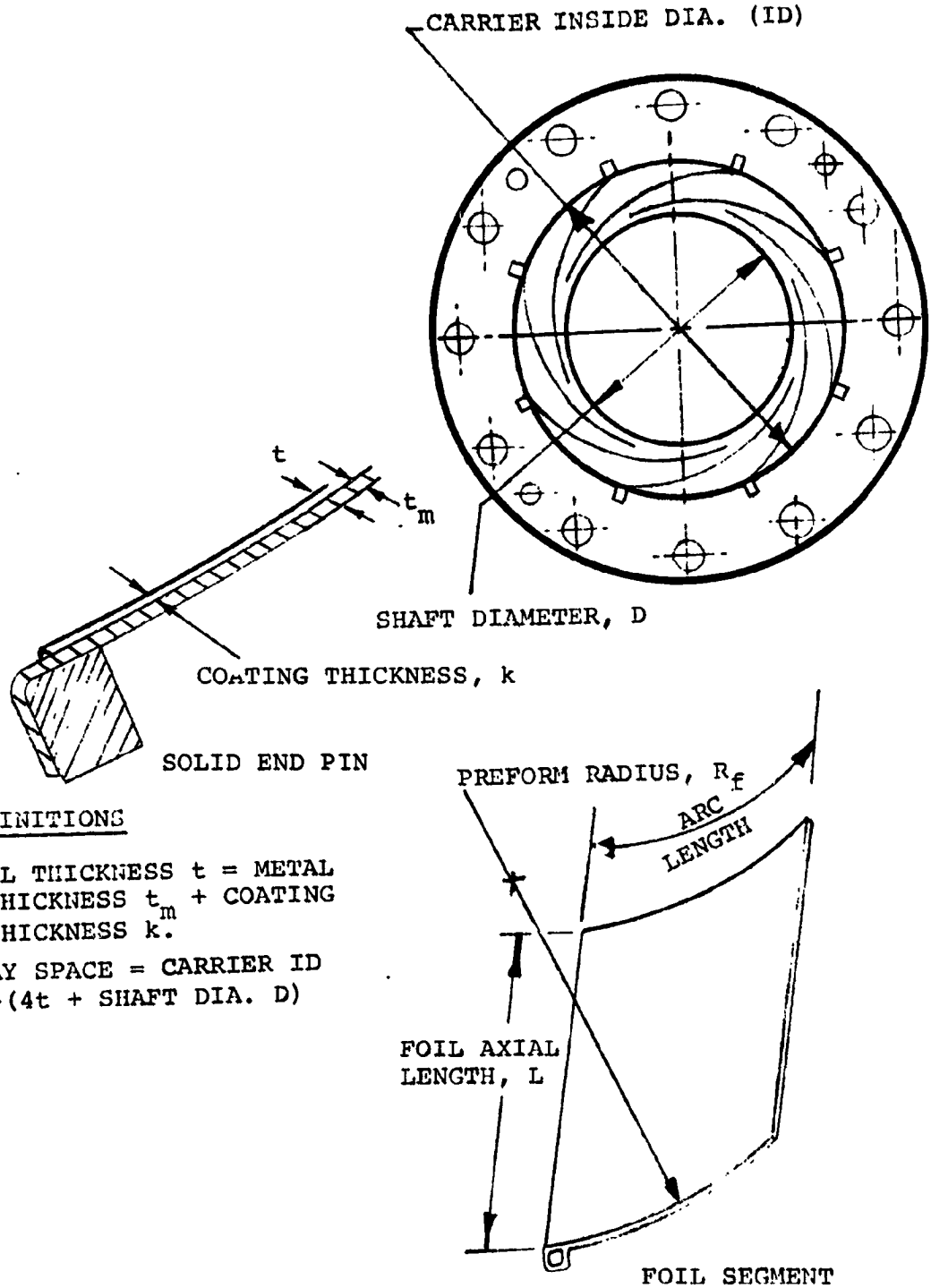


Figure 137. - Local Static Pressure Recovery in Turbine.



DEFINITIONS

FOIL THICKNESS t = METAL THICKNESS t_m + COATING THICKNESS k.

SWAY SPACE = CARRIER ID -(4t + SHAFT DIA. D)

Figure 138. - Foil Journal Bearing Nomenclature.

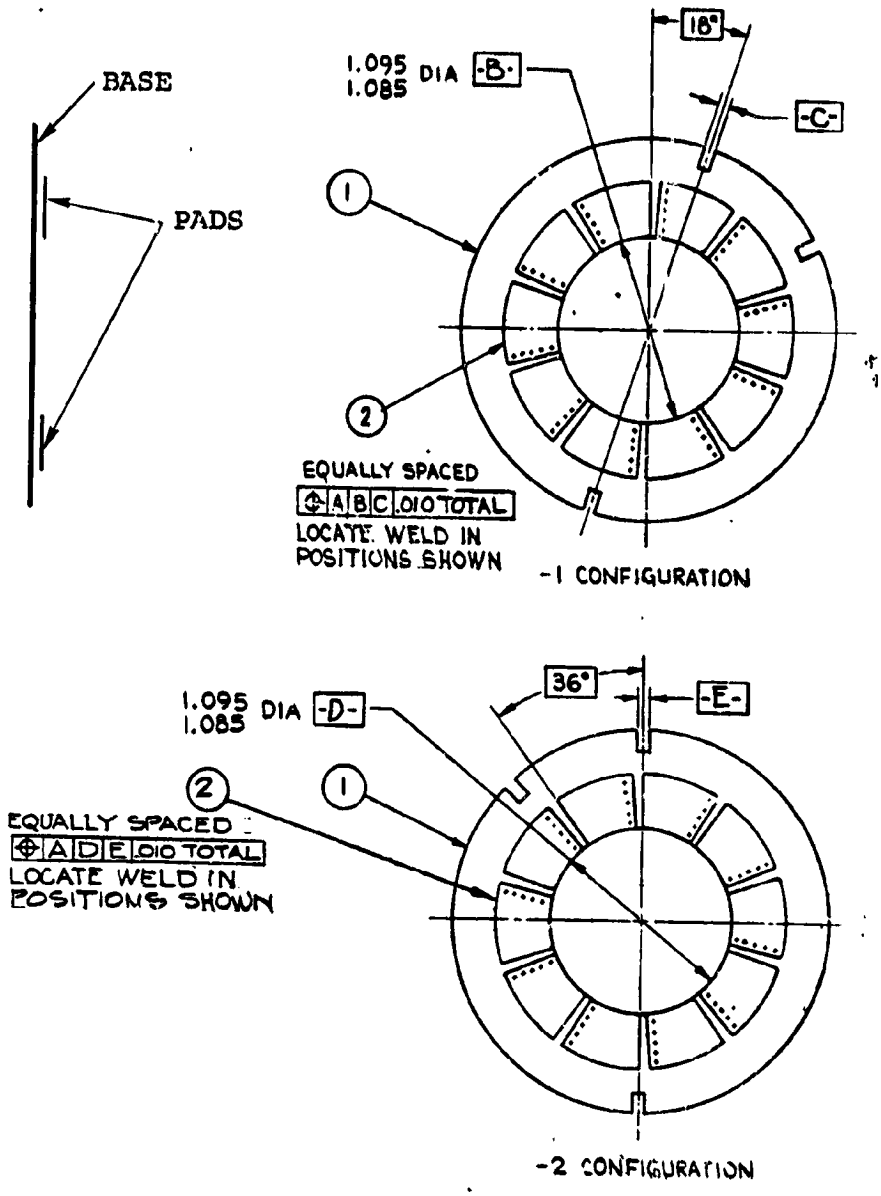


Figure 139. - Foil Thrust Bearing.

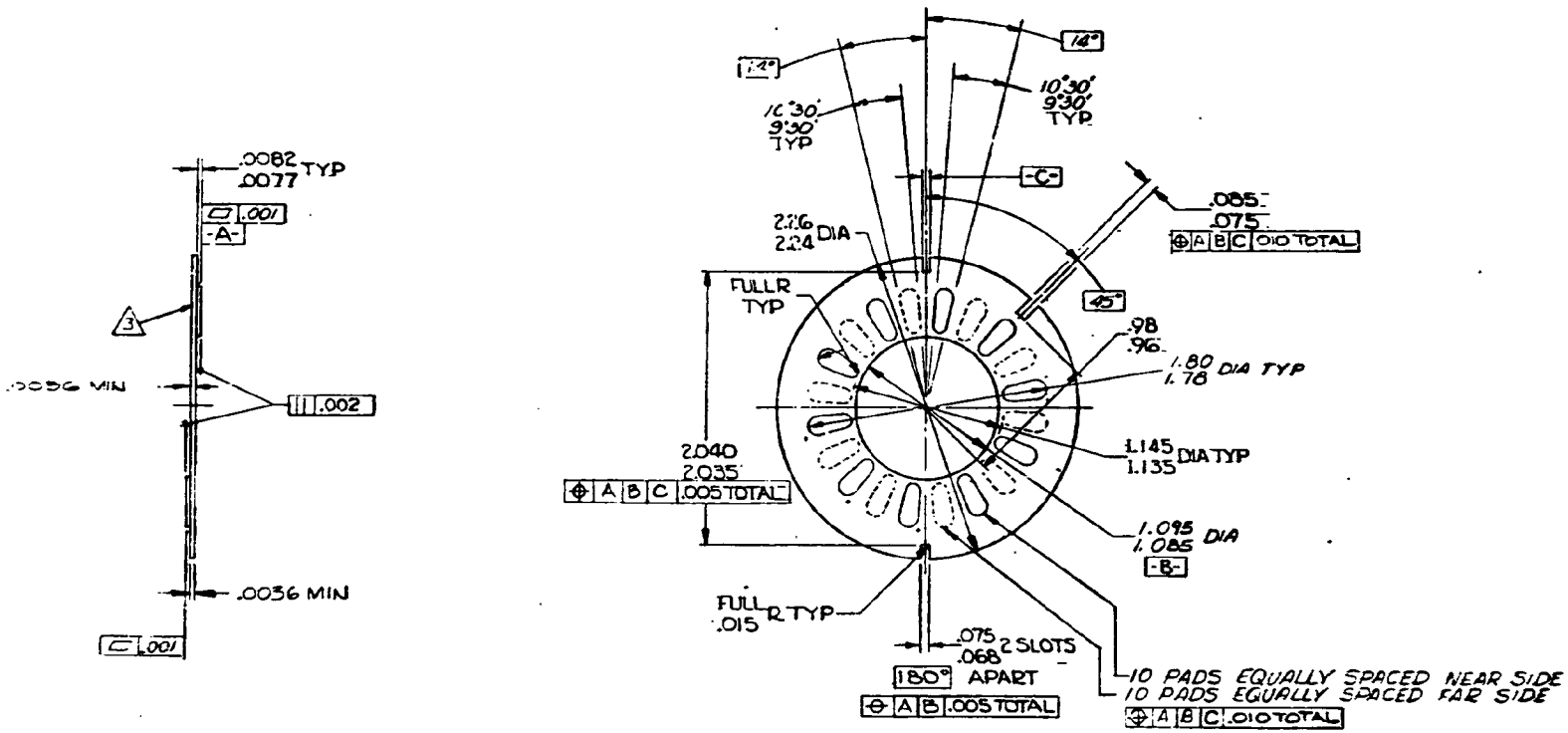


Figure 140. - Thrust Bearing Spring.

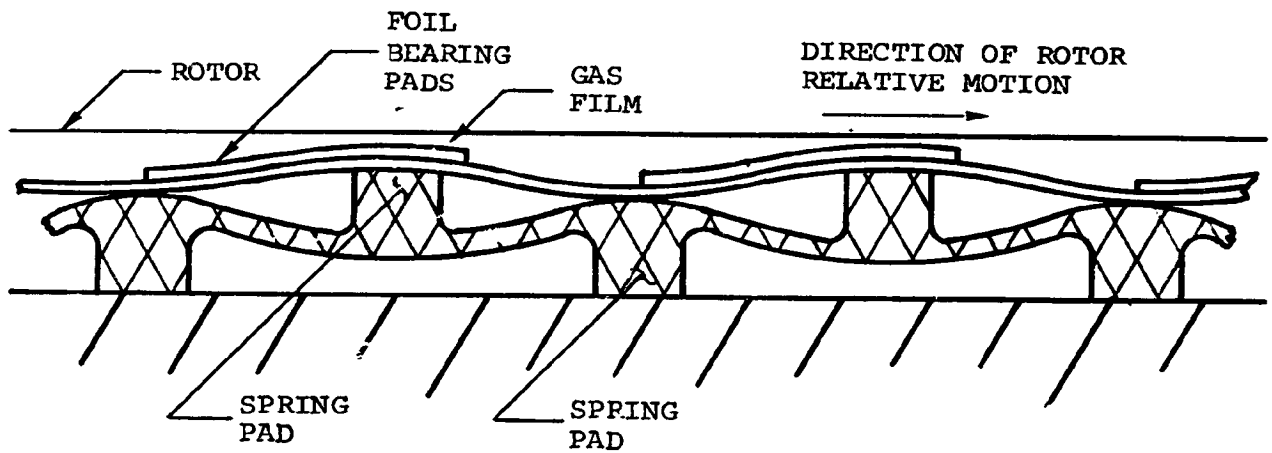


Figure 141. - Bearing Shape.

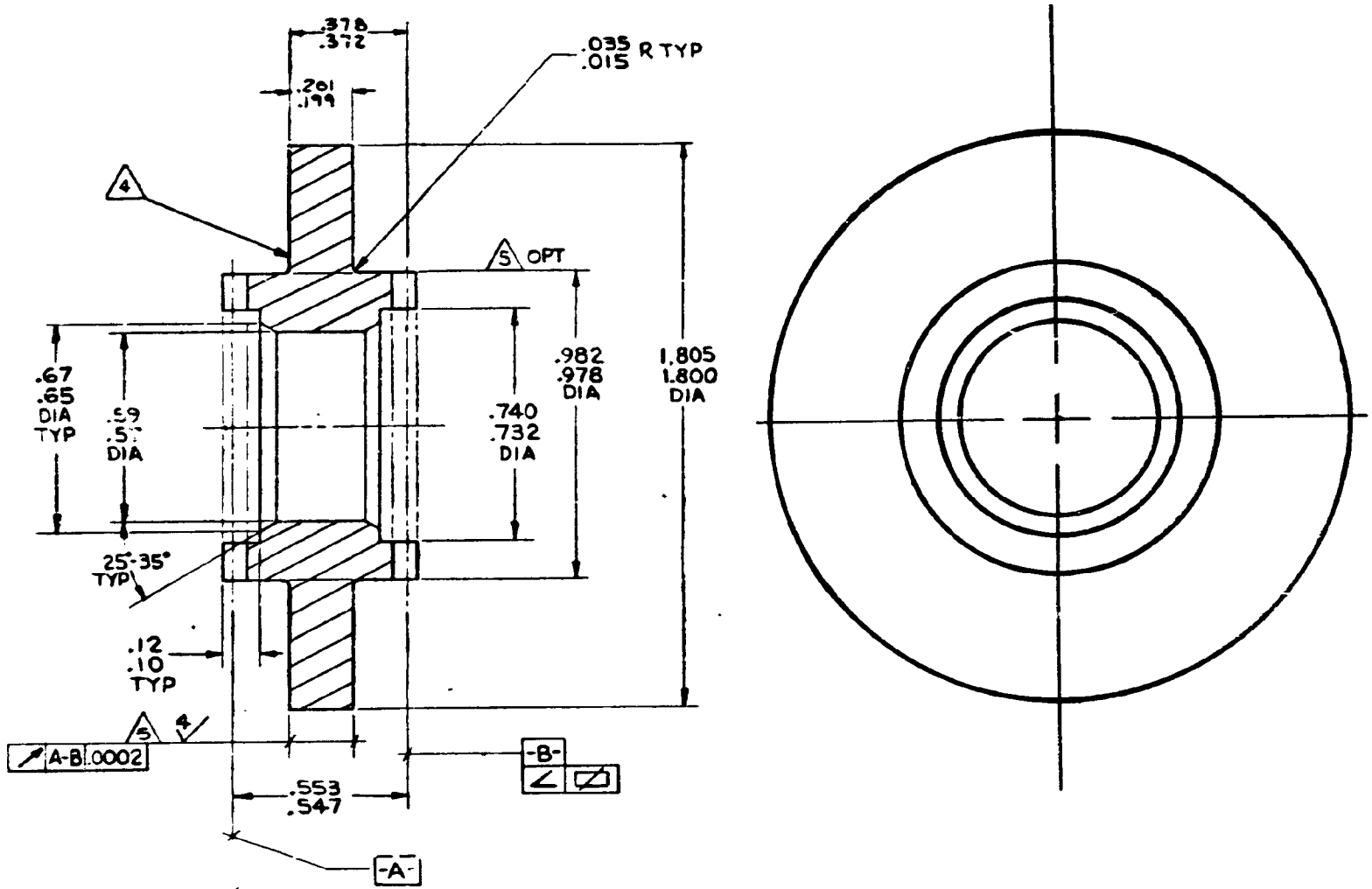


Figure 142. - Thrust Rotor.

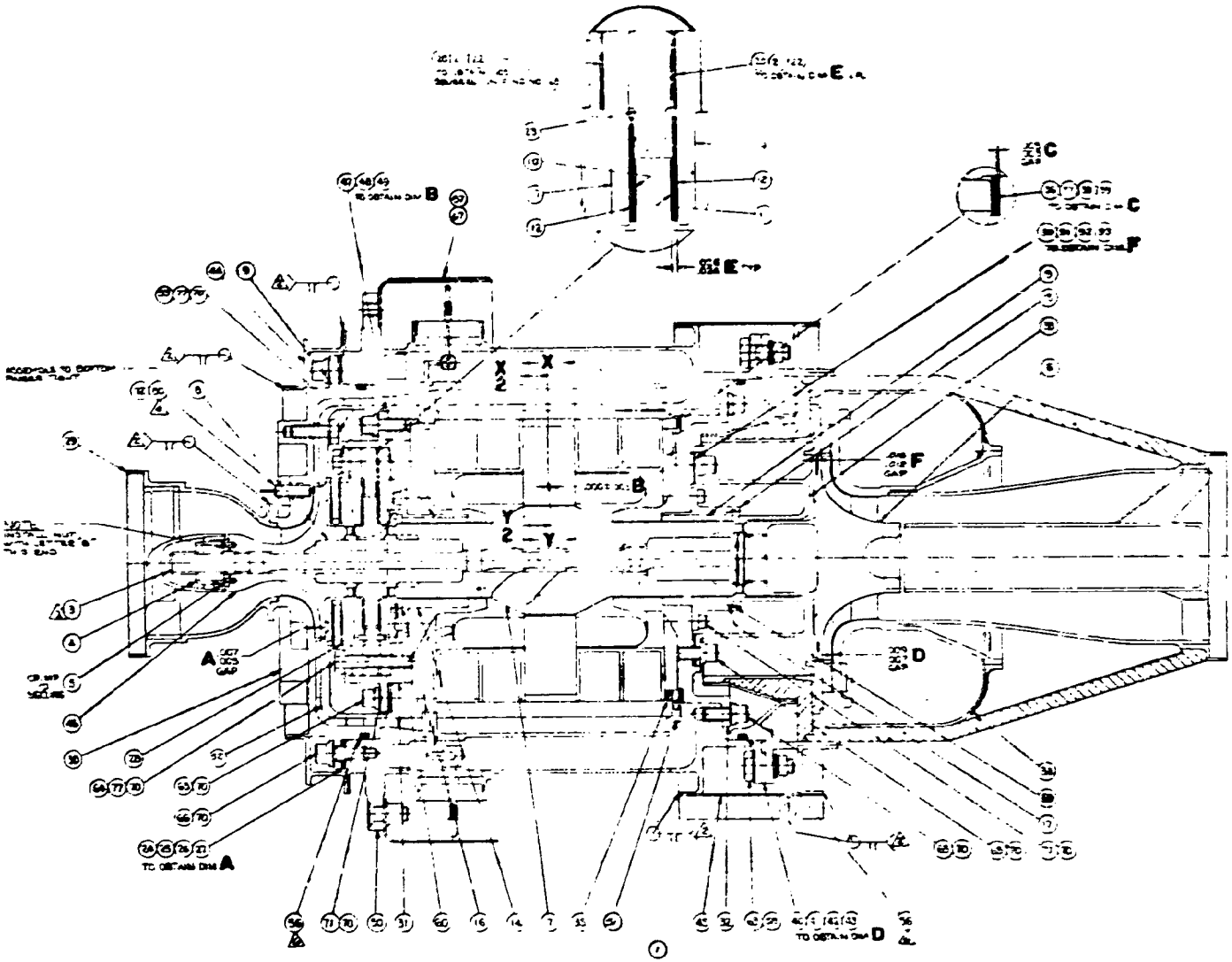


Figure 143. - Engine Assembly Mini-Brayton Rotating Unit, Turboalternator.

DIMENSIONS ARE IN INCHES.

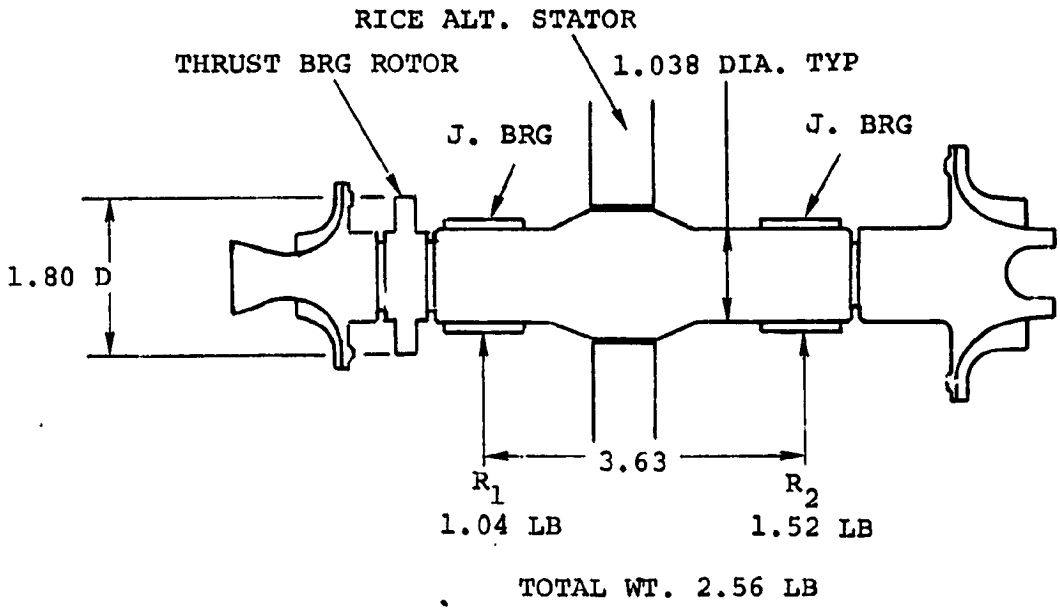


Figure 144. - Mini-BRU Rotating Group Bearing Spacing.

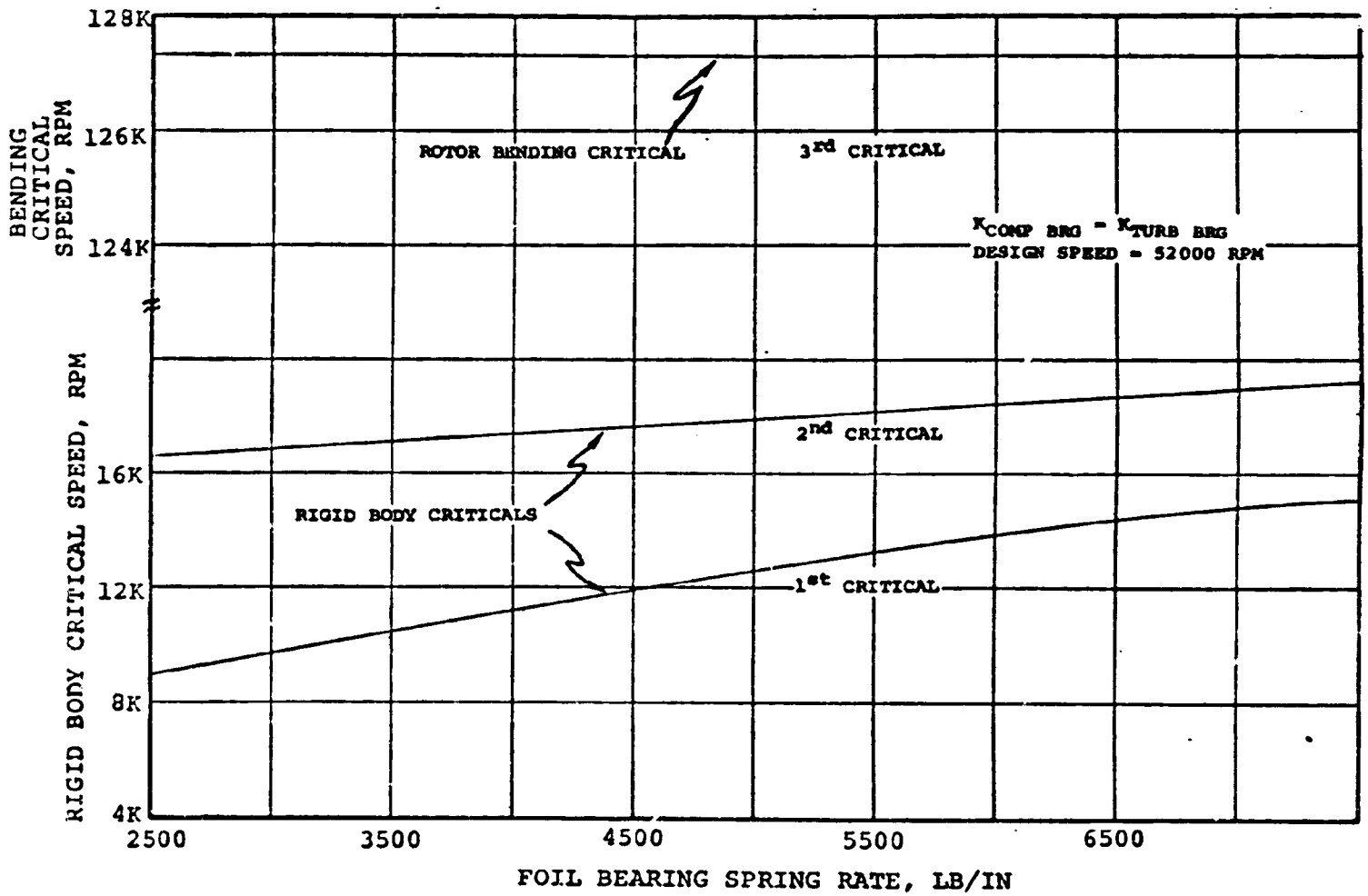


Figure 145. - Foil Bearing Spring Rate, lb/in.

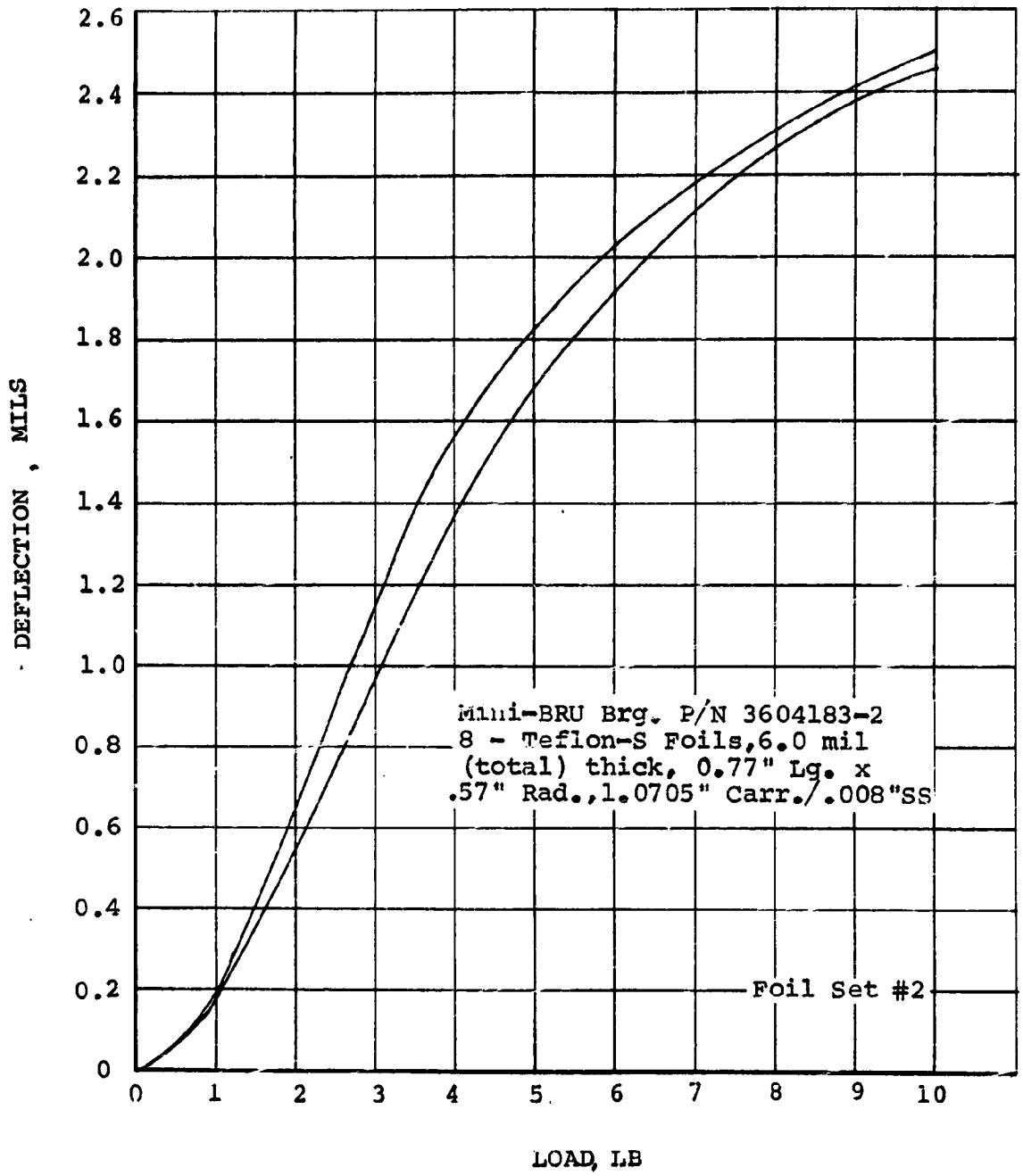


Figure 146. - Mini-BRU Bearing P/N 3604183-2, 8 Teflon-S Foils, 6.0 Mil (Total) Thick, 0.77 in. Long x 0.57 in. Radius, 1.0705 in. Carr./0.008 in. SS.

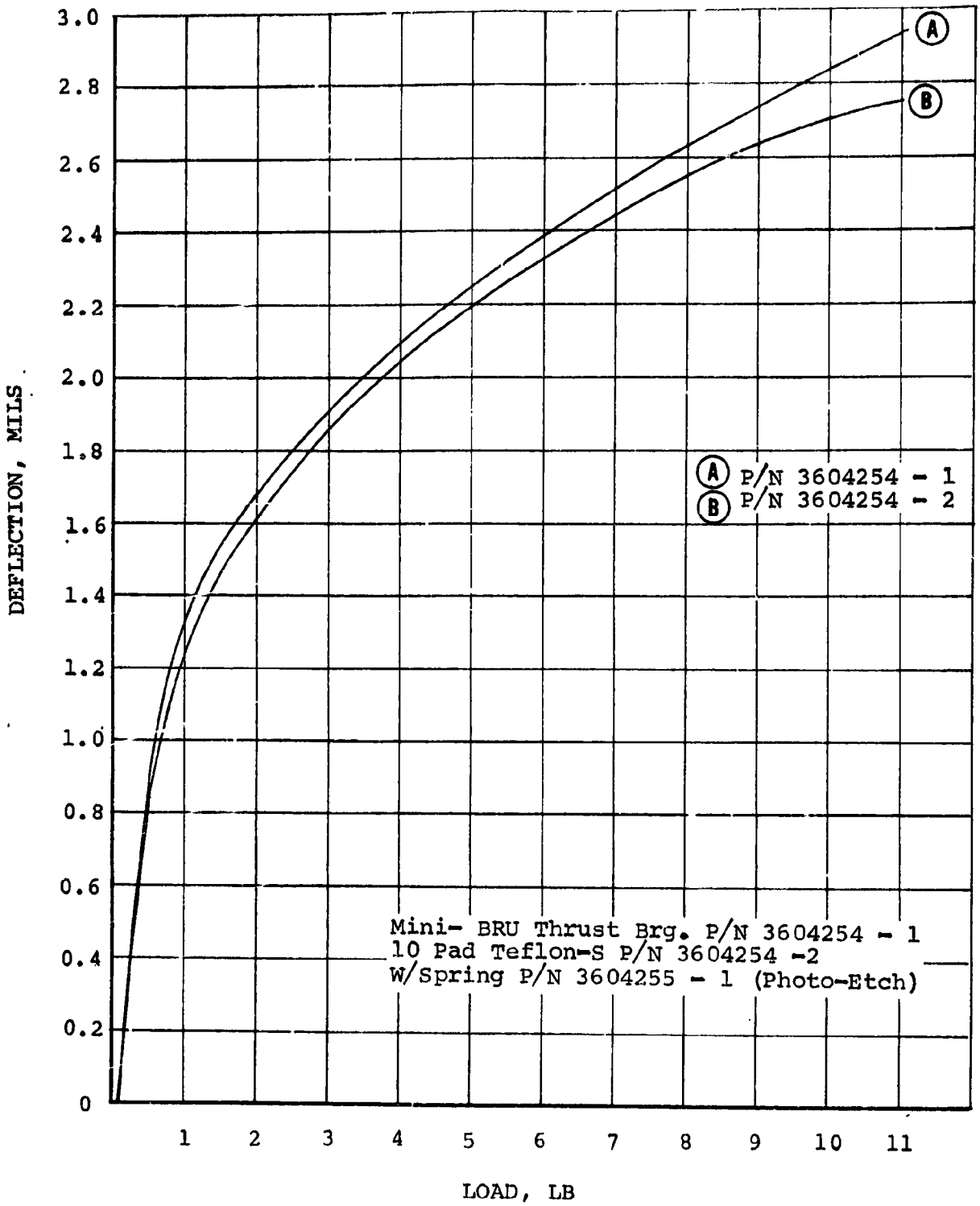


Figure 147. - Mini-BRU Thrust Bearing P/N 3604254-1, 10-Pad Teflon-S P/N 3604254-2, w/Spring P/N 3604255-1 (Photo-Etch).

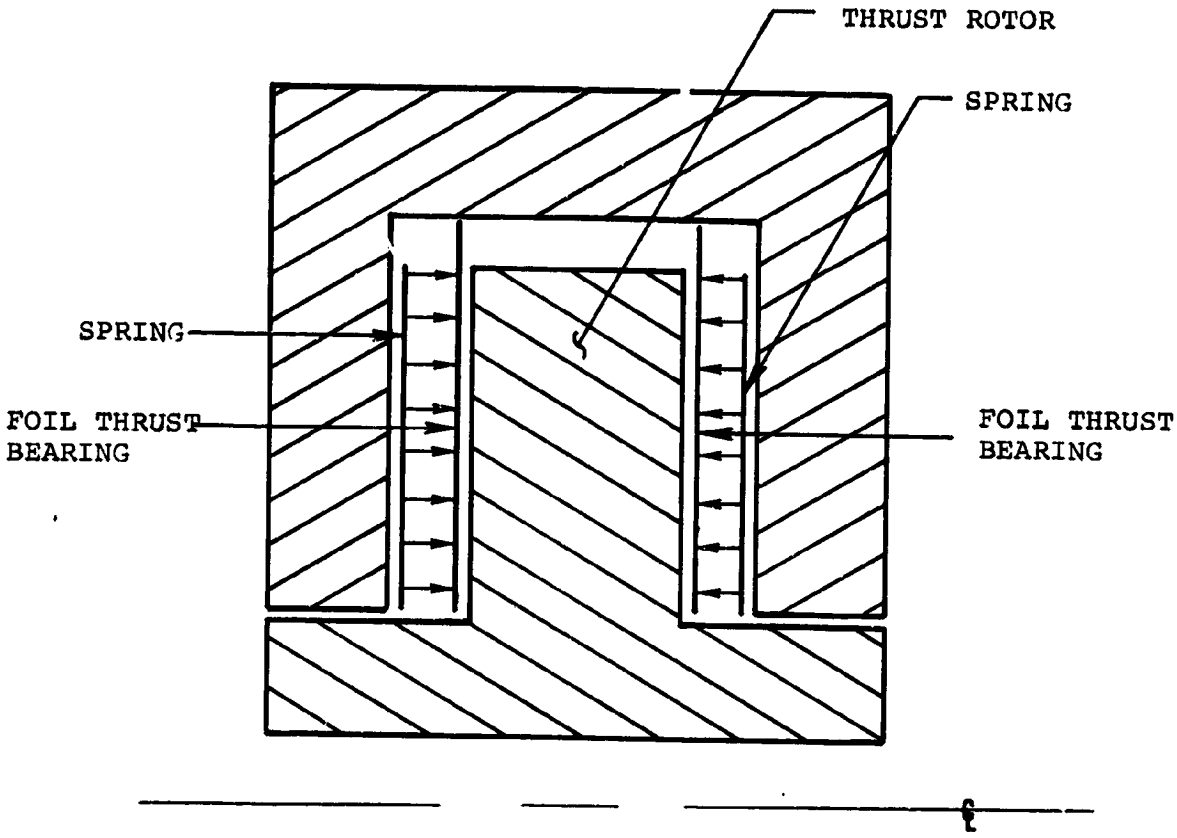
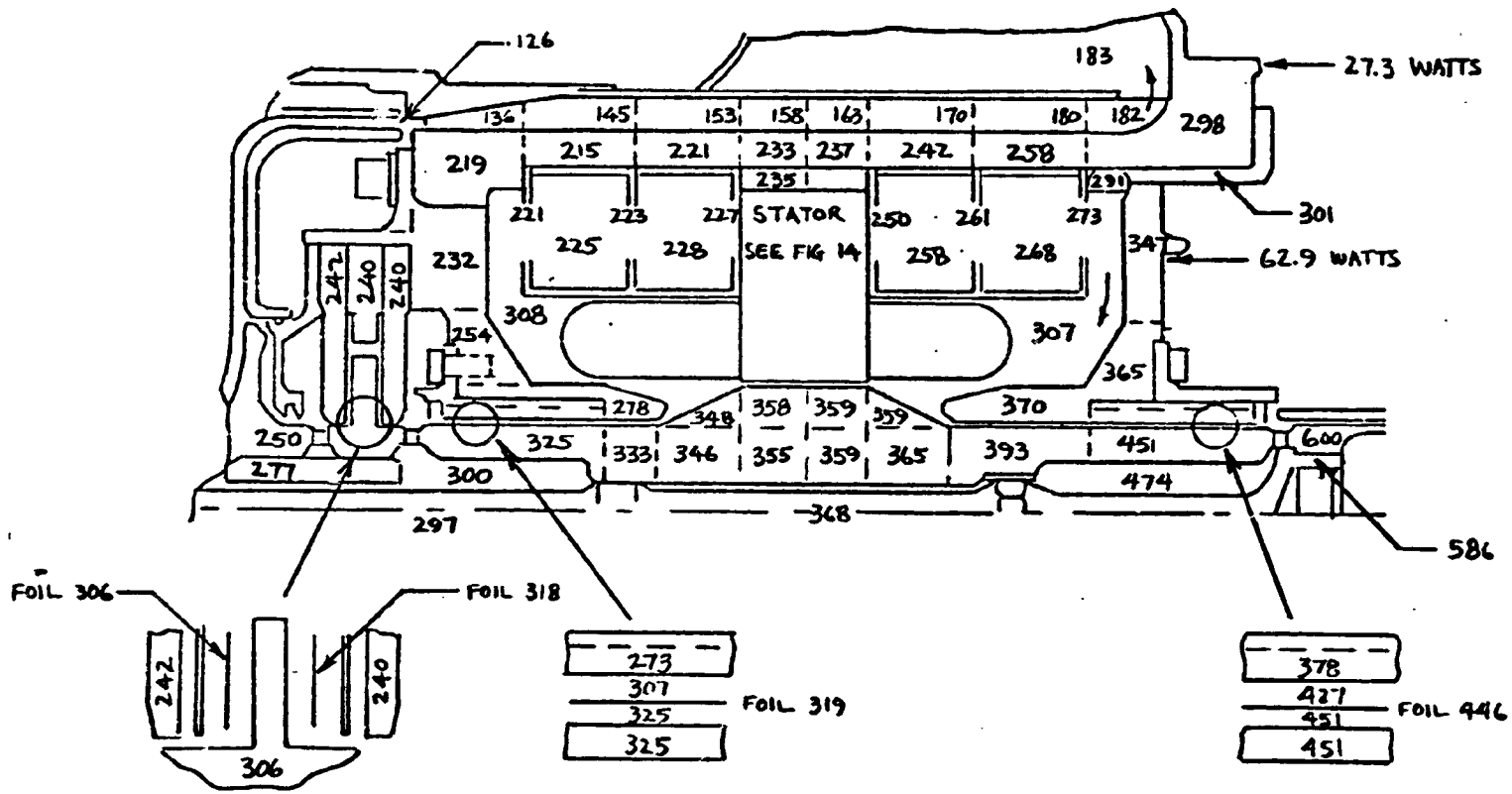
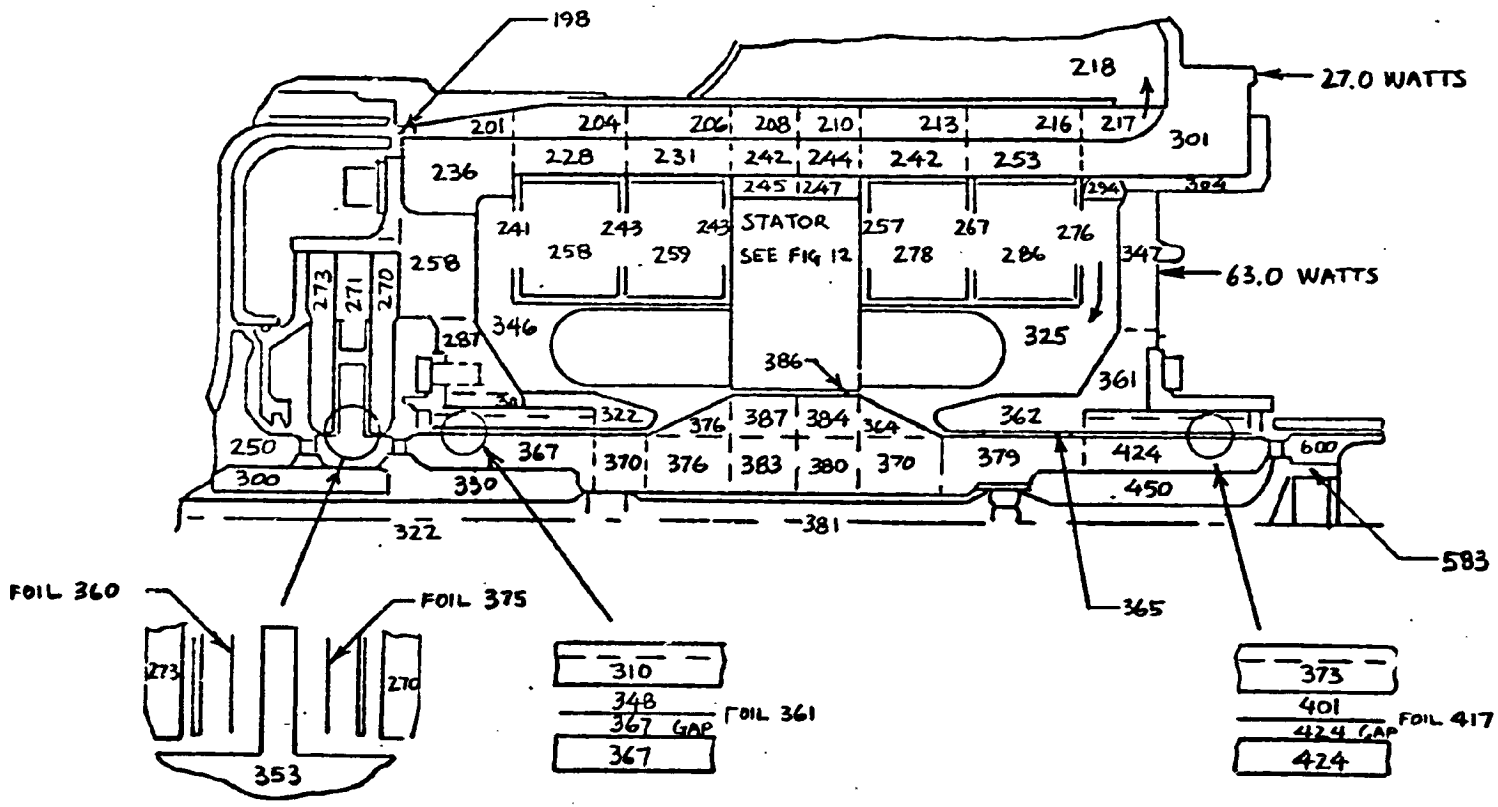


Figure 148. - Thrust Bearing Cross Section.



TEMPERATURES ARE SHOWN IN °F

Figure 149. - Model 2 Alternator Temperatures at Low-Power Operation.



TEMPERATURES ARE SHOWN IN °F

Figure 150. - Model 2 Alternator Temperatures at High-Power Operation.

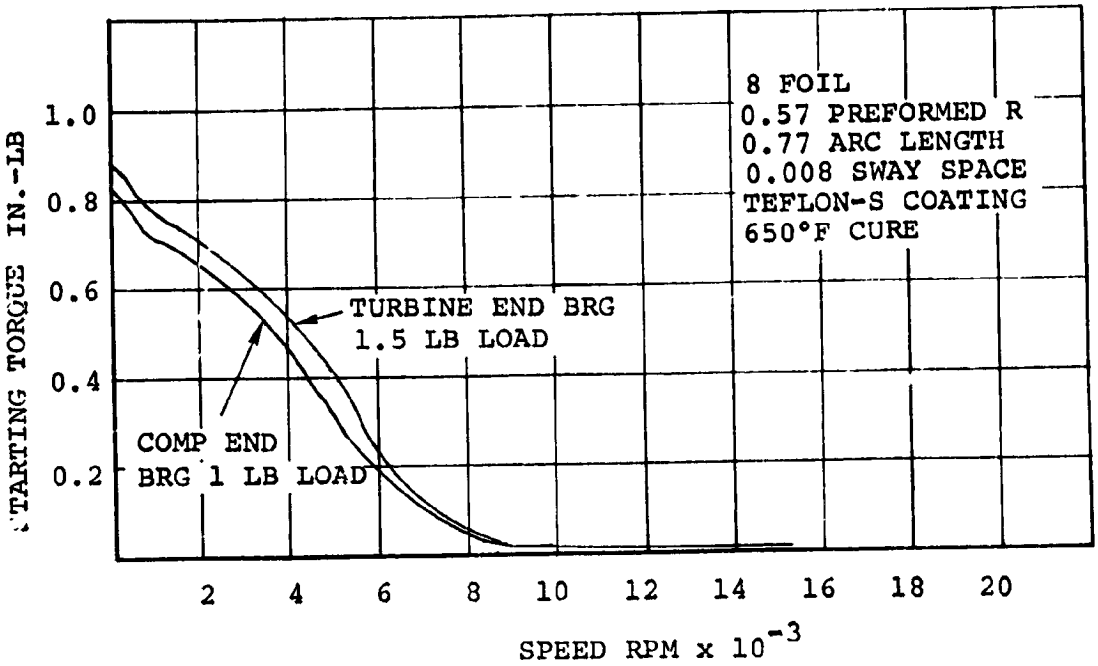


Figure 151. - Starting Torque - Journal Bearing - Mini-BRU.

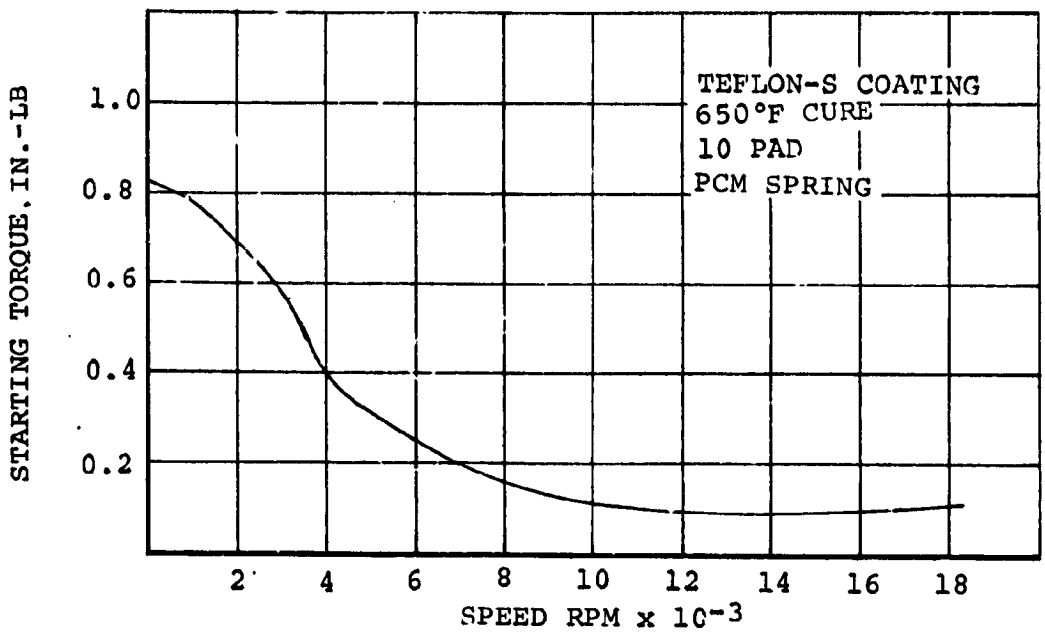


Figure 152. - Starting Torque - Thrust Bearing - Mini-BRU.

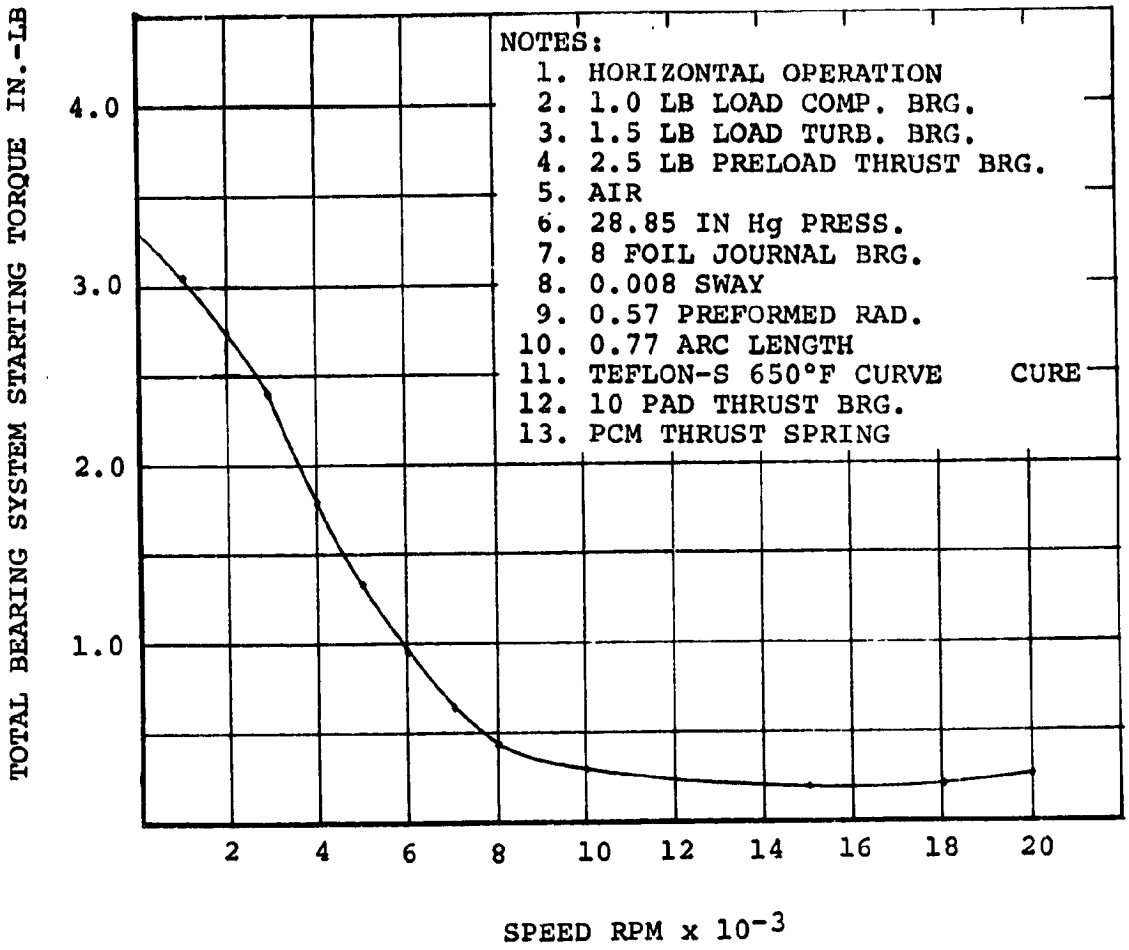


Figure 153. - Starting Torque - Mini-BRU.

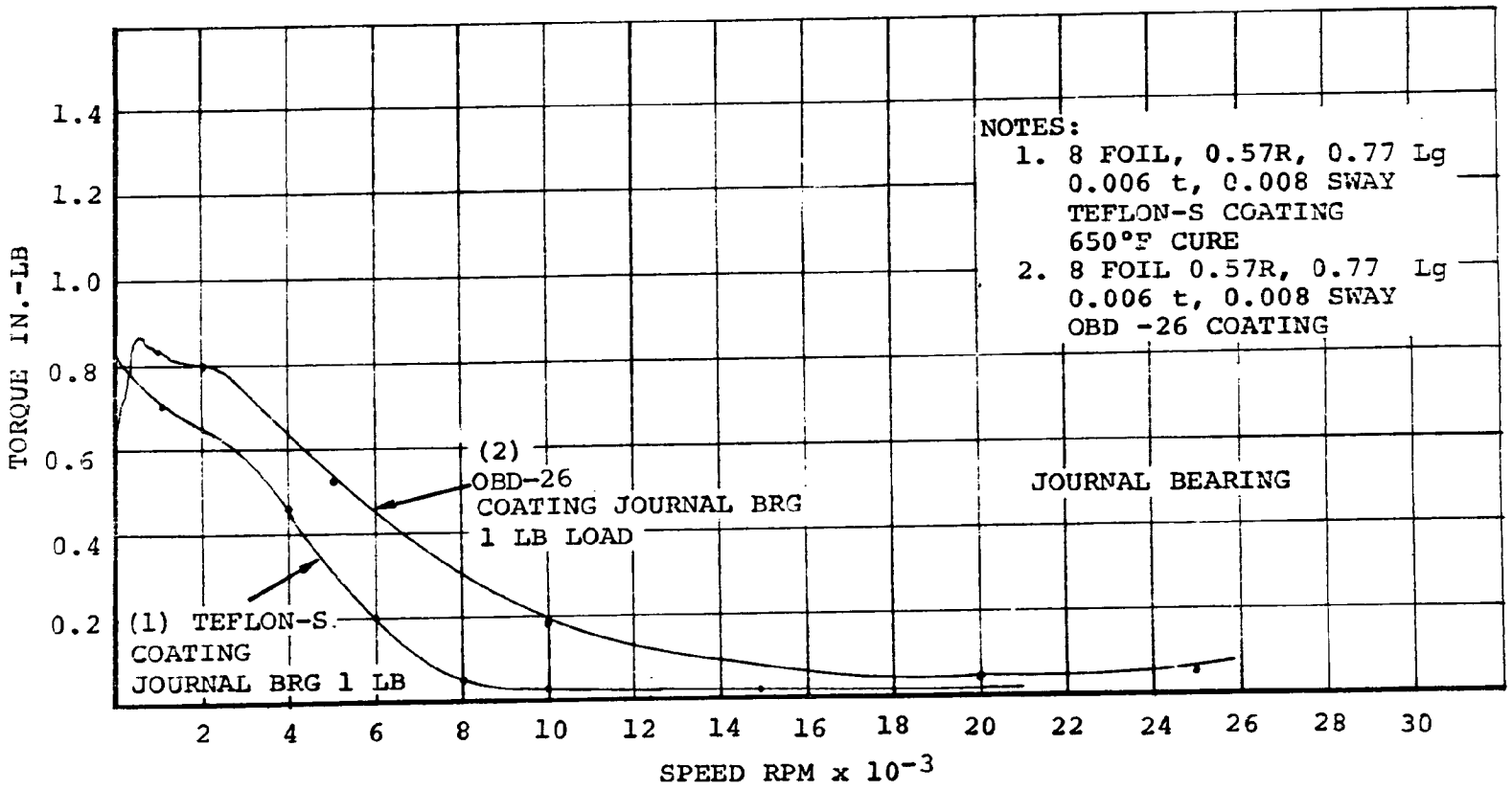


Figure 154. - Starting Torque Comparison Teflon-S/OBD-26 Coatings.

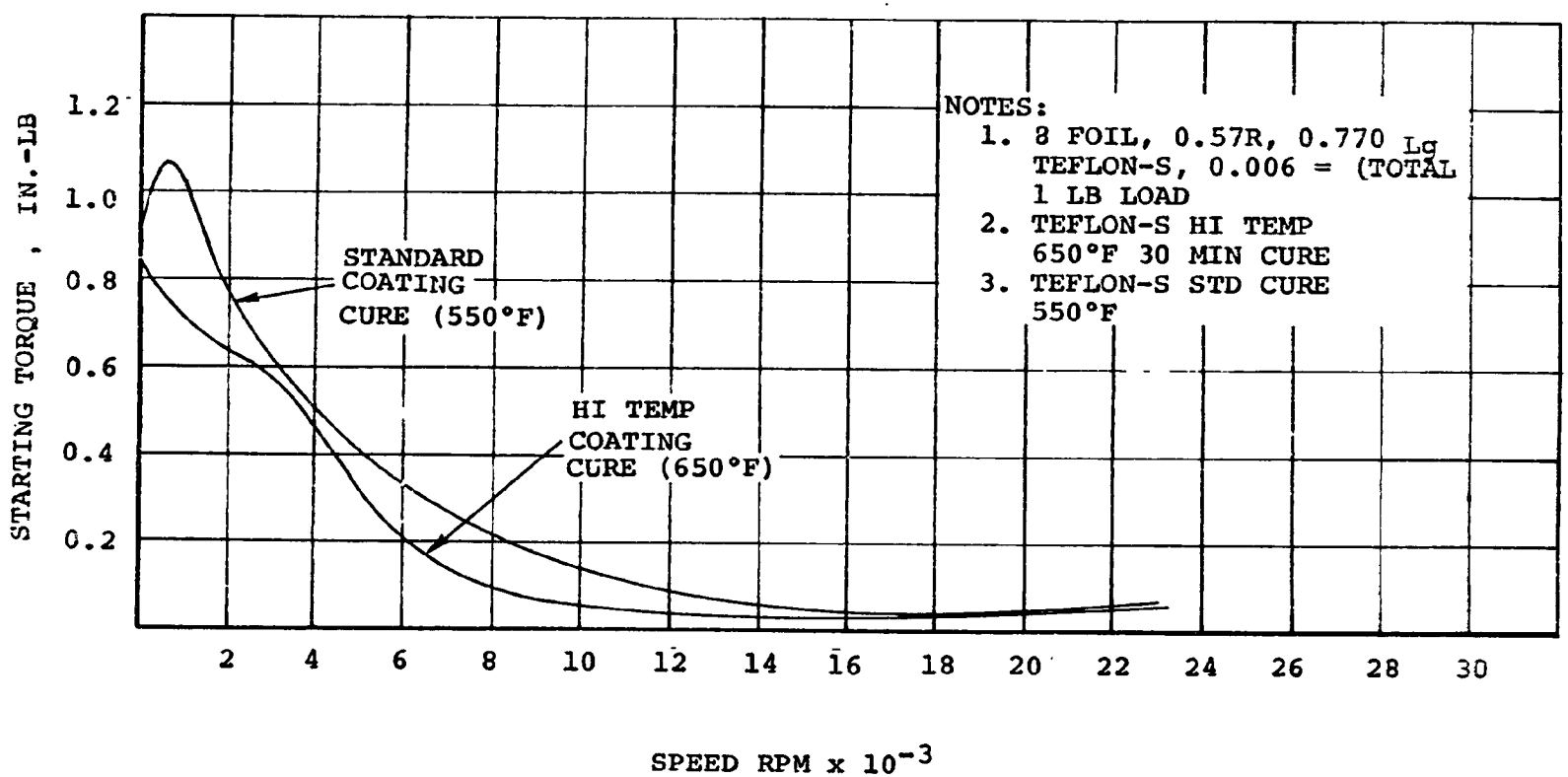


Figure 155. - Starting Torque, Journal Bearing, Mini-BRU, Coating Cures.

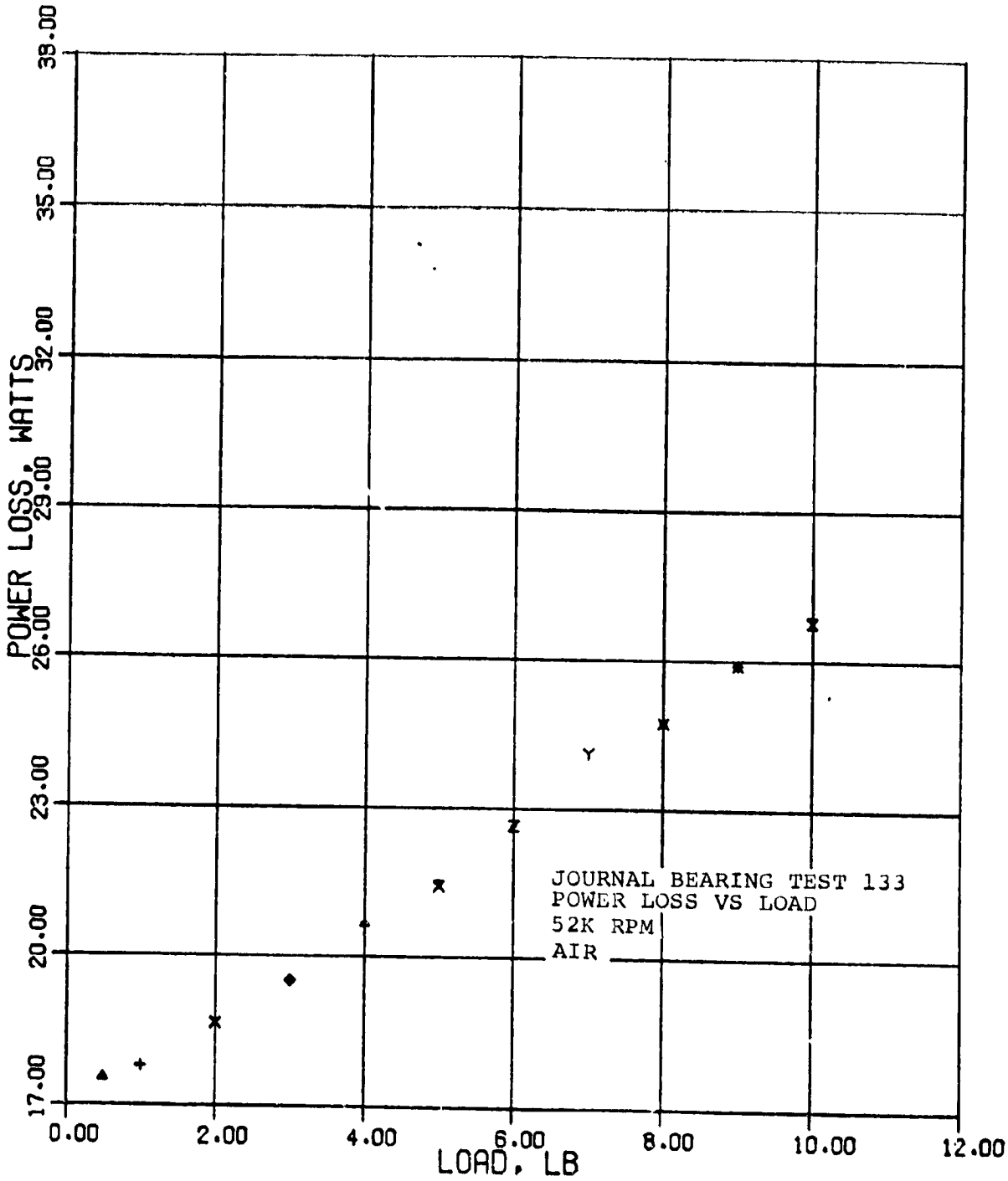


Figure 156. - Journal Bearing Test 133, Power Loss Versus Load, 52K RPM, Air.

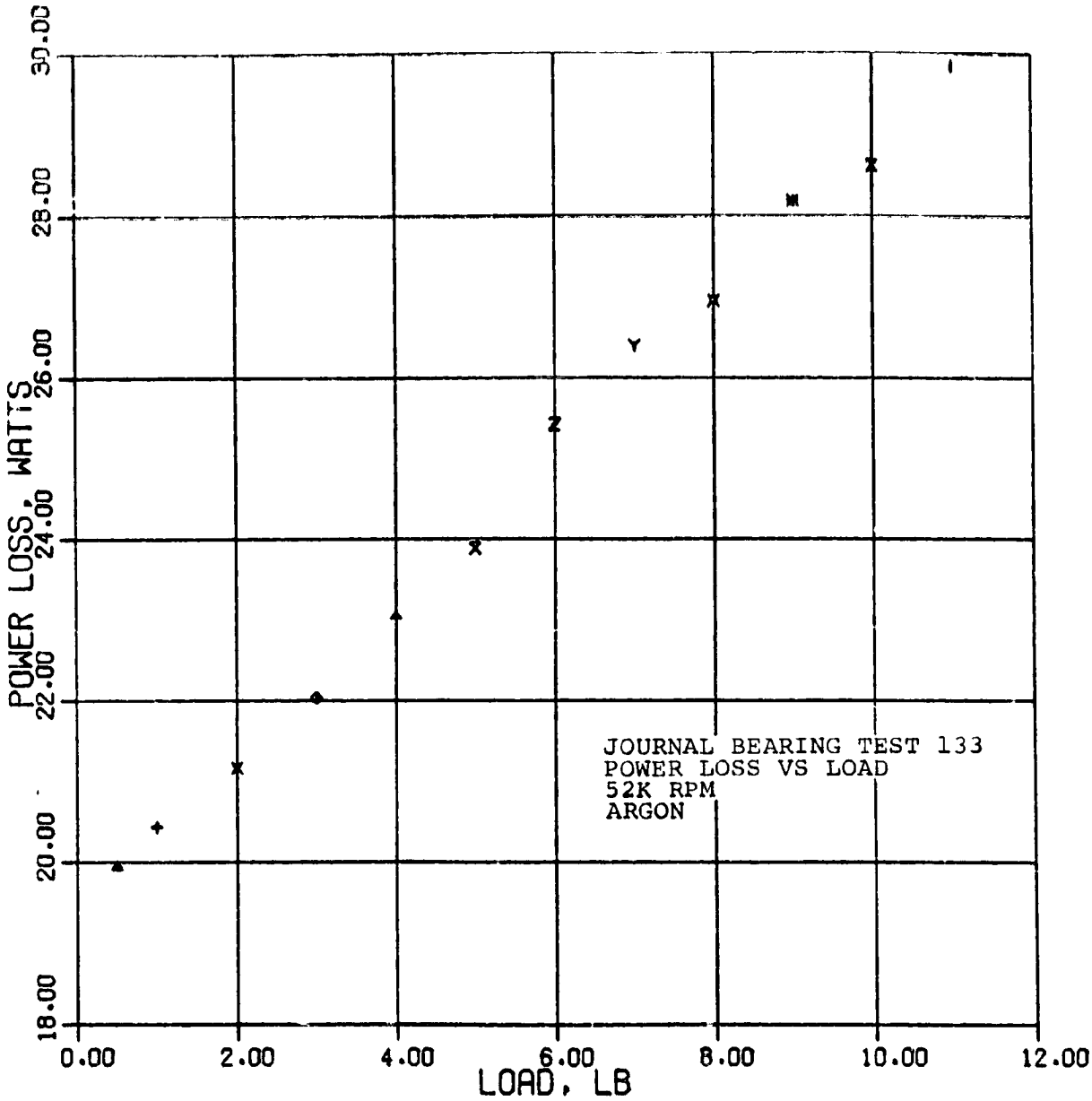
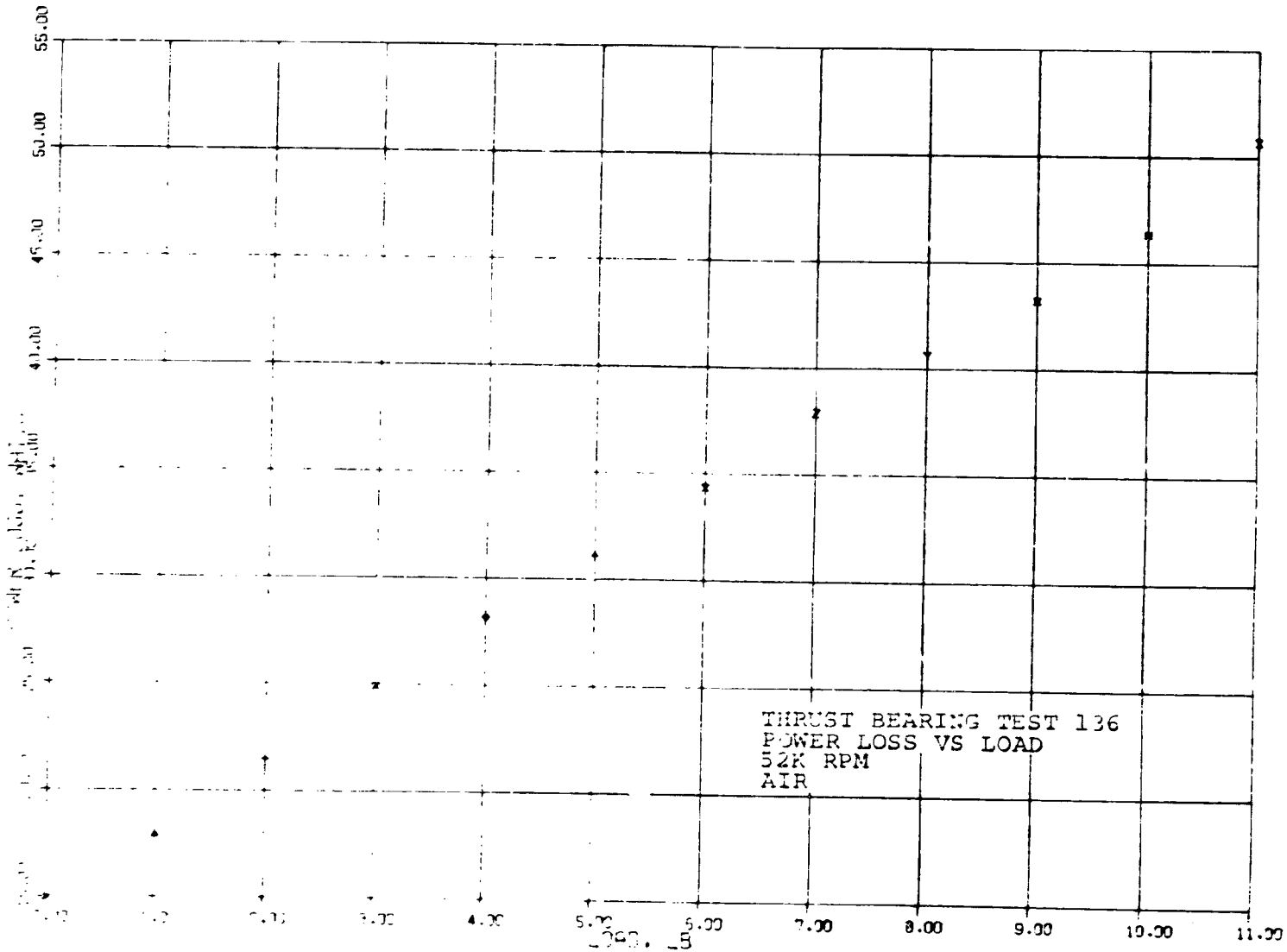


Figure 157. - Journal Bearing Test 133, Power Loss Versus Load, 52K RPM, Argon.



[illegible] Thrust Bearing Test 136, Power Loss Versus Load, [illegible]

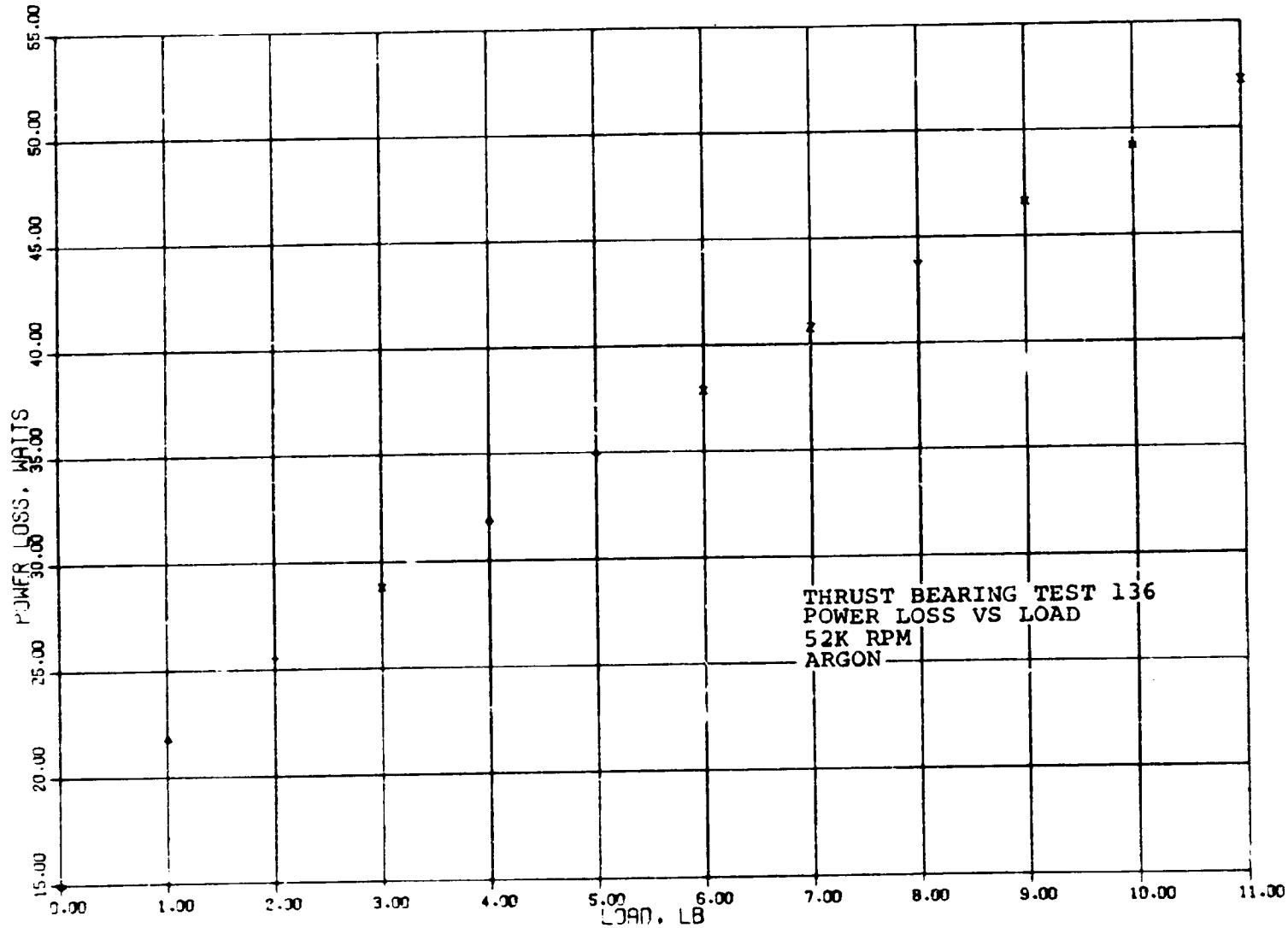


Figure 159. - Thrust Bearing Test 136, Power Loss Versus Load, 52K RPM, Argon.

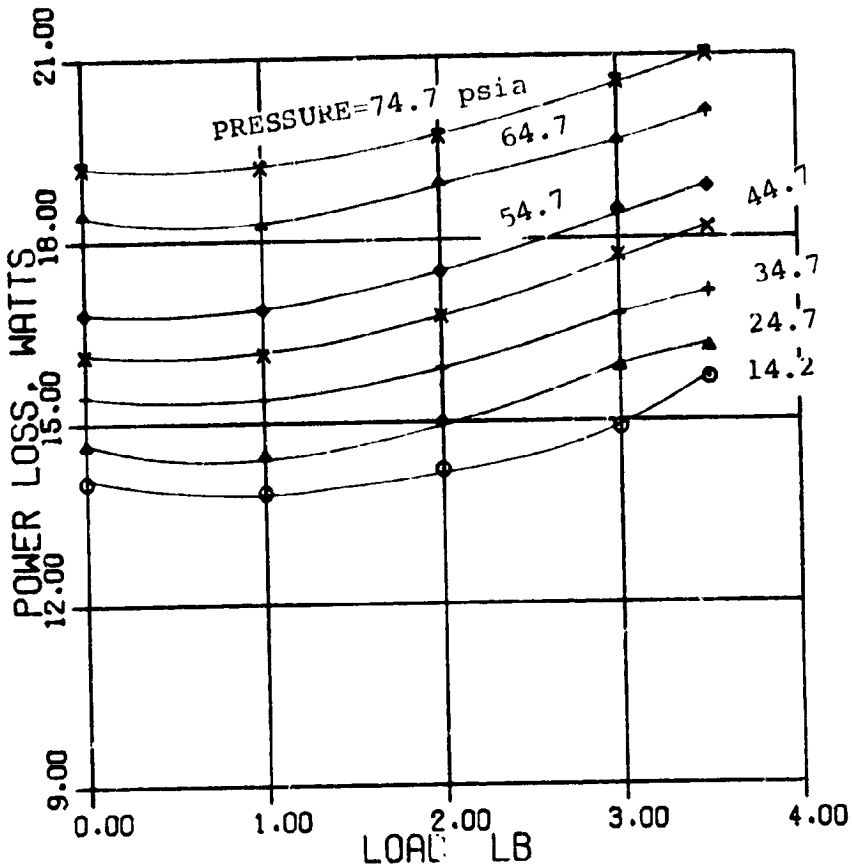


Figure 160. - Journal Bearing Test 128, Power Loss Versus Load, 52K RPM, Air.

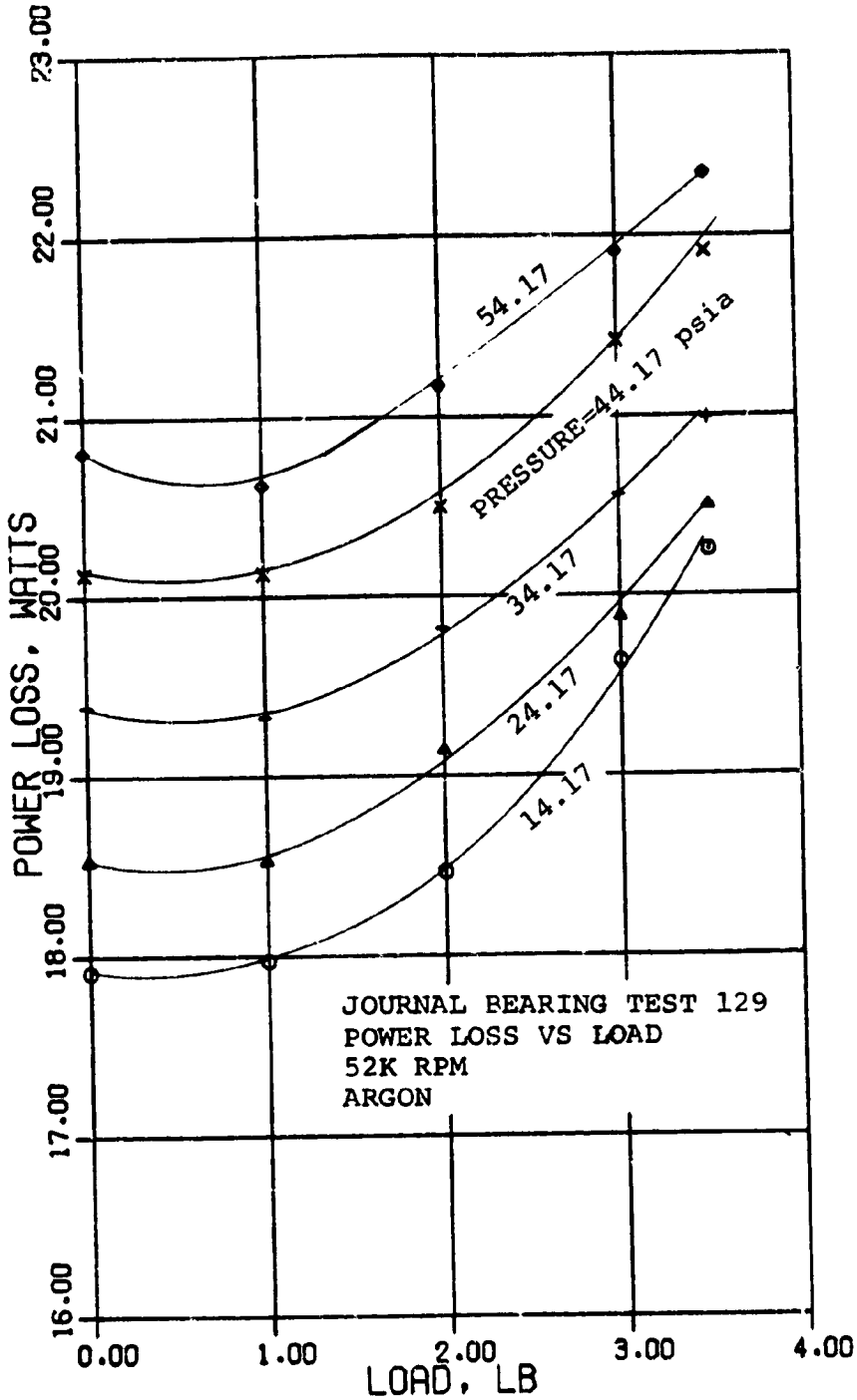


Figure 161. - Journal Bearing Test 129, Power Loss Versus Load, 52K RPM, Argon.

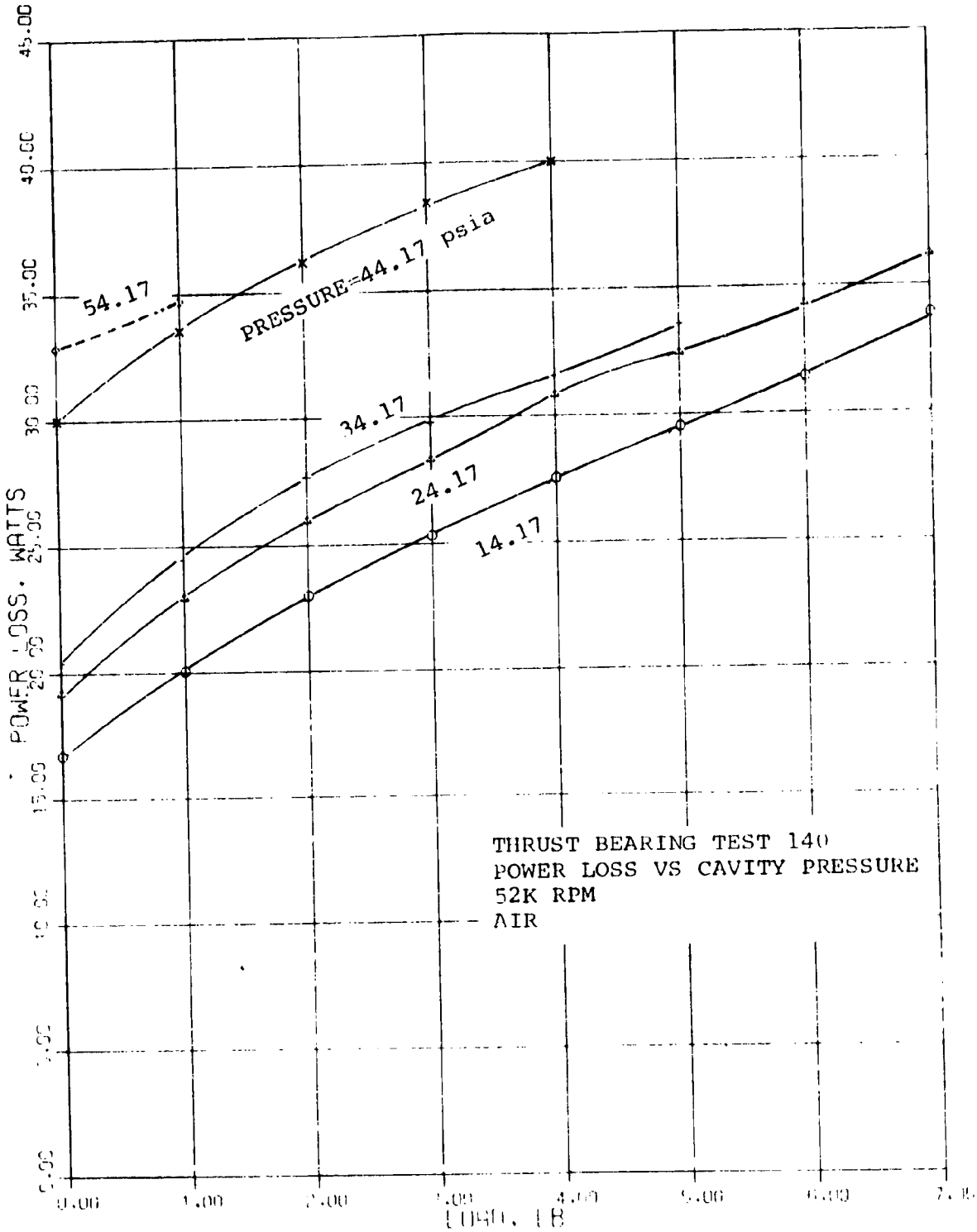


Figure 162. - Thrust Bearing Test 140, Power Loss Versus Cavity Pressure, 52K RPM, Air.

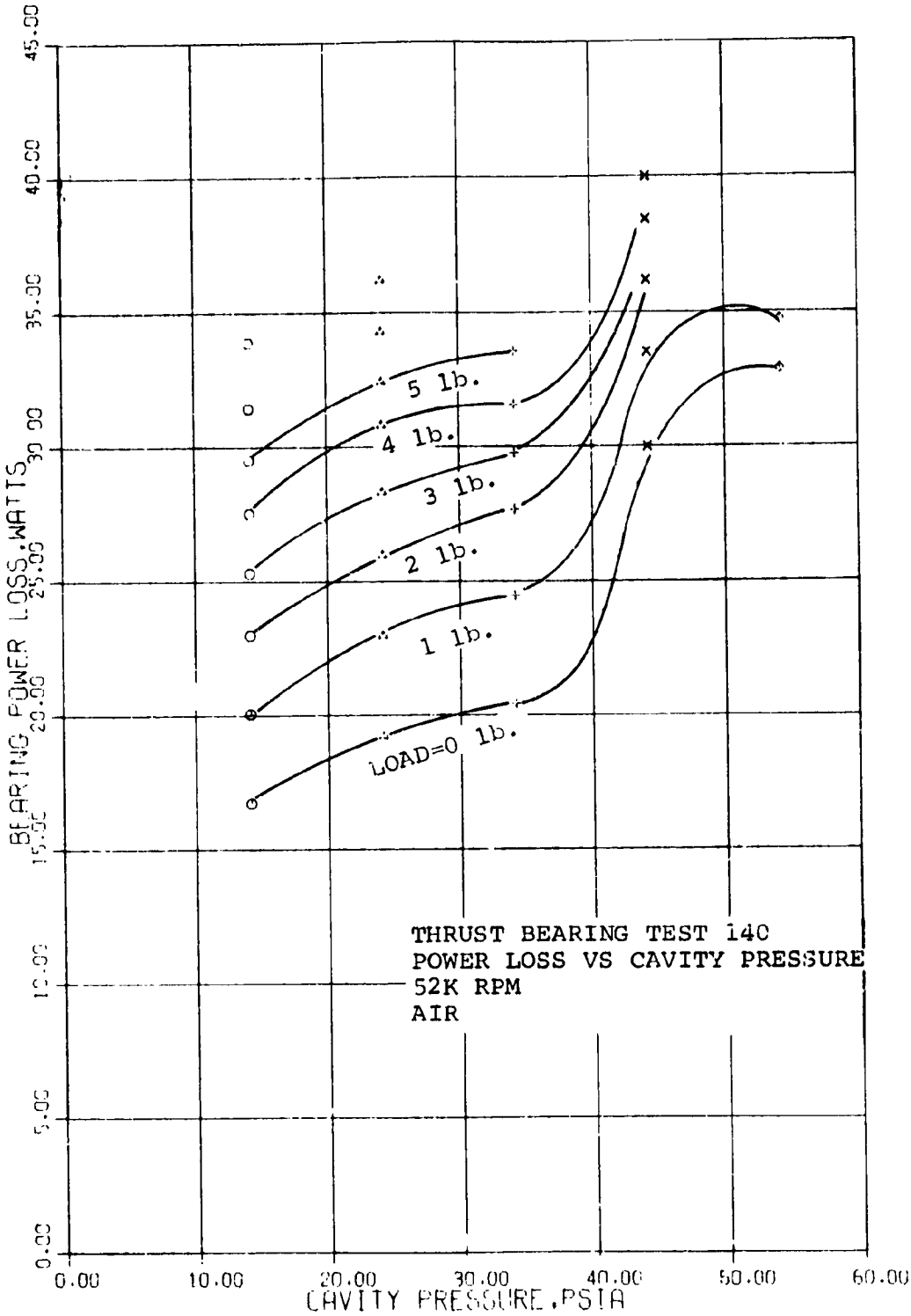


Figure 163. - Thrust Bearing Test 140, Power Loss Versus Cavity Pressure, 52K RPM, Air.

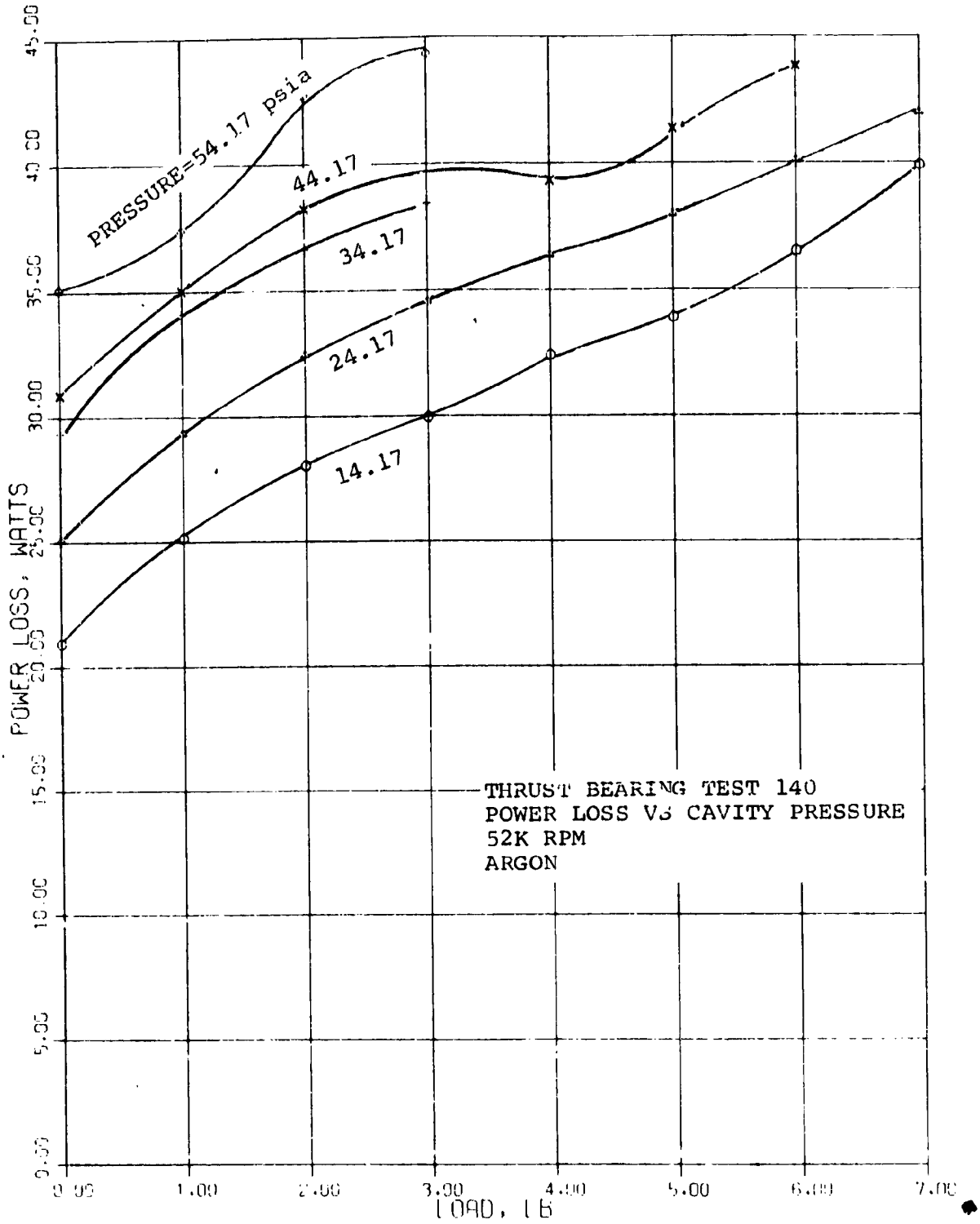


Figure 164. - Thrust Bearing Test 140, Power Loss Versus Cavity Pressure, 52K RPM, Argon.

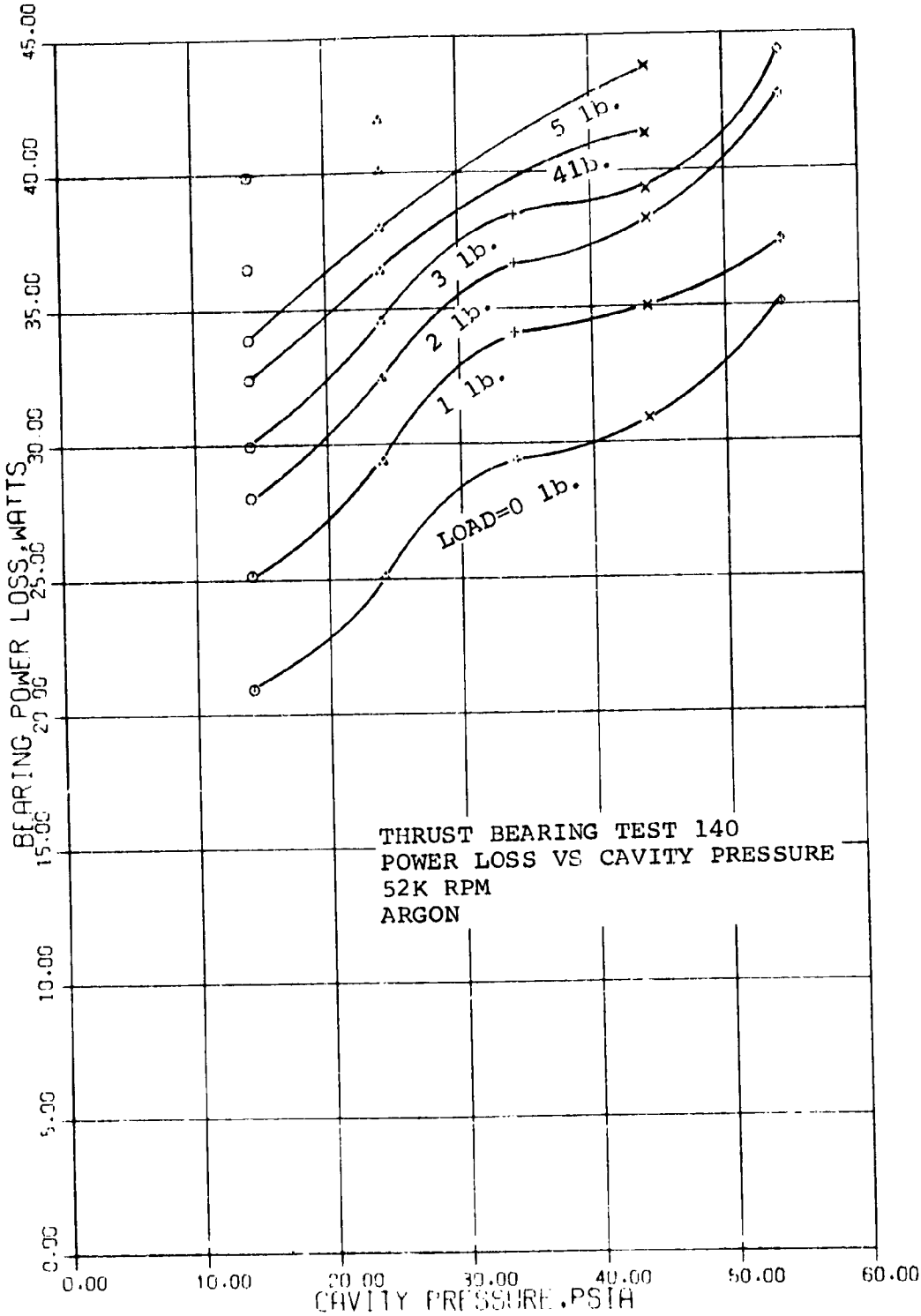


Figure 165. - Thrust Bearing Test 140, Power Loss Versus Cavity Pressure, 52K RPM, Argon.

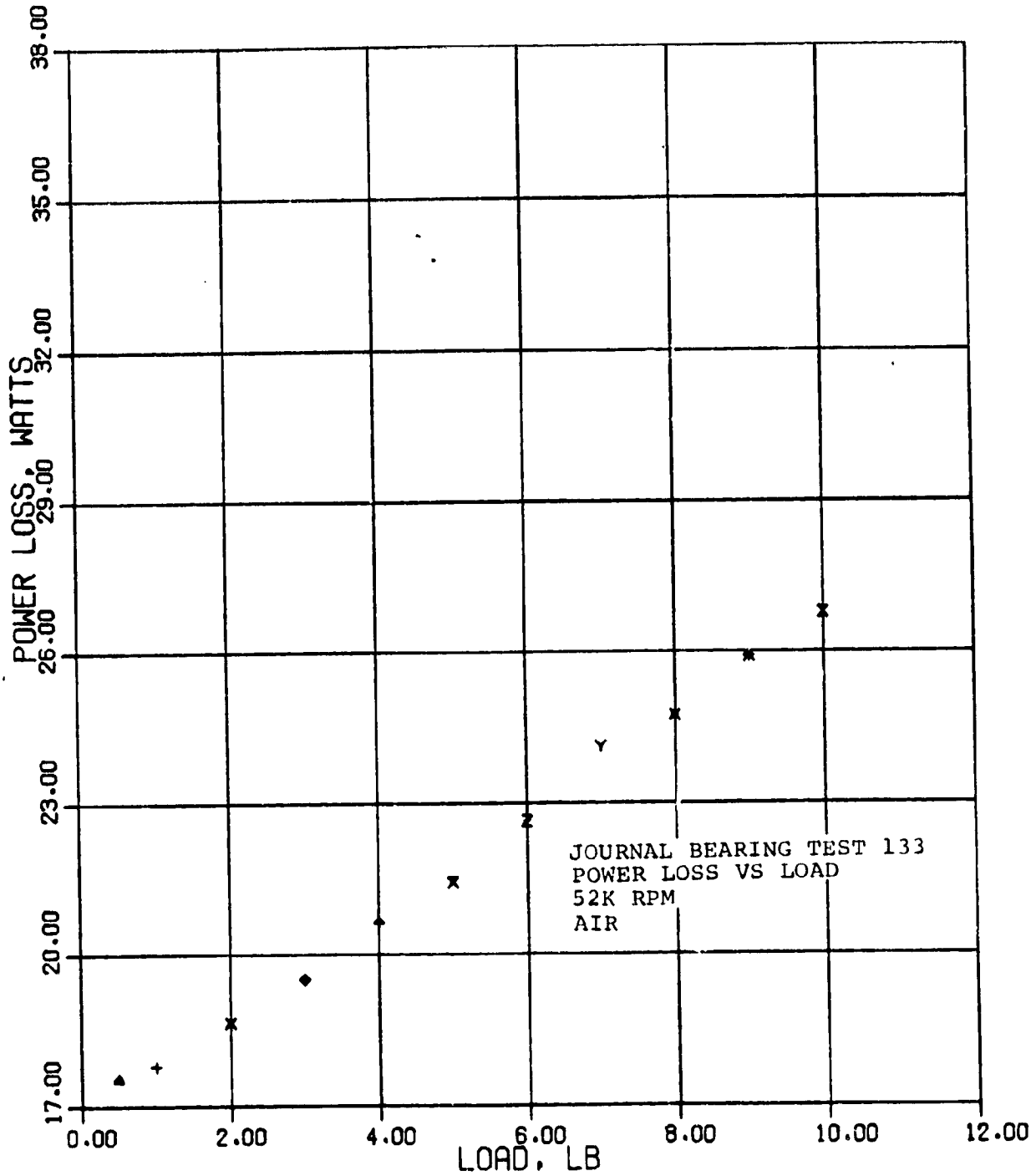


Figure 166. - Journal Bearing Test 133, Power Loss Versus Load, 52K RPM, Air.

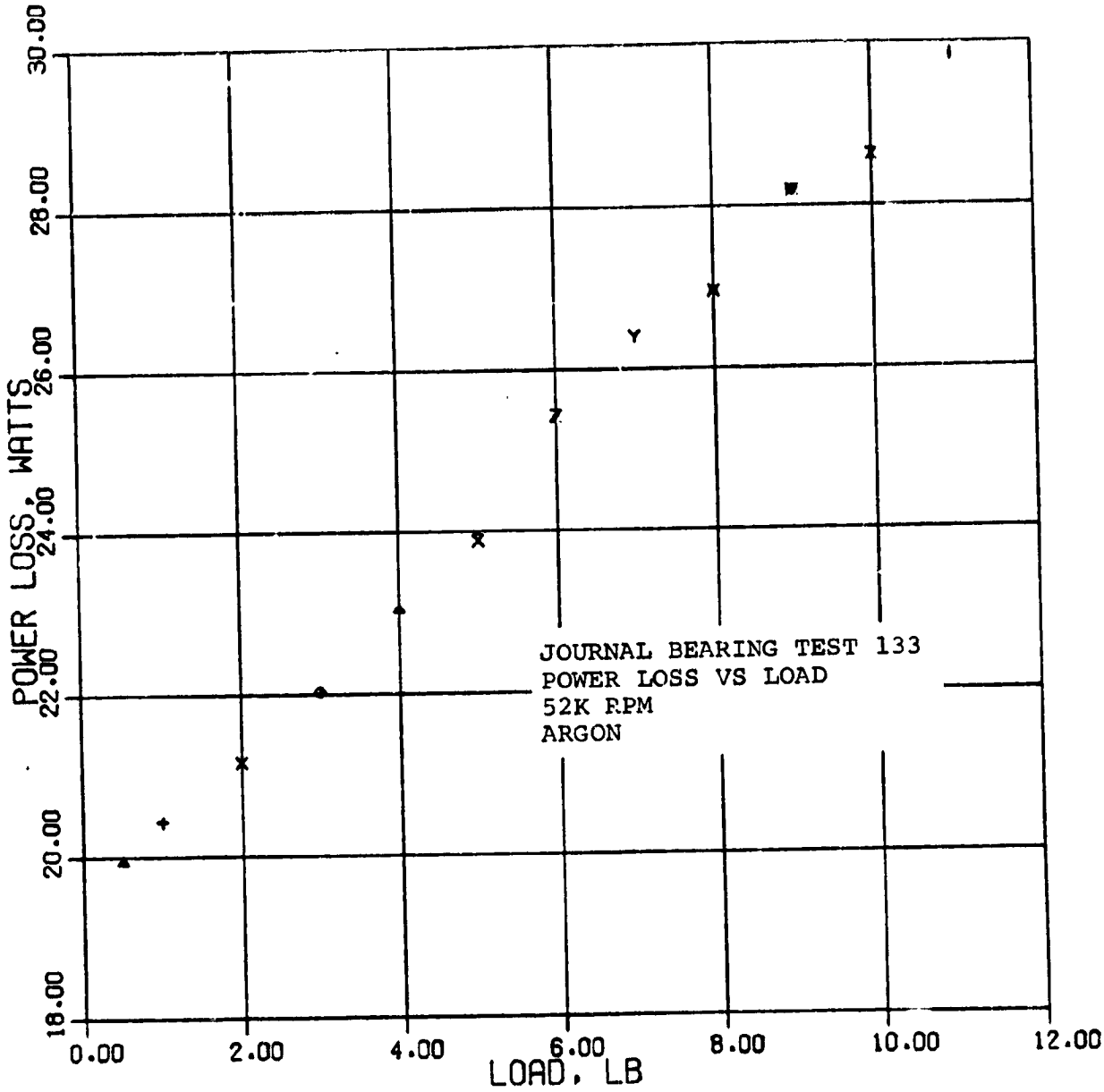


Figure 167. - Journal Bearing Test 133, Power Loss Versus Load, 52K RPM, Argon.

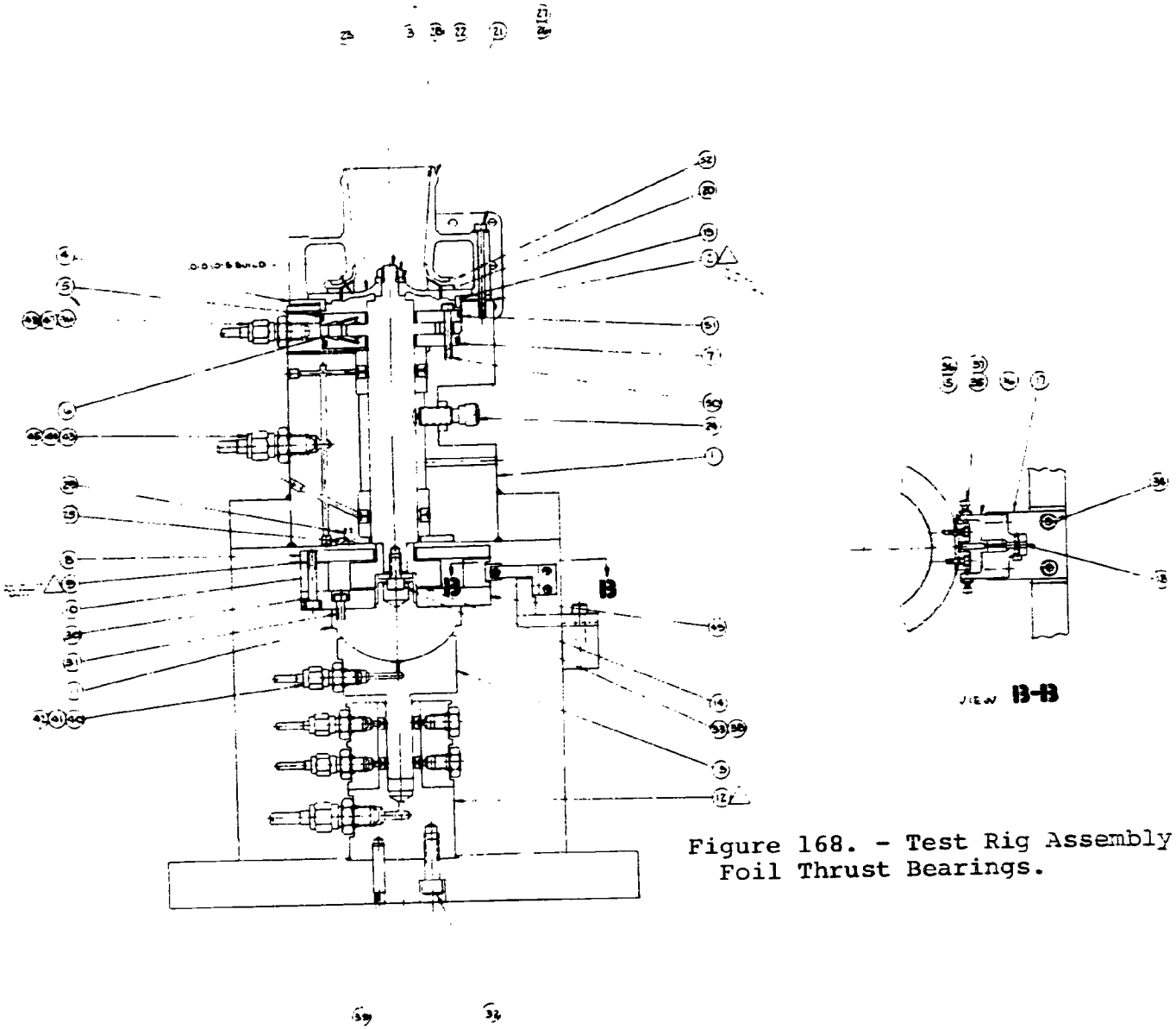


Figure 168. - Test Rig Assembly, Mini-BRU Foil Thrust Bearings.

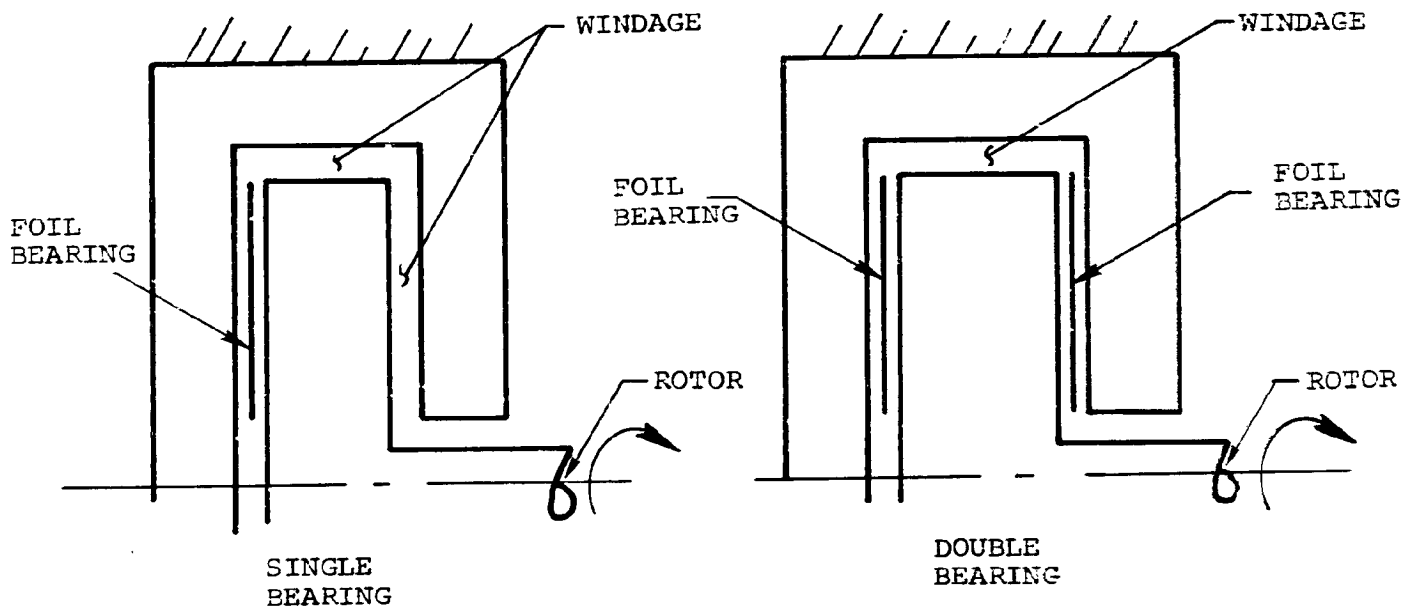


Figure 169. - Windage Generation Around the Rotor.

Figure 170. - Strain Gaged Beam.

MP-57619

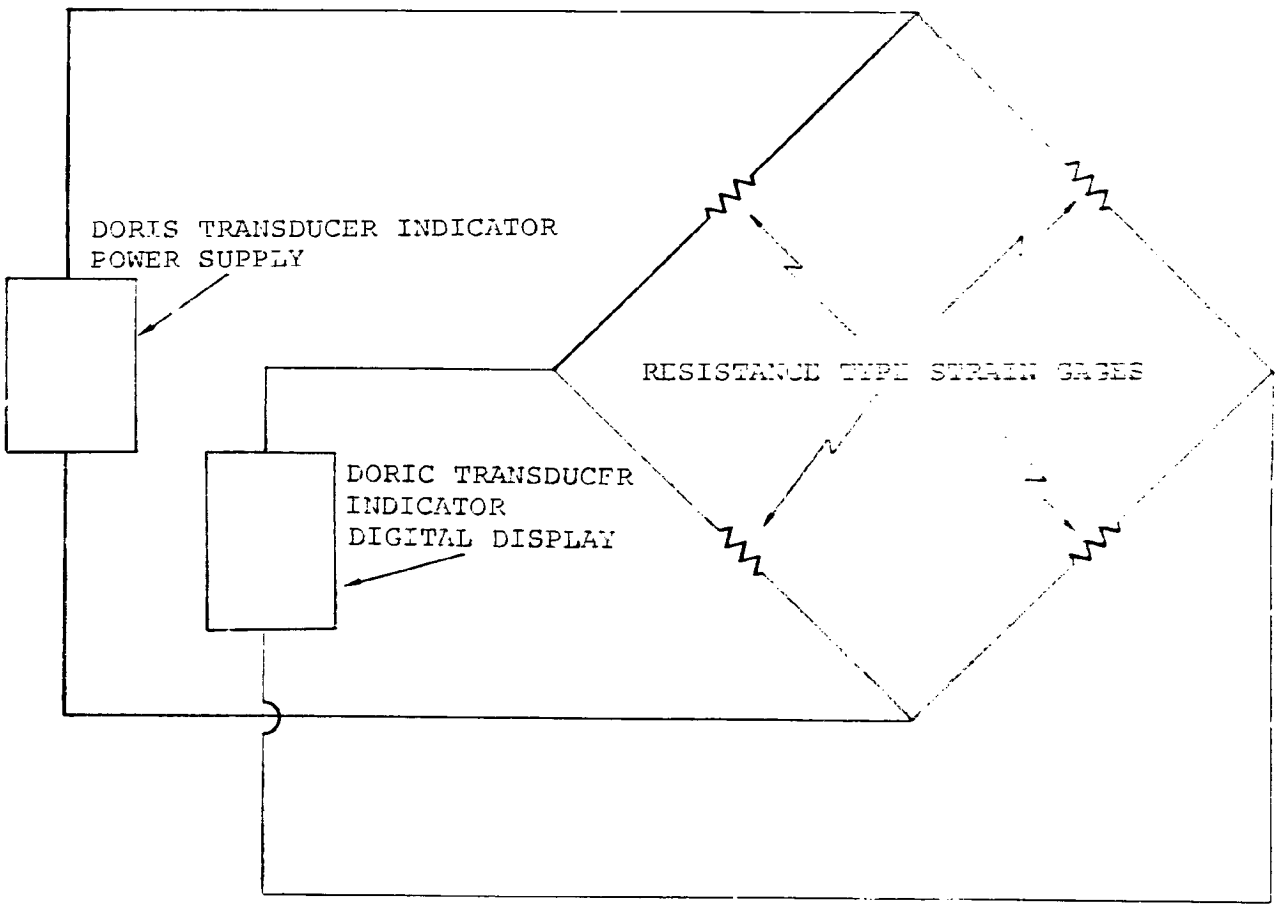


Figure 171. - Strain Gage Bridge Schematic.

Figure 172. - Transducer Indicator.

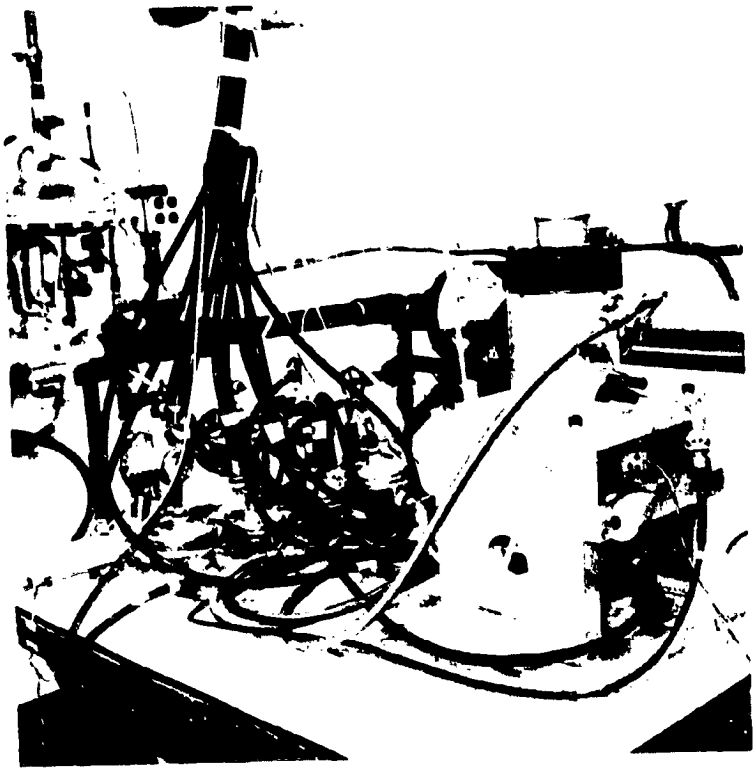


Figure 173. - Thrust Bearing Test Rig.

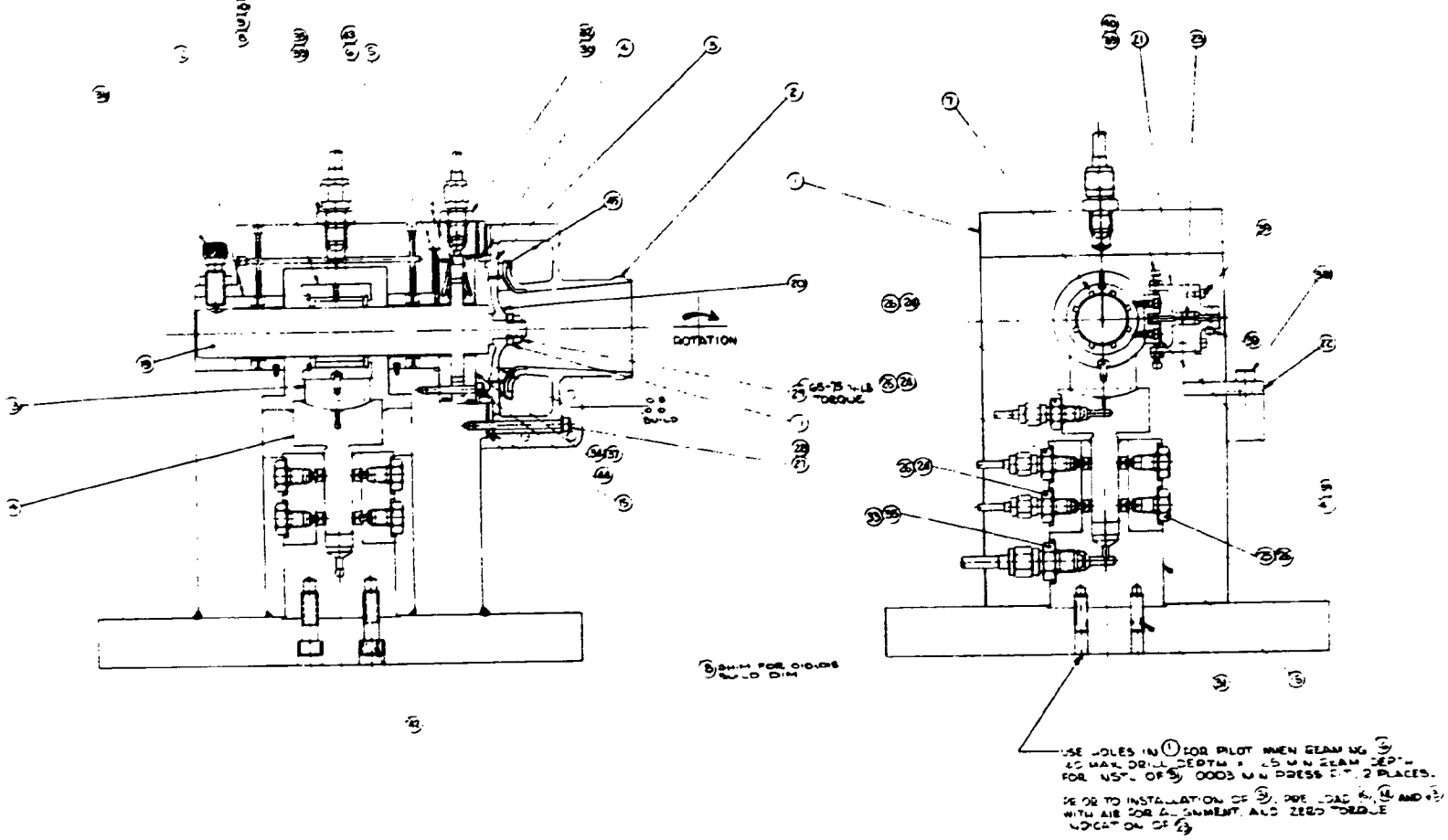


Figure 174. - Test Rig Assembly, Mini-BRU Thrust Bearings.

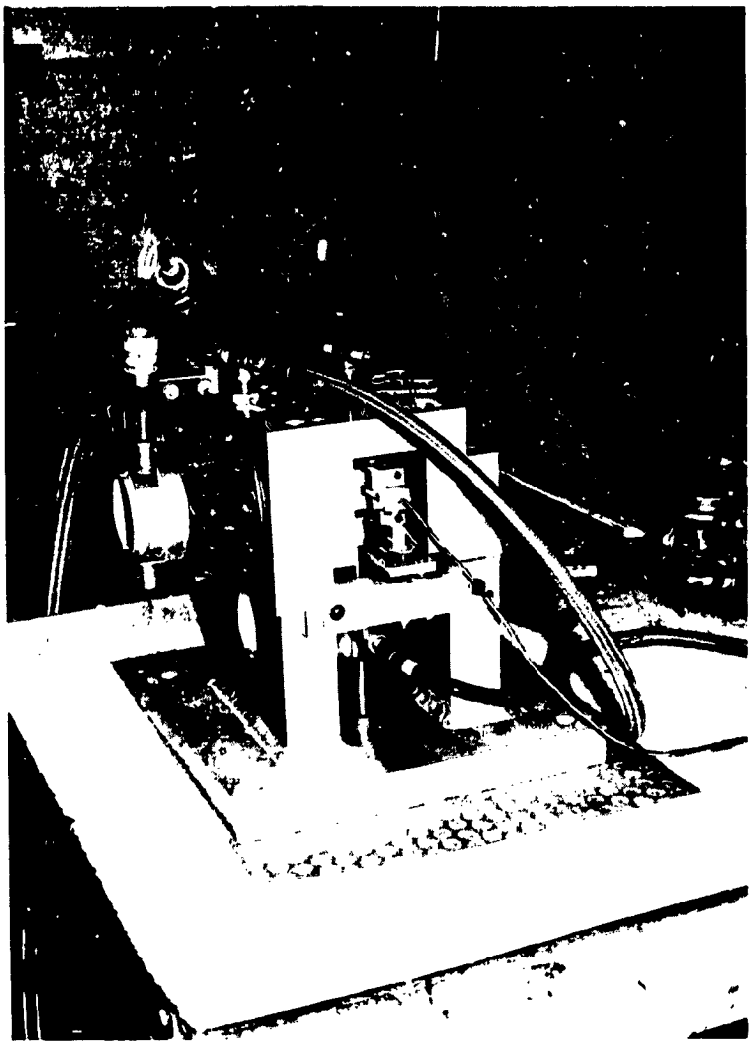


Figure 175. - Journal Bearing Test Rig.

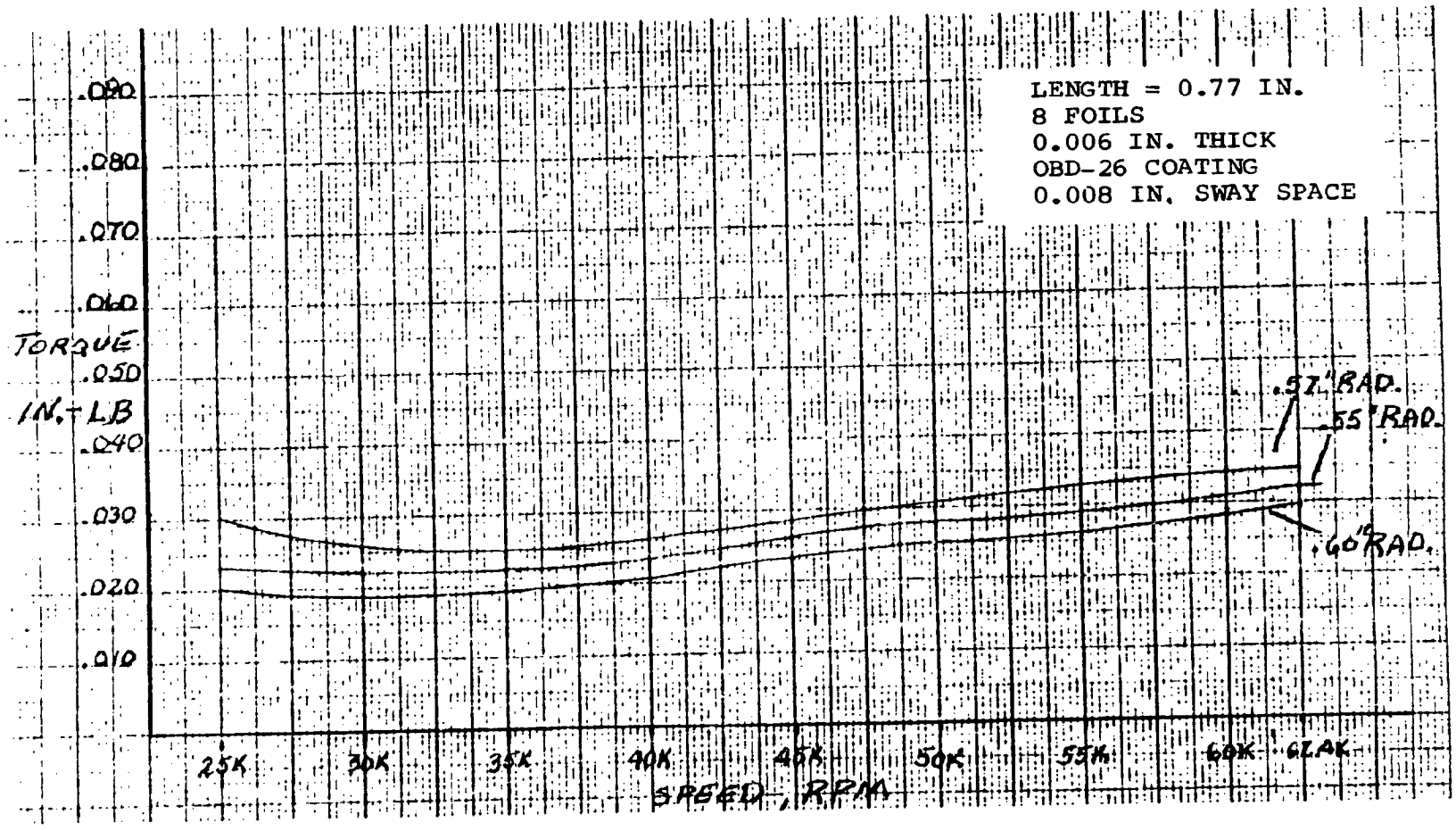


Figure 176. - Mini-BRU Journal Bearing Torque Versus Speed for Three Values of Radius of Curvature.

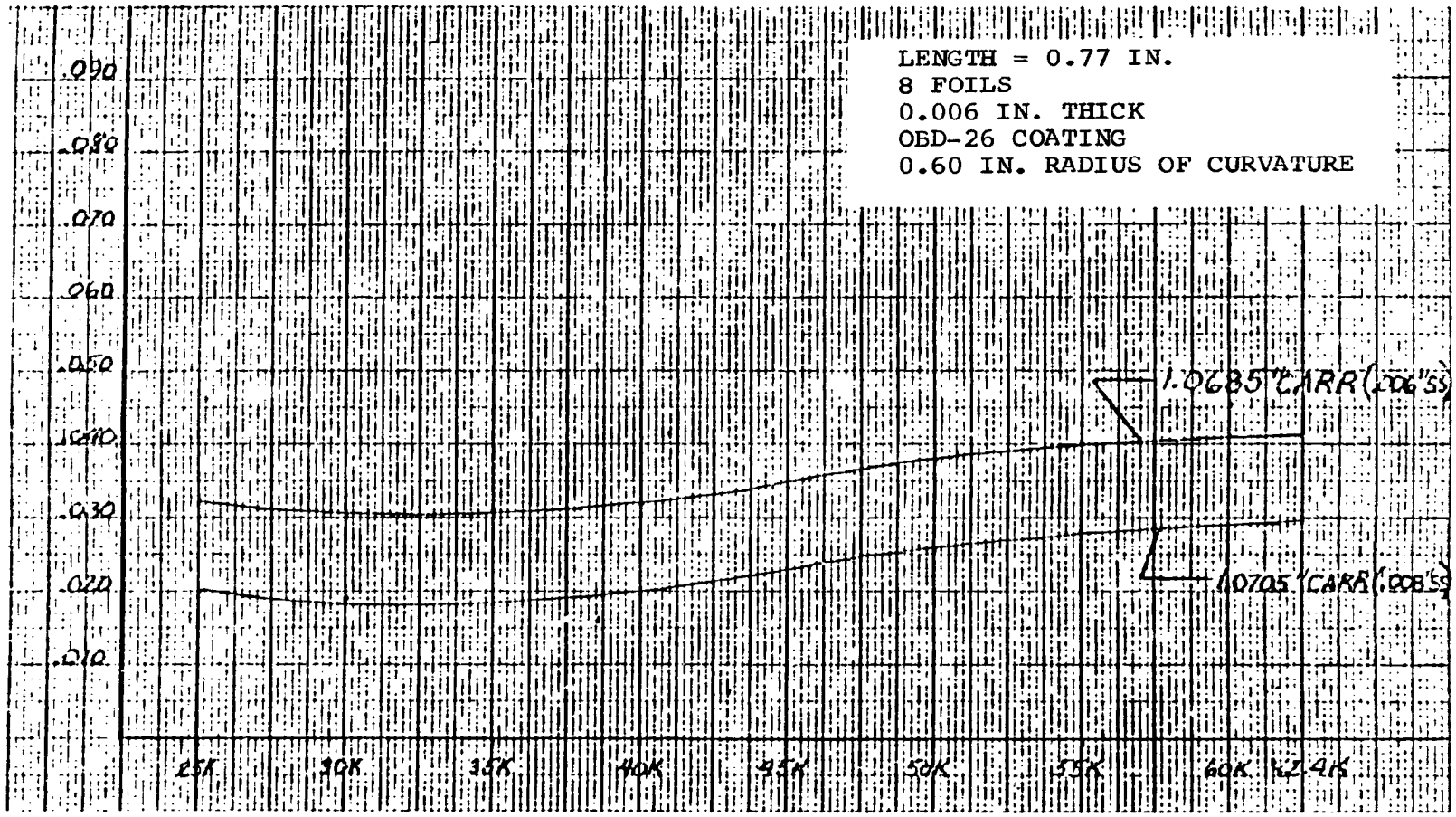


Figure 177. - Mini-BRU Journal Bearing Torque Versus Speed for Two Values of Sway Space.

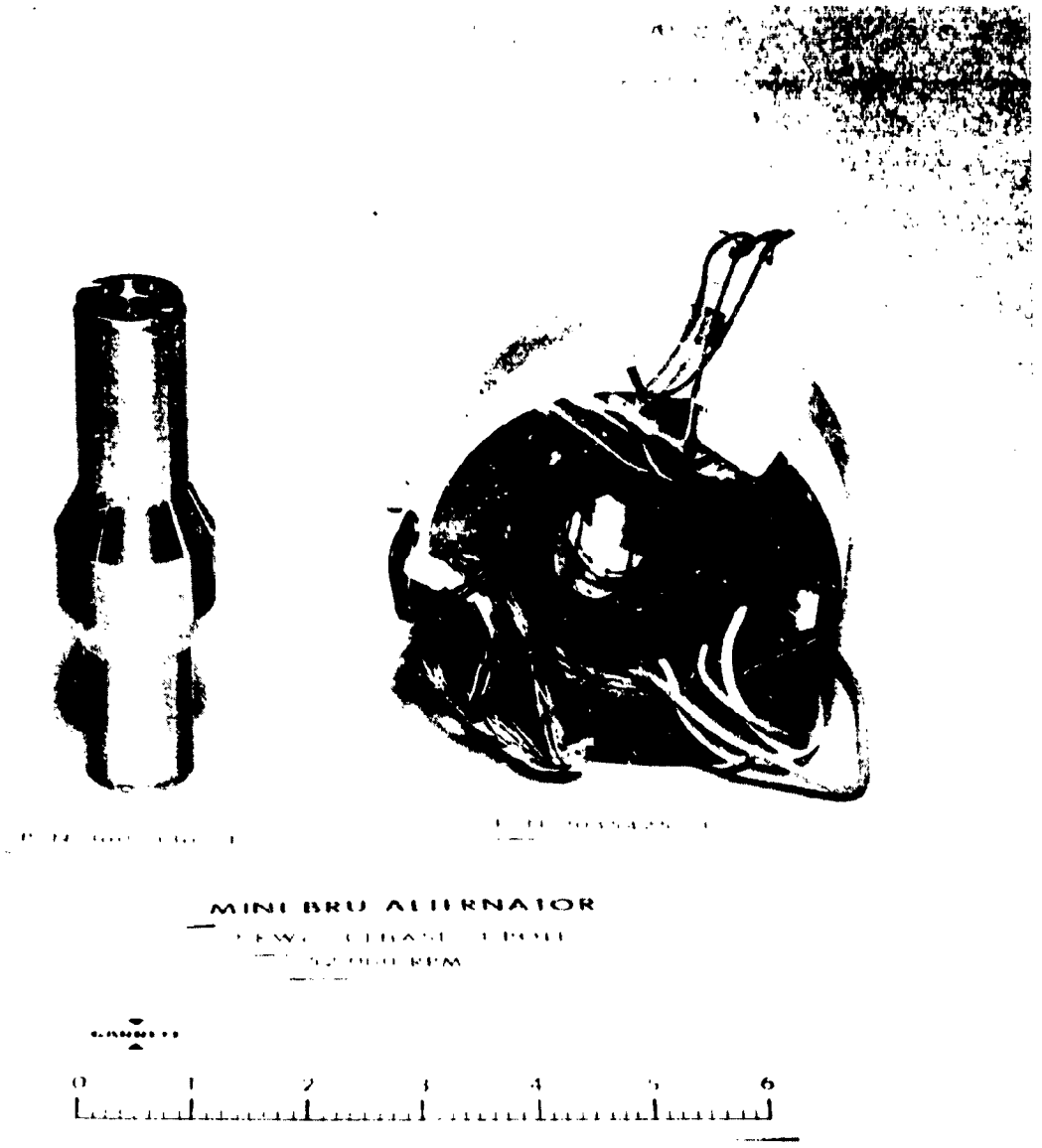


Figure 178. - Mini-BRU Alternator Assembly.

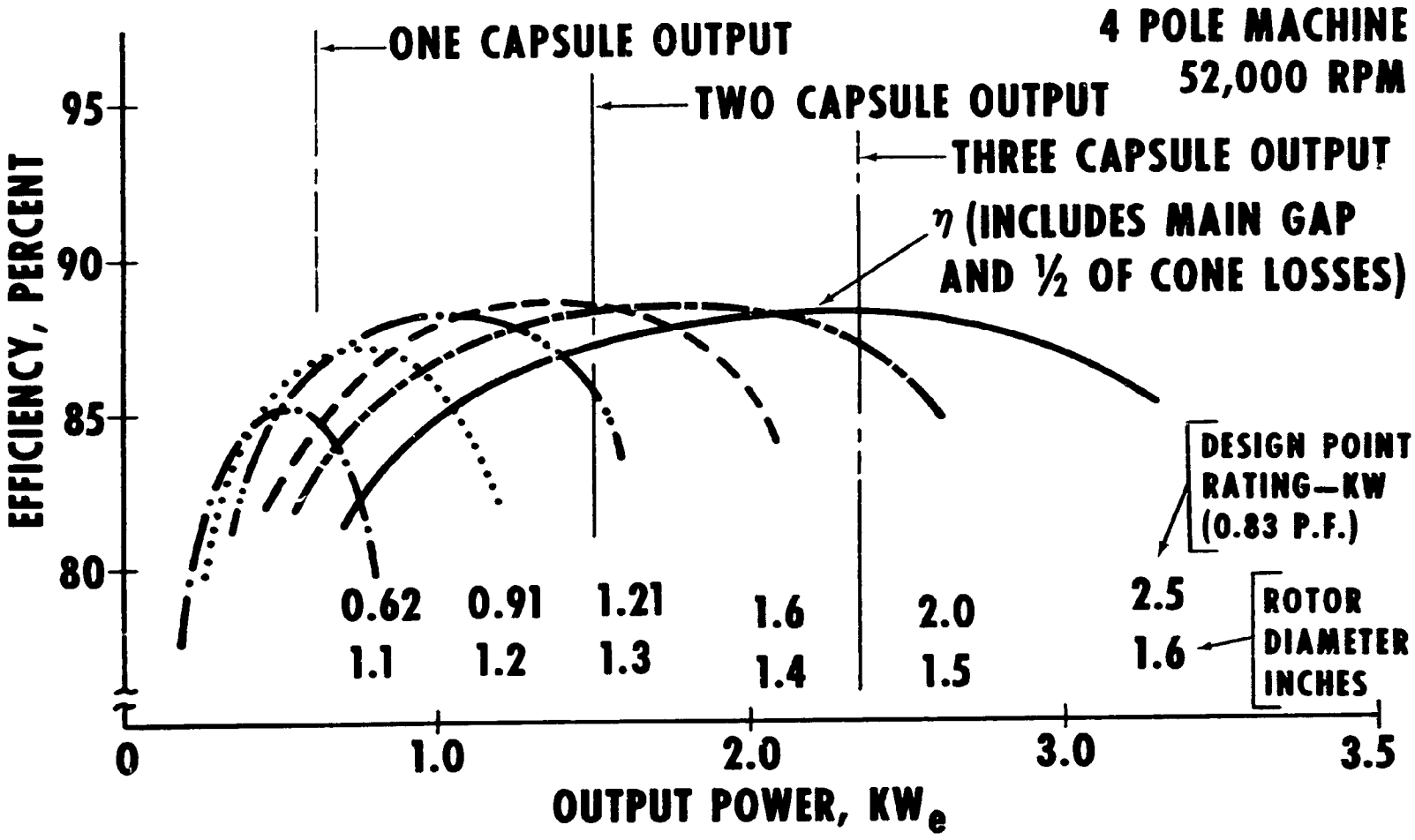
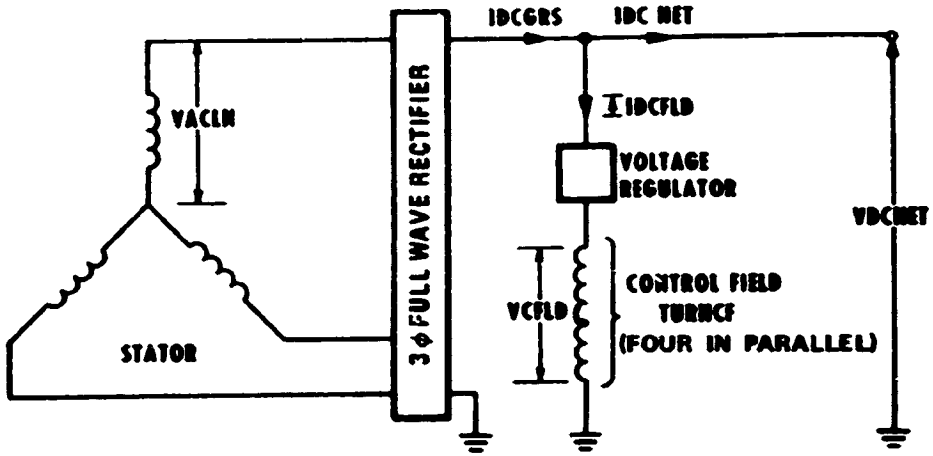


Figure 179. - Alternator Efficiency Data.



IDCGRS - TOTAL DC CURRENT FROM RECTIFIER, AMPS

IDCFLD - CONTROL FIELD CURRENT, AMPS

IDCNET - DC LOAD CURRENT, AMPS

VACLN - LINE TO NEUTRAL VOLTAGE, AC VOLTS

VCFLD - VOLTAGE ACROSS CONTROL FIELD, DC VOLTS

VDC NET - DC BUS VOLTAGE, DC VOLTS

TURNCF - TOTAL NUMBER OF TURNS IN CONTROL FIELD

Figure 180. - Wiring Diagram.

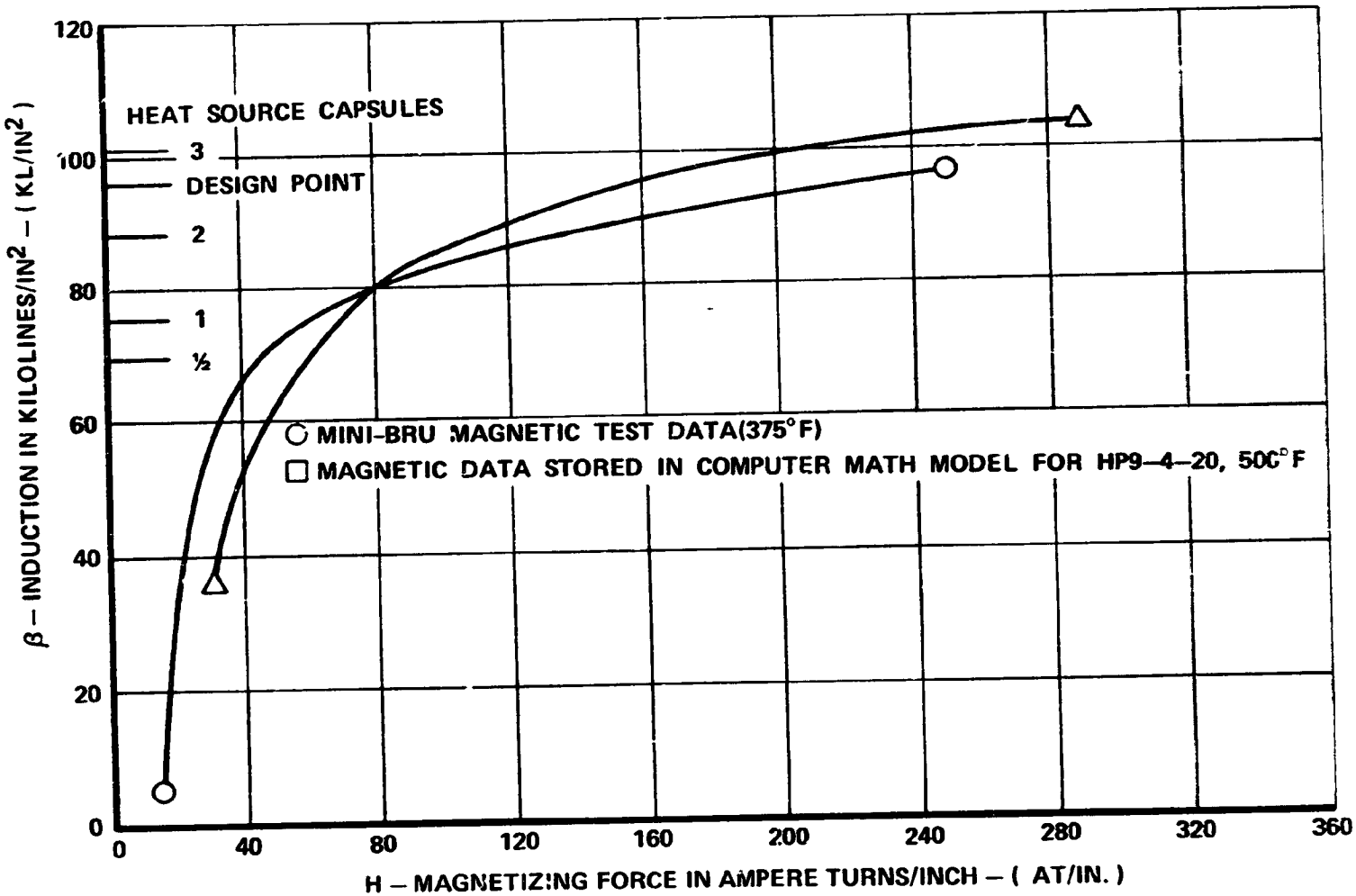


Figure 181. - Comparison of Magnetic Test Data to Mini-BRU Design Specification.

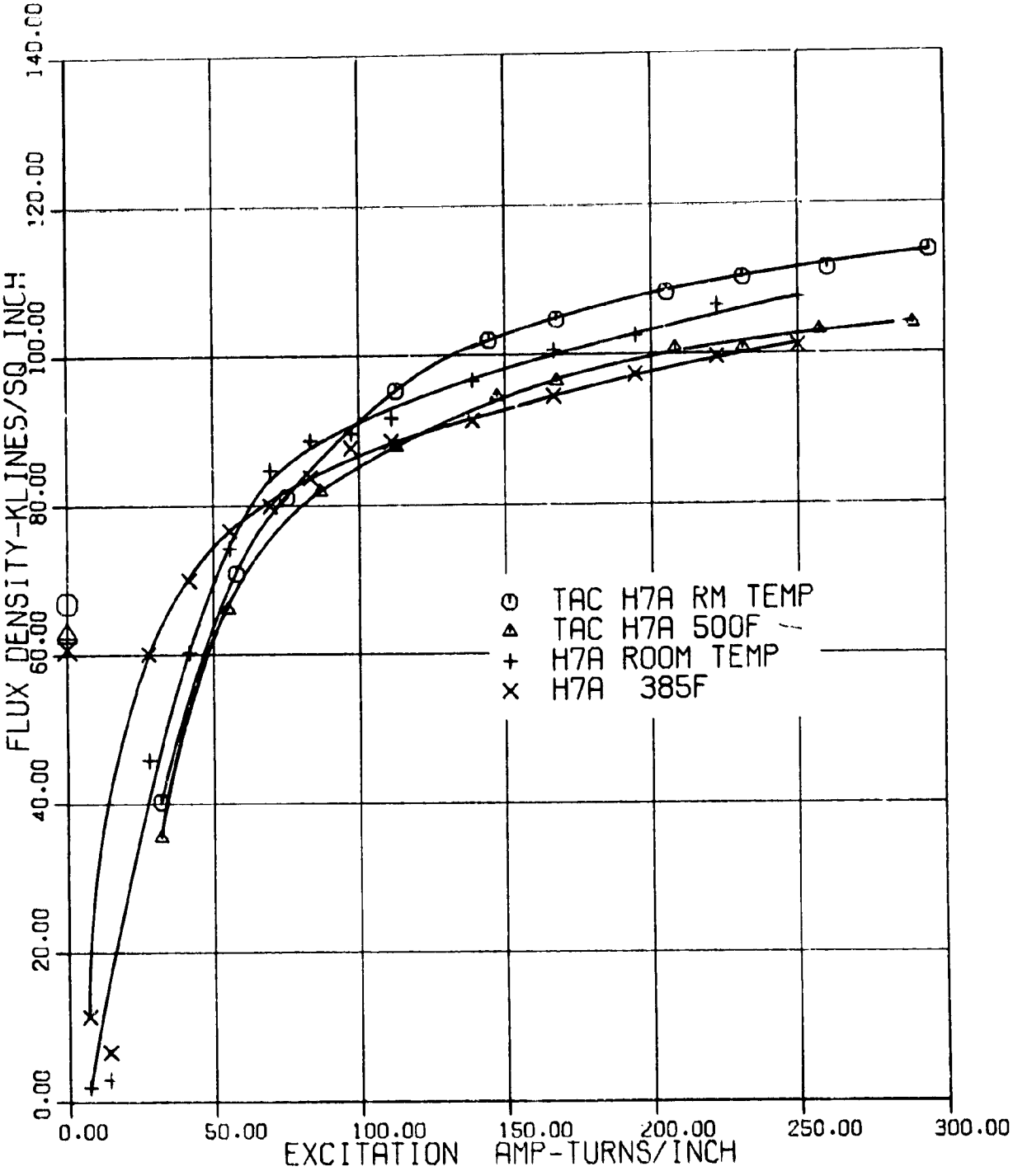


Figure 182. - Comparison of Magnetic Test Data for TAC and Mini-BRU Rotor Heat Treat Processes.

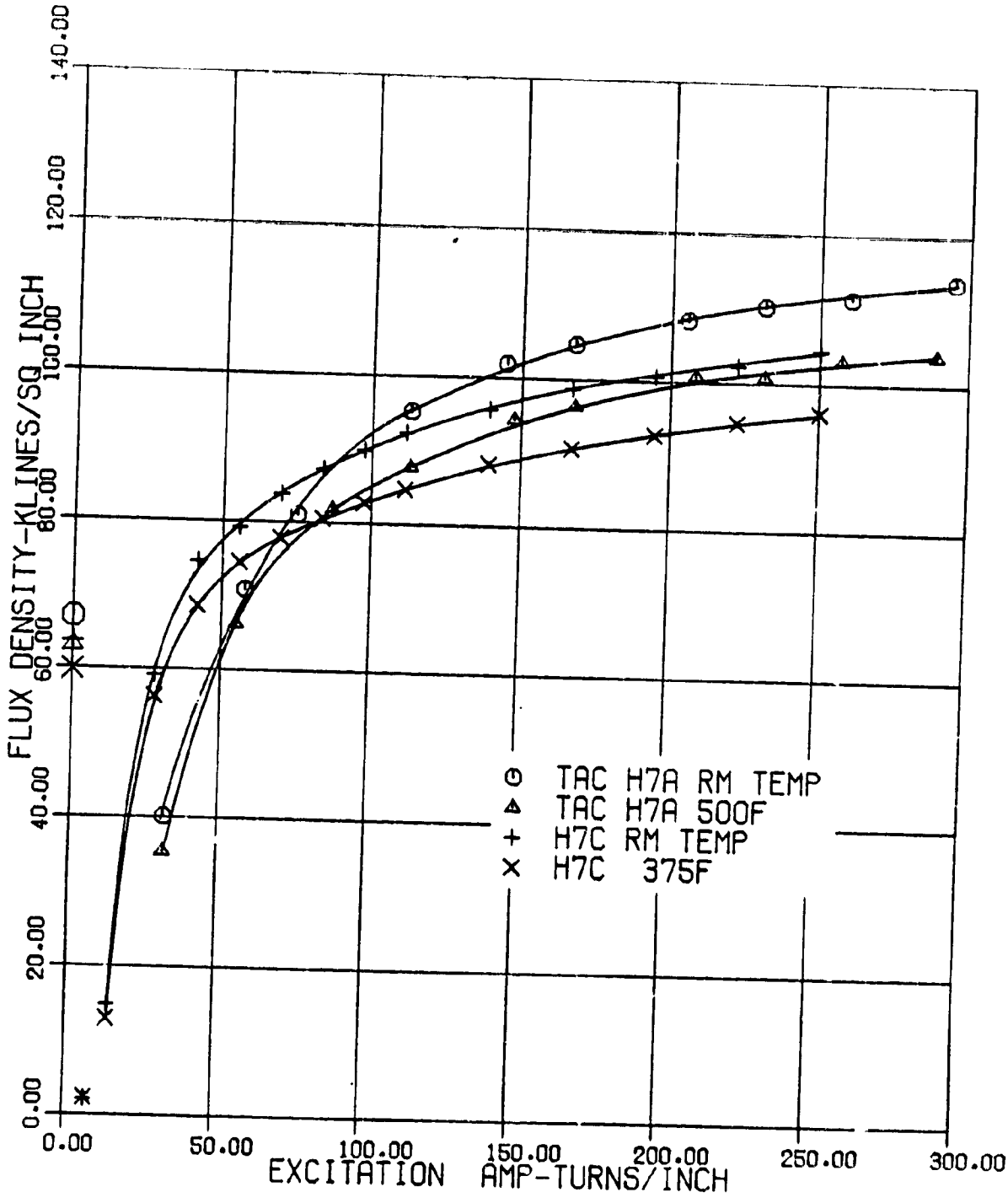


Figure 183. - Comparison of Magnetic Test Data for TAC and Final Mini-BRU Heat Treat Processes.

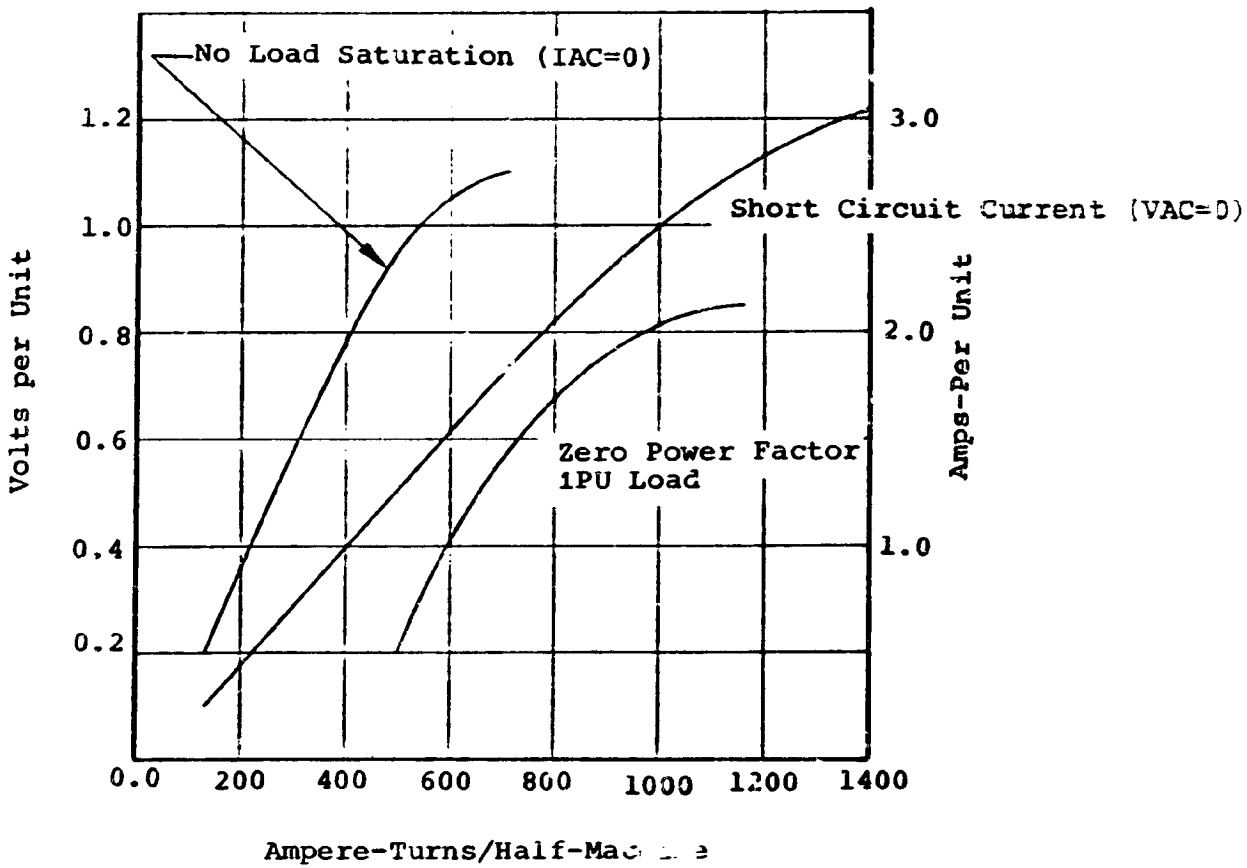


Figure 184. - Excitation Chara ristics, Short Circuit, No Load, Zero Power Factor.

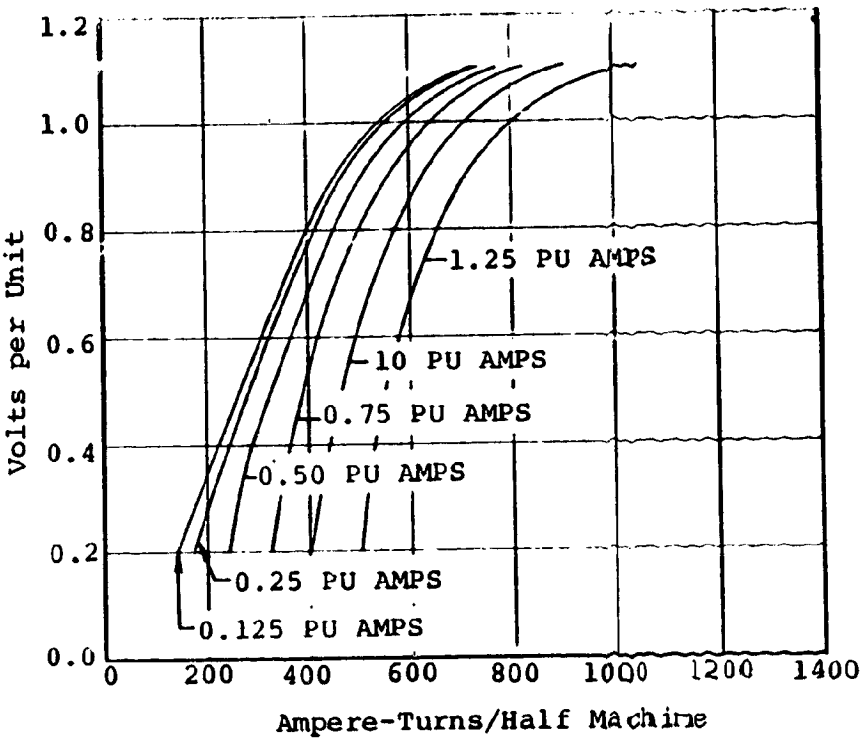
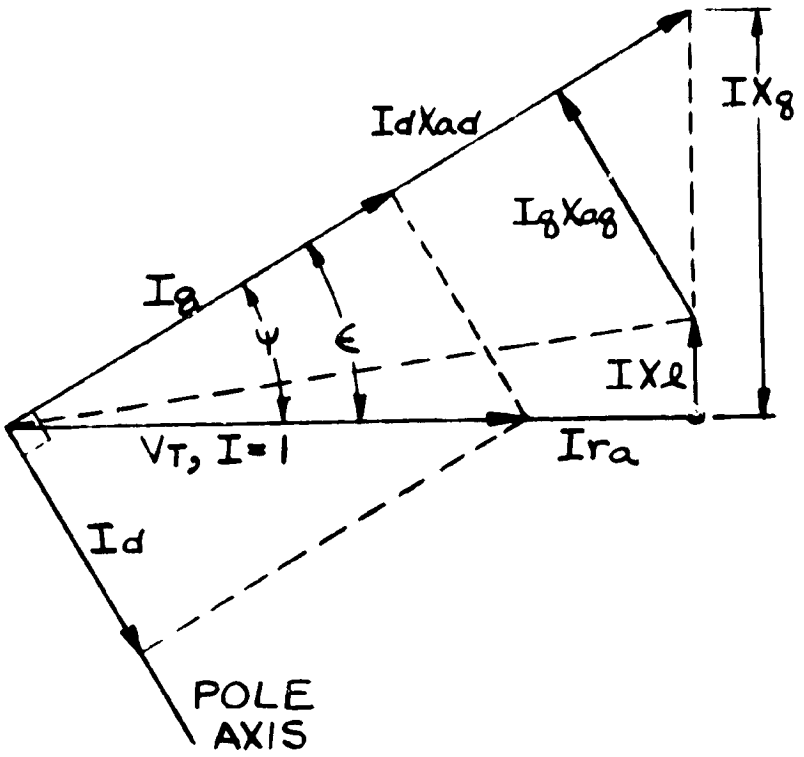


Figure 185. - Excitation Characteristics (Unity Power Factor).



$I_{ra} = .09384$ PU

$IX_\ell = .1530$ PU

$IX_q = .5585$ PU

$I_q = I \cos \psi = .8766$ PU

$I_d = I \sin \psi = .4812$ PU

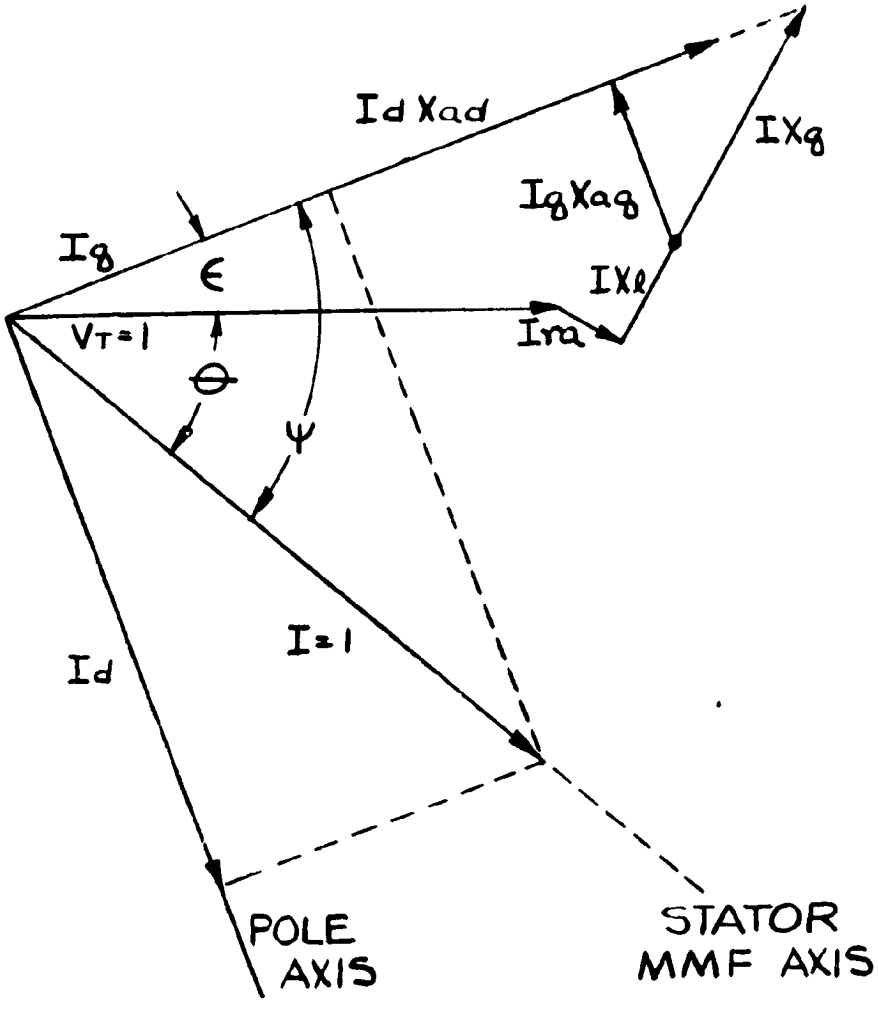
$\psi = \epsilon = 28.7625°$

$I_d X_{ad} = .4812 * .8931 = .4298$ PU

$I_q X_{aq} = .8766 * .4056 = .3555$ PU

$\theta = 0°$

Figure 186. - Vector Diagram - Unity Power Factor.



$I_{ra} = .09384$ PU

$IX_\ell = .1530$ PU

$IX_q = .5585$ PU

$\psi = 53.3653$ PU

$I_q = I \cos \psi = .5967$ PU

$I_d = I \sin \psi = .8025$ PU

$I_d X_{ad} = .8025 * .8931 = .7167$

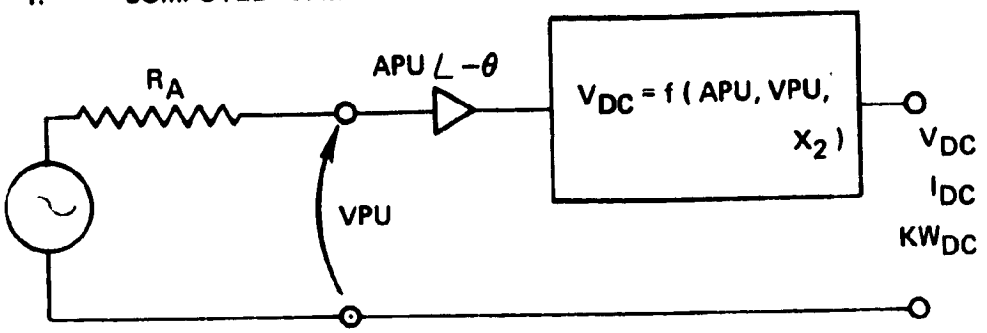
$I_q X_{aq} = .5967 * .4056 = .2420$

$\epsilon = 18.62°$

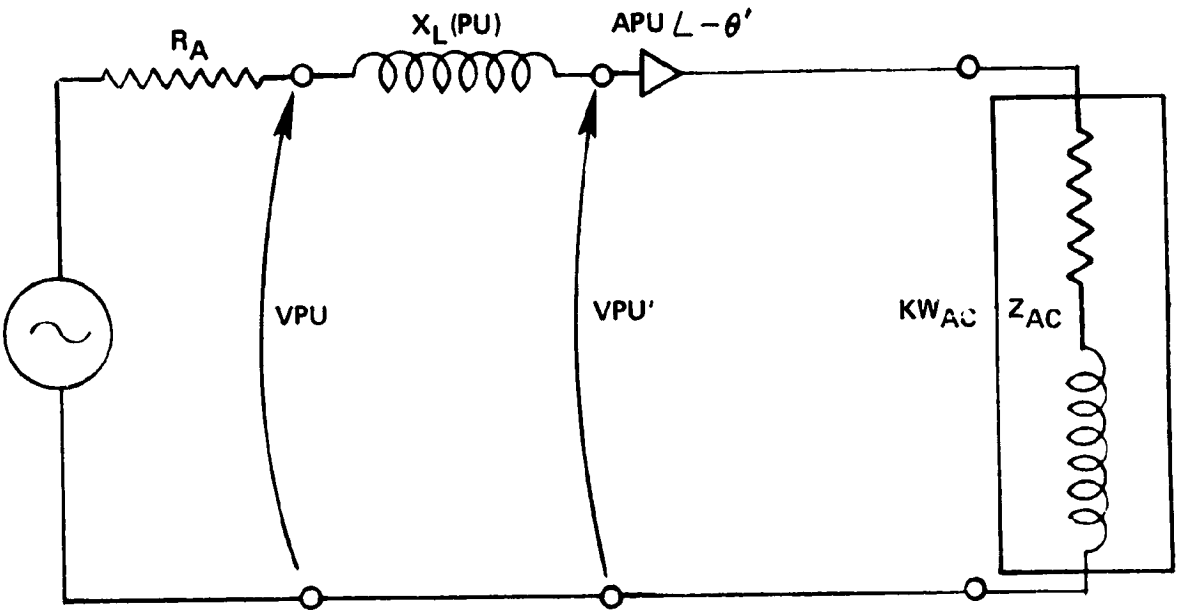
$\theta = 34.7447°$

Figure 187. - Vector Diagram, -0.8217 Power Factor.

1. COMPUTED VALUES IN DC MODE



2. COMPUTED VALUES IN AC MODE



A. $KW_{AC} = KW_{DC}$ BY DEFINITION

B. $KW_{DC} = m\ VPU * APU \cos(-\theta)$ WHERE $\theta \equiv$ INCLUSIVE ANGLE BETWEEN VPU AND APU
(NO RESISTIVE COMPONENT)

C. $KW_{AC} = m\ VPU' * APU \cos(-\theta')$ WHERE $\theta' \equiv$ INCLUSIVE ANGLE BETWEEN VPU' AND APU

$\therefore \cos(-\theta') = KW_{DC}/(m\ VPU'\ APU)$
AND

D. $VPU' = VPU - \left(APU \angle -\theta * j\ X_L(PU)\right)$

Figure 188. - Calculation Methods for Computing DC and AC Modes.

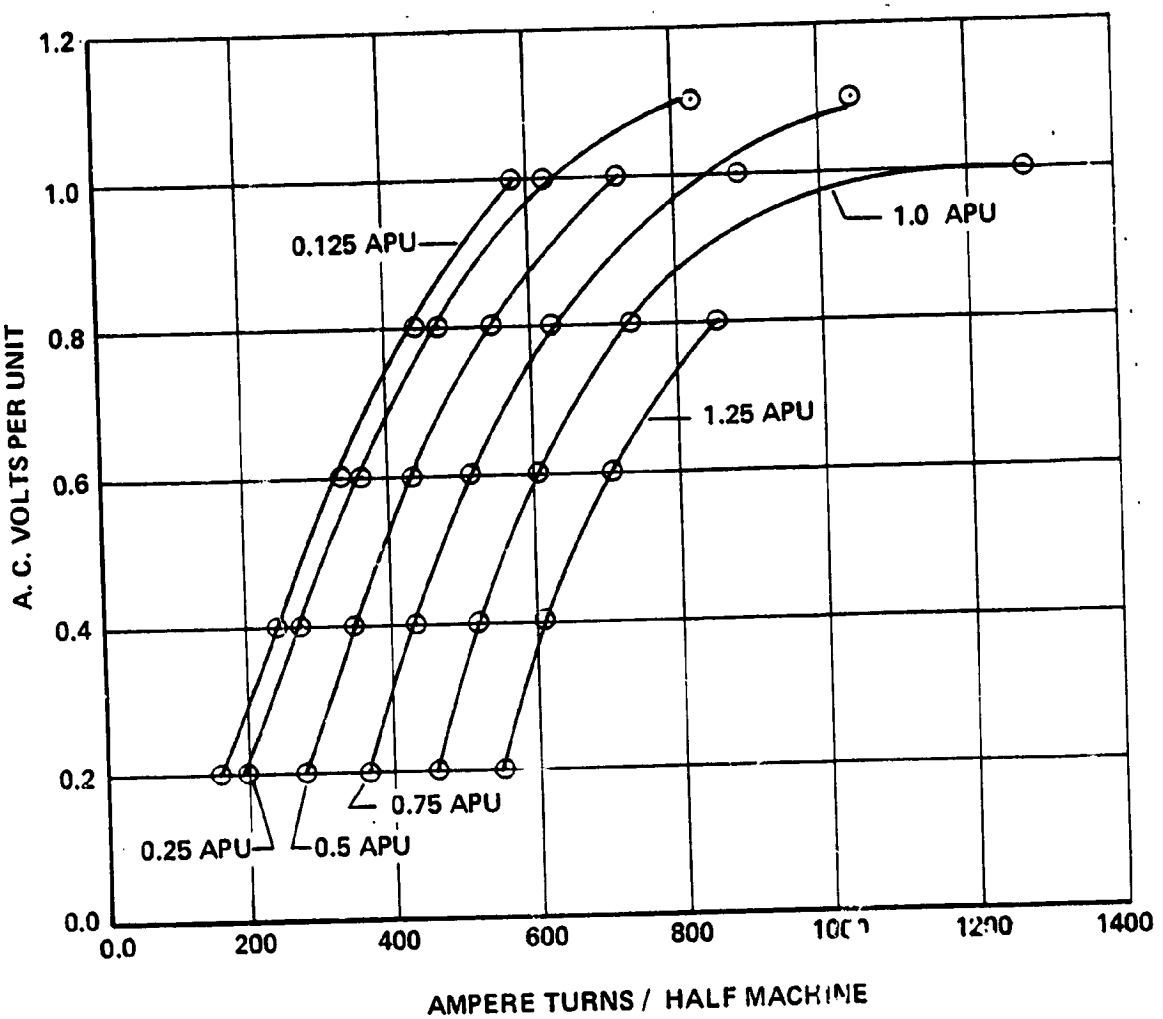


Figure 189. - Excitation Characteristics Equivalent AC Load (-0.8924 Power Factor).

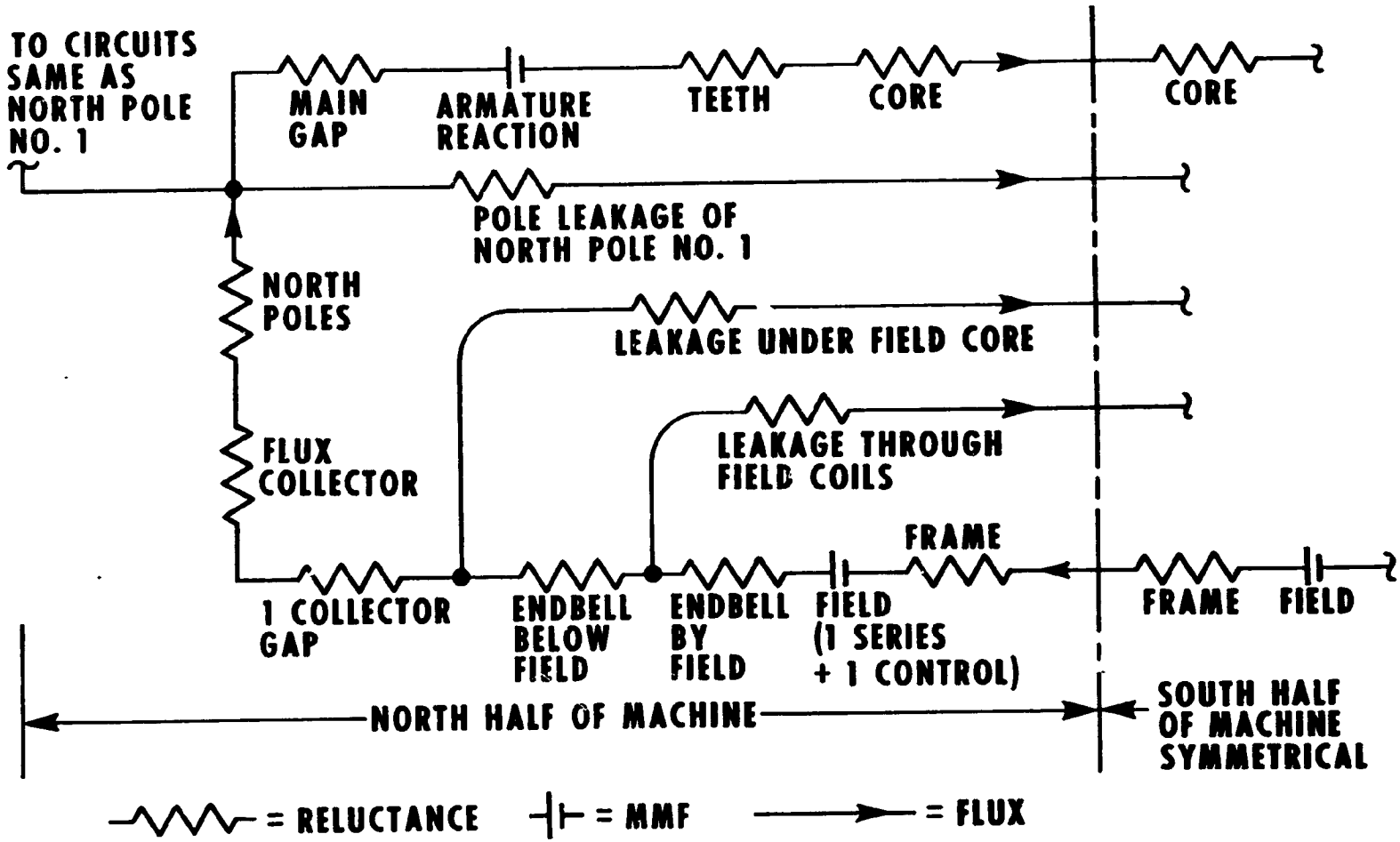


Figure 190. - Rice Alternator Magnetic Circuit.

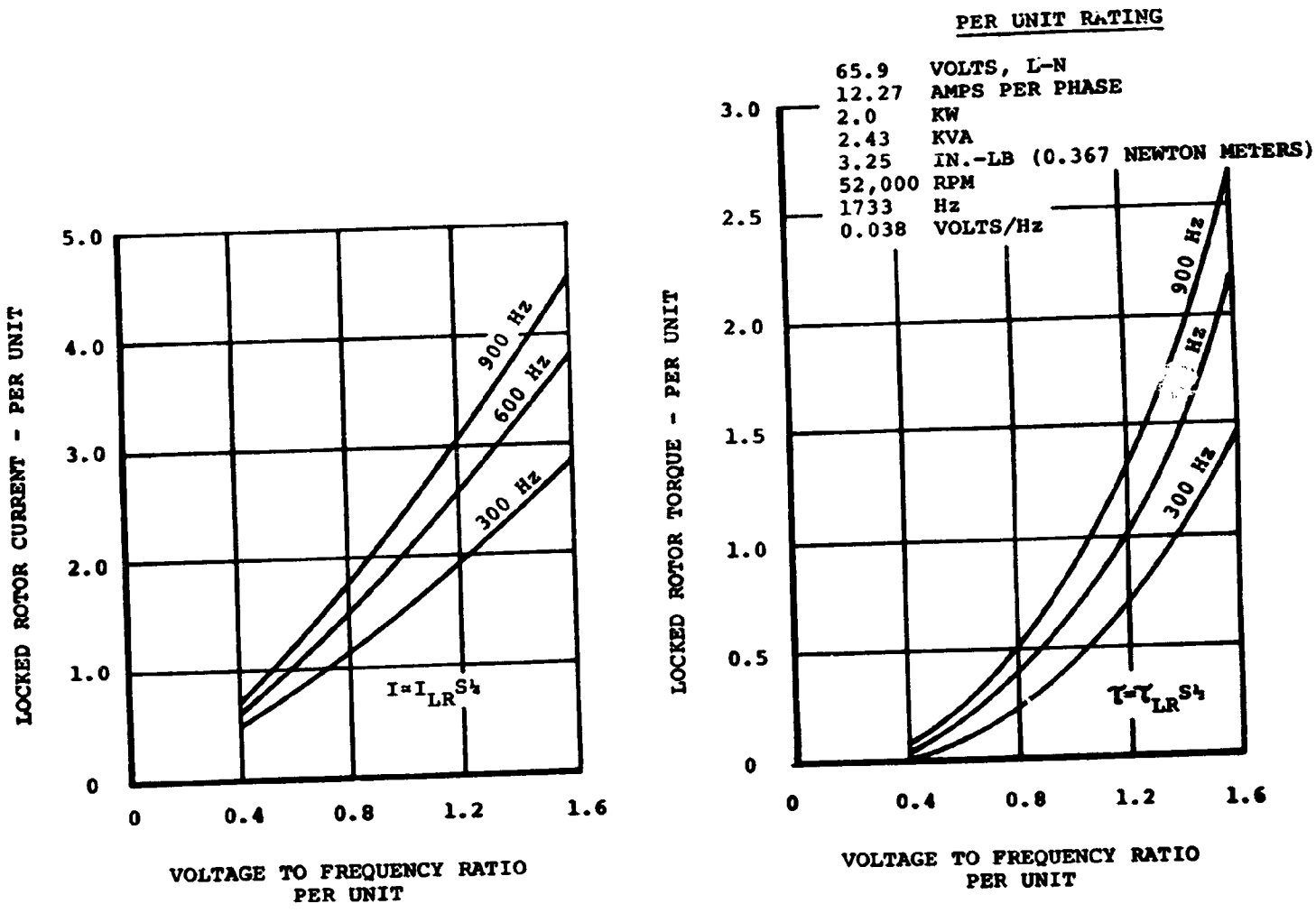


Figure 191. - Motor Start Characteristics I.

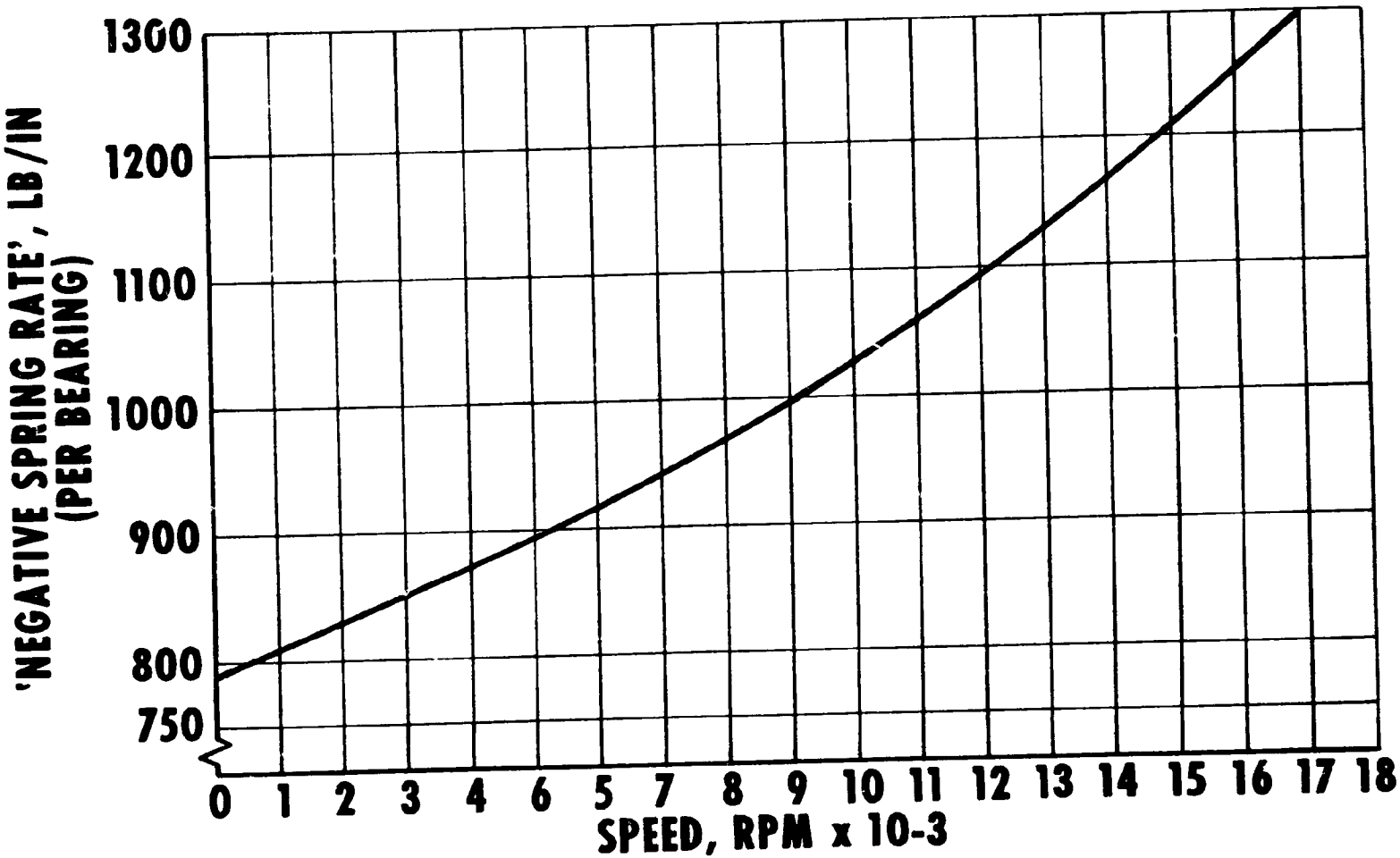
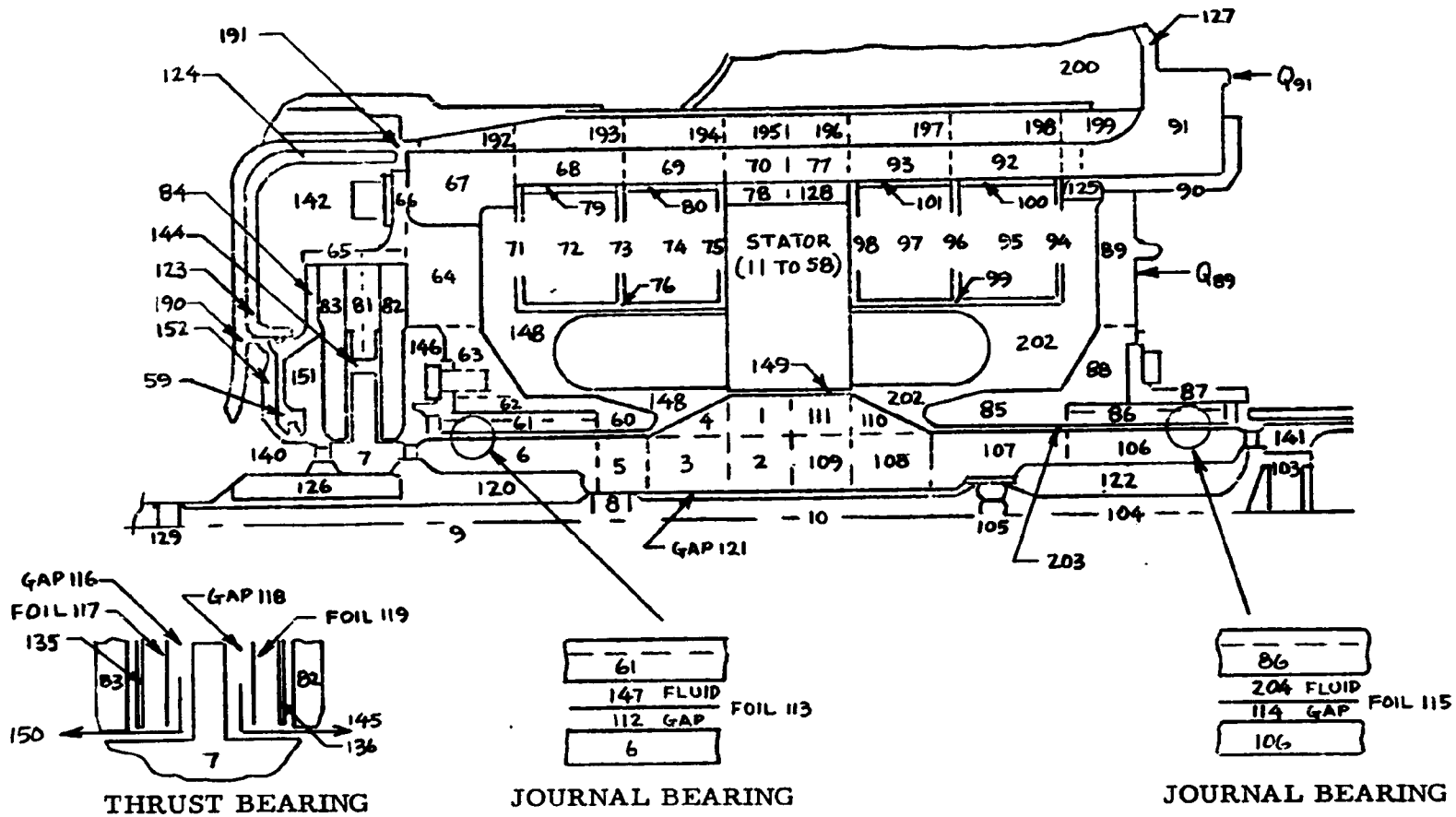


Figure 192. - Magnetic Unbalance - Motor Start Operation.



NUMBERS SHOWN ARE NODE NUMBERS

Figure 193. - Mini-BRU Alternator Thermal Model.

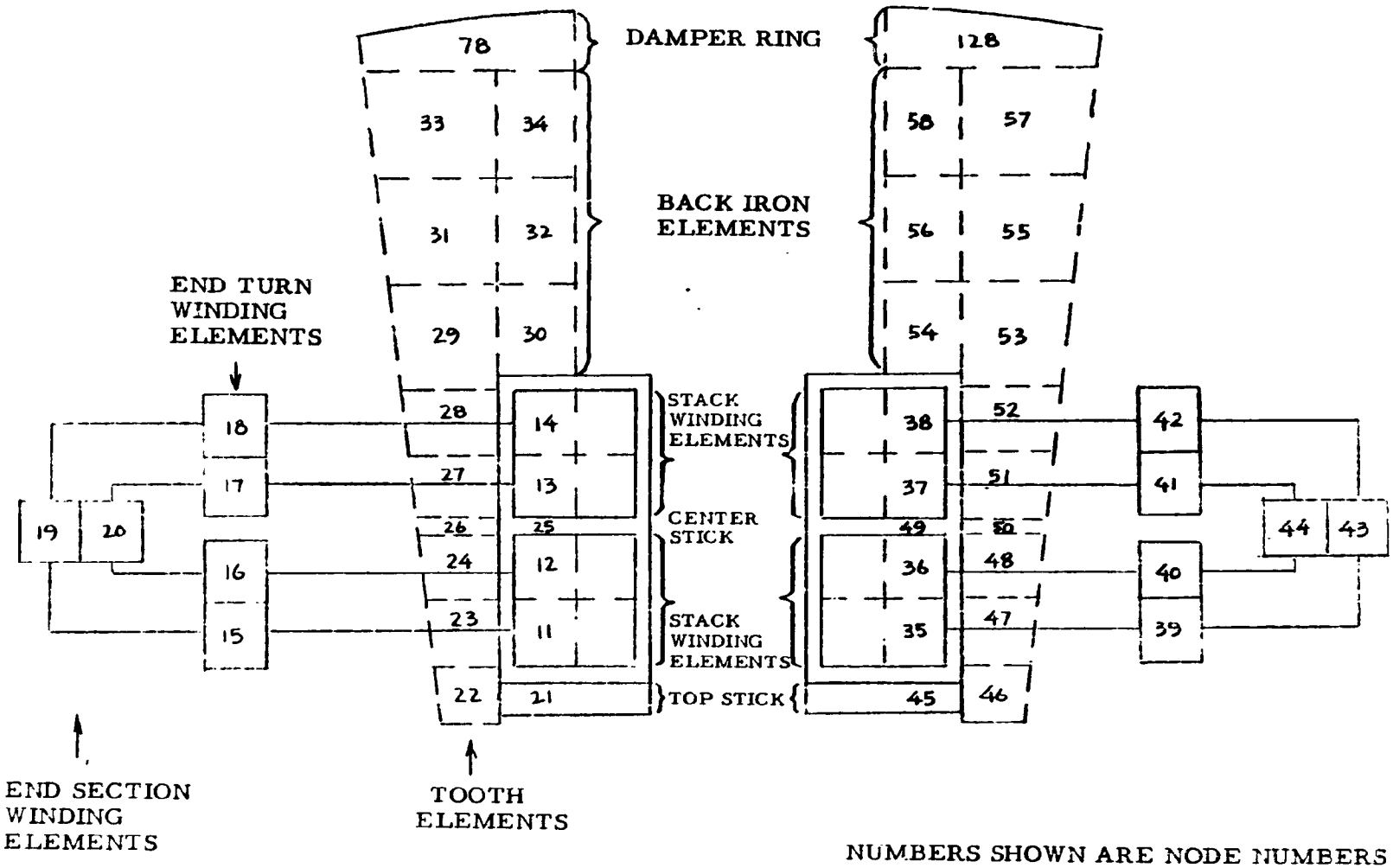


Figure 194. - Mini-BRU Alternator Stator Thermal Model.

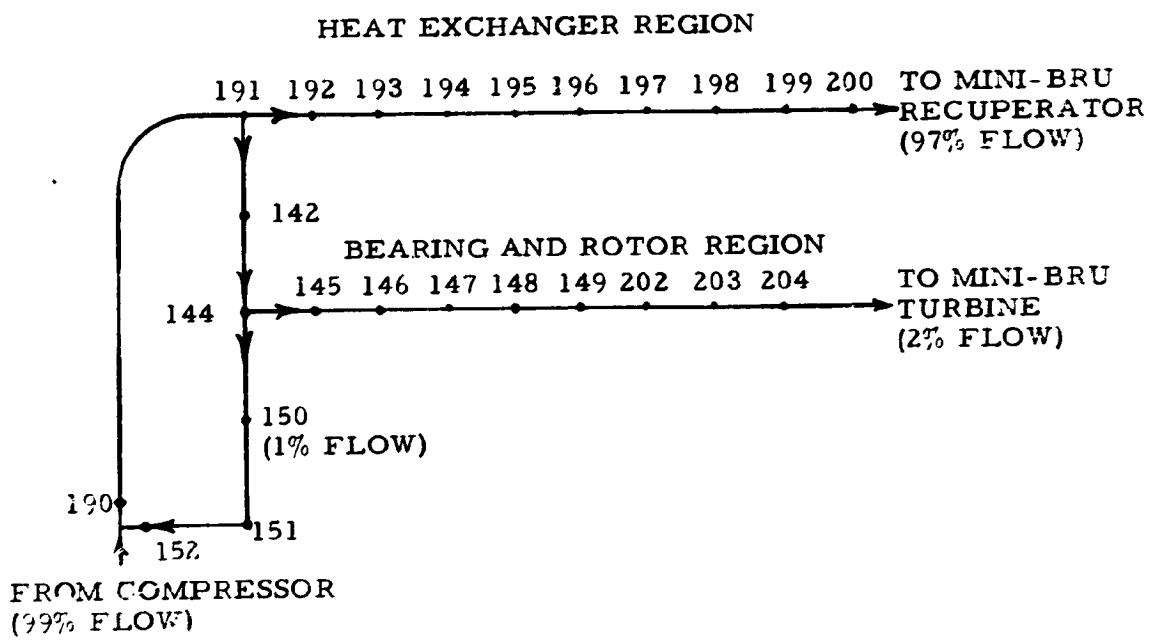


Figure 195. - Model 1 Flow Arrangement.

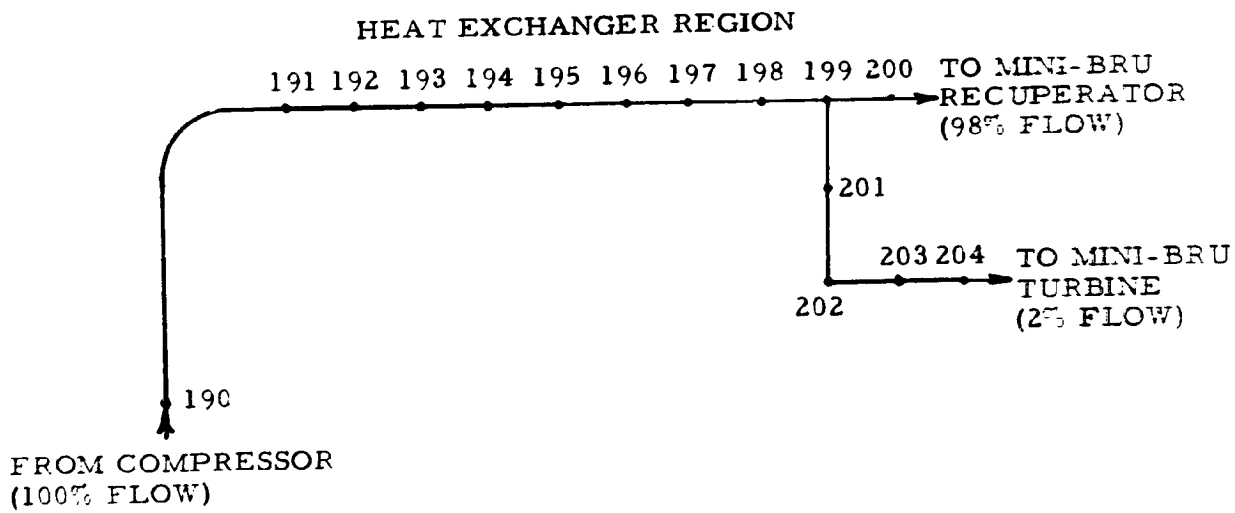


Figure 196. - Model 2 Flow Arrangement.

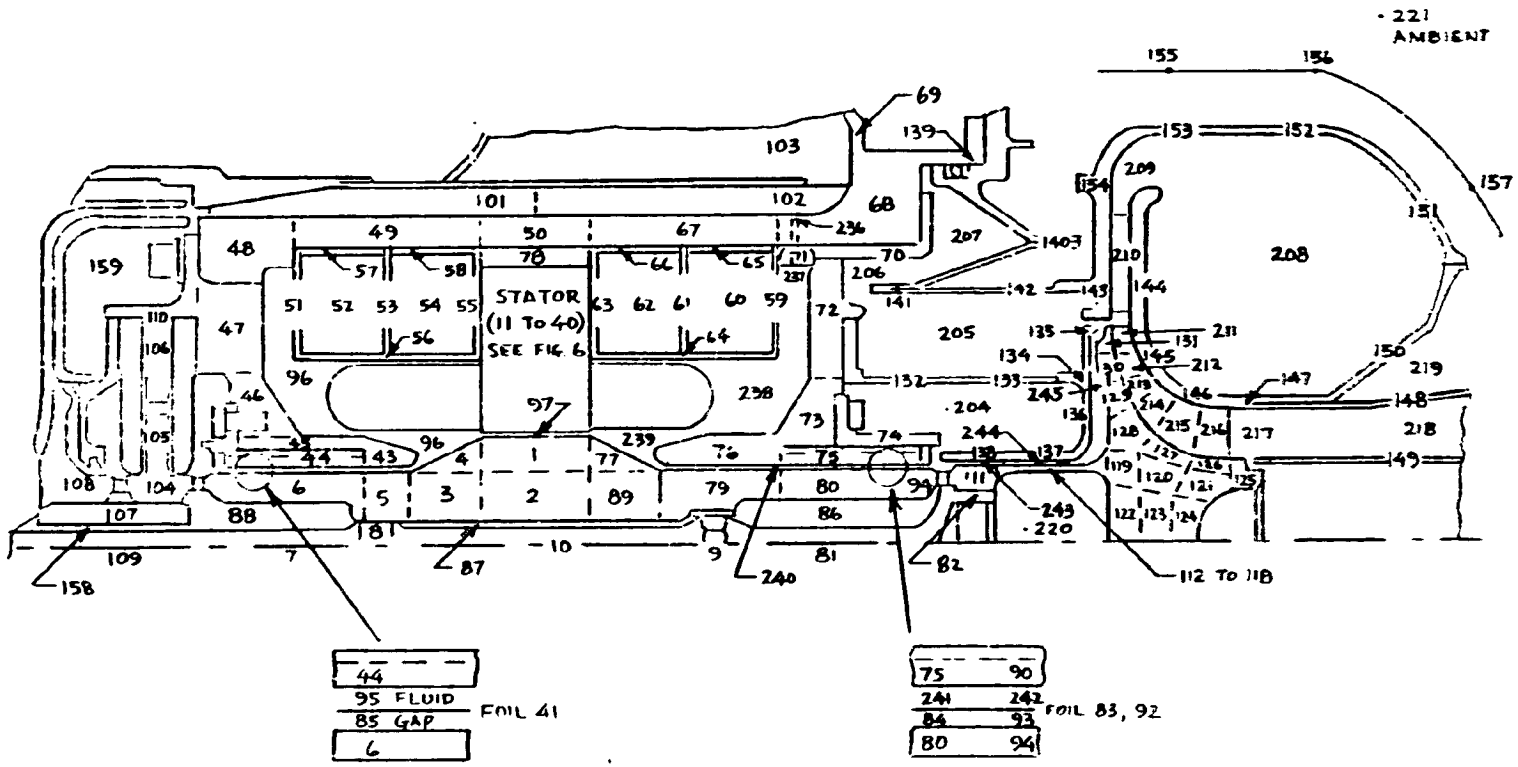


Figure 197. - Mini-BRU Alternator and Turbine Simplified Thermal Model (Model 3).

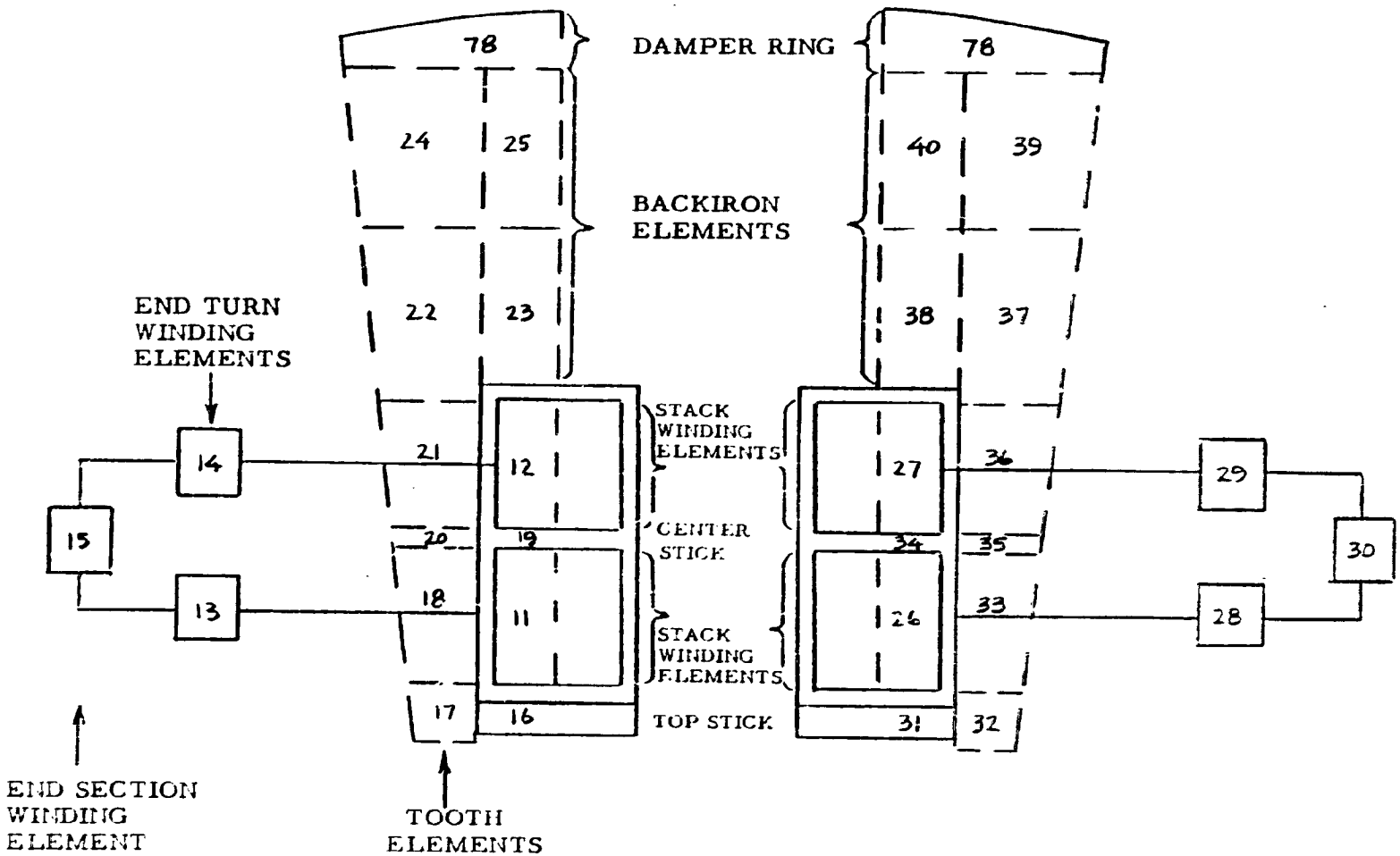


Figure 198. - Mini-BRU Alternator and Turbine Simplified Thermal Model (Model 3).

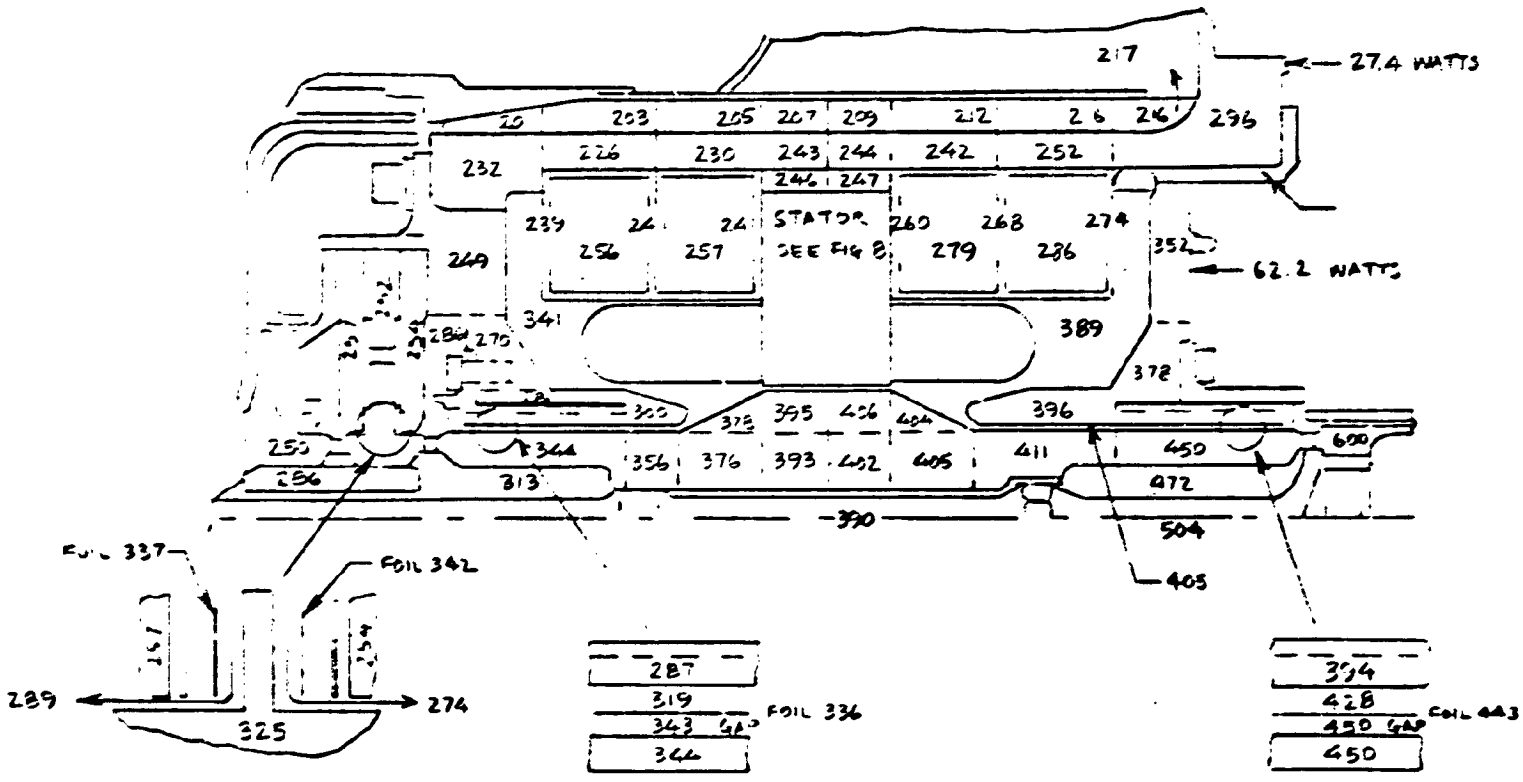


Figure 133. - Model 1 Alternator Temperatures at High-Power Operation.

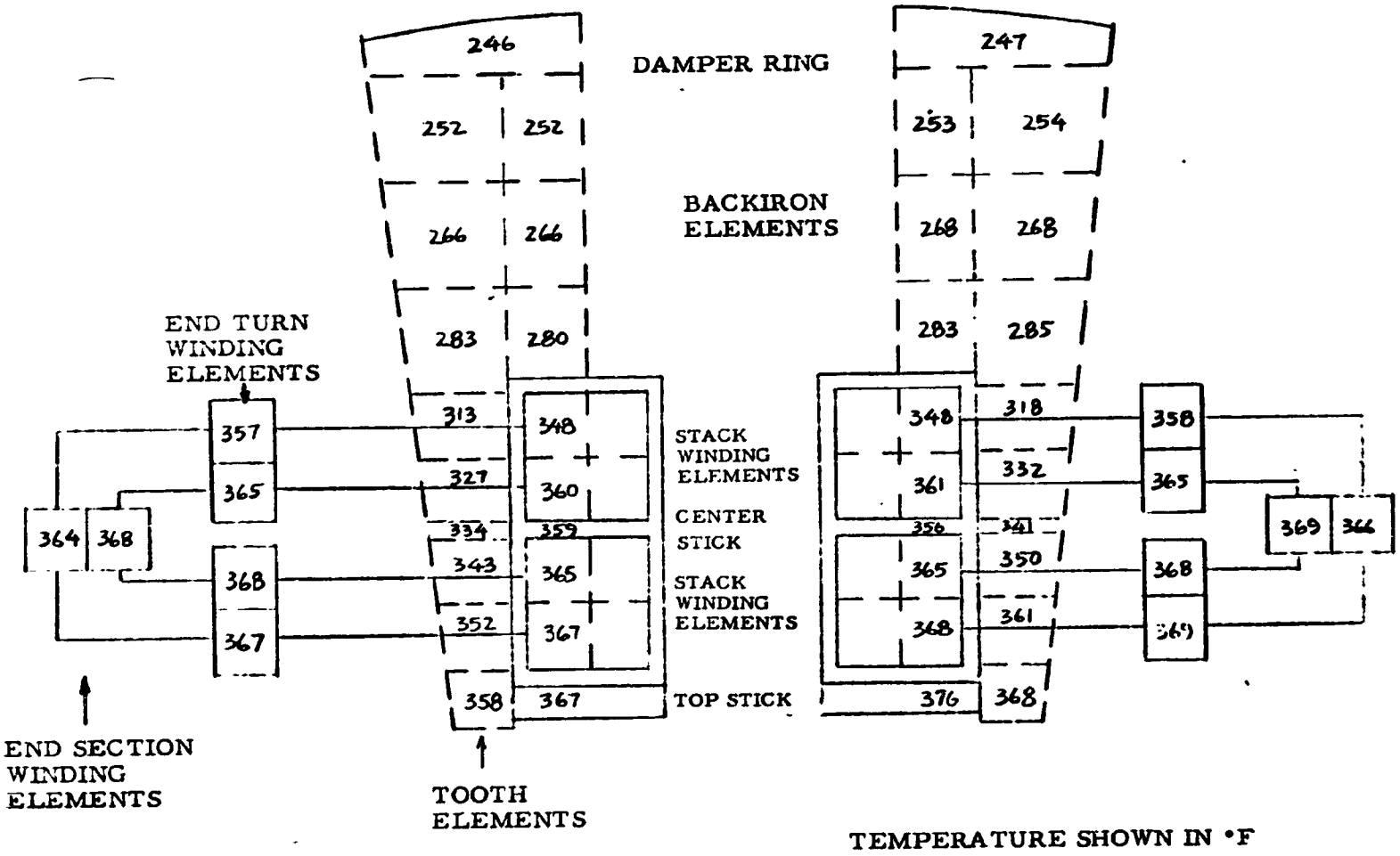


Figure 200. - Model 1 Alternator Stator Temperatures at High-Power Operation.

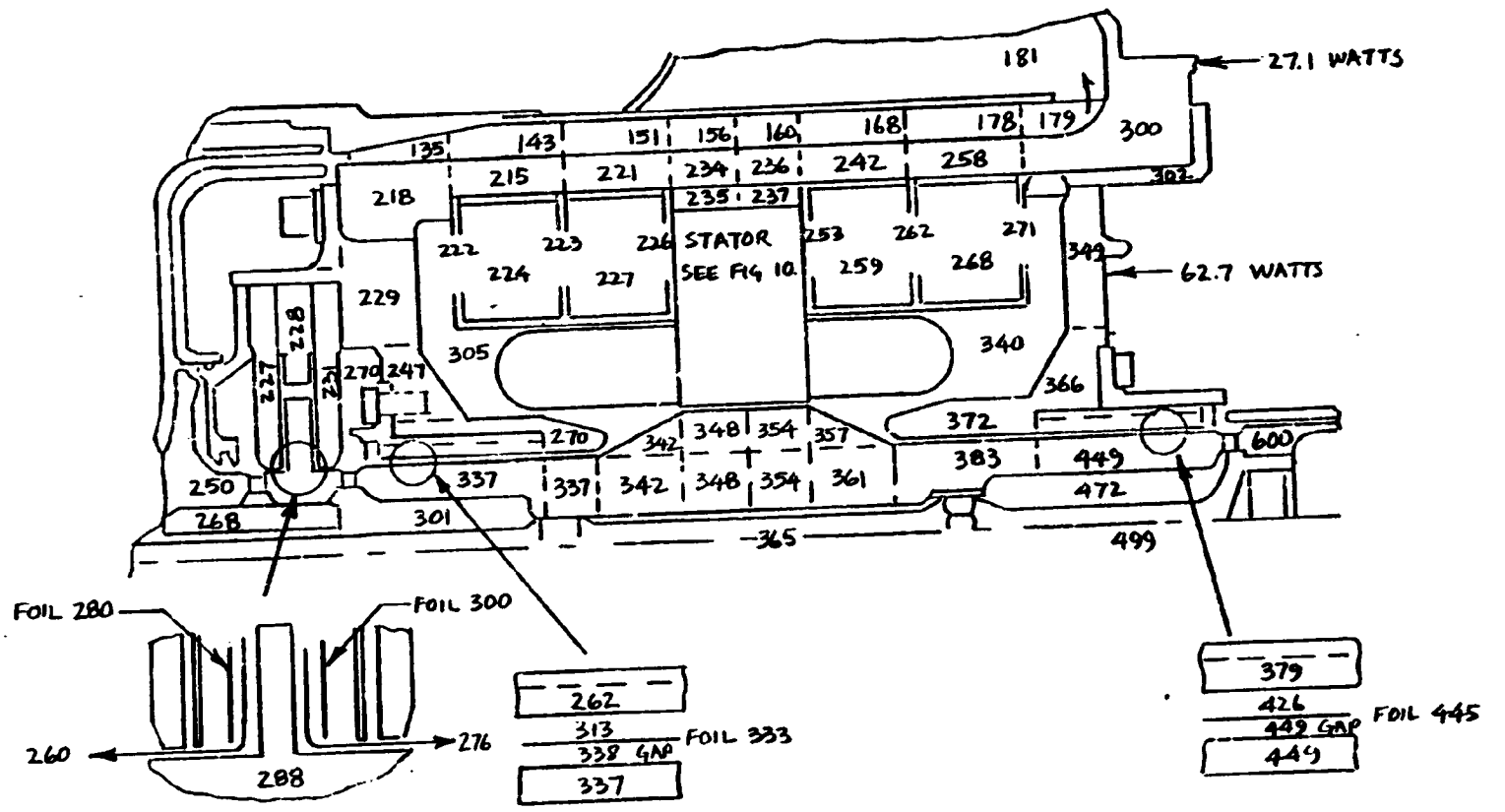


Figure 201. - Model 1 Alternator Temperatures at Low-Power Operation.

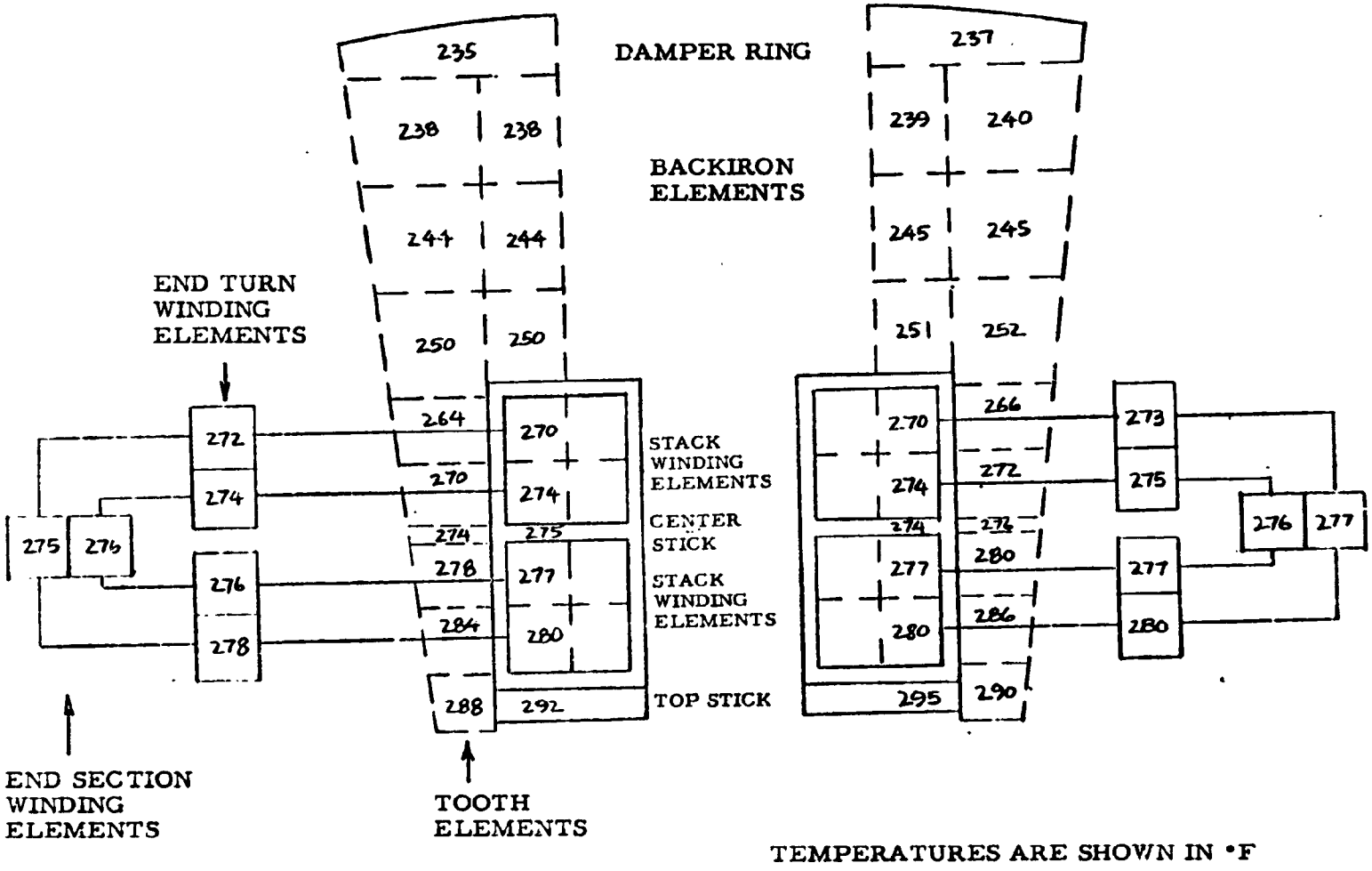
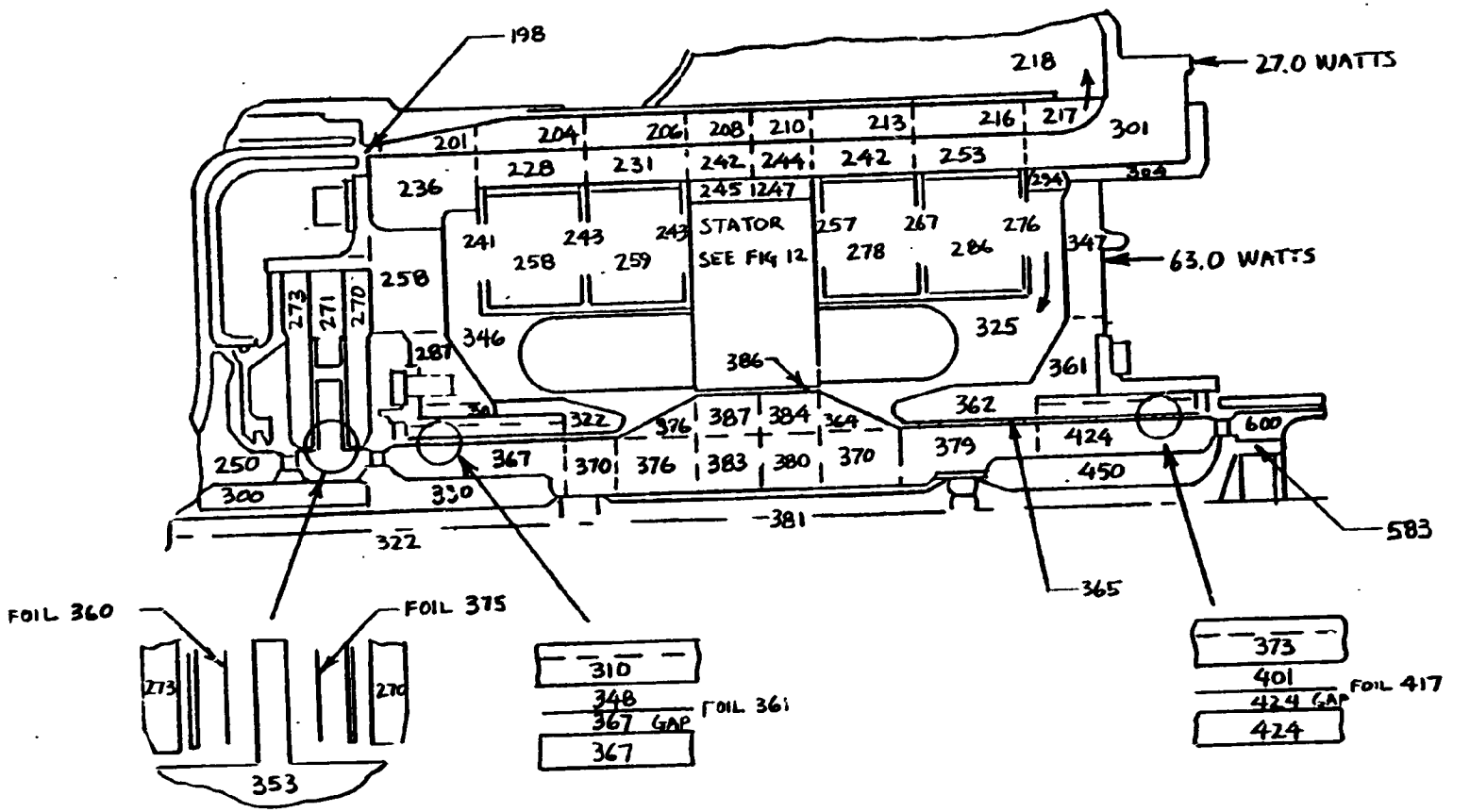


Figure 202. - Model 1 Alternator Stator Temperatures at Low-Power Operation.



TEMPERATURES ARE SHOWN IN °F

Figure 203. - Model 2 Alternator Temperatures at High-Power Operation.

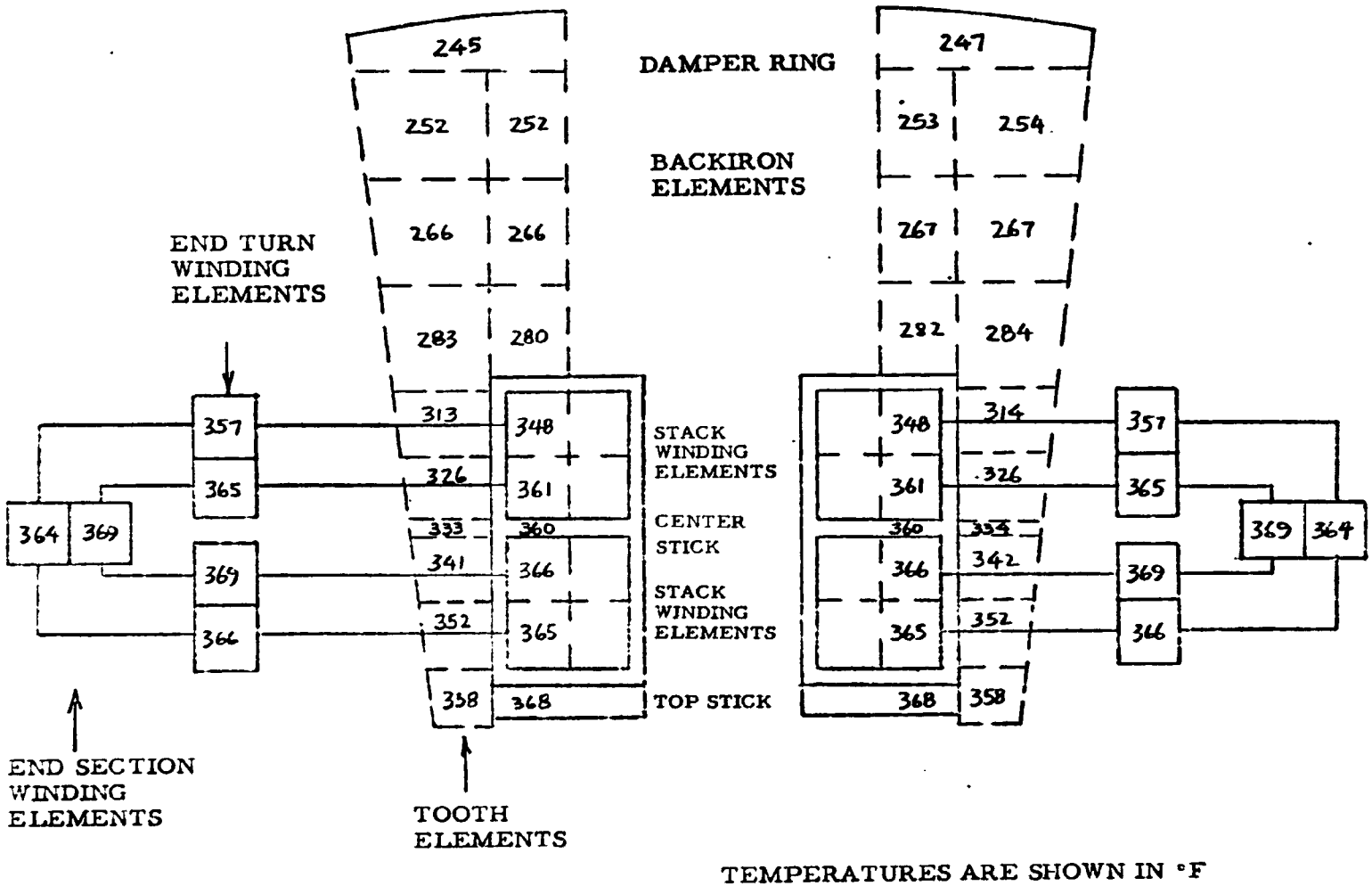
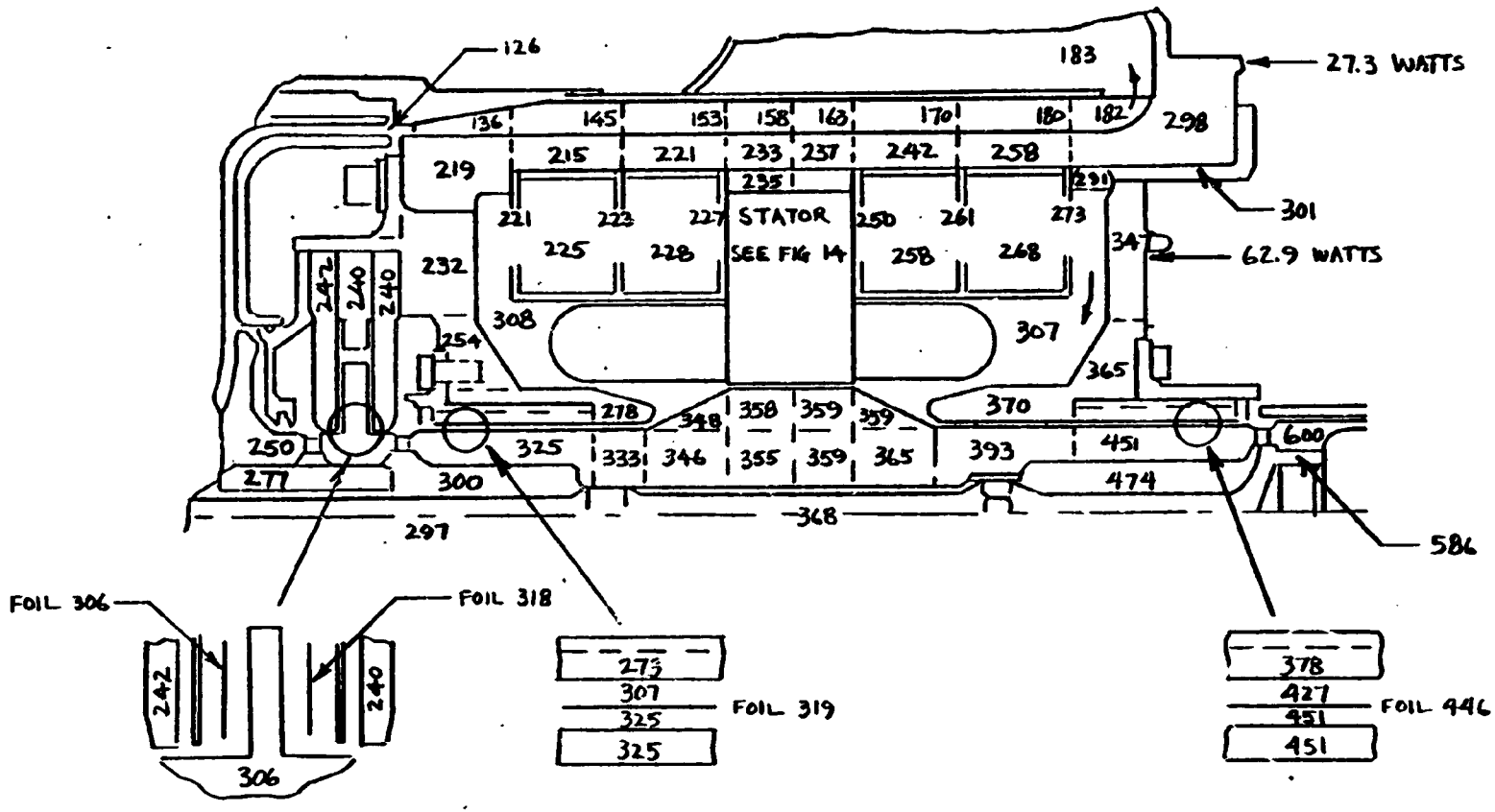


Figure 204. - Model 2 Alternator Stator Temperatures at High-Power Operation.



TEMPERATURES ARE SHOWN IN °F

Figure 205. - Model 2 Alternator Temperatures at Low-Power Operation.

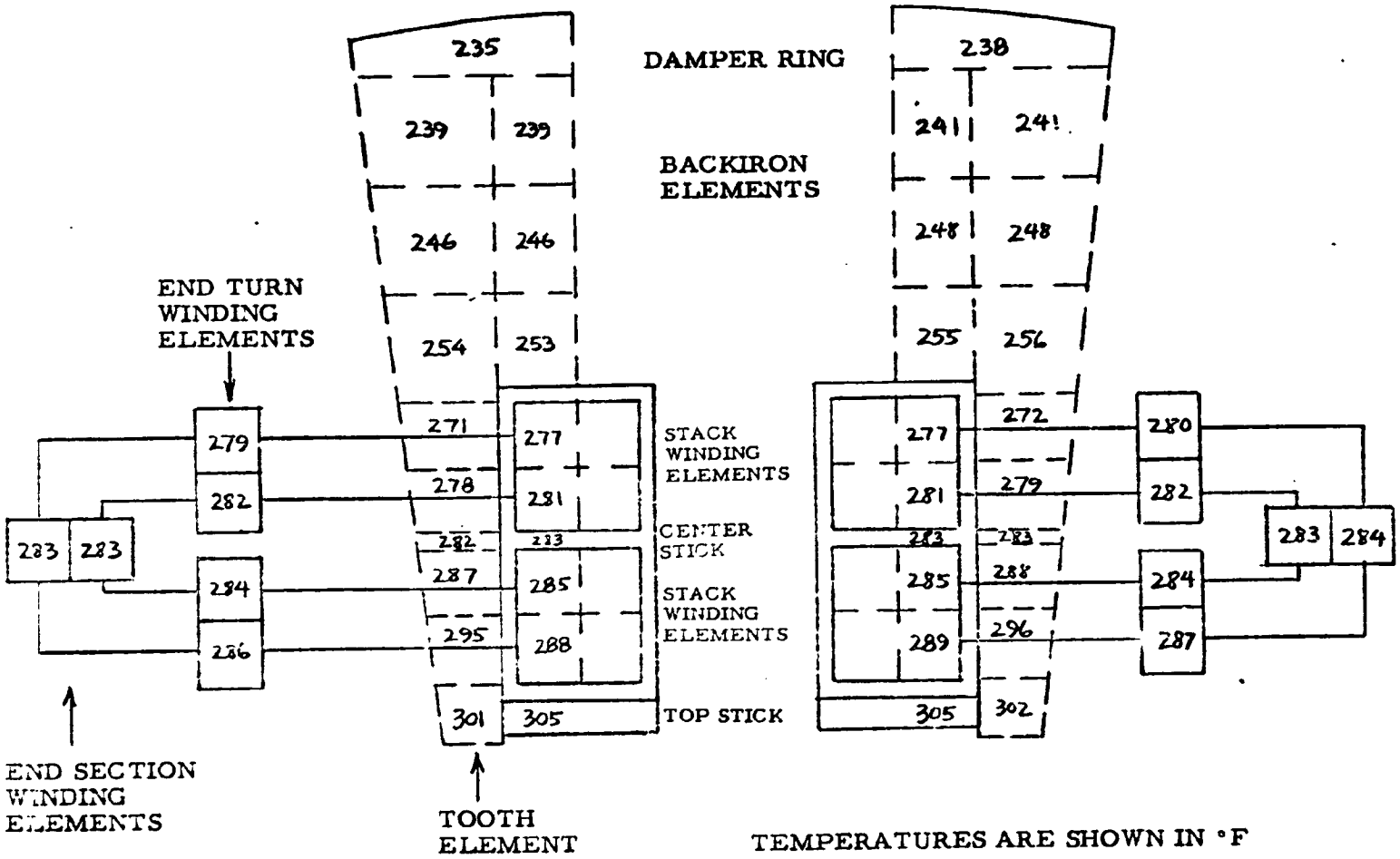


Figure 206. - Model 2 Alternator Stator Temperatures at Low-Power Operation.

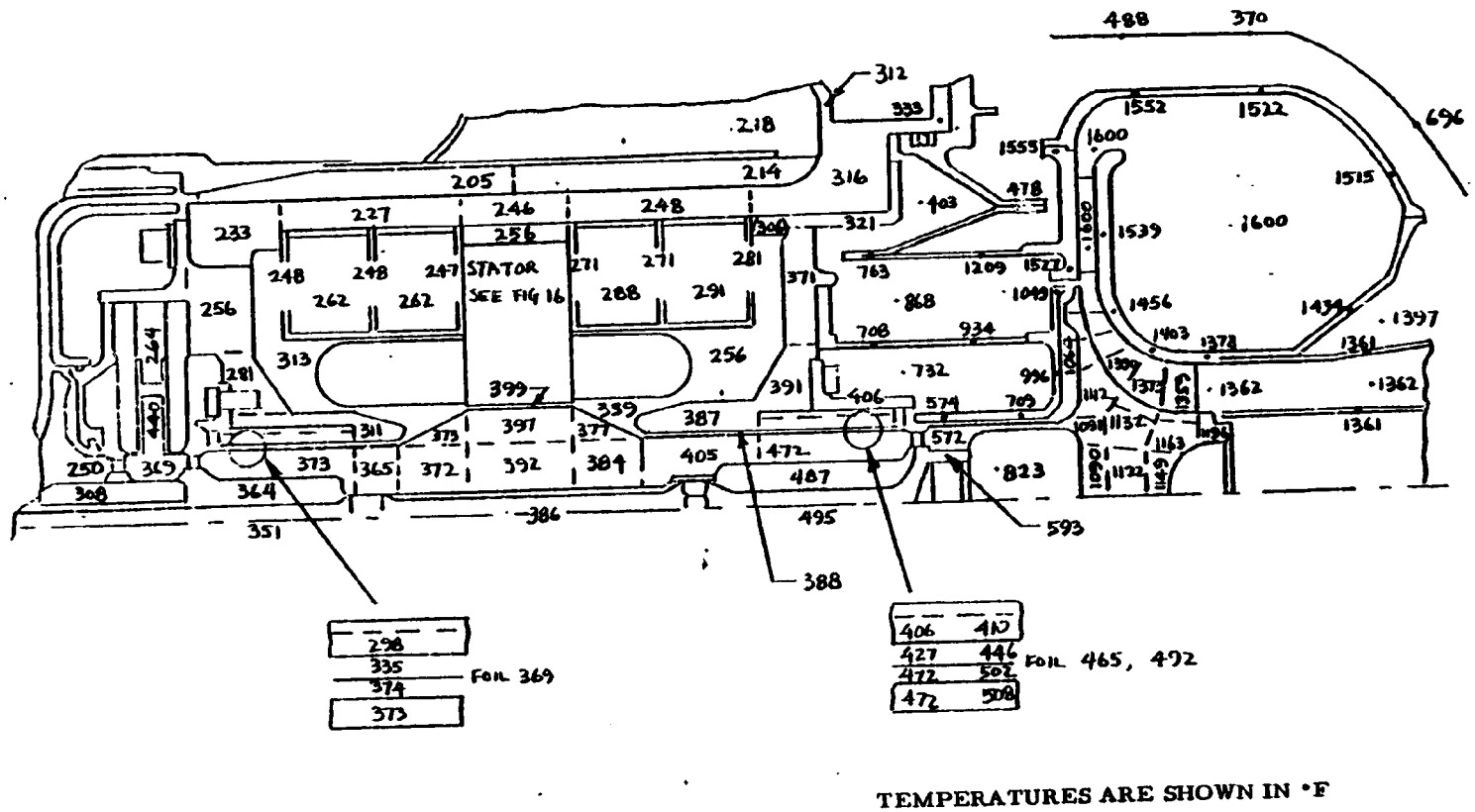


Figure 207. - Alternator and Turbine Temperature at High Power Operation.

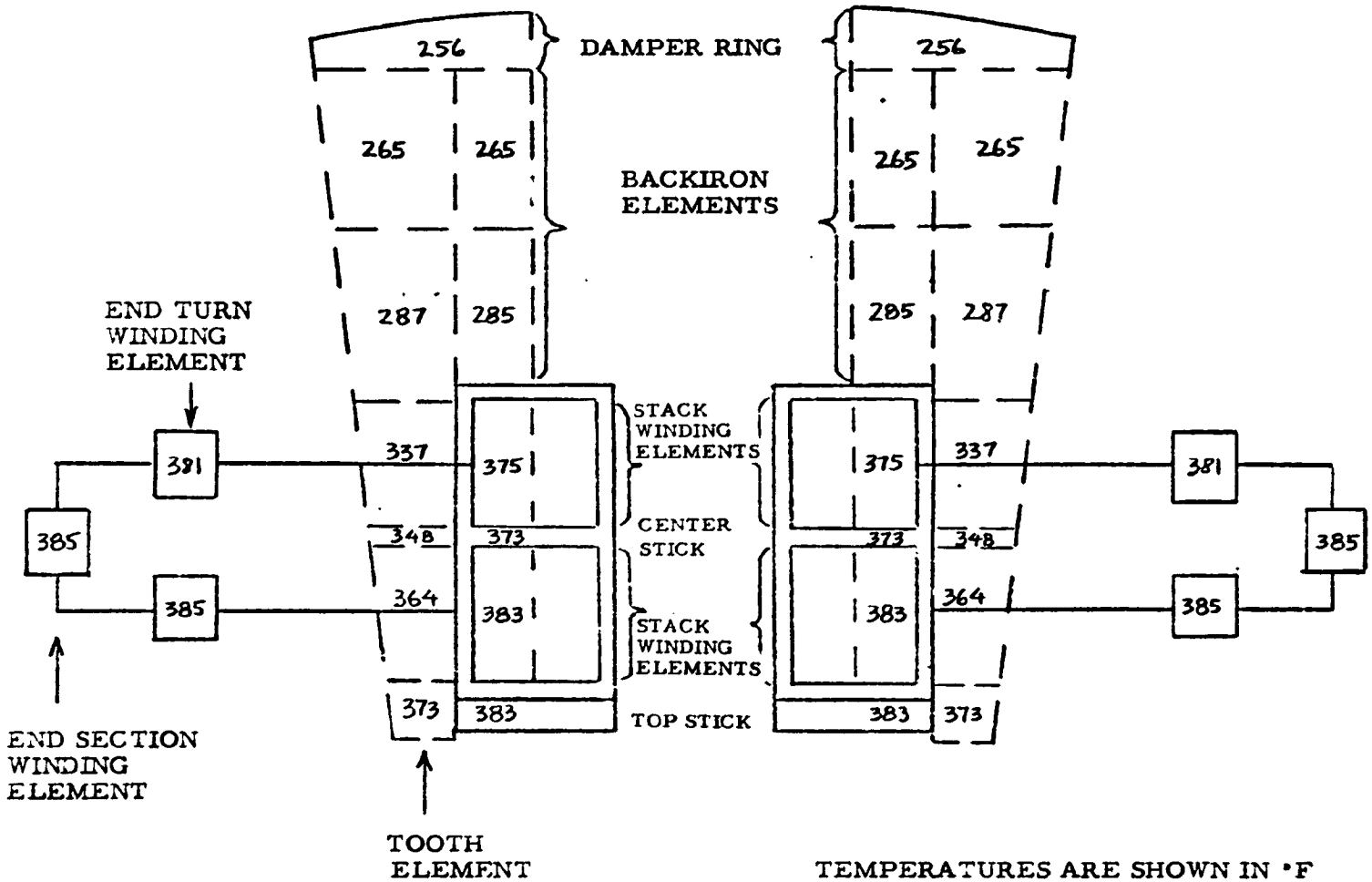


Figure 208. - Model 3 Alternator Stator Temperatures at High-Power Operation.

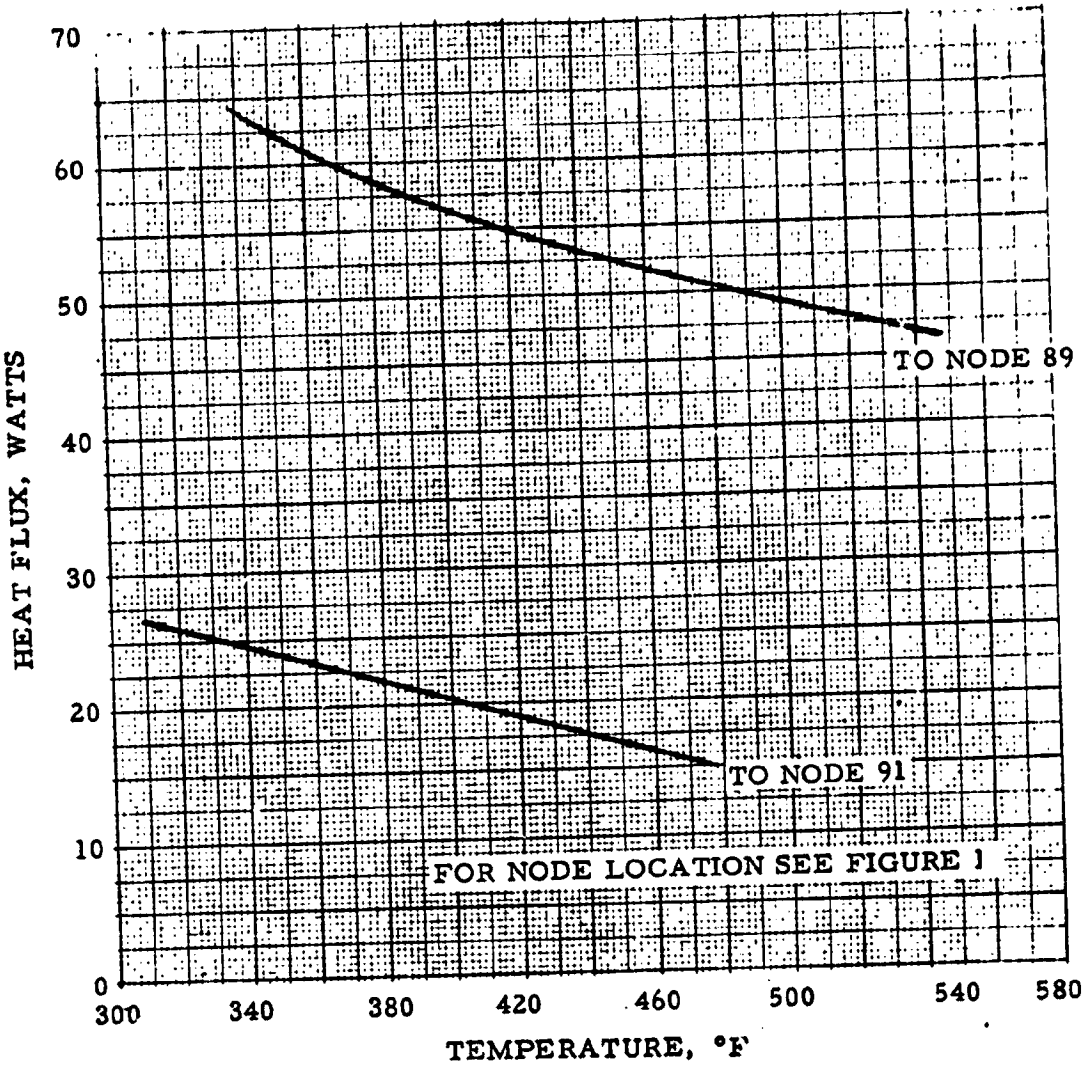
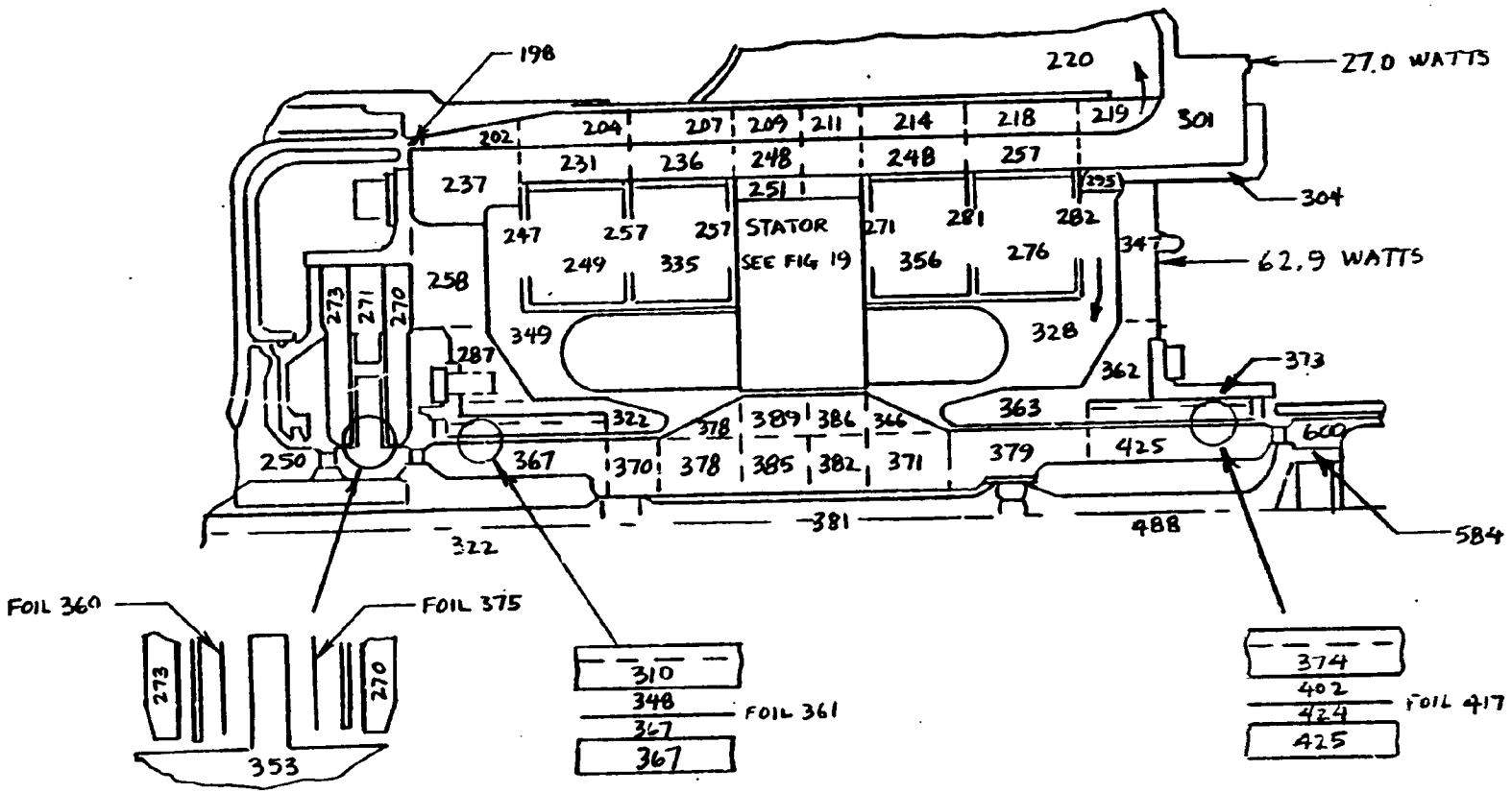


Figure 209. - Interface Turbine-to-Alternator Heat Fluxes.



TEMPERATURES ARE SHOWN IN °F

Figure 210. - Model 2 Alternator Temperatures at Field Coil Failure Mode.

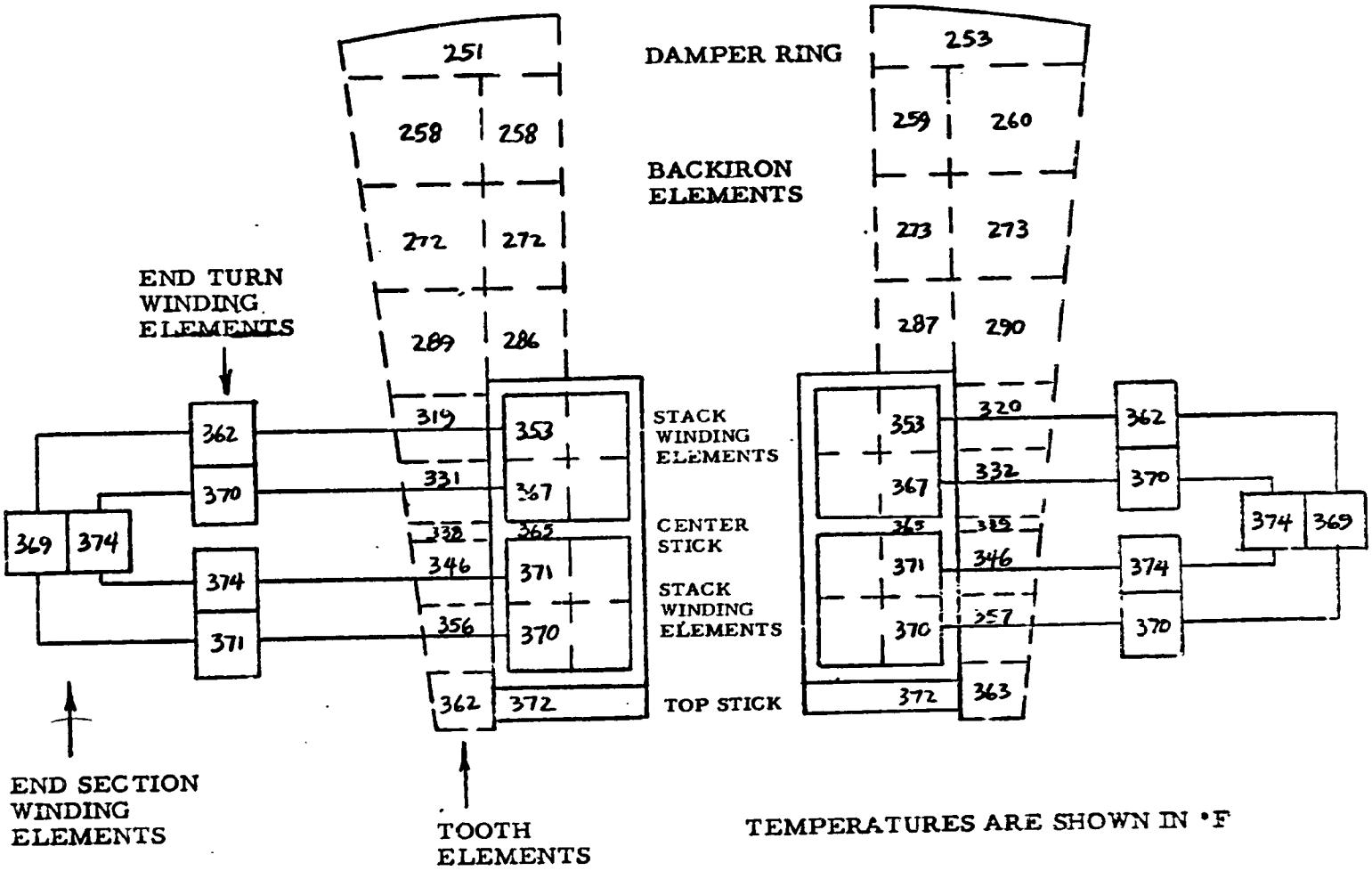


Figure 211. - Model 2 Alternator Stator Temperatures at Field Coil Failure Mode.

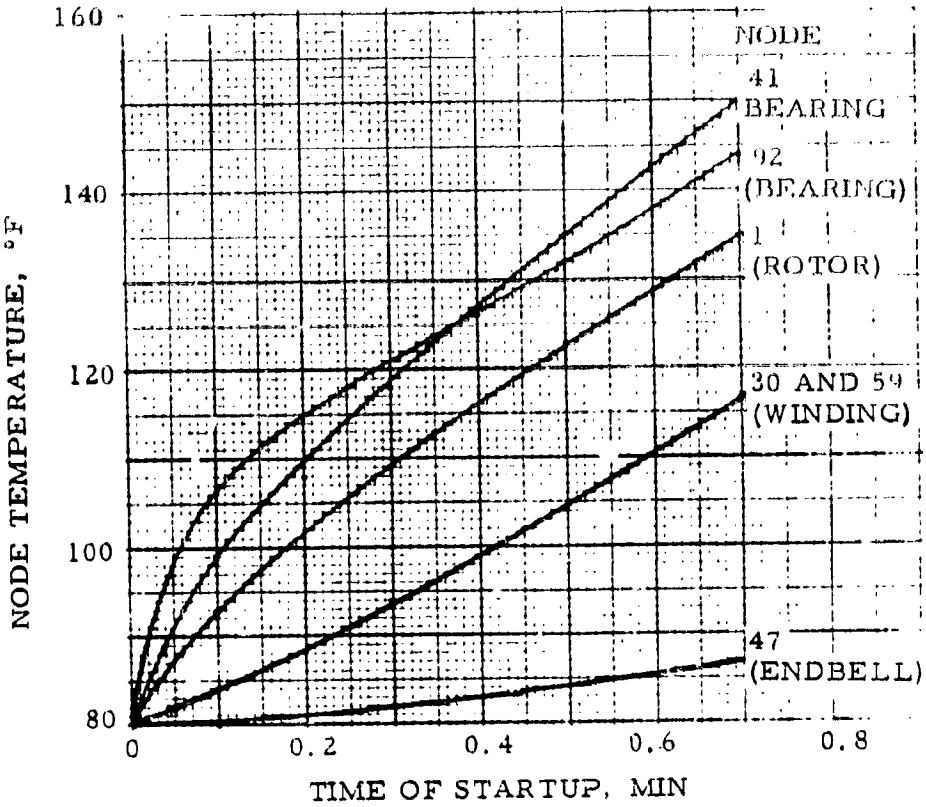


Figure 212. - Startup Temperatures, Alternator Section.

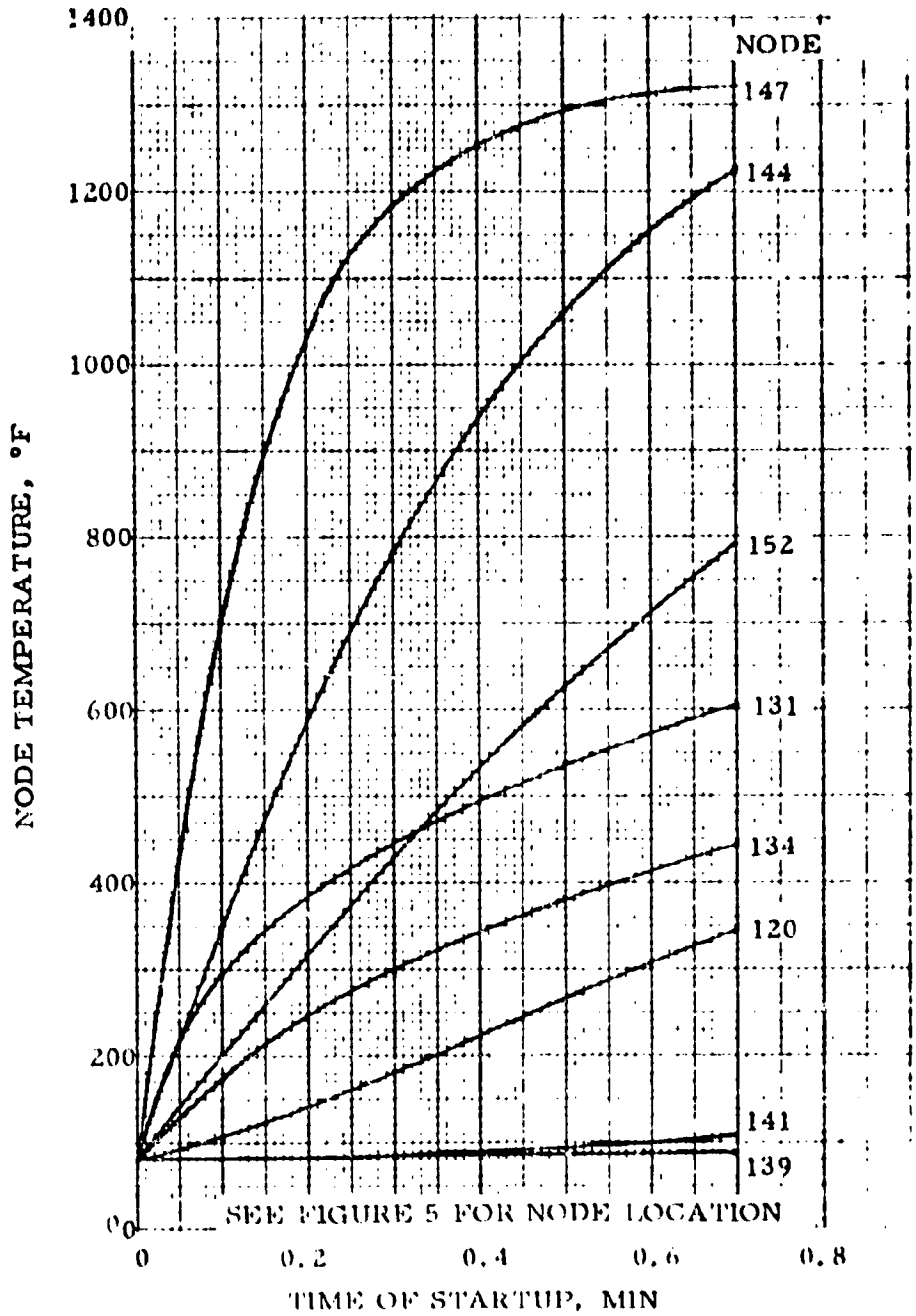


Figure 213. - Startup Temperatures, Turbine Section.

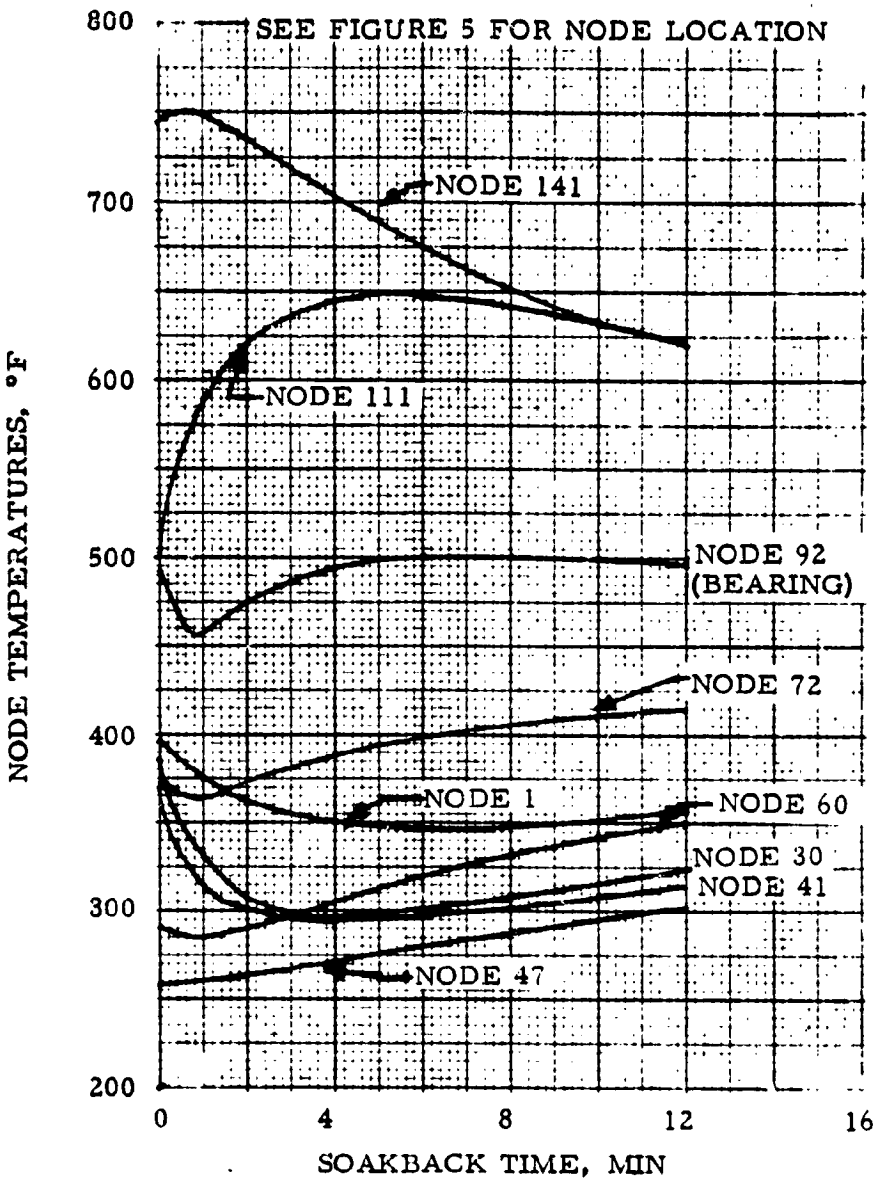


Figure 214. - Soakback Temperatures.

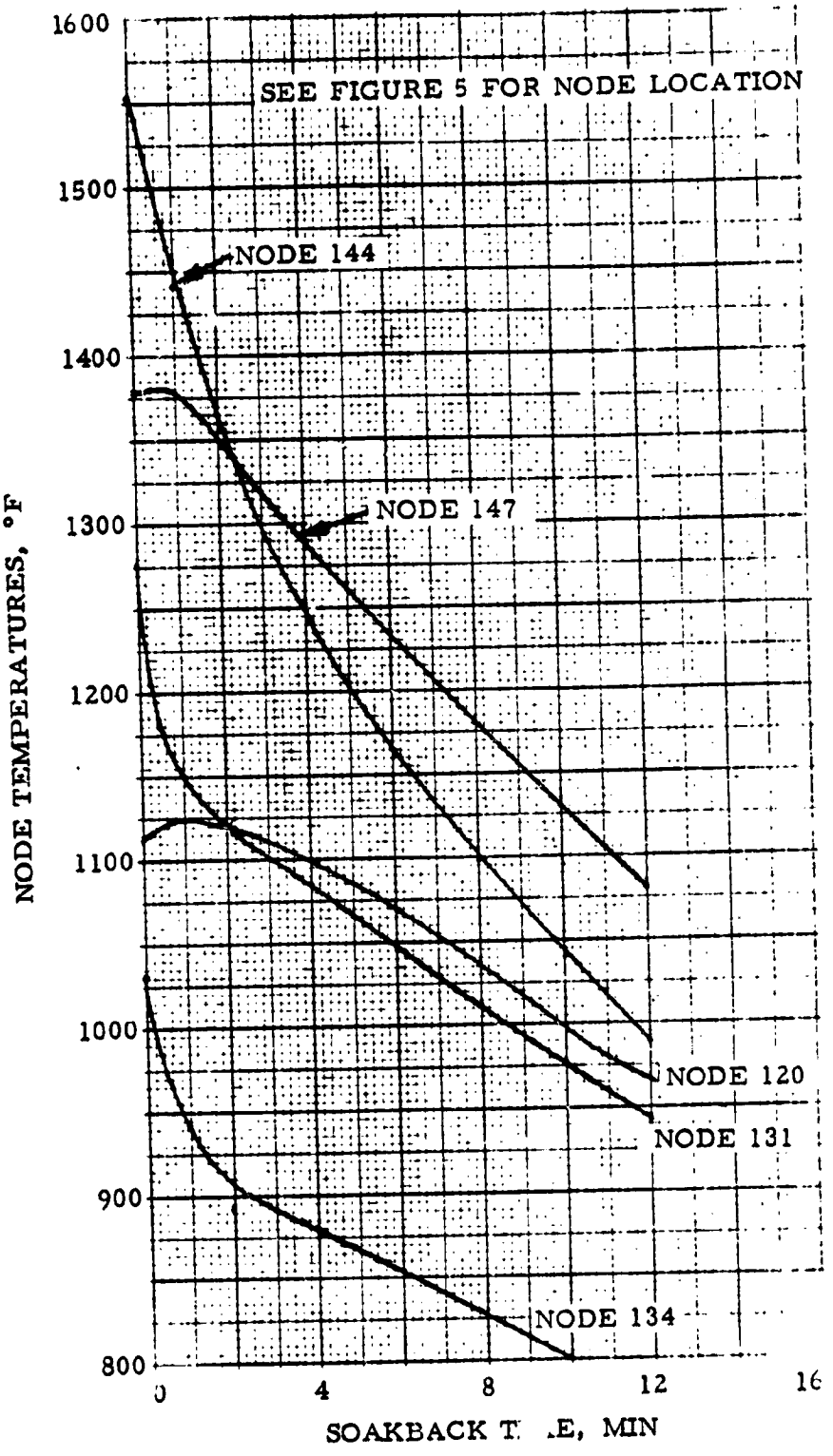
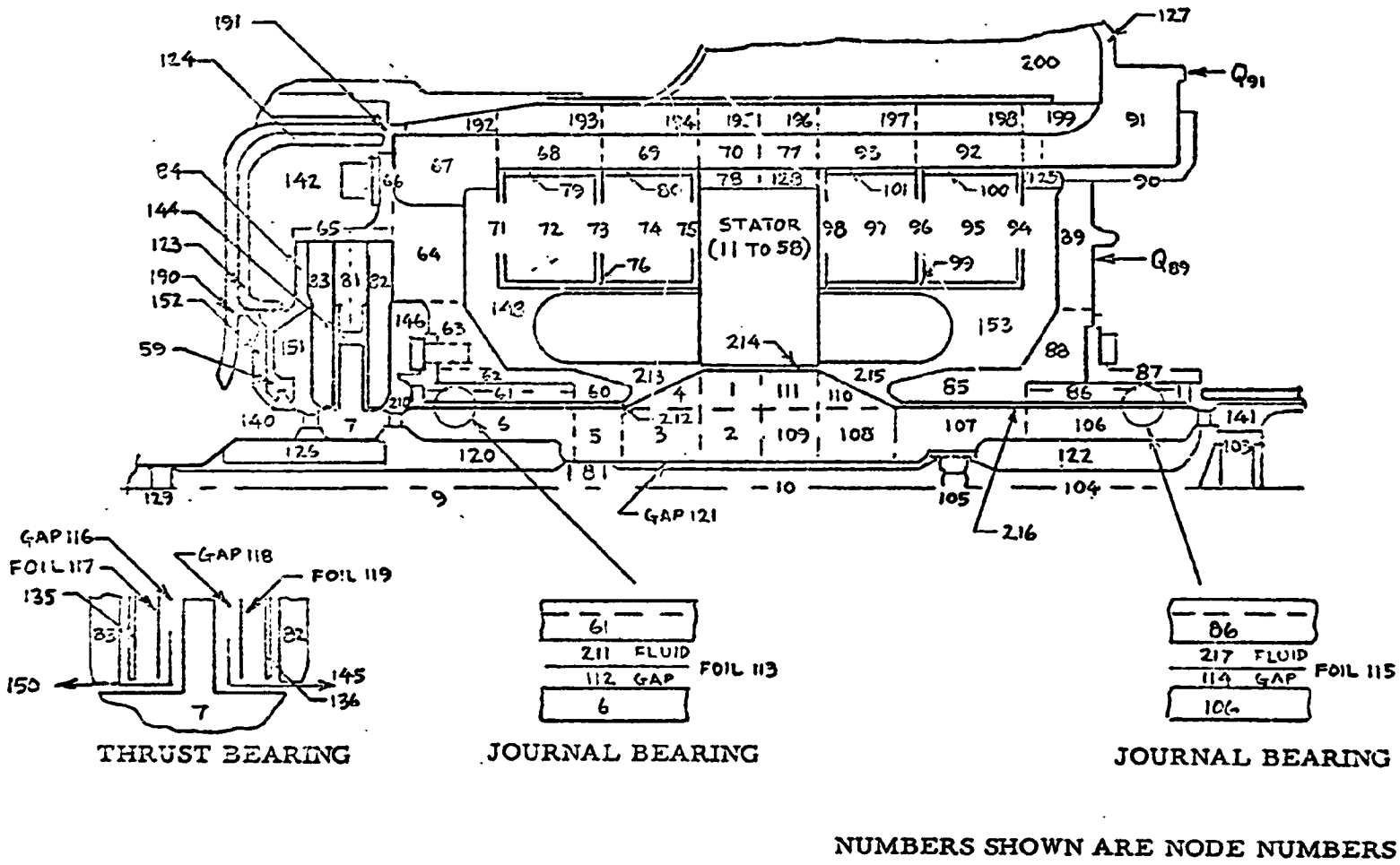


Figure 215. - Soakback Temperatures.



NUMBERS SHOWN ARE NODE NUMBERS

Figure 216. - Mini-BRU Alternator Thermal Model.

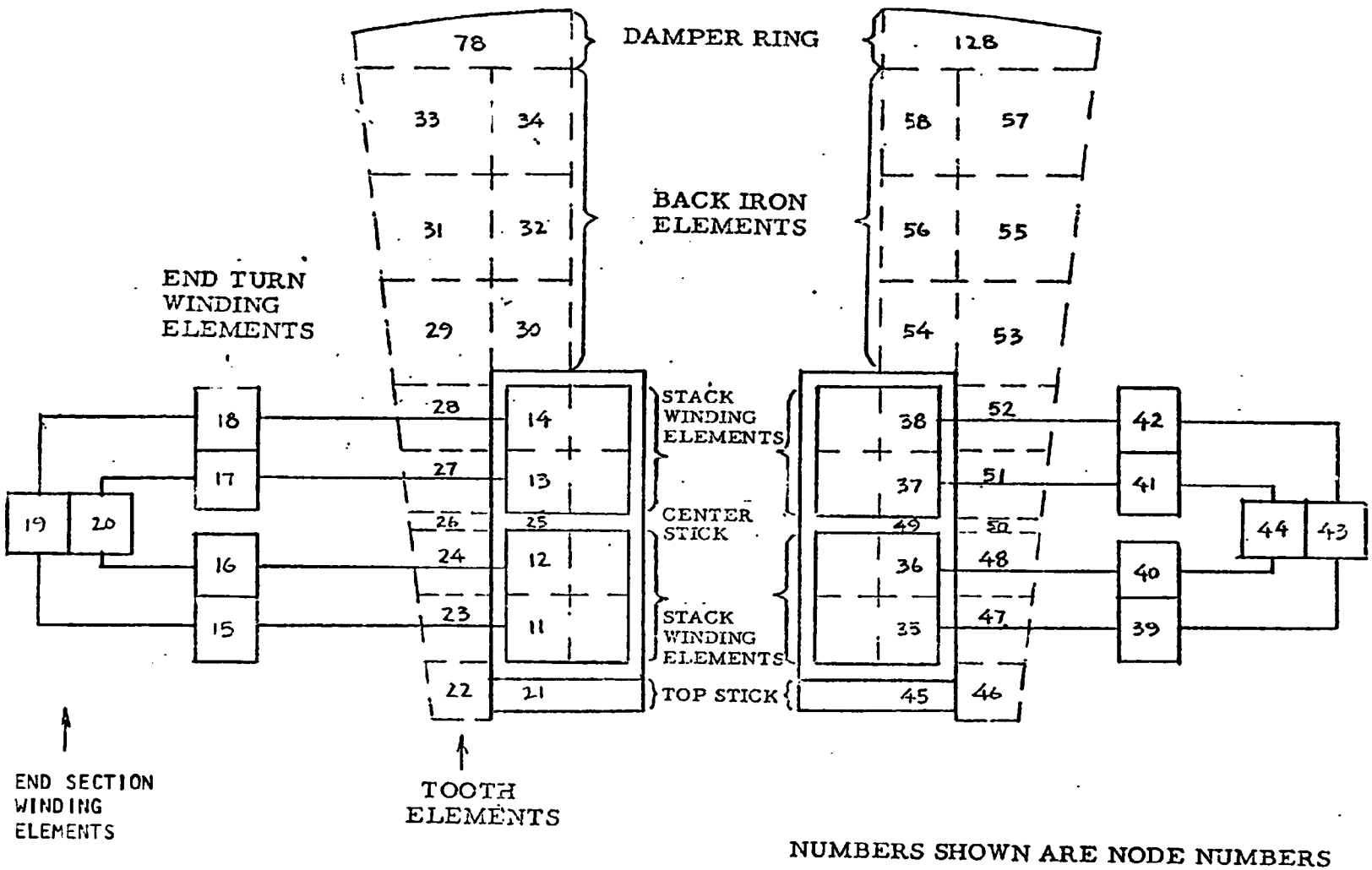


Figure 217. - Mini-BRU Alternator Stator Thermal Model.

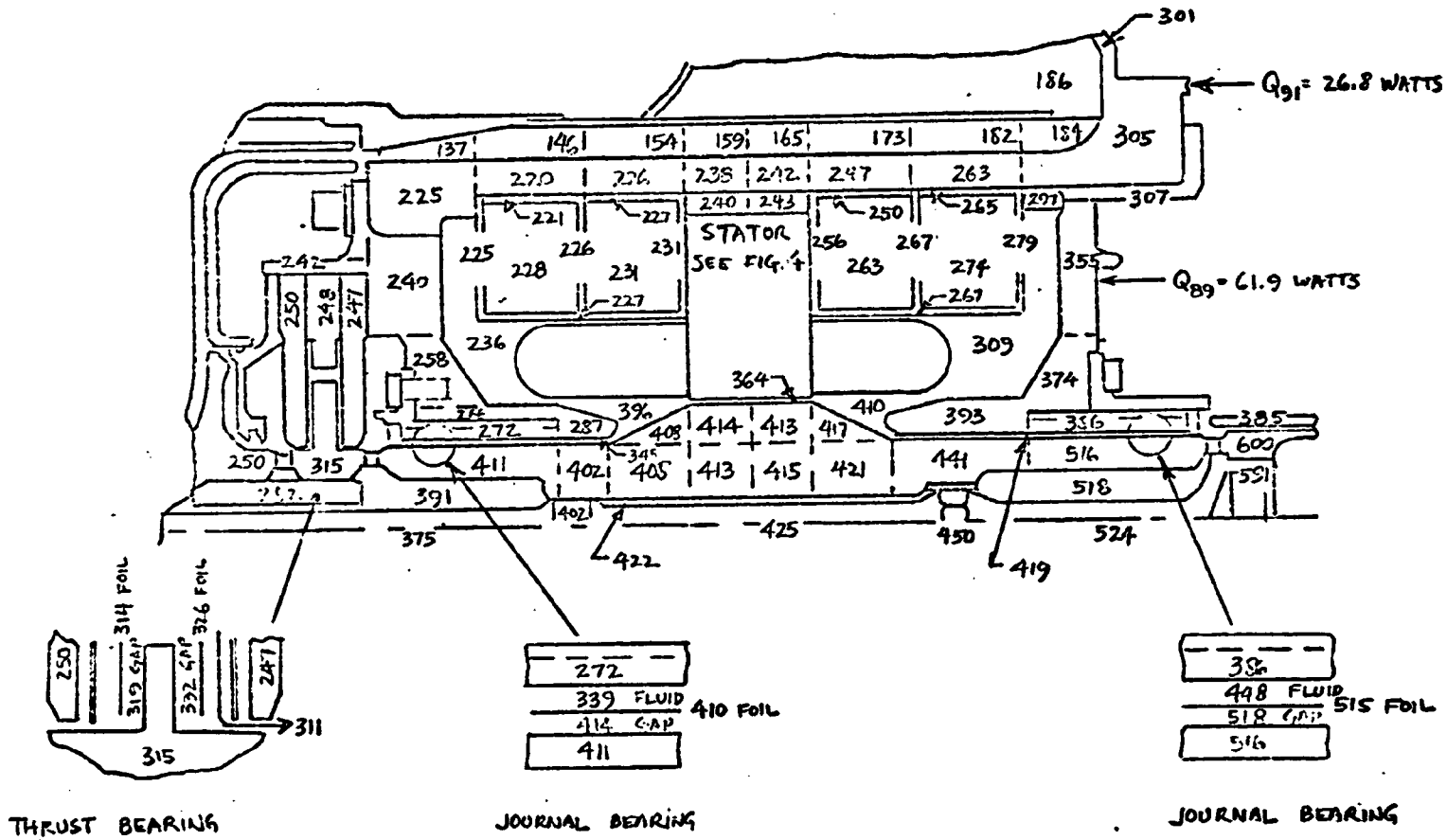


Figure 218. - Alternator Temperatures at Low-Power Operation.

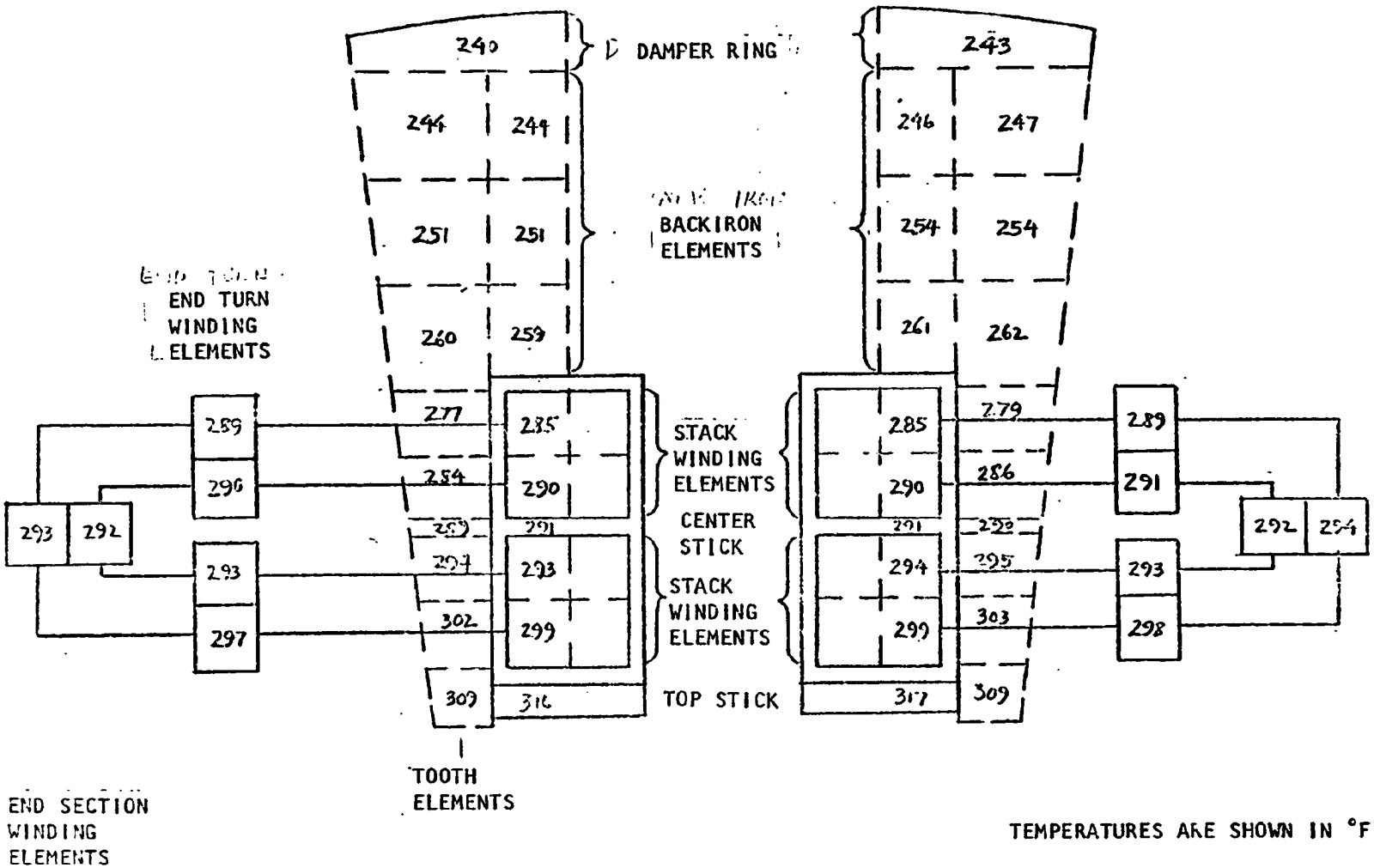


Figure 219. - Alternator Stator Temperatures at Low-Power Operation.

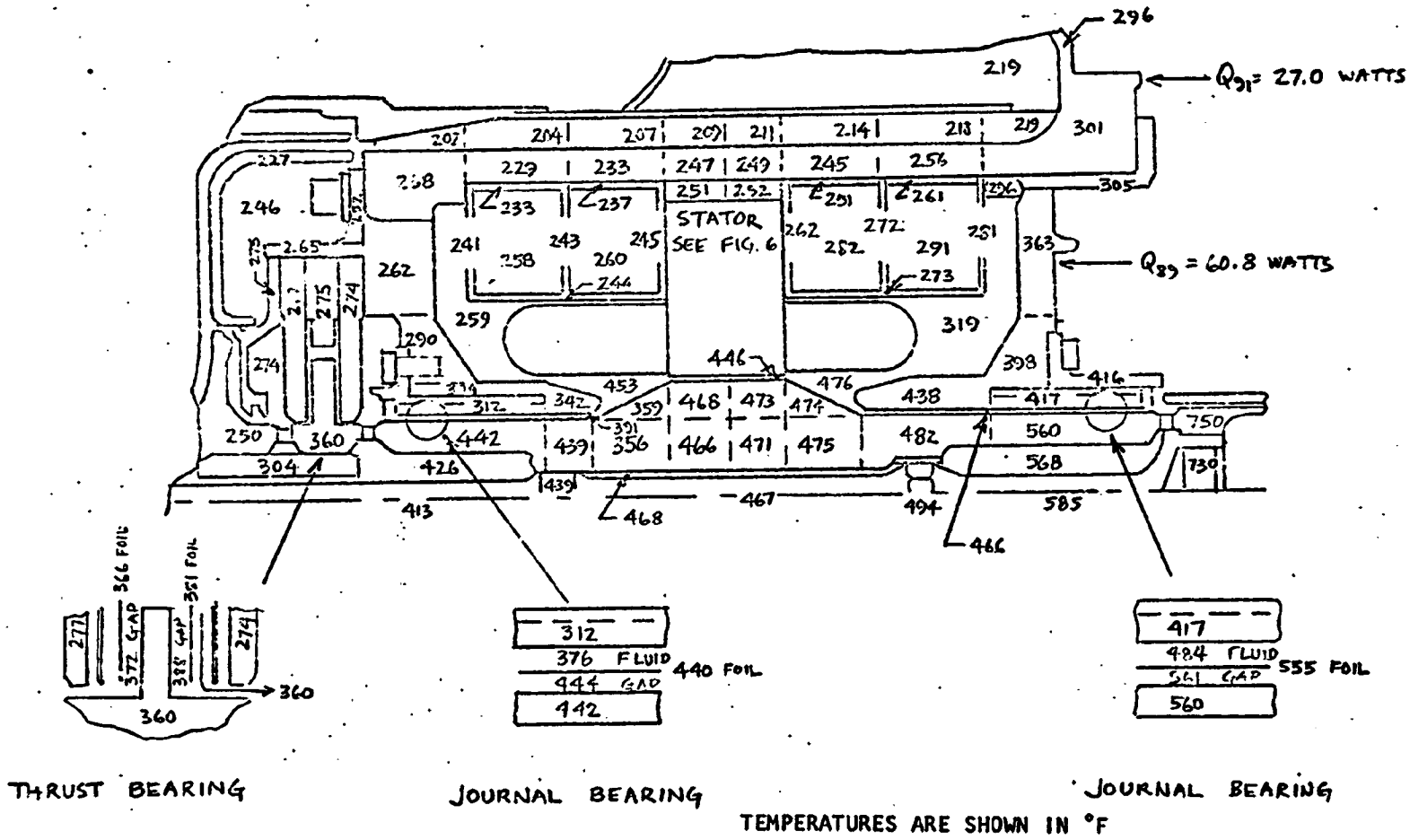


Figure 220. - Alternator Temperatures at High-Power Operation.

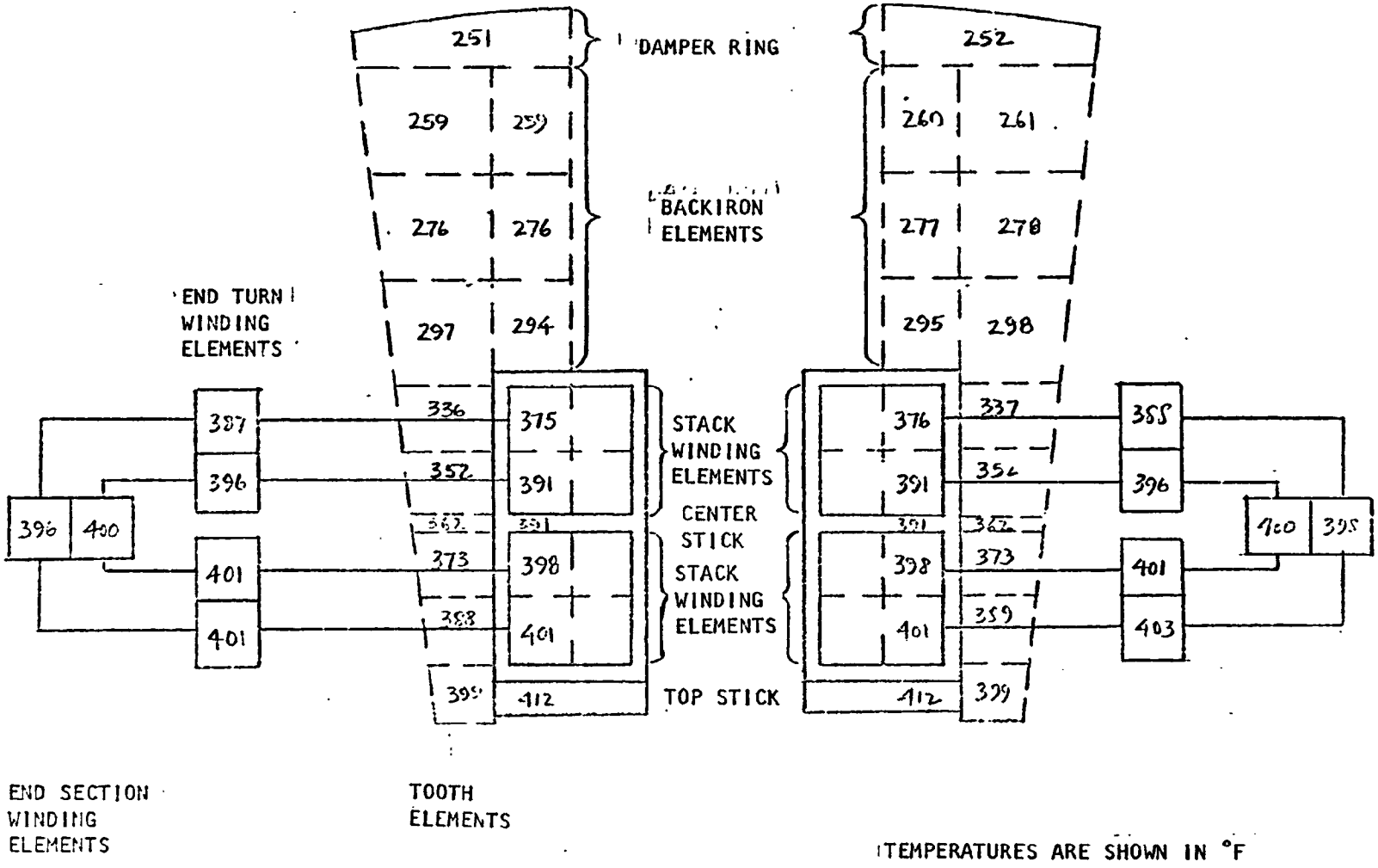


Figure 221. - Alternator Stator Temperature at High-Power Operation.

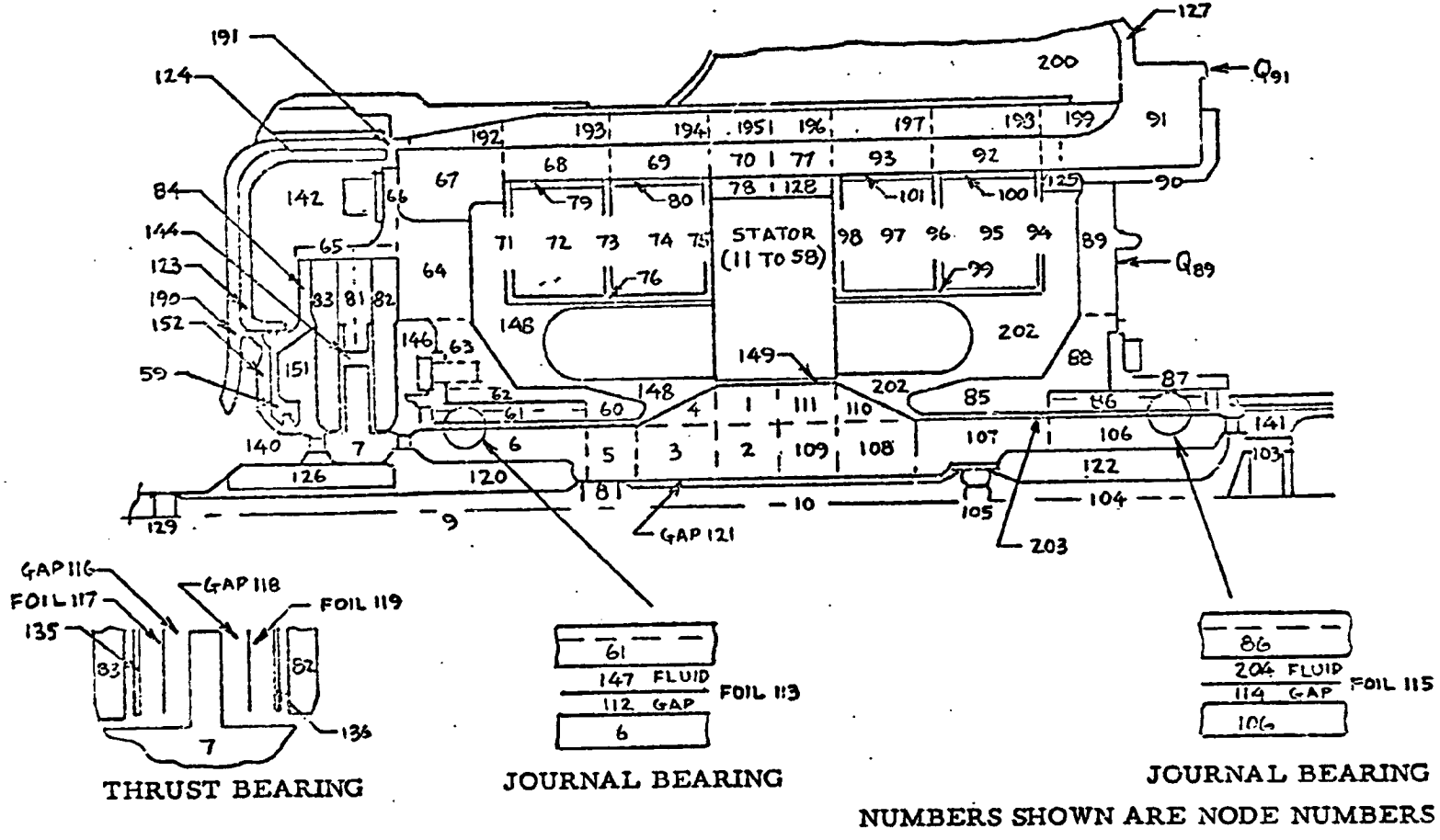


Figure 222. - Mini-BRU Alternator Thermal Model.

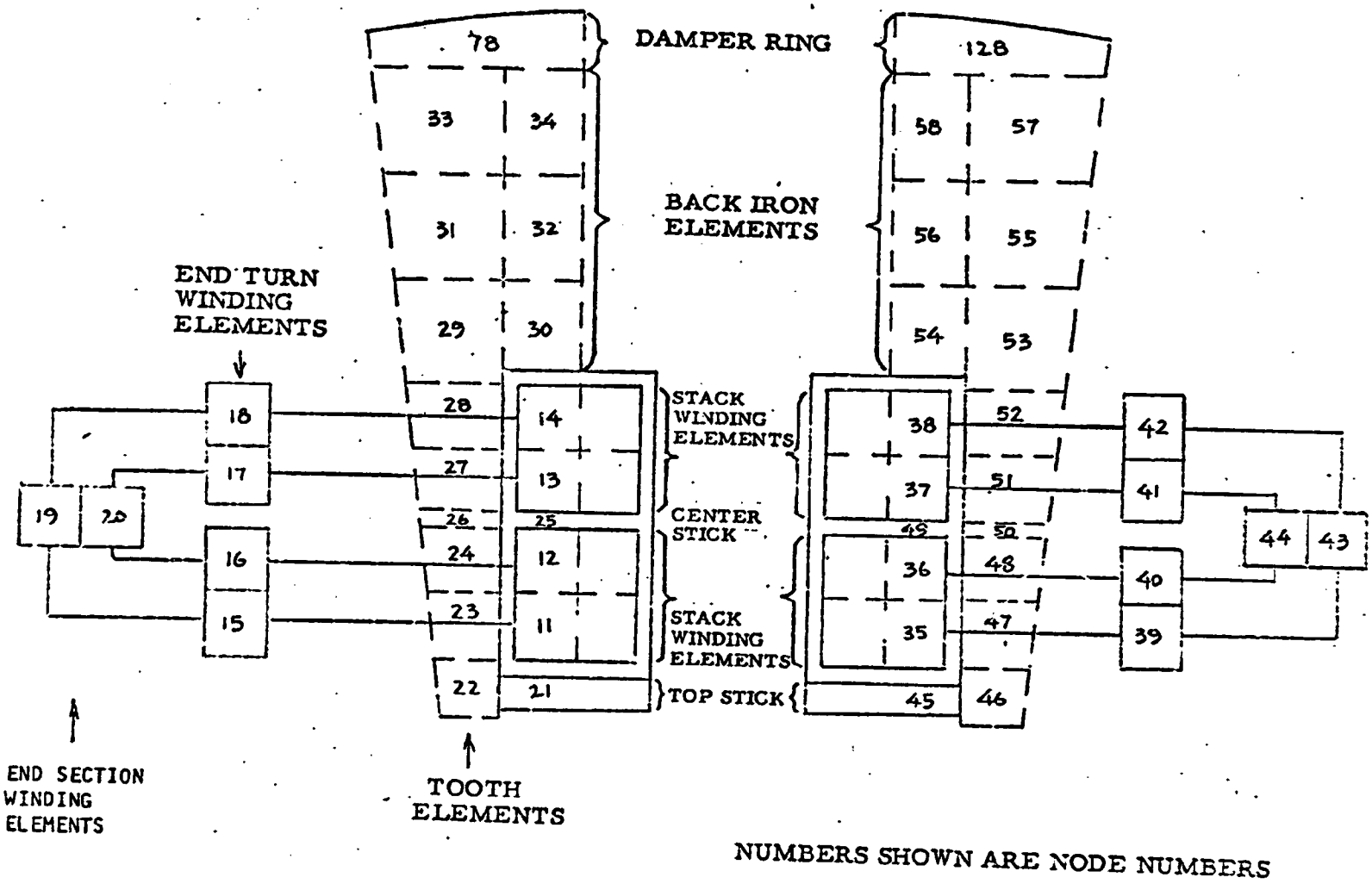


Figure 223. - Mini-BRU Alternator Stator Thermal Model.

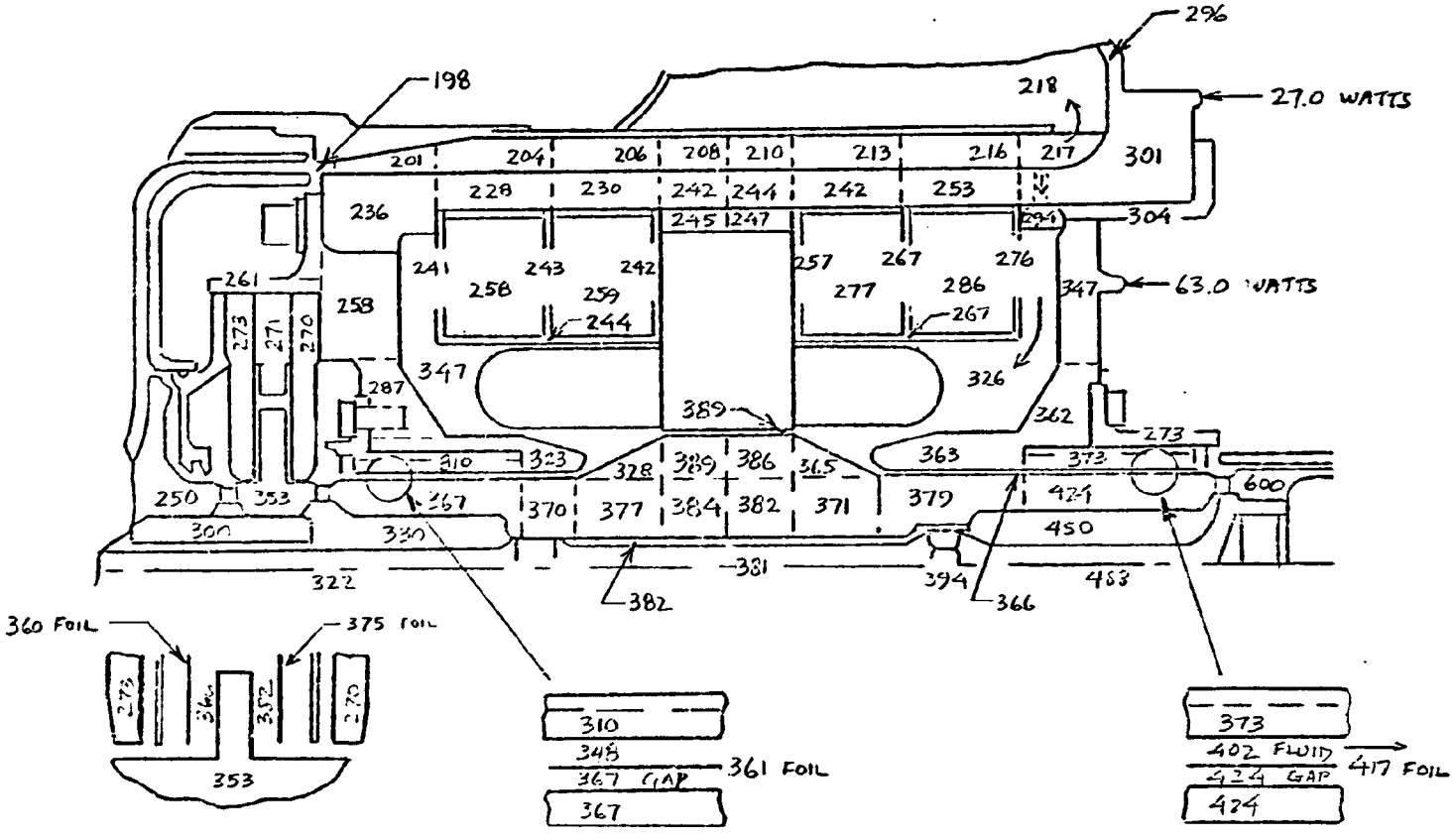


Figure 224. - Alternator Temperatures at High-Power Operation.

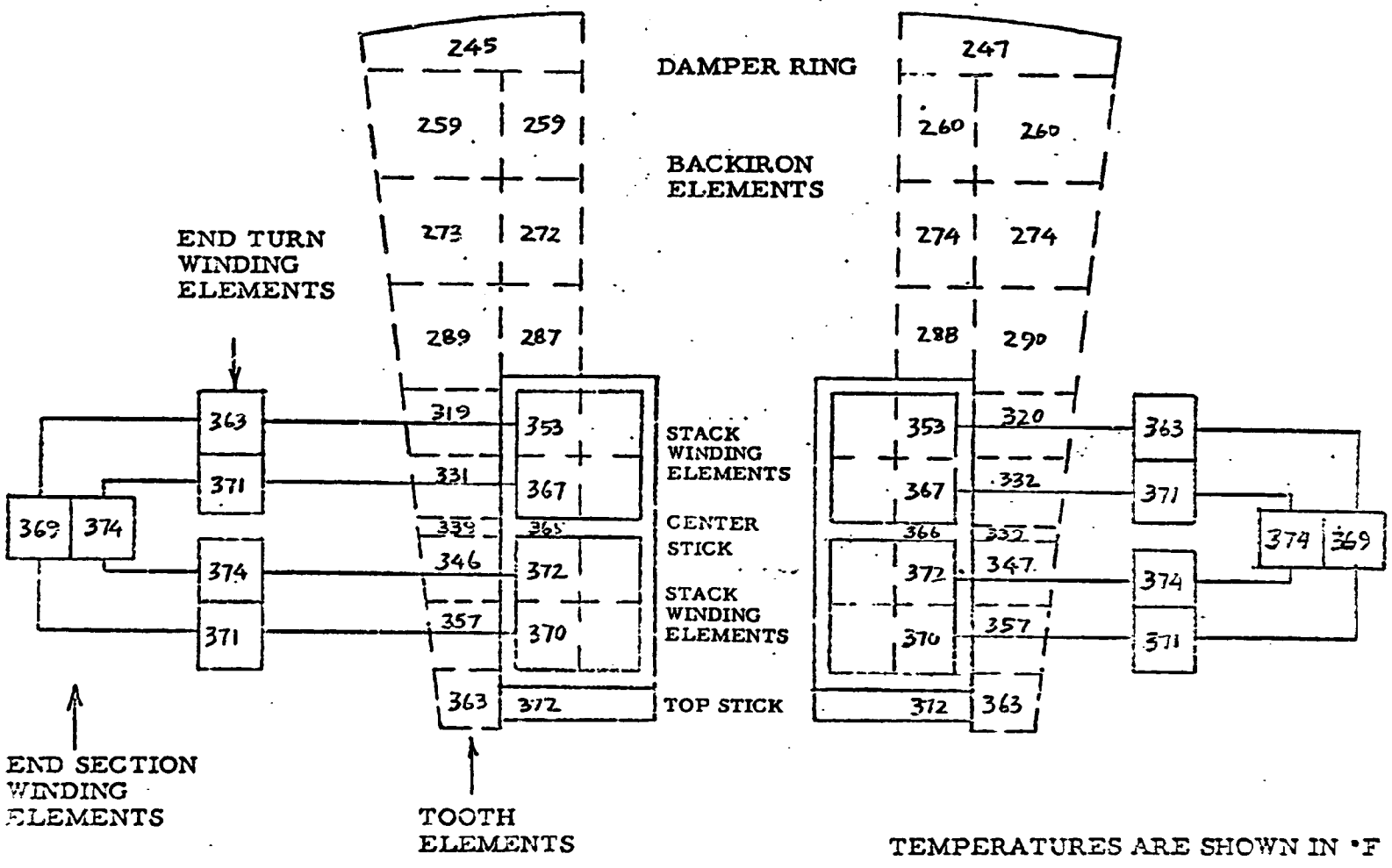


Figure 225. - Alternator Stator Temperatures at High-Power Operation.

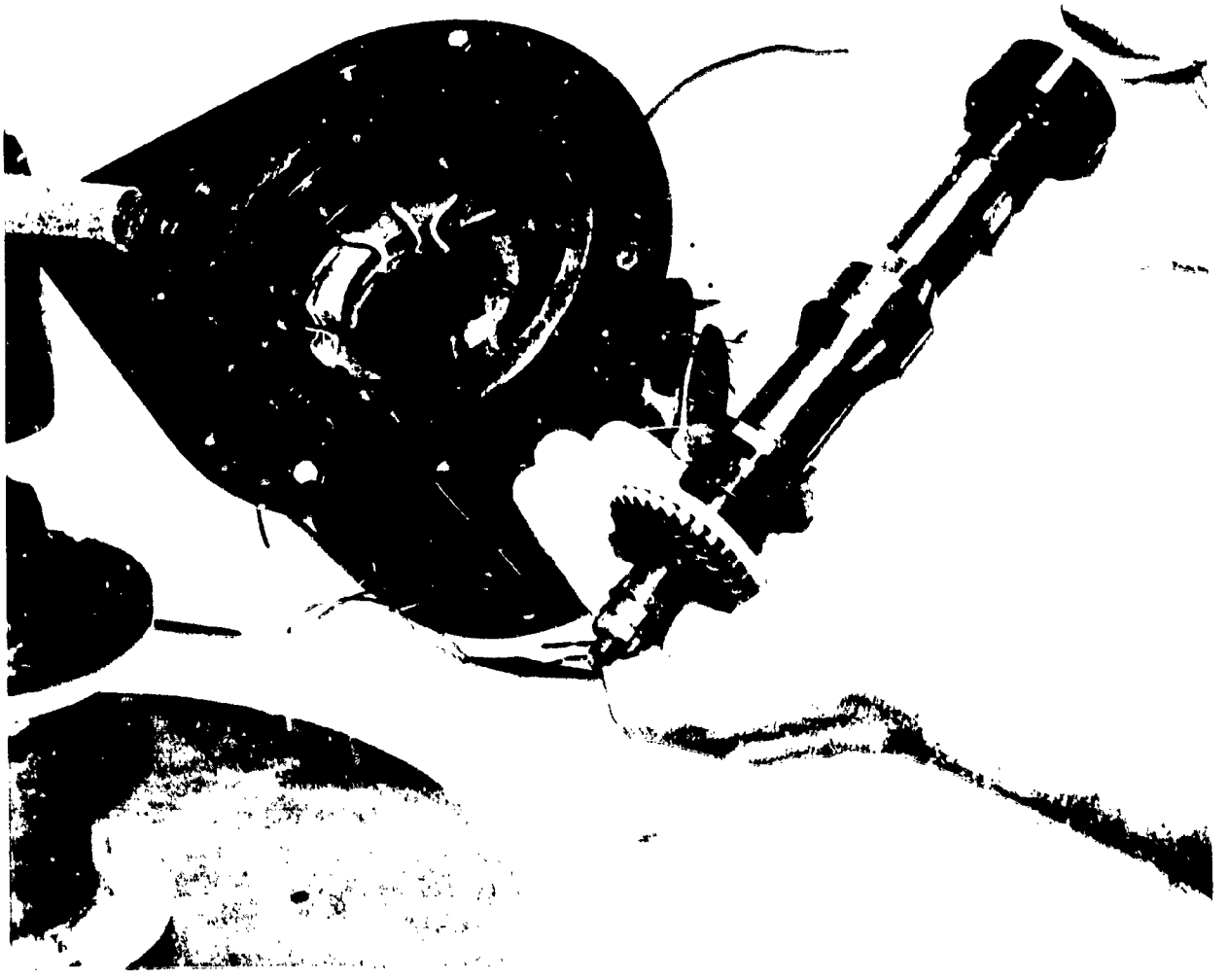


Figure 226. - Mini-BRU Alternator Stator and Rotor.

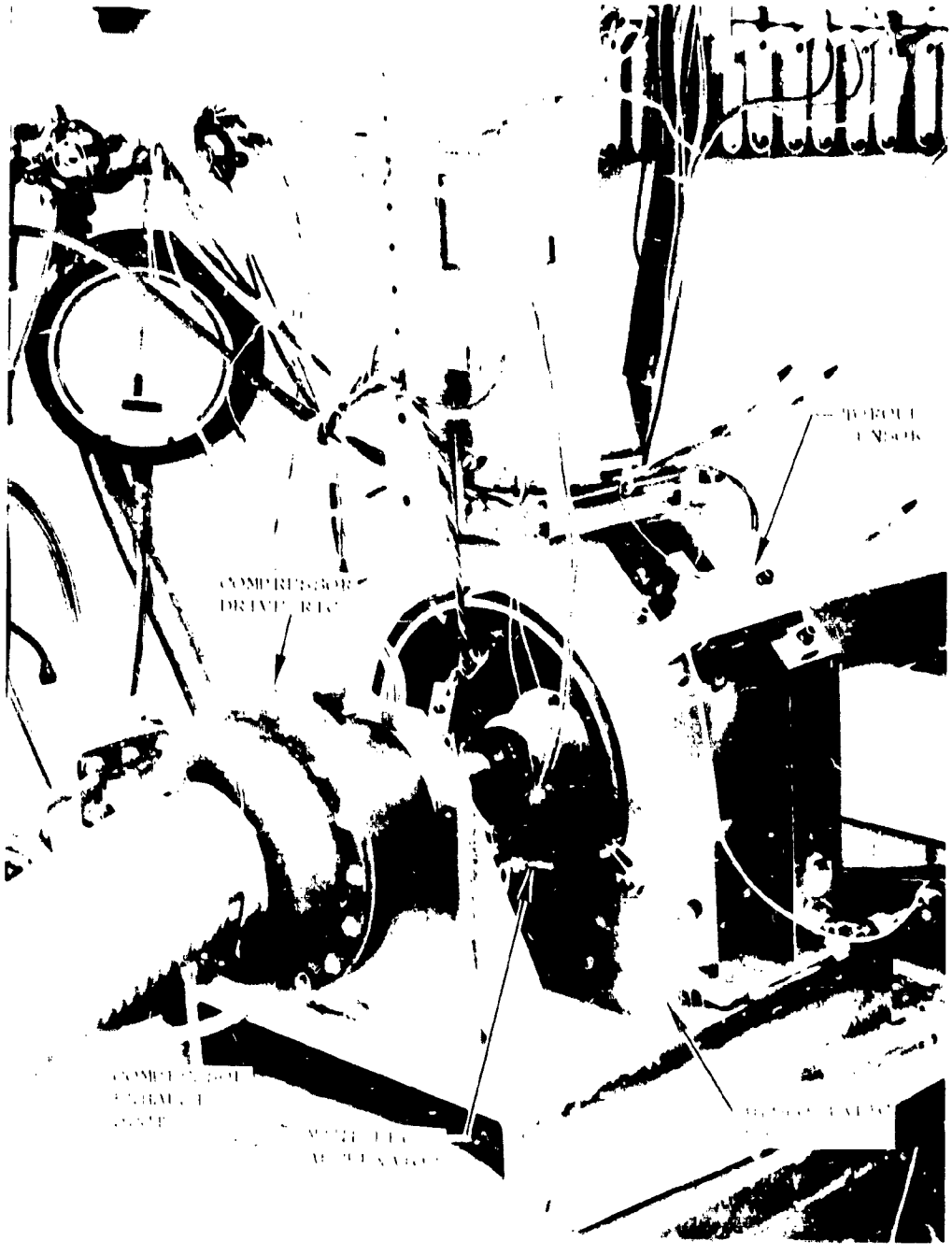


Figure 22. - Mini-BRF Alternator Test Rig Assembly P/N 3005310.

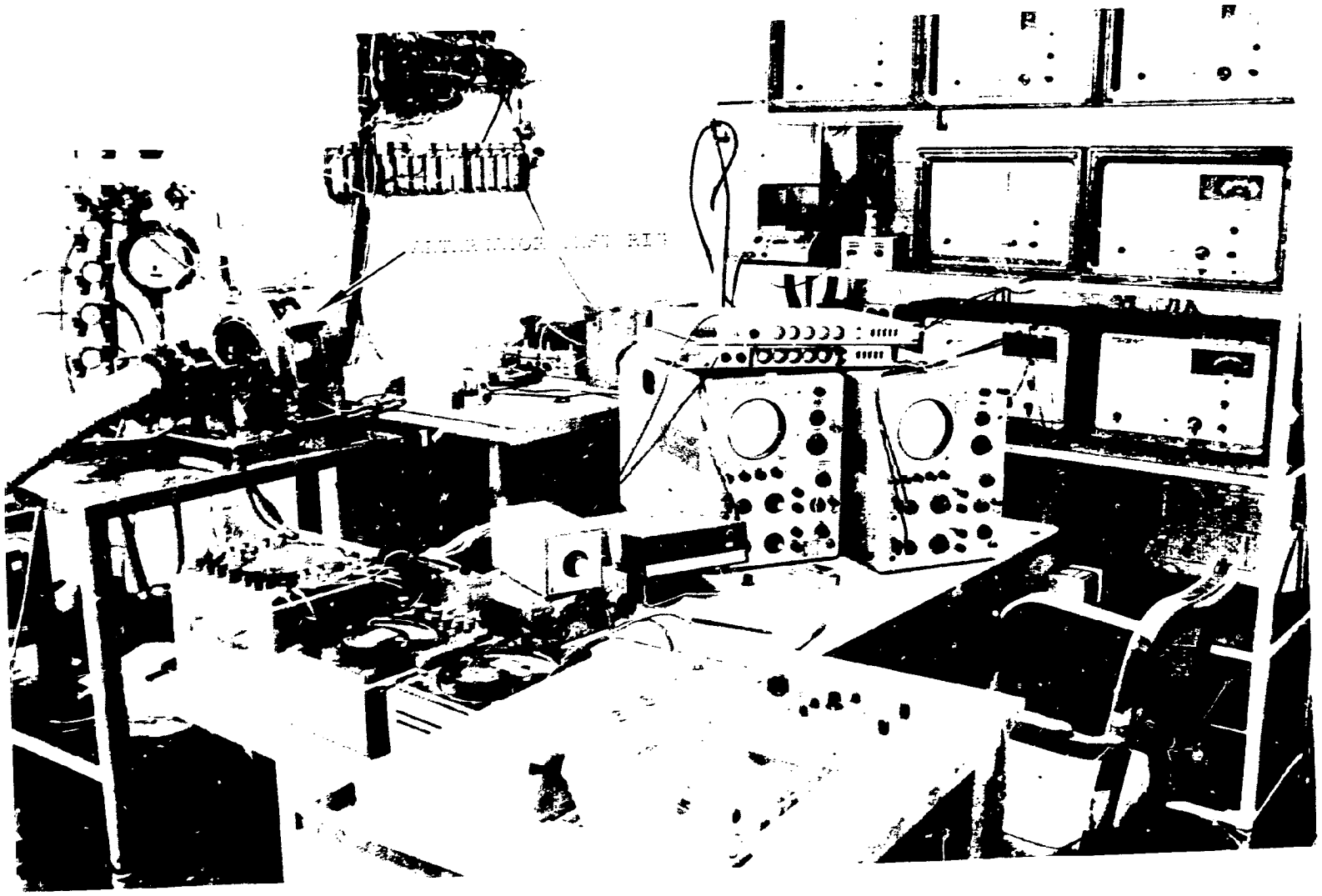


Figure 228. - Alternator Test Rig and Instrumentation.

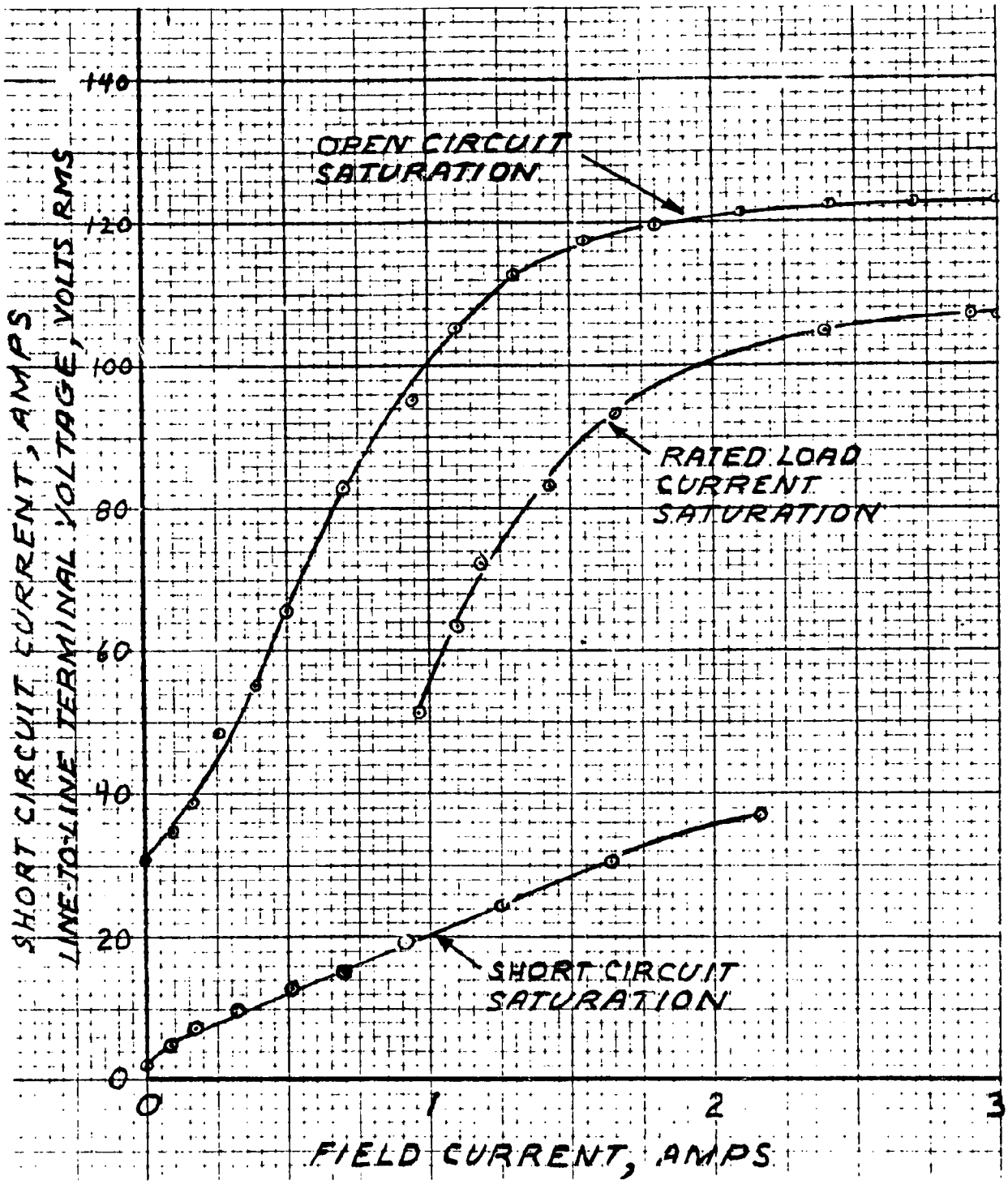


Figure 229. - Alternator Family of Saturation Curves.

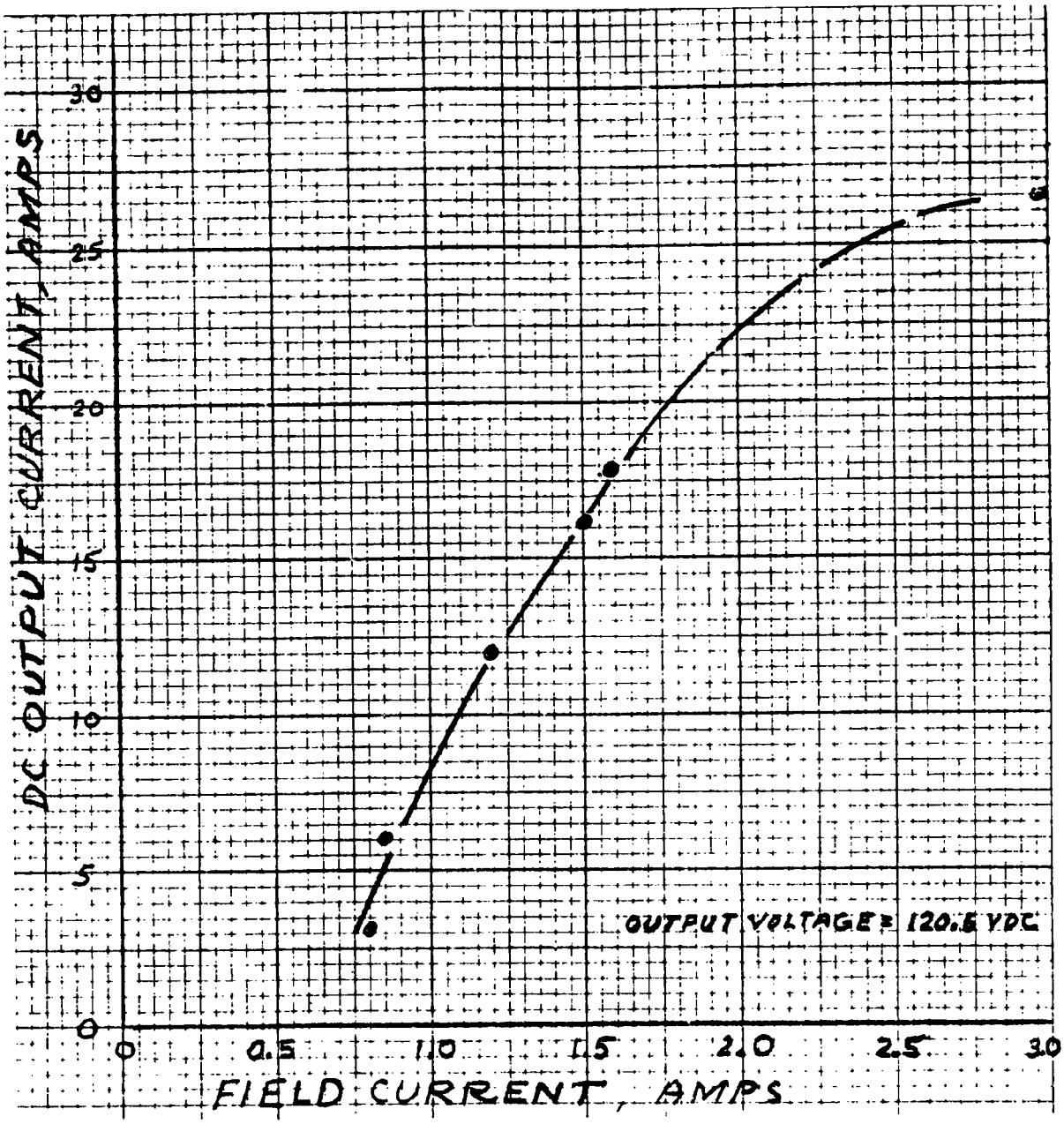


Figure 230. - Alternator DC Load Current Saturation.

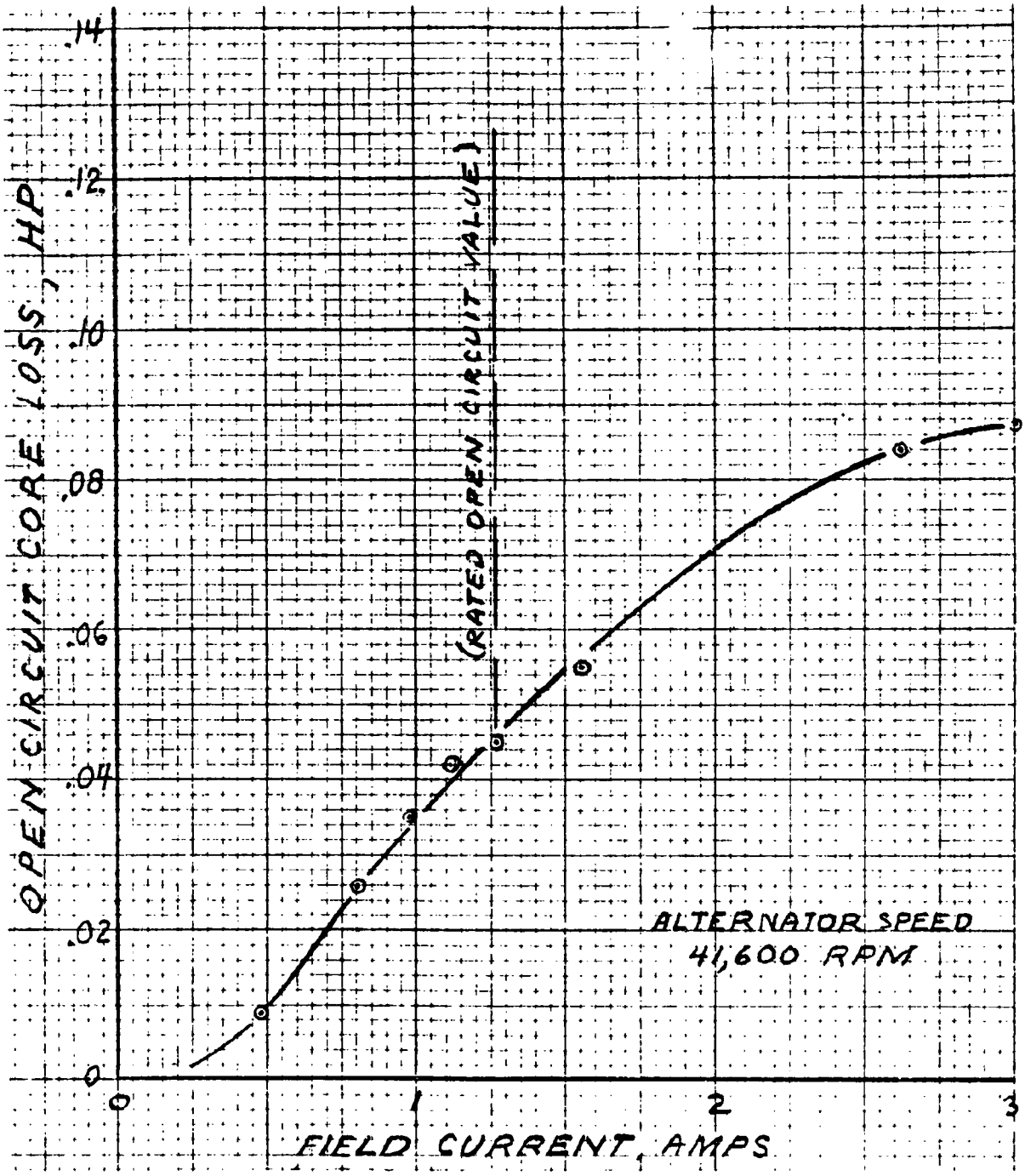


Figure 231. - Alternator Open Circuit Core Loss.

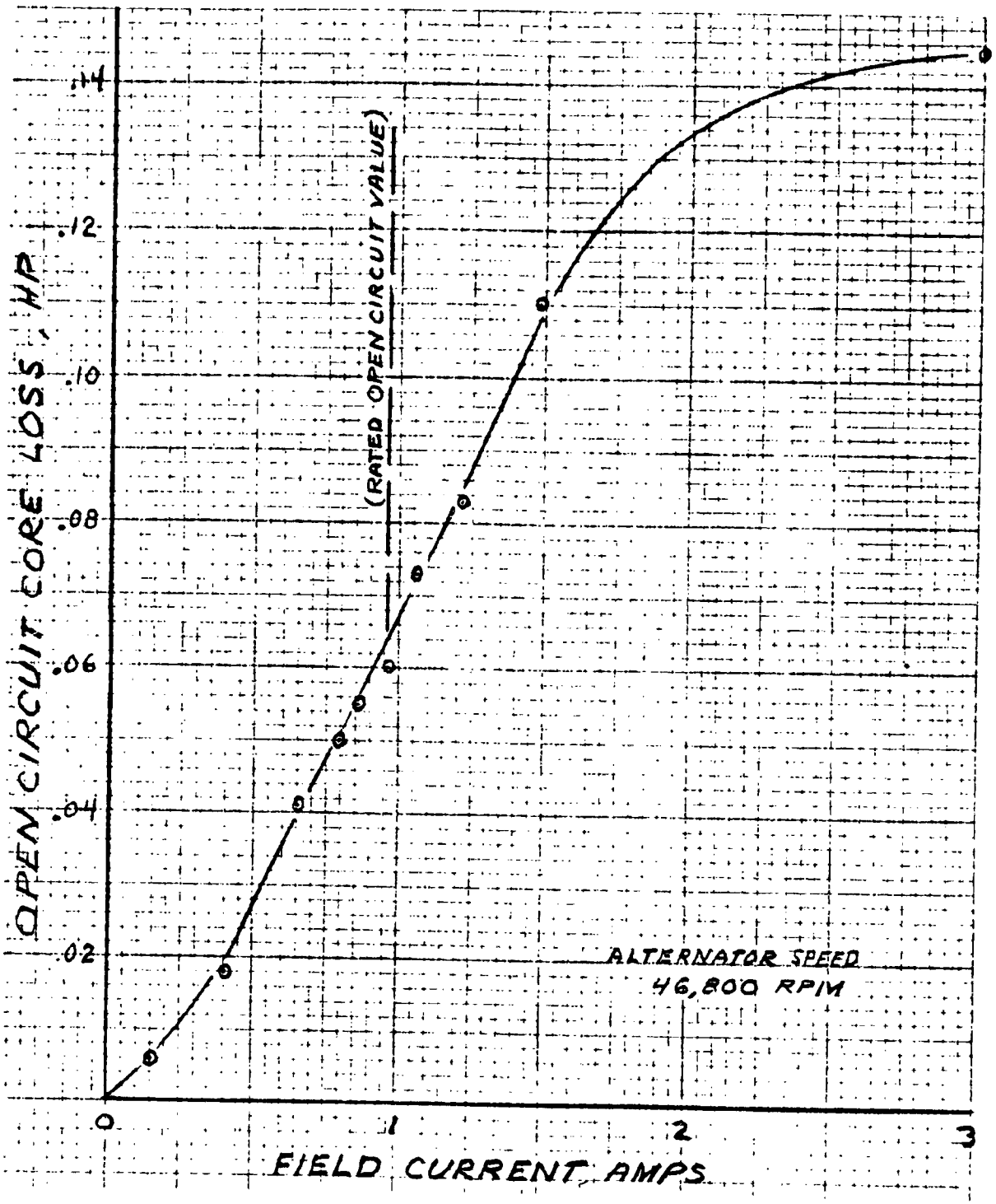


Figure 232. - Alternator Open Circuit Core Loss.

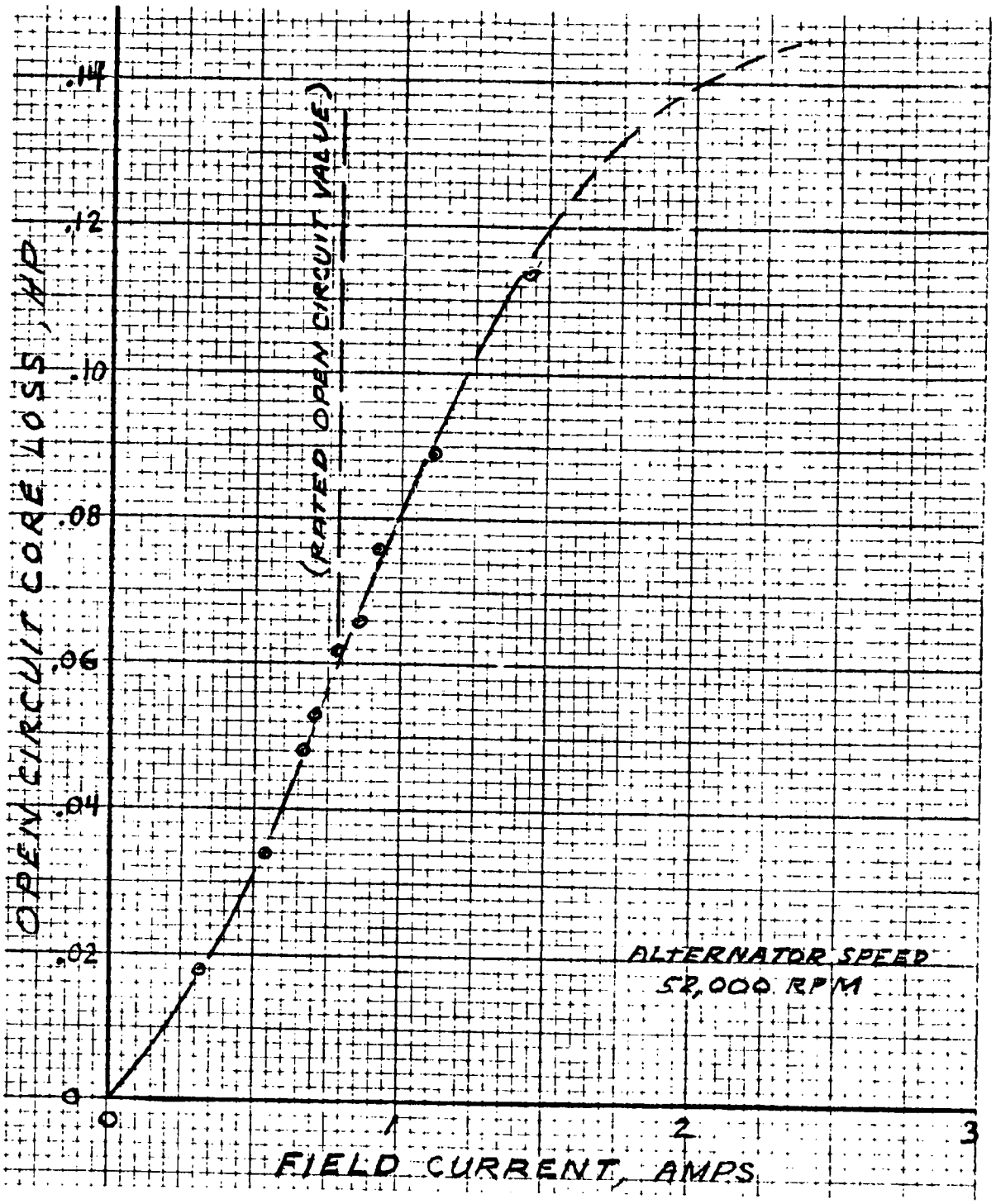


Figure 233. - Alternator Open Circuit Core Loss.

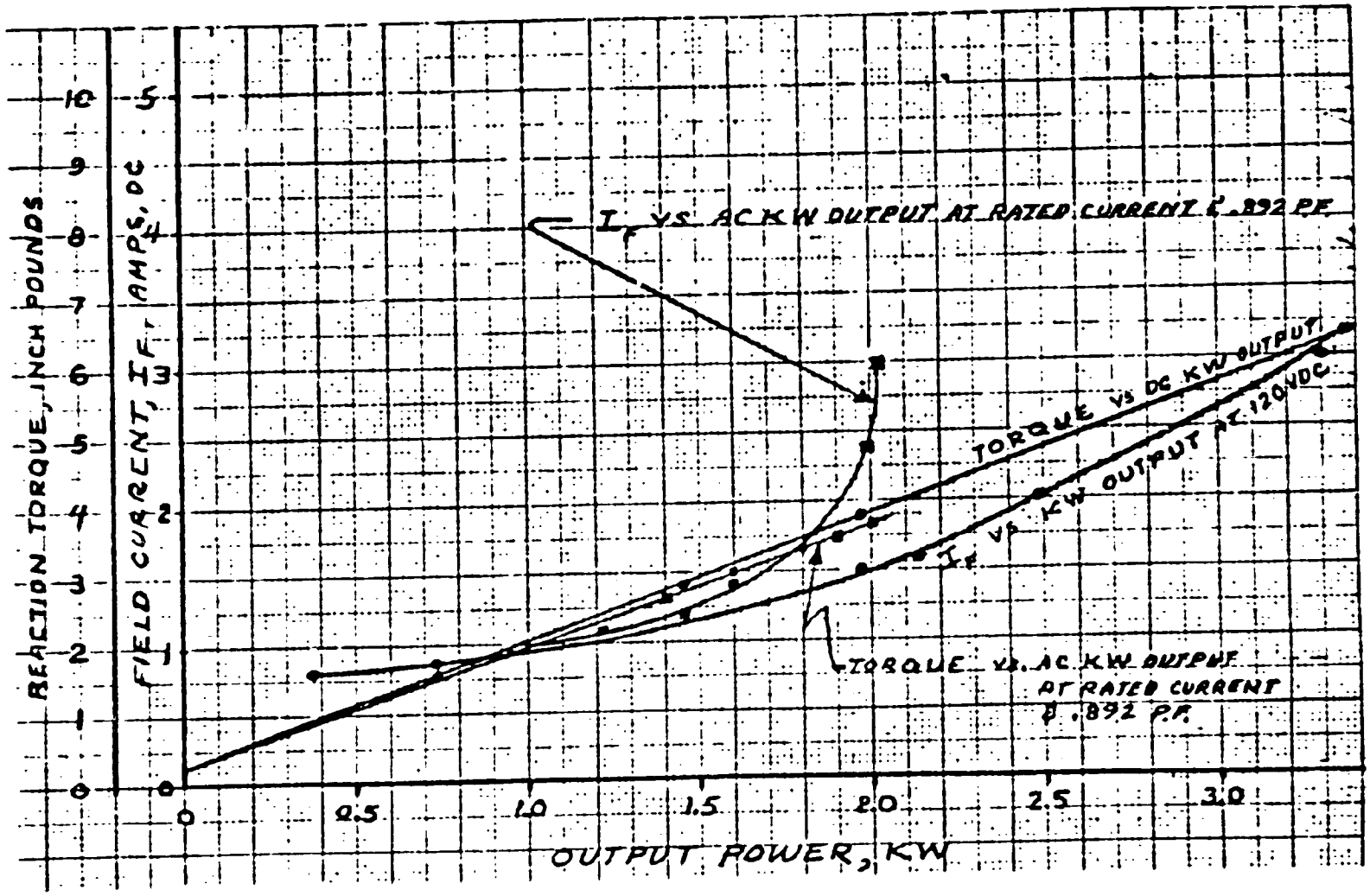


Figure 234. - Alternator Performance Characteristics at Rated Speed.

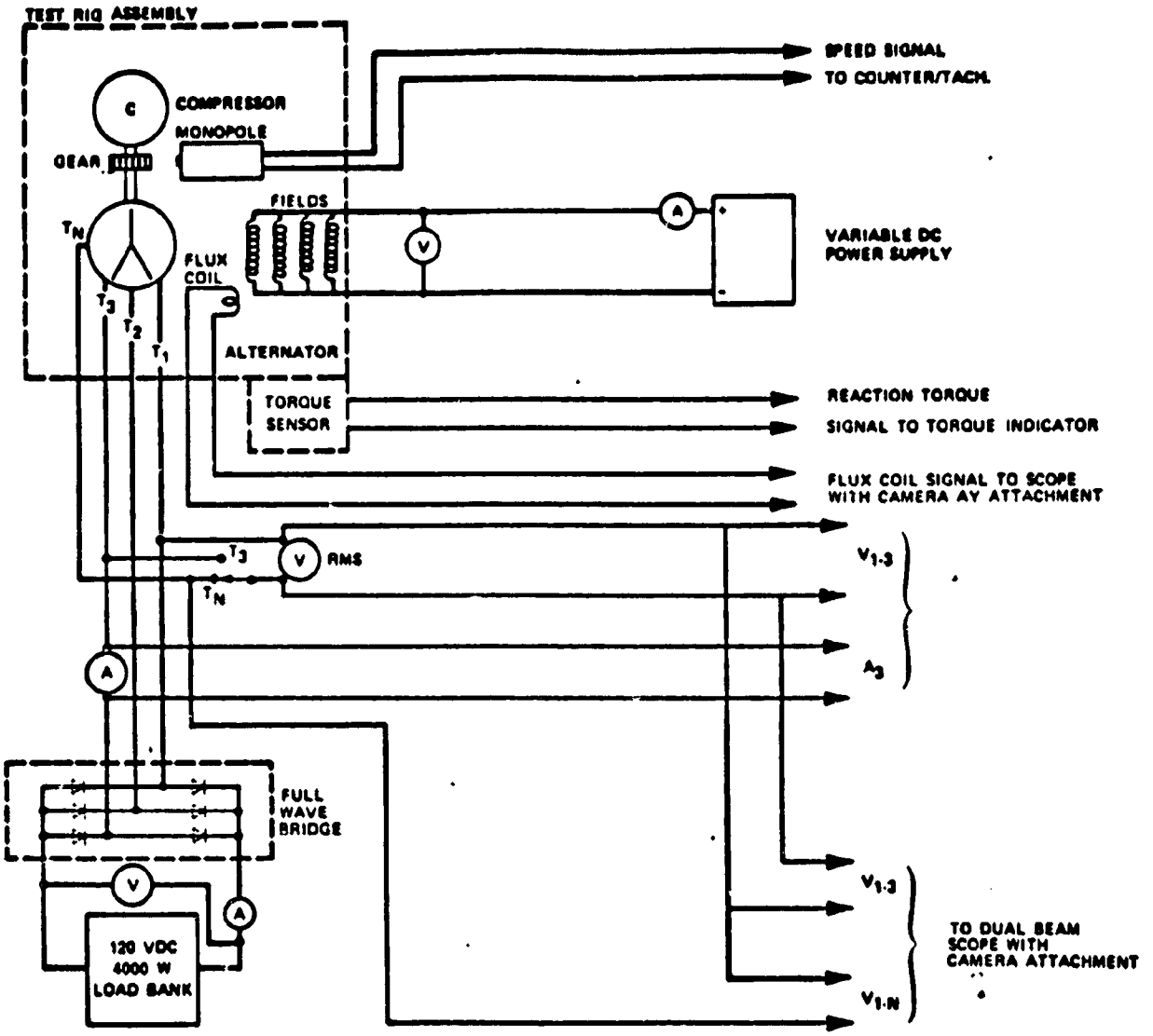
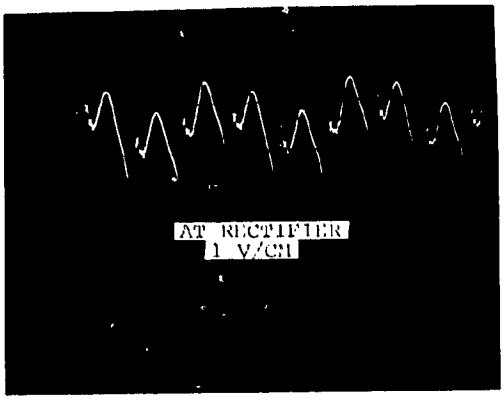


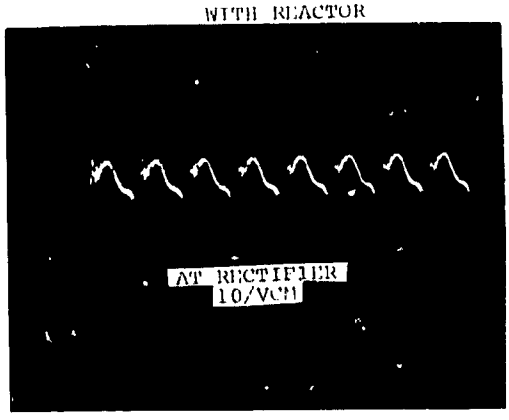
Figure 235. - DC Load Current Saturation, Torque, and Commutation Angle Test Setup.

NO REACTOR



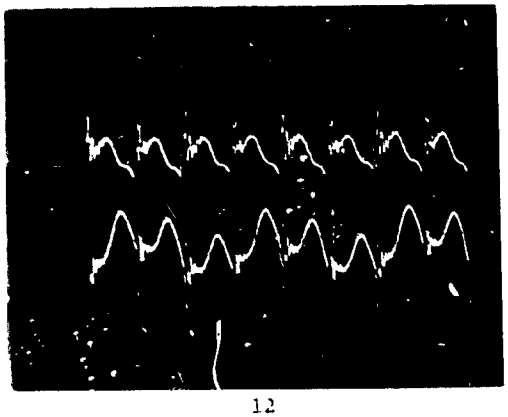
10

WITH REACTOR



11

WITH REACTOR



AT RECTIFIER
10 V/CM

AT LOAD
1 V/CM

12

Figure 236. - DC Ripple Waveforms.

Intentionally Left Blank

Figure 237

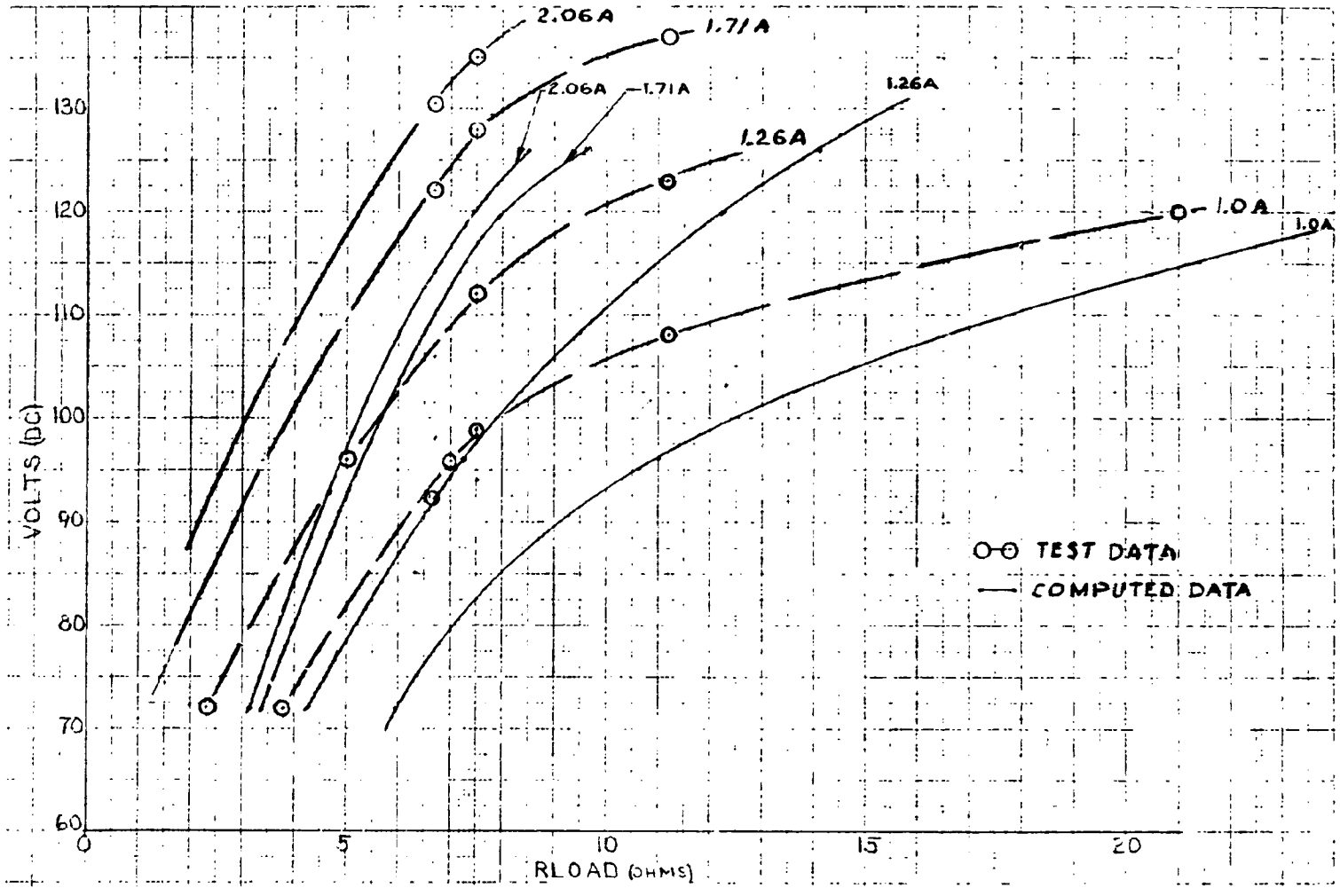


Figure 238. - CCPS-2 Rice Alternator Performance 50,000 RPM.

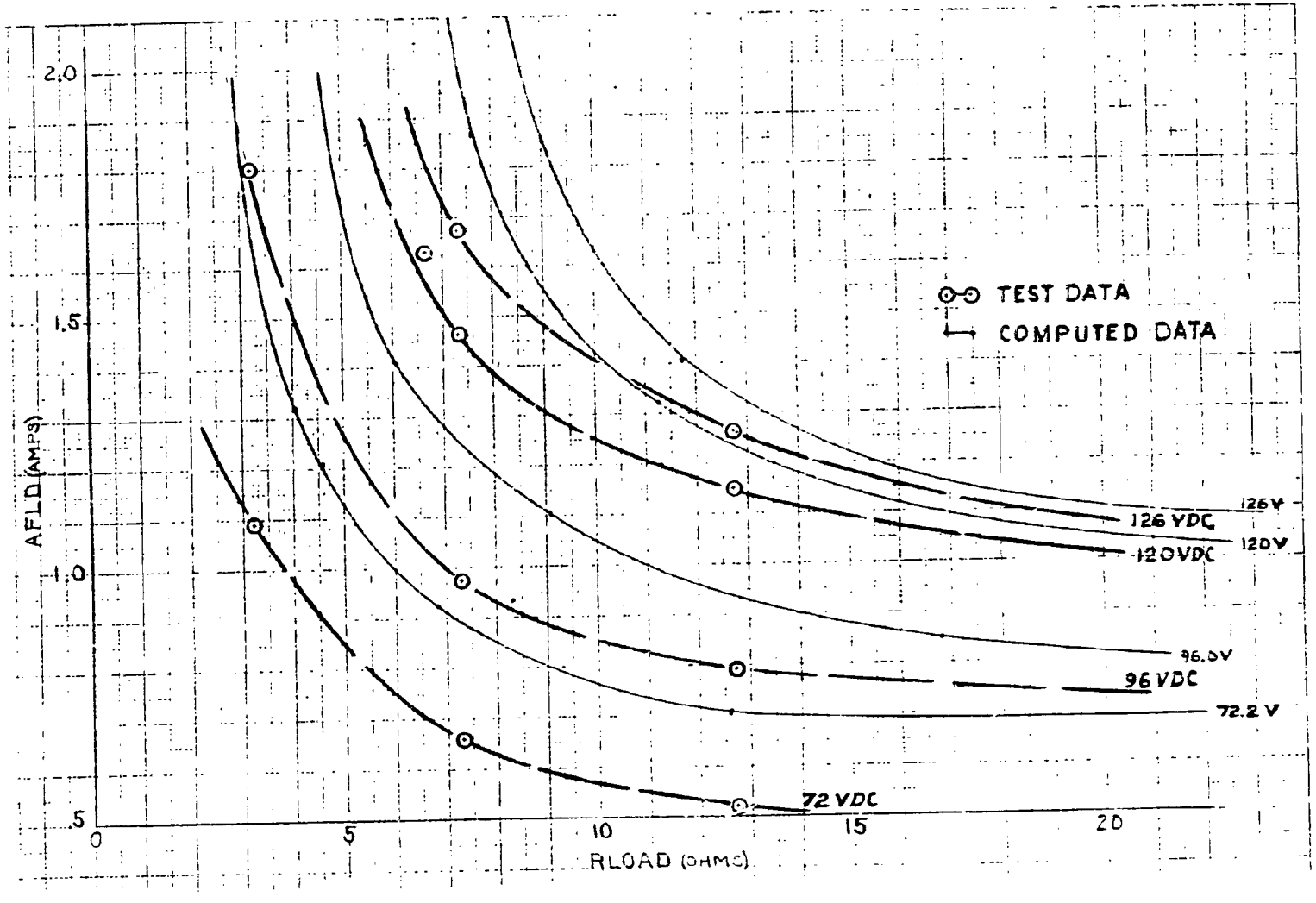


Figure 239. - CCPS-2 Rice Alternator Performance 50,000 RPM.

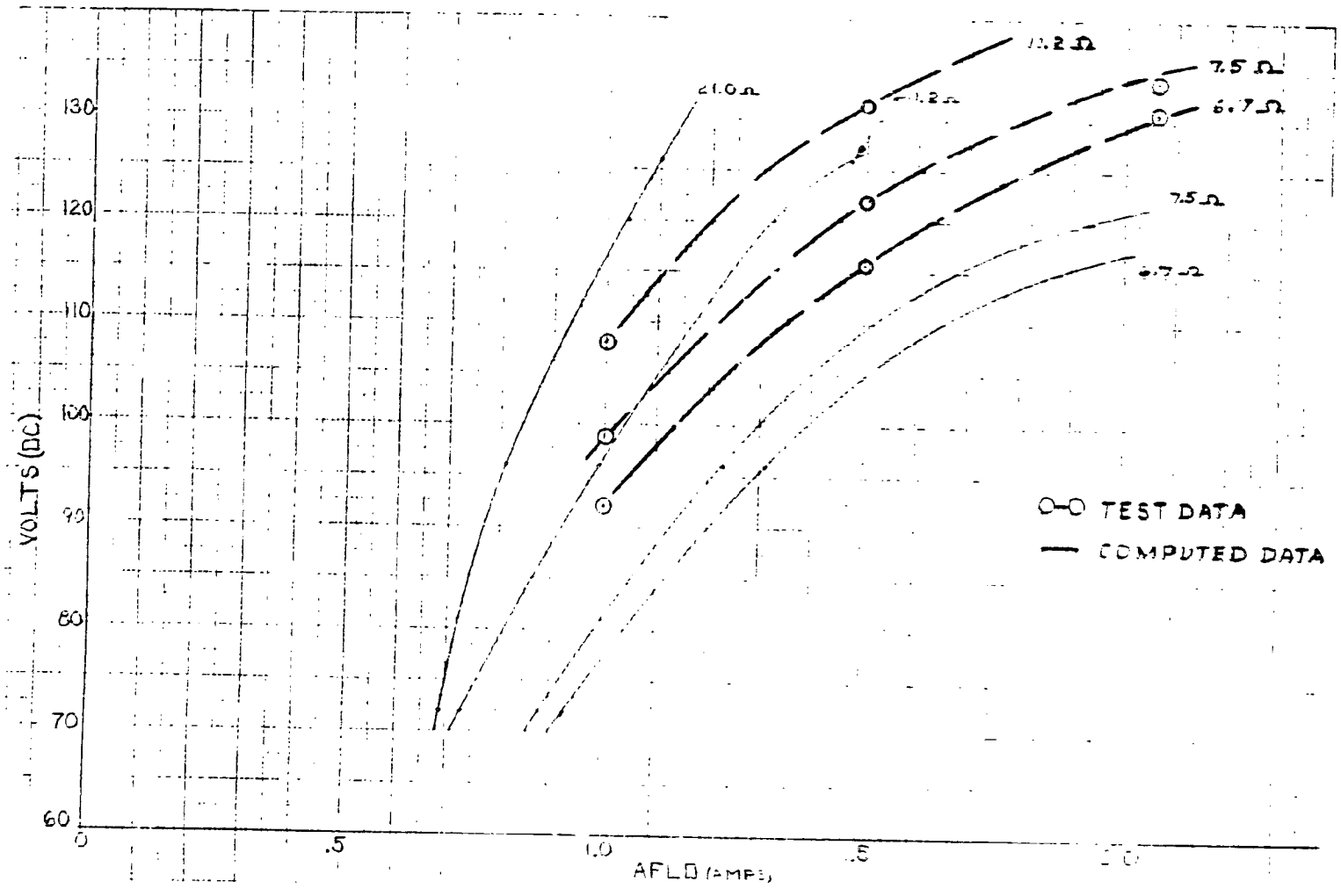


Figure 240. - CCPS-2 Rice Alternator Performance 50,000 RPM.

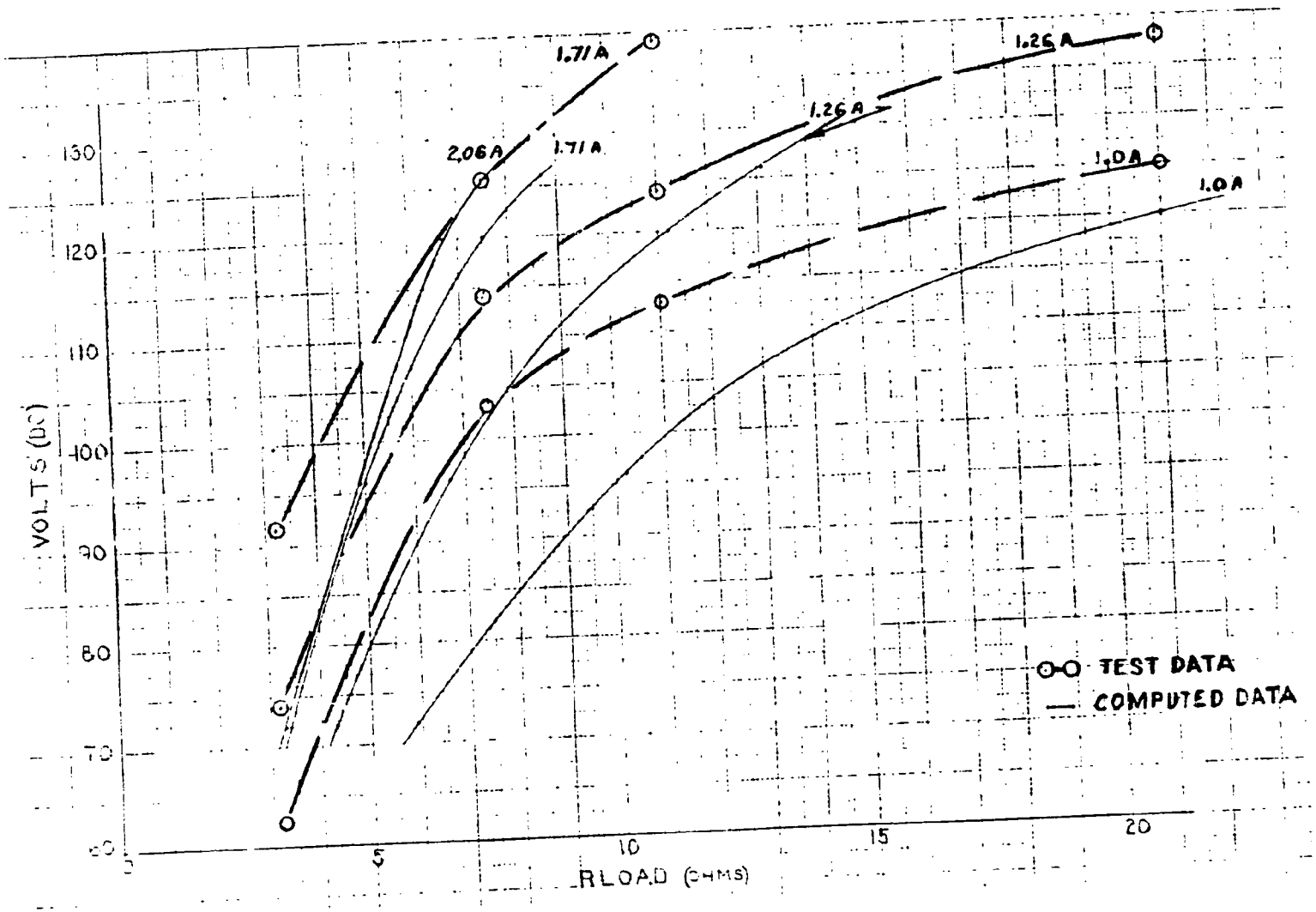


Figure 241. - CCPS-2 Rice Alternator Performance 52,000 RPM.

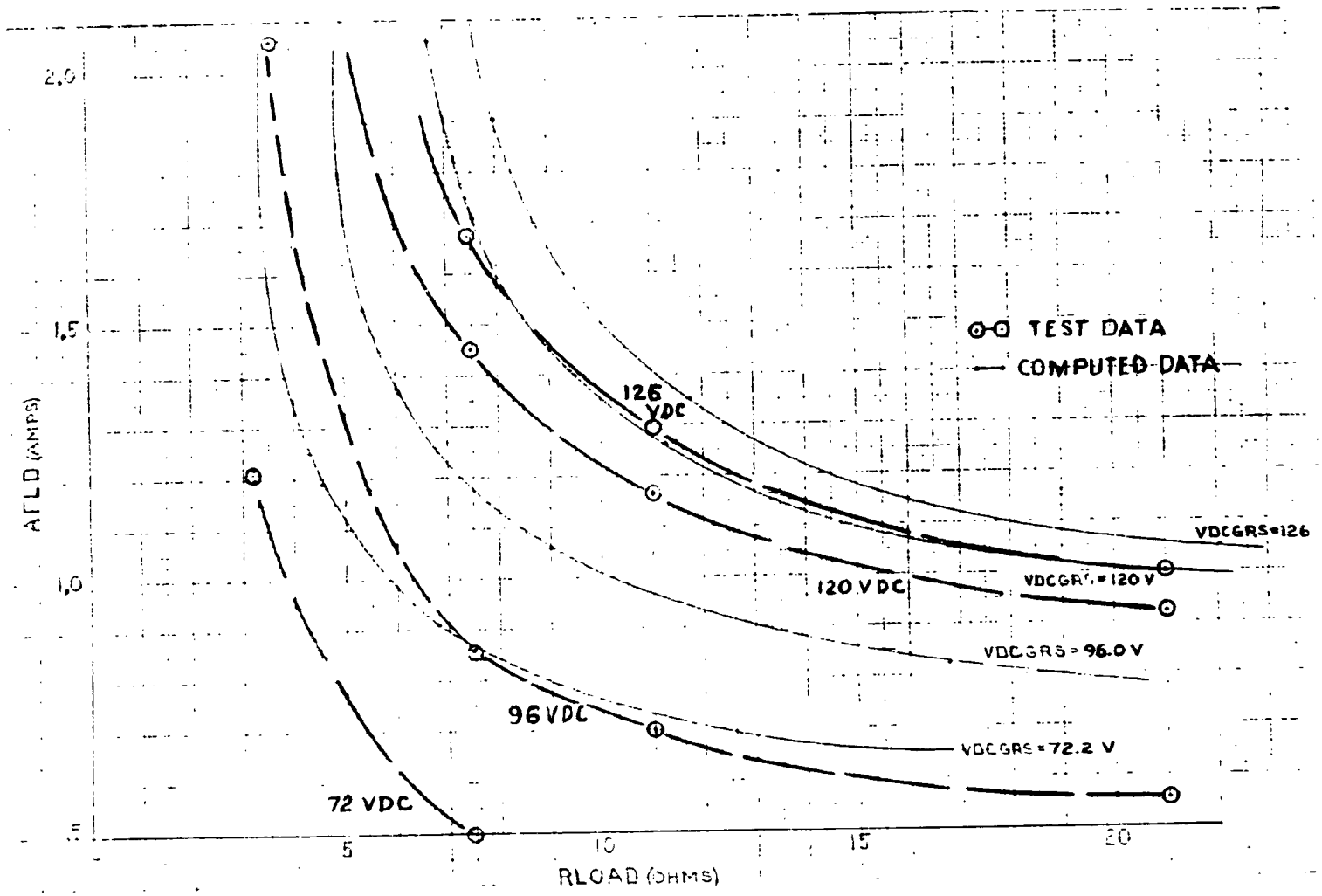


Figure 242. - CCPS-2 Rice Alternator Performance 52,000 RPM.

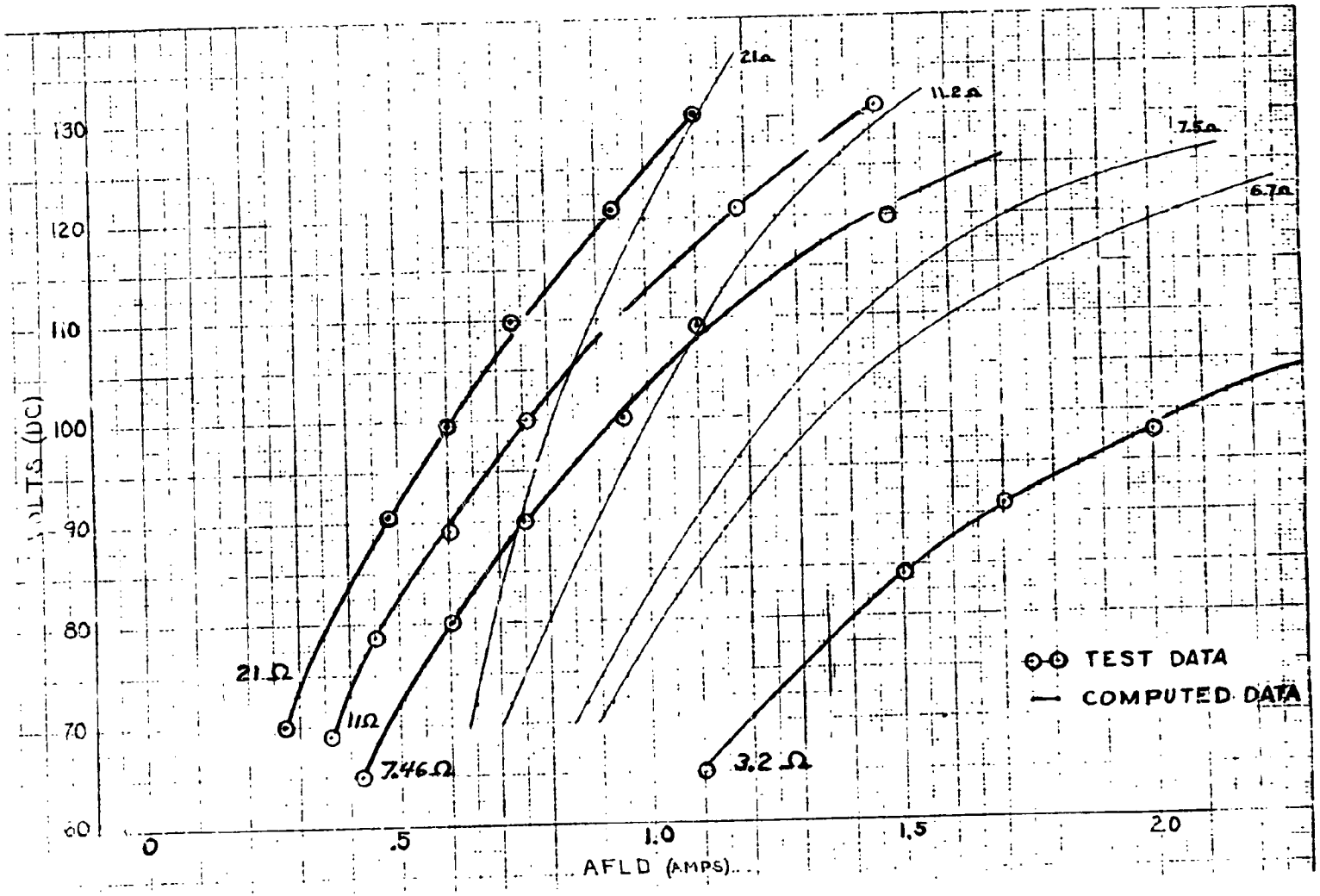


Figure 243. - CCPS-2 Rice Alternator Performance 52,000 RPM.

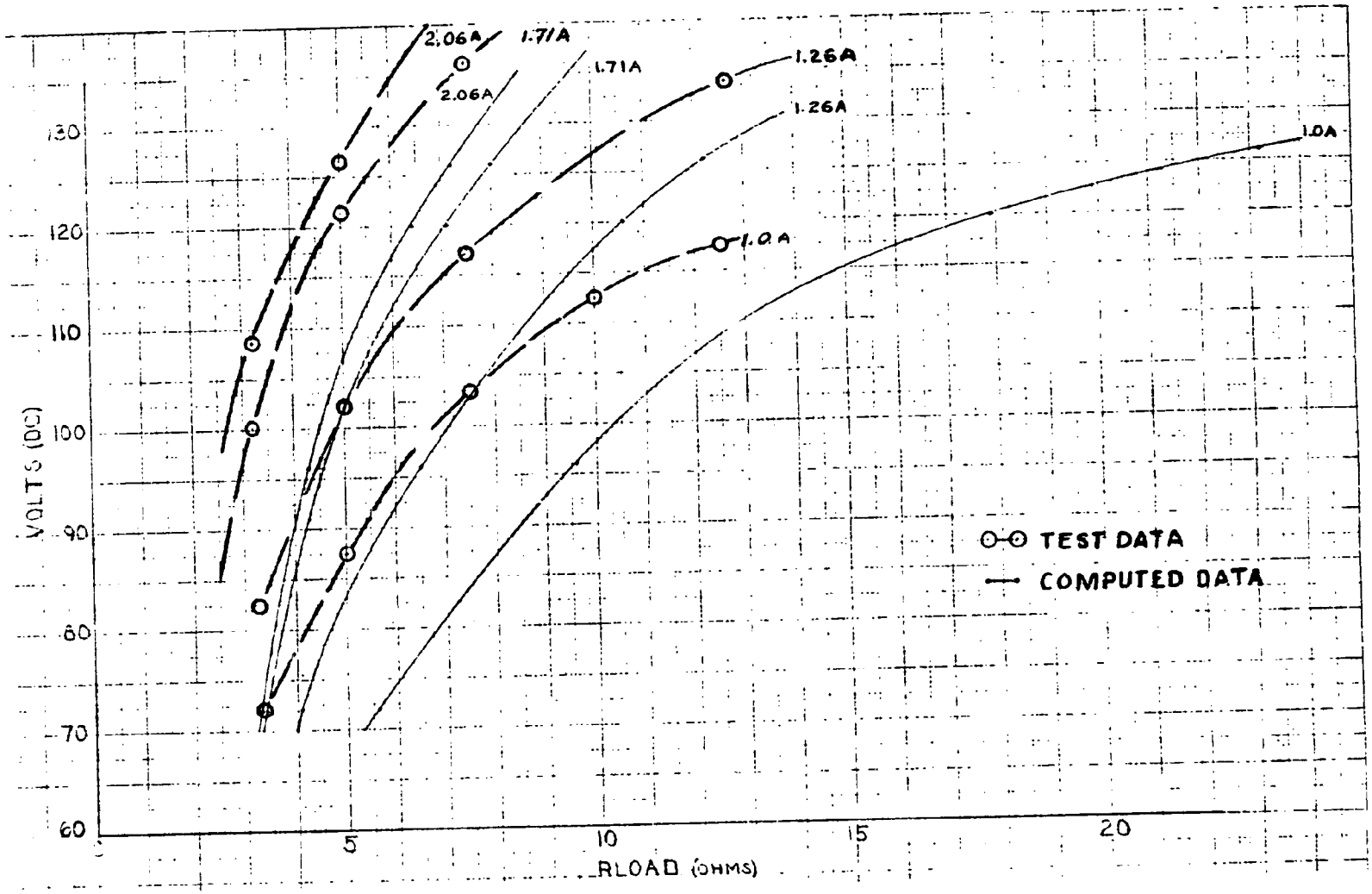


Figure 244. - CCPS-2 Rice Alternator Performance 54,000 RPM.

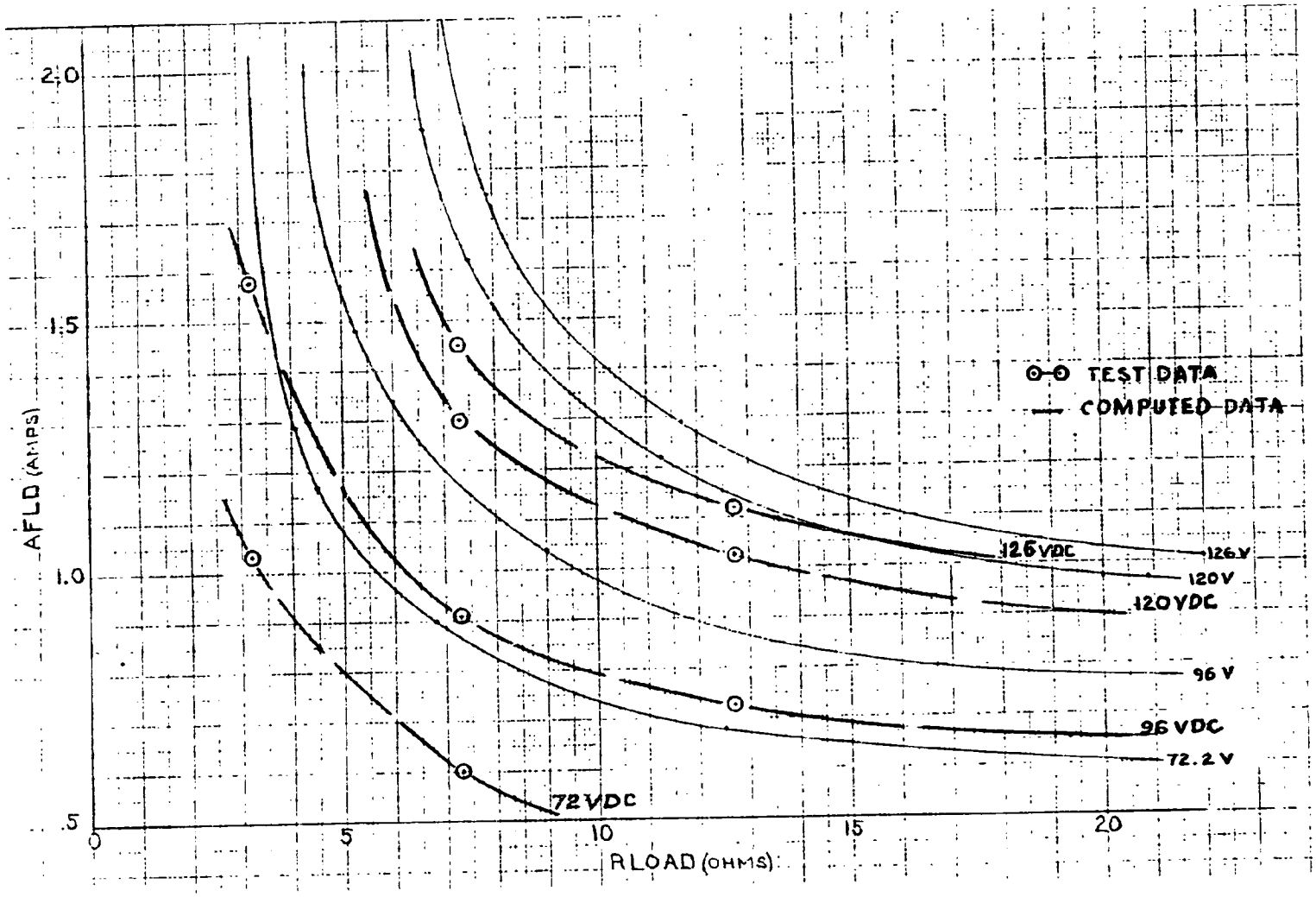


Figure 245. - CCPS-2 Rice Alternator Performance 54,000 RPM.

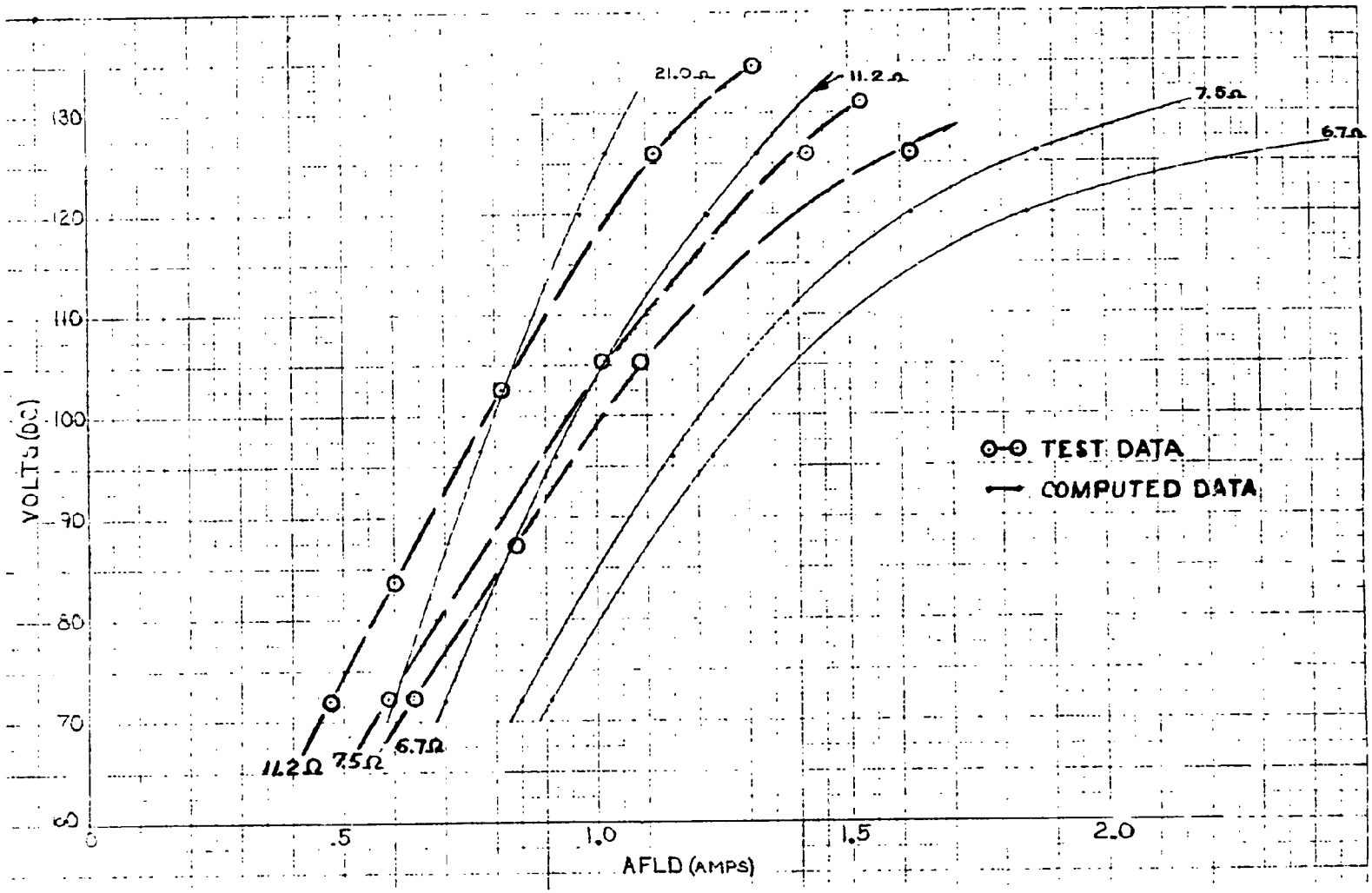


Figure 246. - CCPS-2 Rice Alternator Performance 54,000 RPM

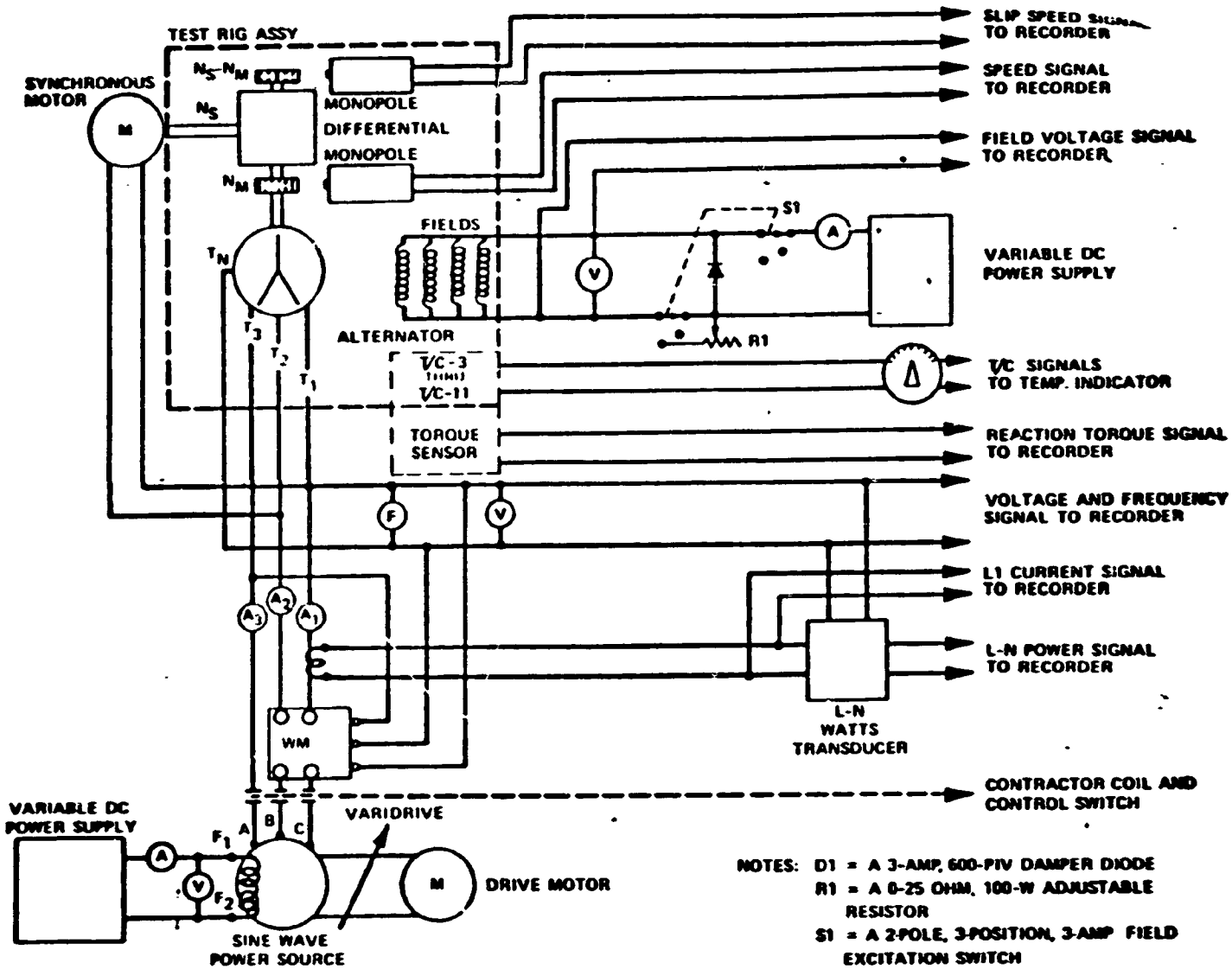


Figure 247. - Hookup Diagram for 400-Hz Motor Test.

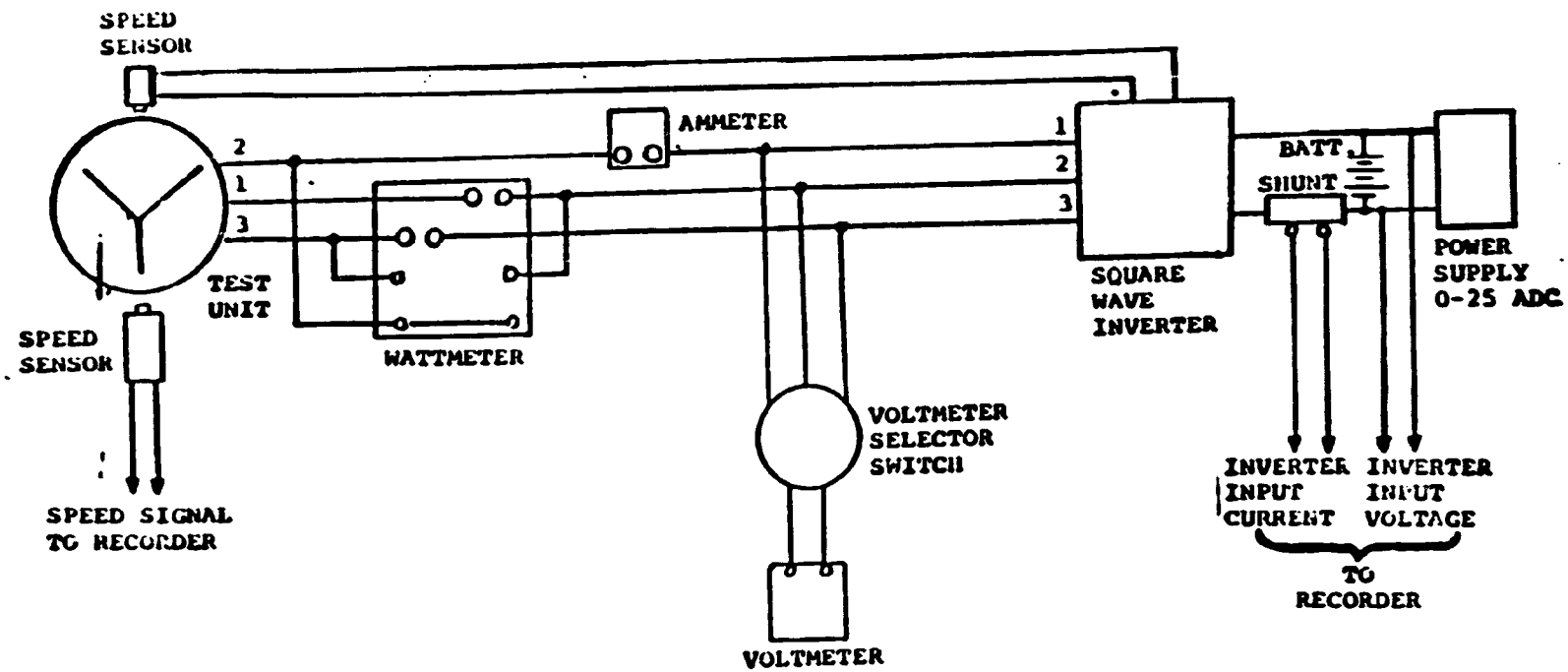


Figure 248. - Motor Test Diagram.

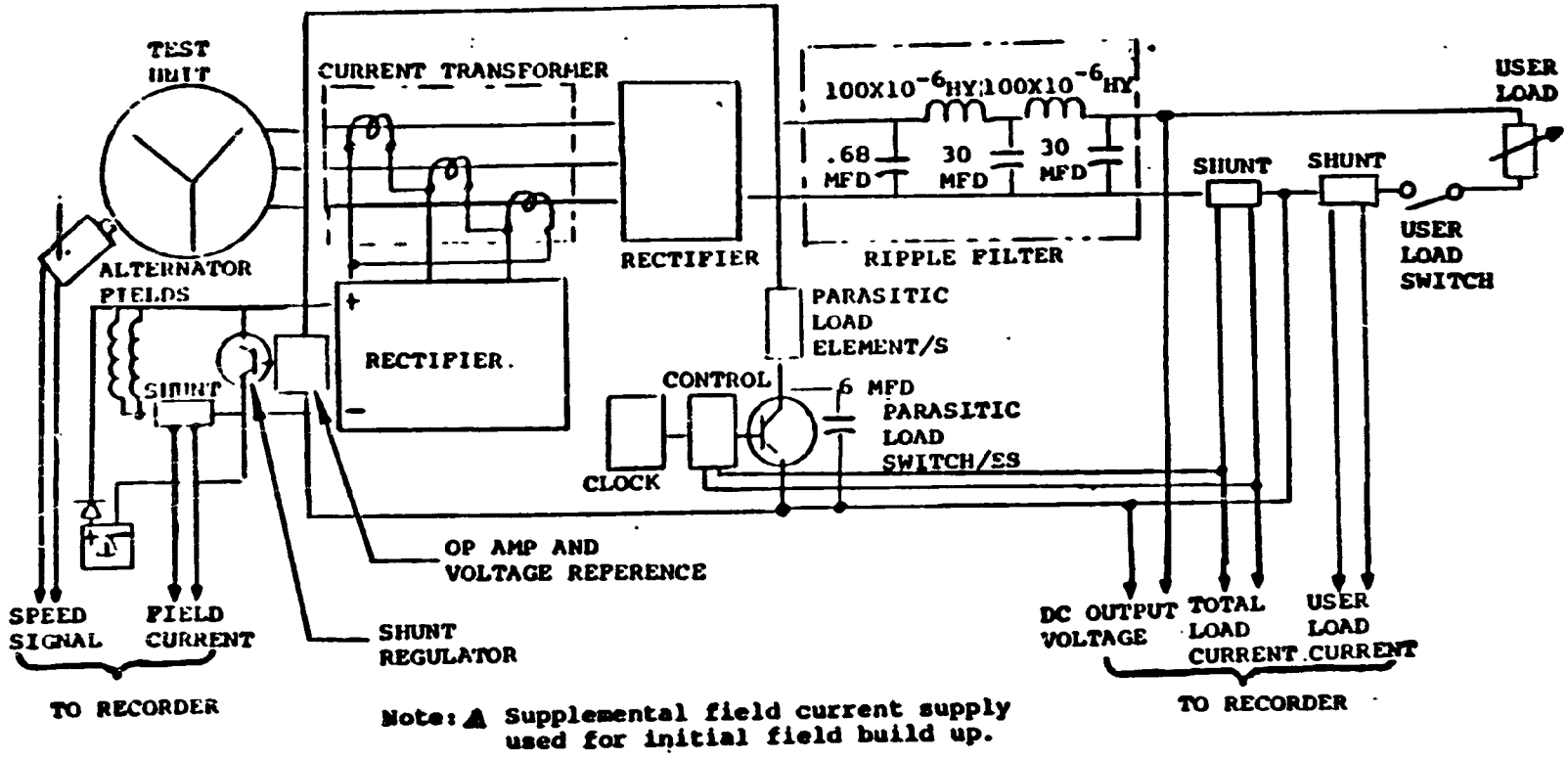


Figure 249. - Voltage, Speed Regulation and Transient Test Diagram.

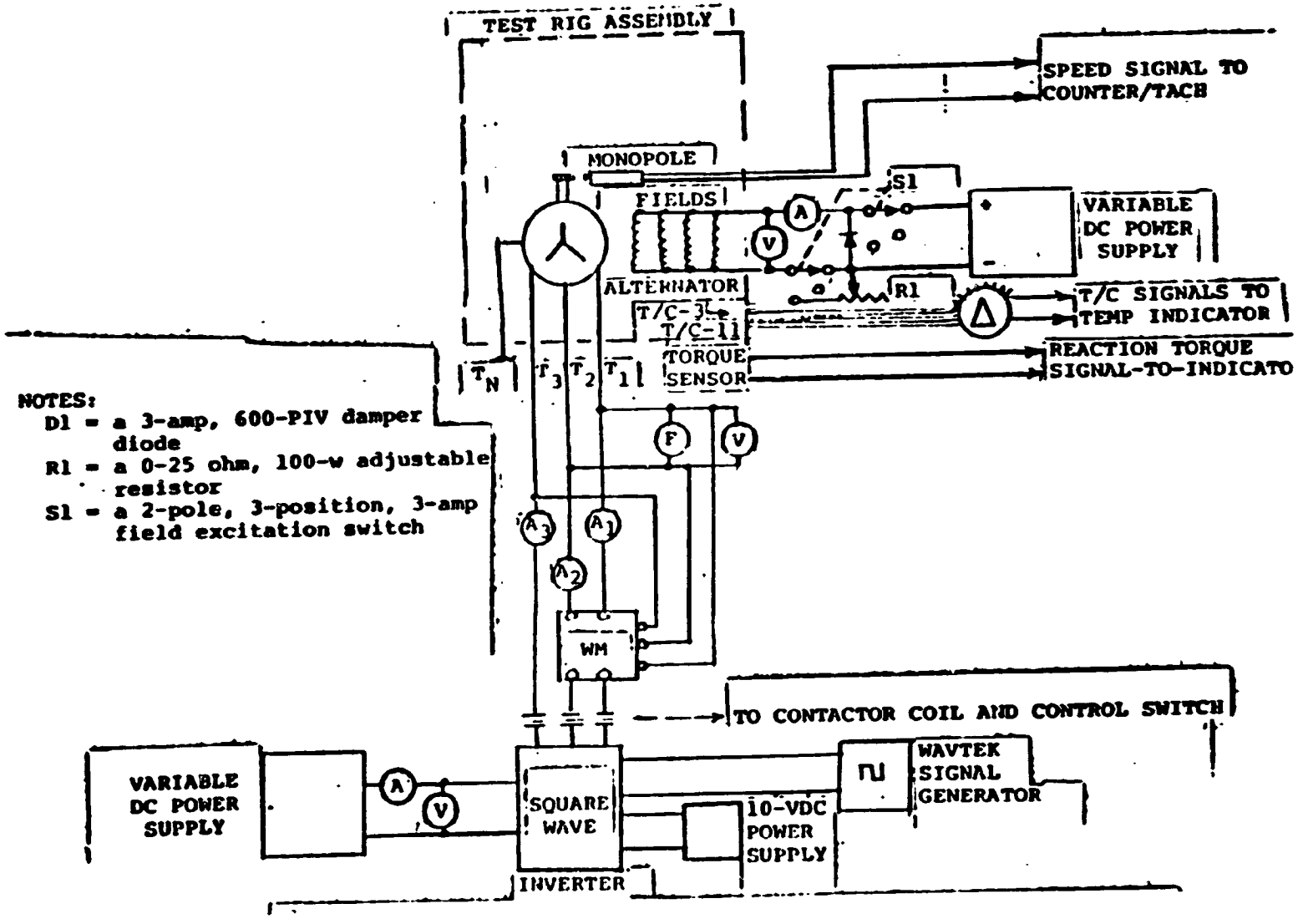


Figure 250. - Hookup Diagram of 400-Hz Motor Test.

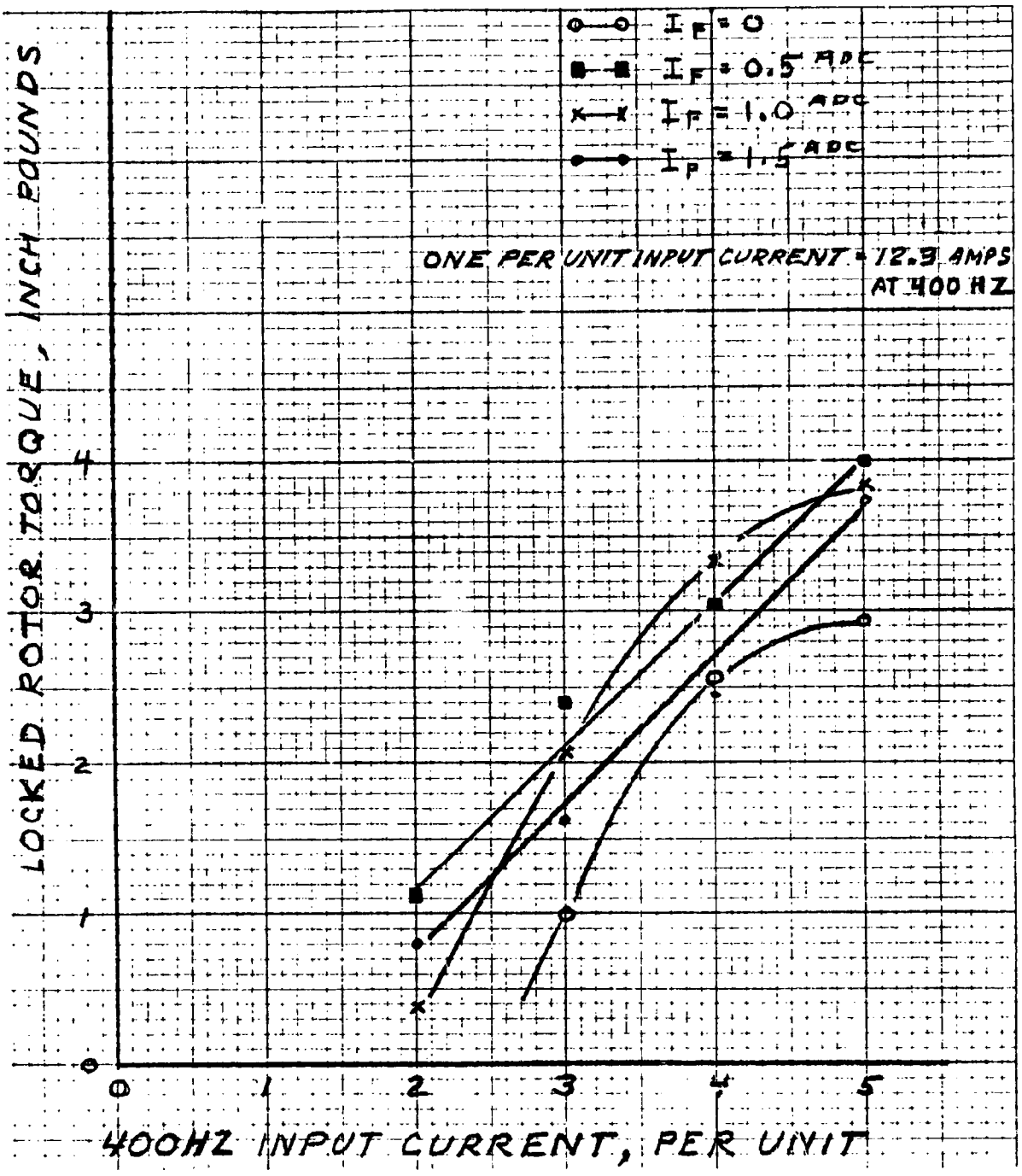


Figure 251. - Locked Rotor Motor Torque.

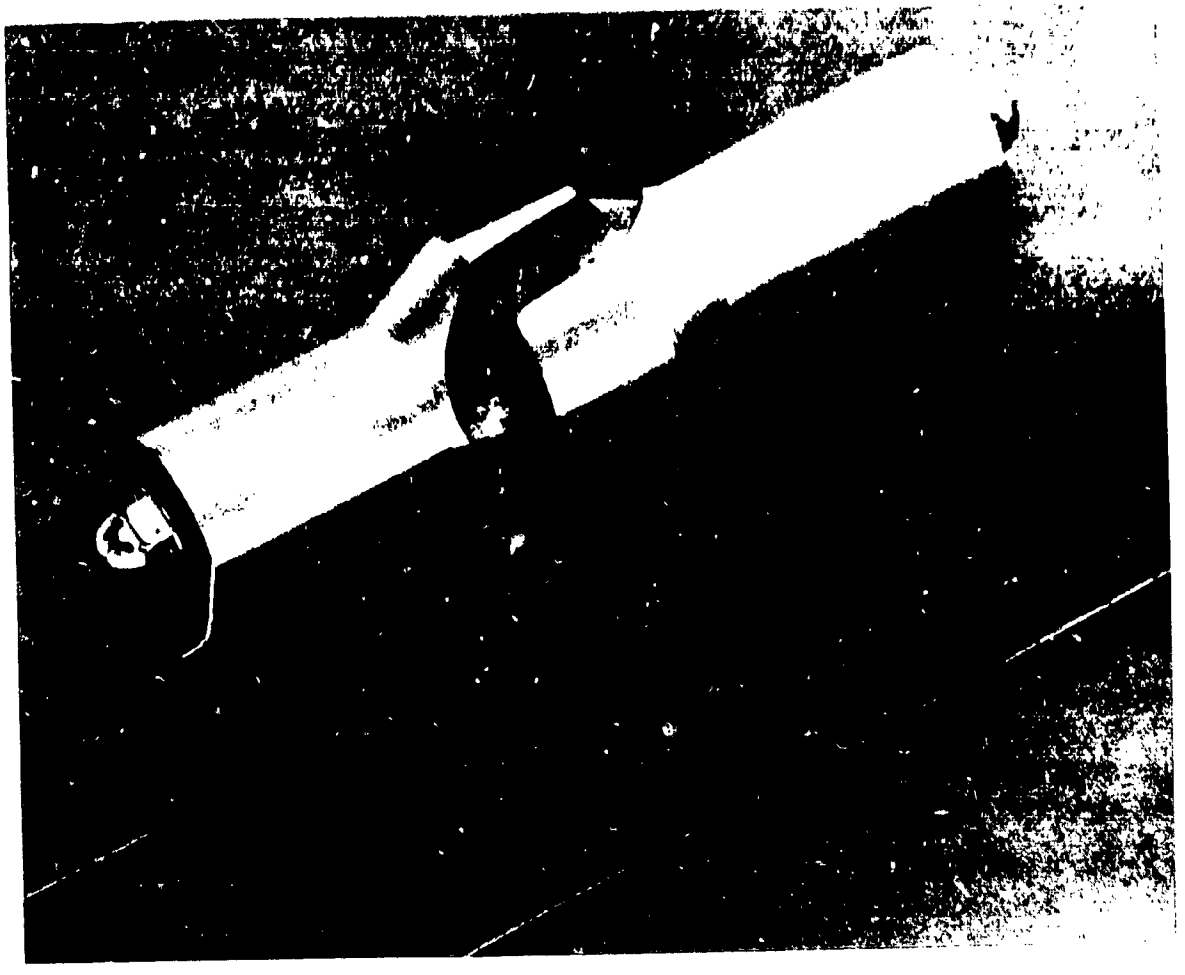


Figure 252. - Visual Model of Mini-BRU Rotor.

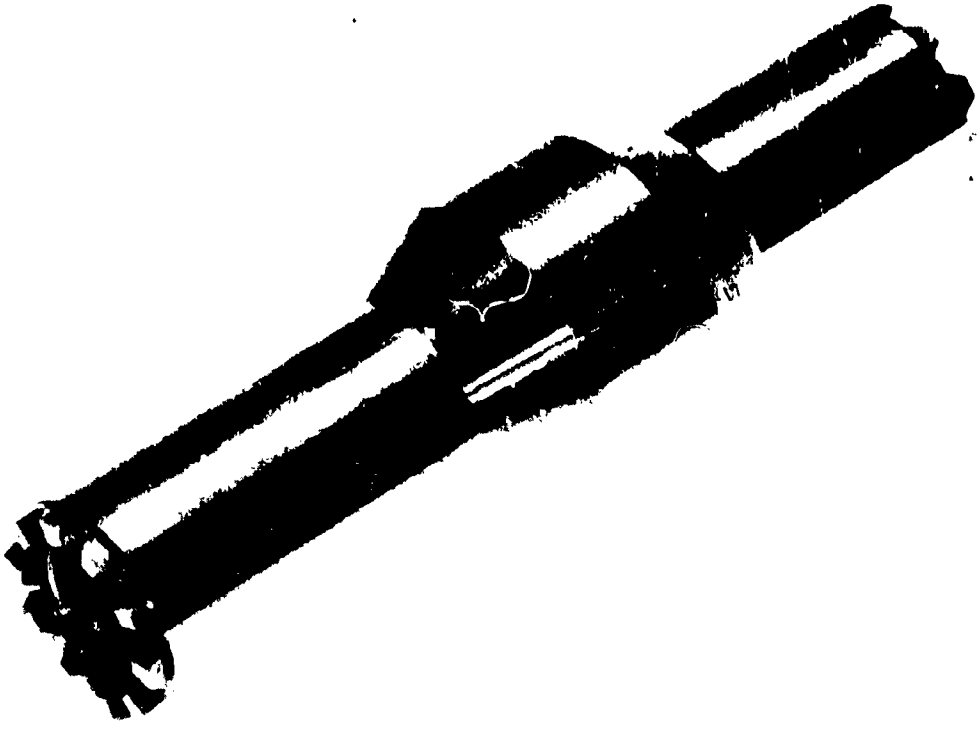


Figure 253. - Final Configuration of the Mini-BRU Rotor.

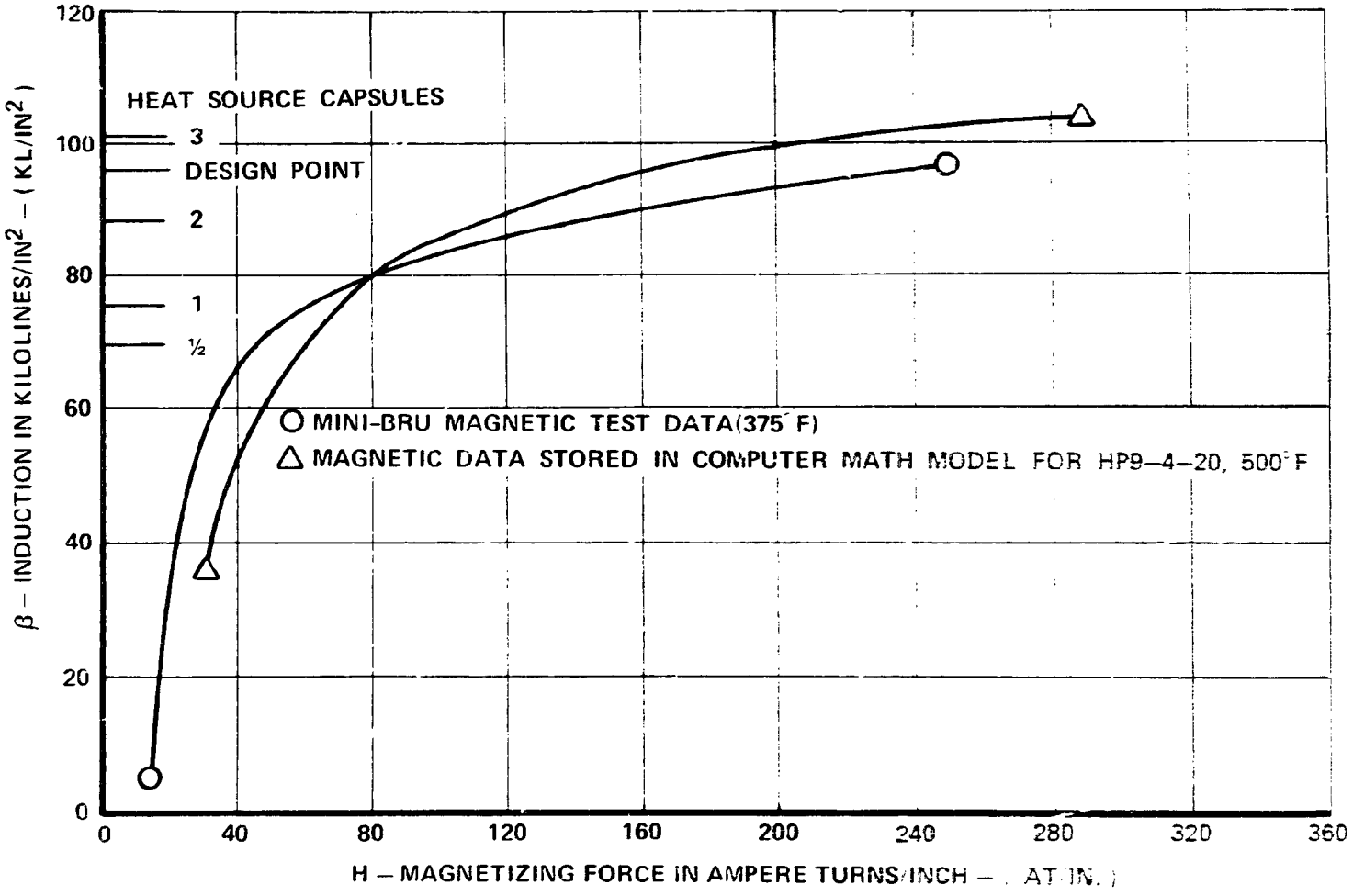


Figure 254. - H-Magnetizing Force in Ampere Turns Inch - (at in.).

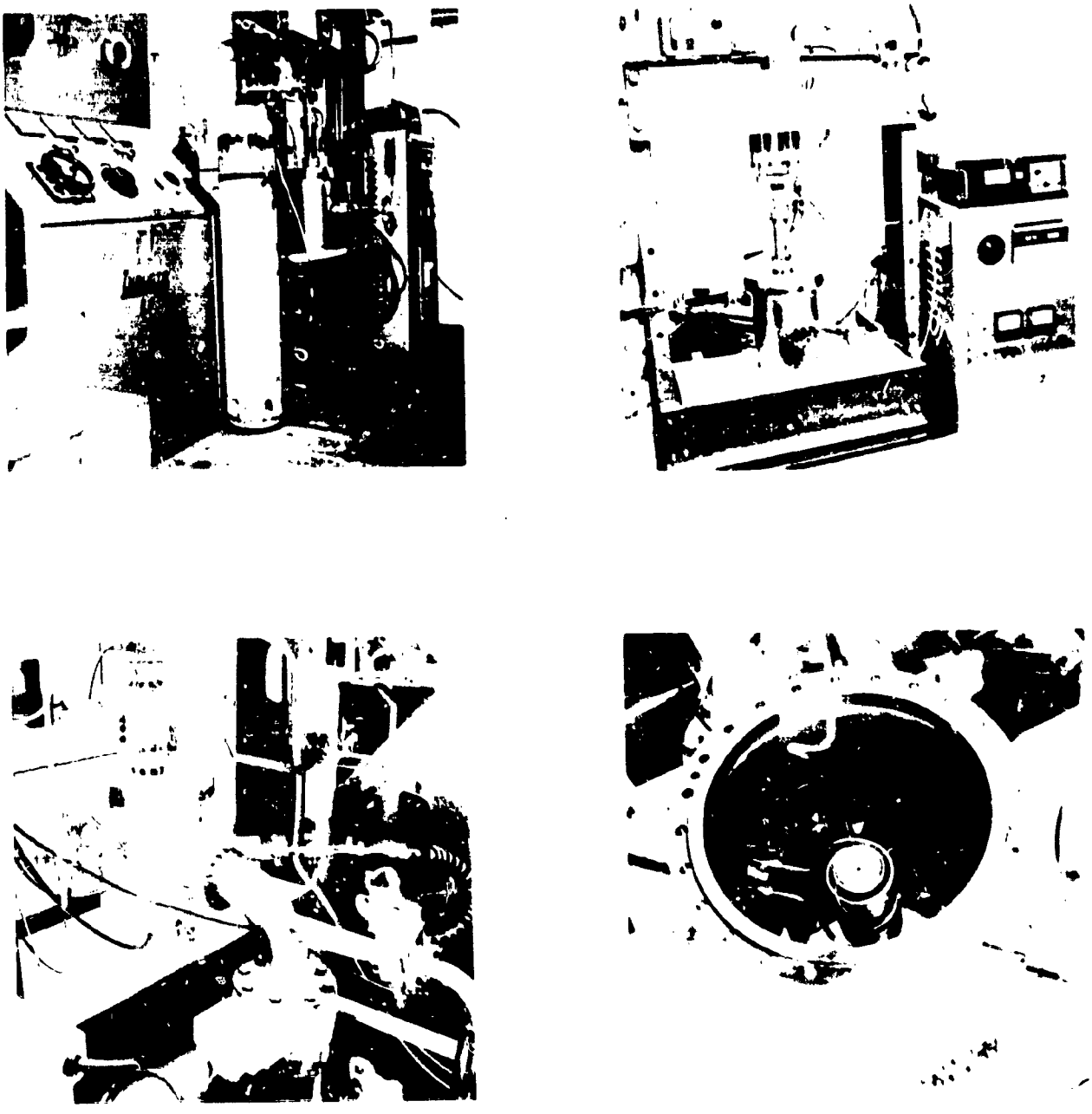


Figure 2-[illegible]. Vacuum Hot Press Facility.

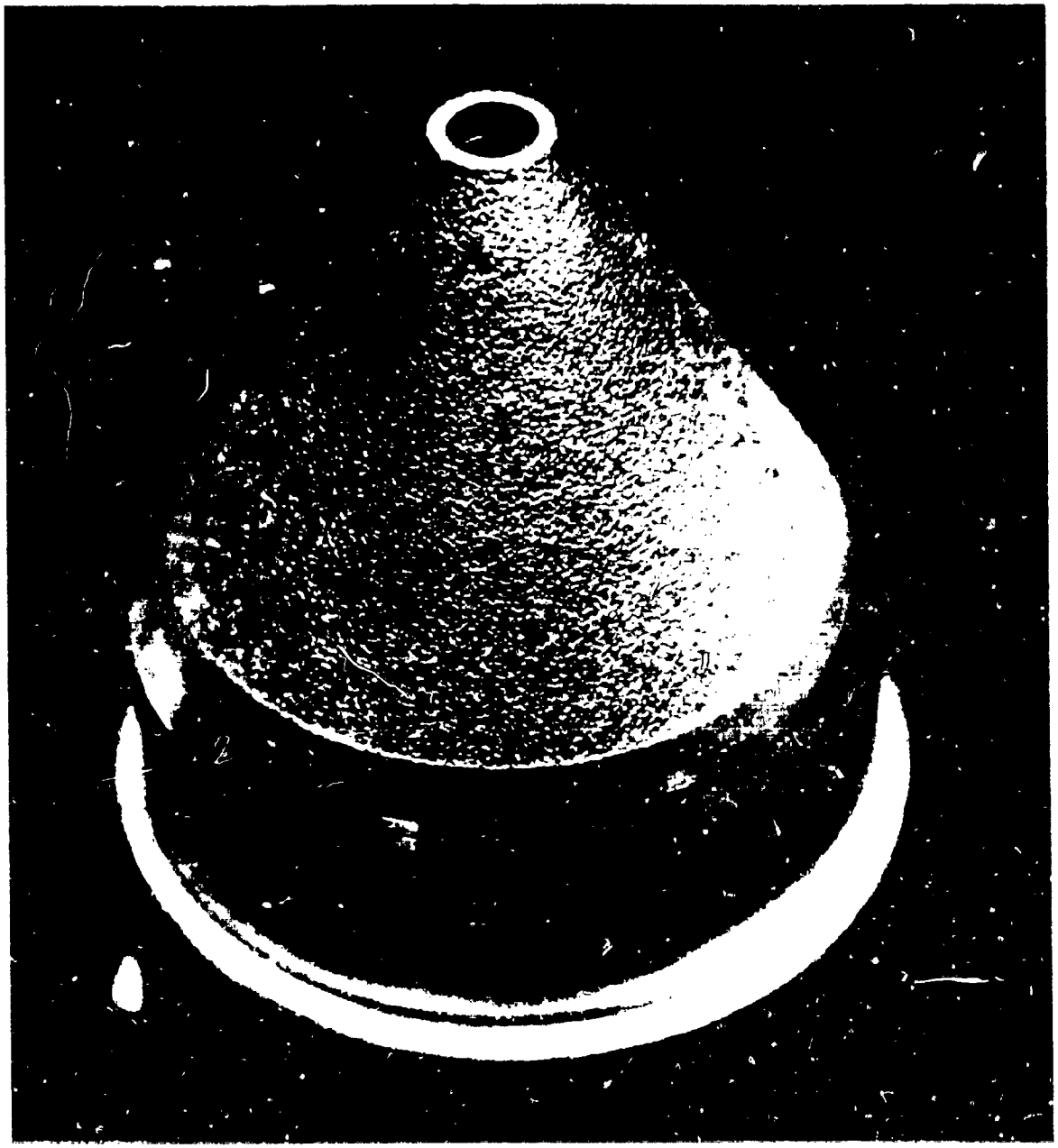


Figure 256. - Typical As-Blowed Bonding Surface.

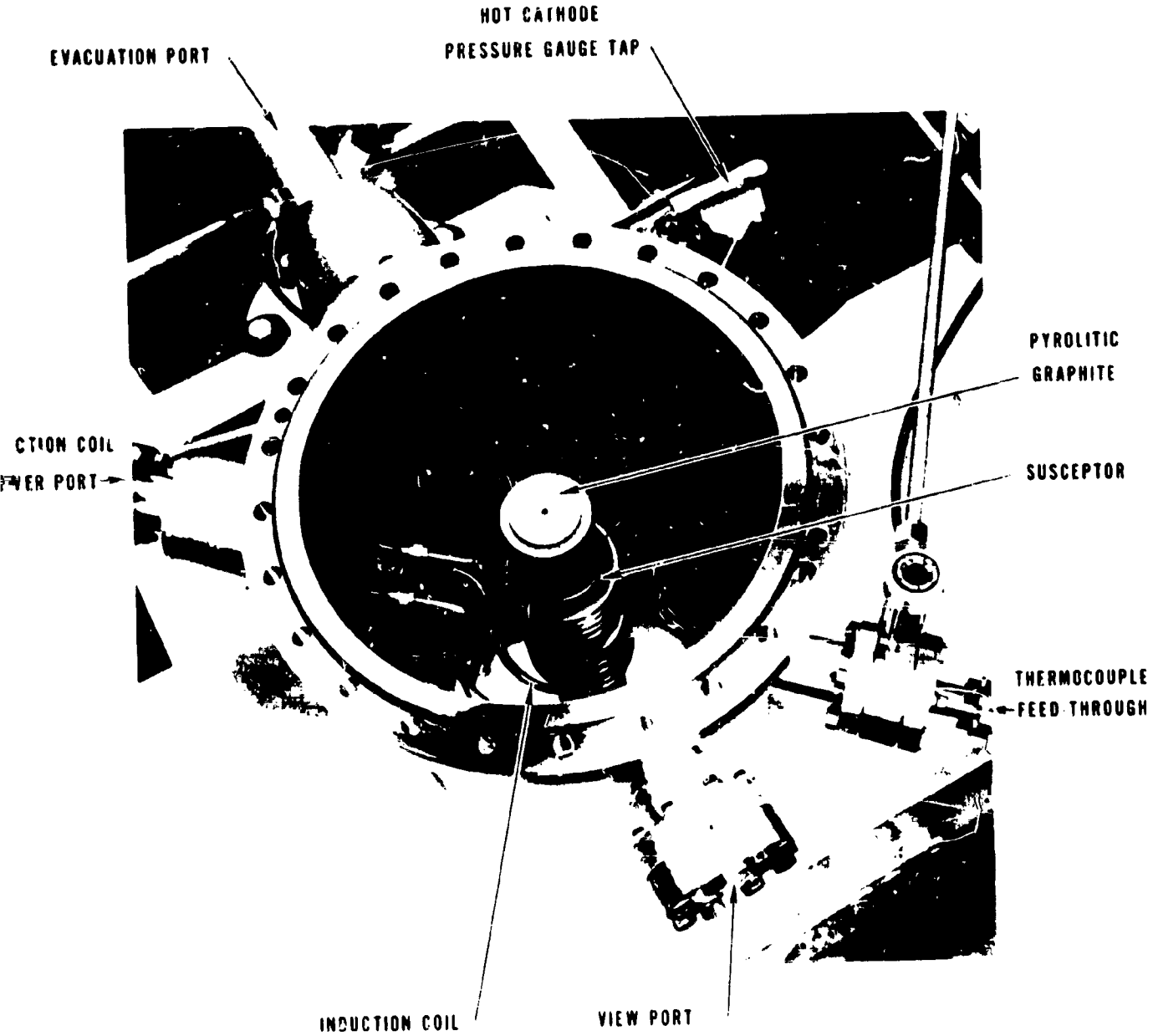


Figure 257. - Test Setup in Vacuum Chamber.

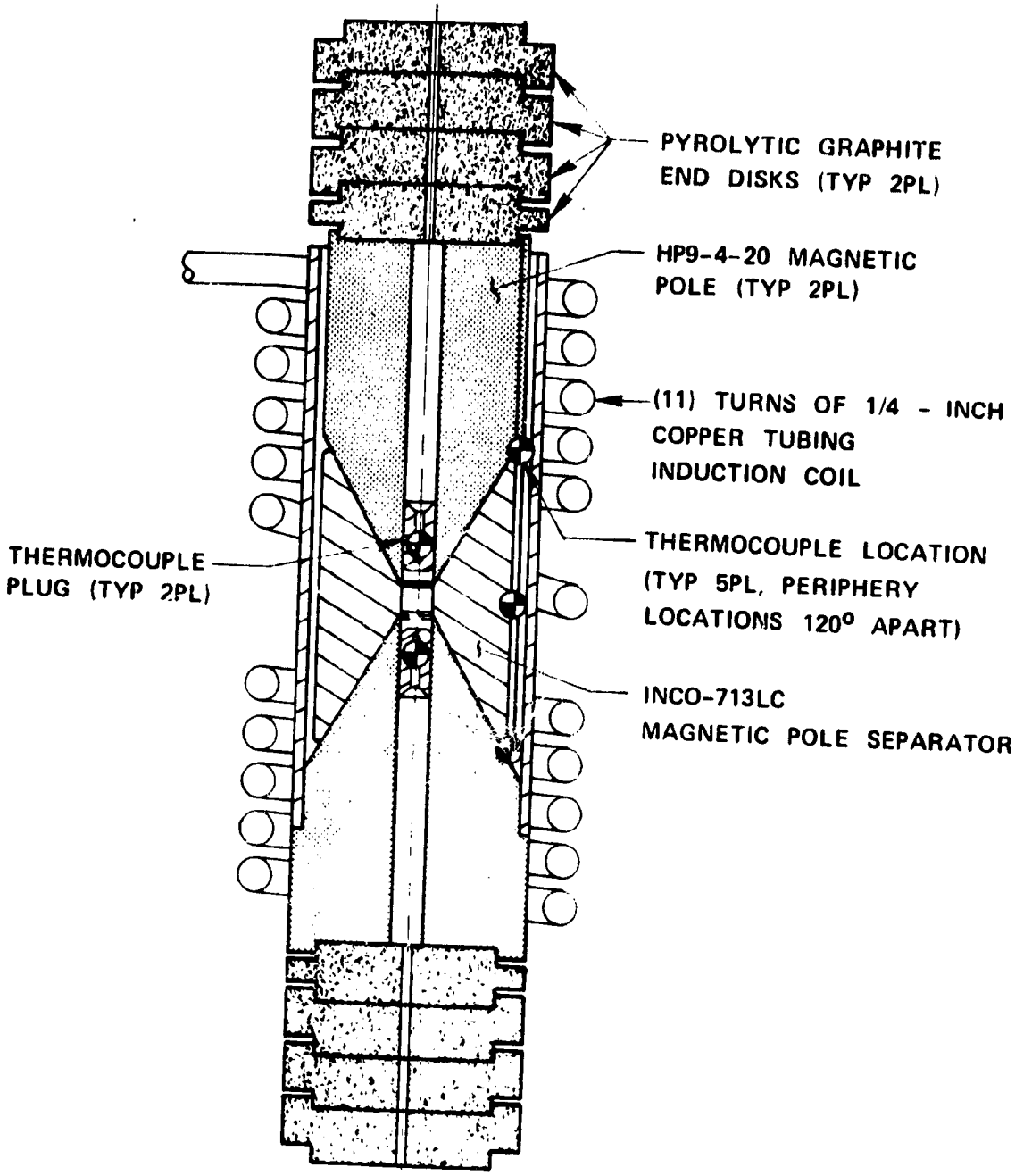


Figure 258. - Temperature Distribution Test Setup, Conical Test Specimens.

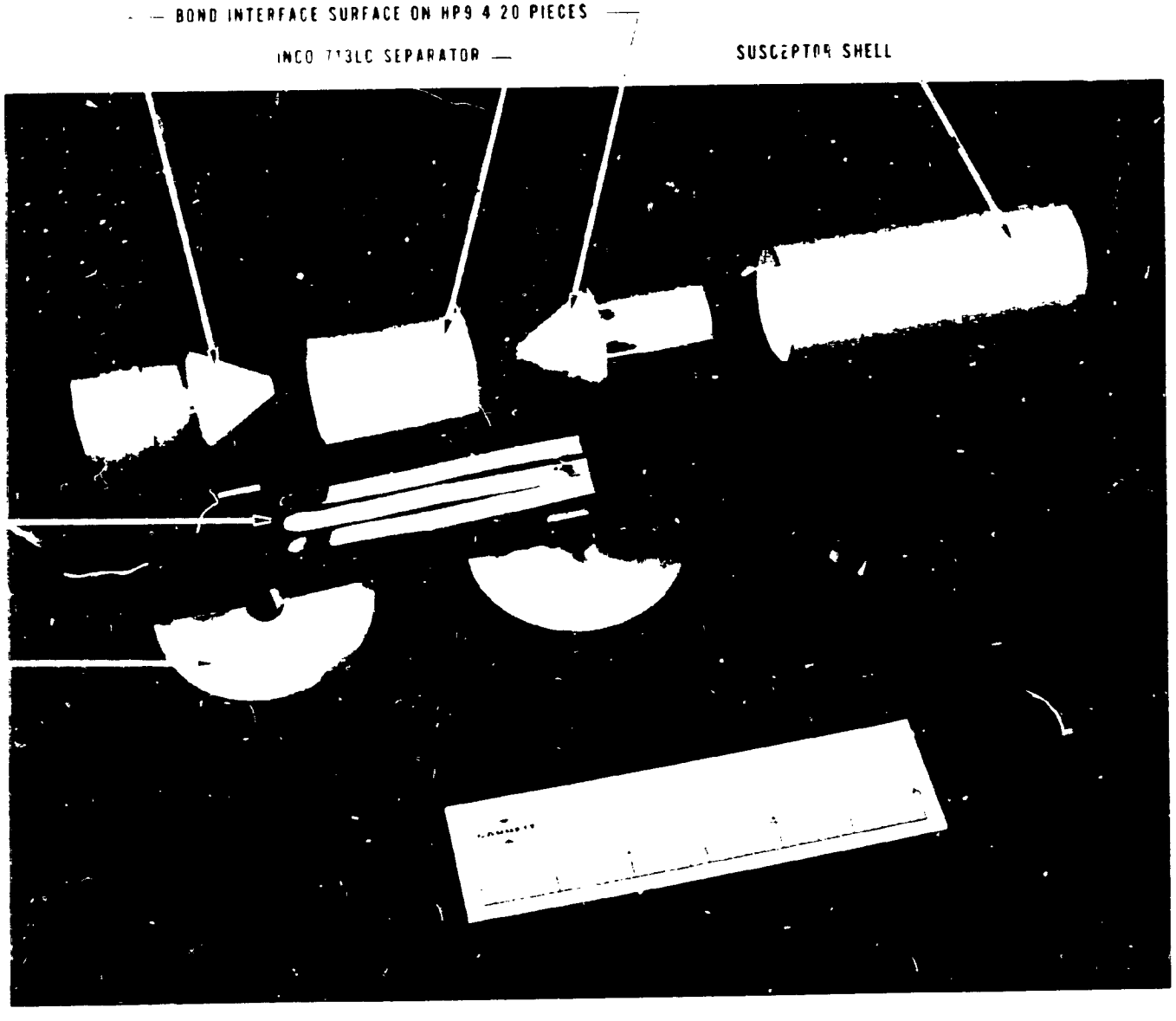


Figure [illegible]. - Gold-Plated Brazing Surfaces, Conical Test Specimen.

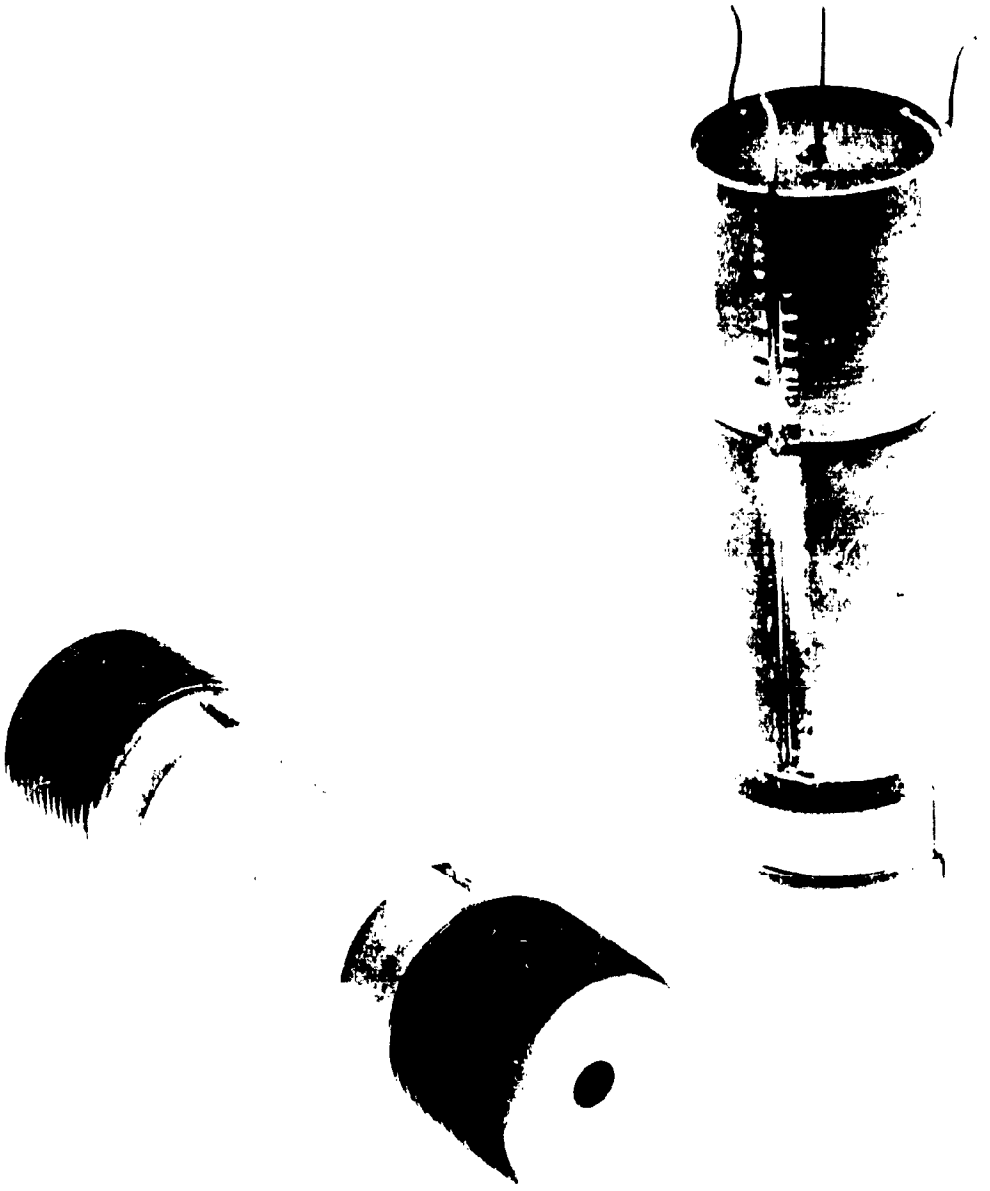


Figure 260. - Conical Tension Test Specimen as Brazed (right) and After Machining (left).

Figure 261. - Conical Test Specimen (PA-3604144) No. 103 After Bonding.

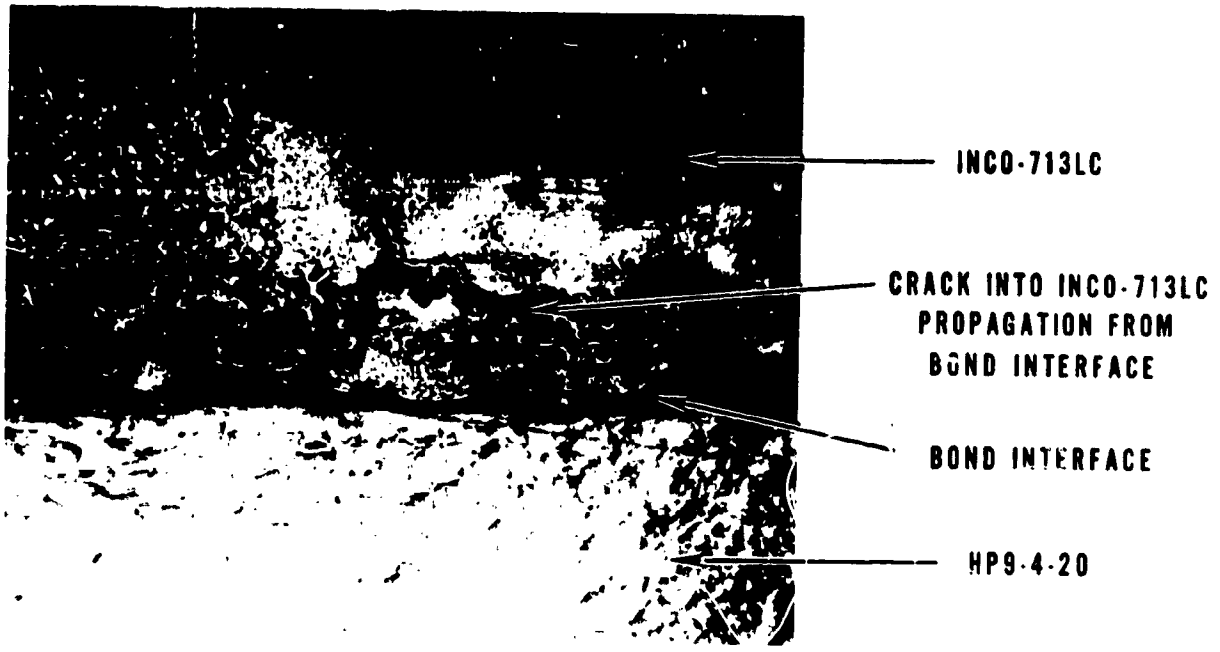


Figure 262. - Surface of Test Specimen No. 105 at Bond Interface After Heat Treat H7A, 50X.

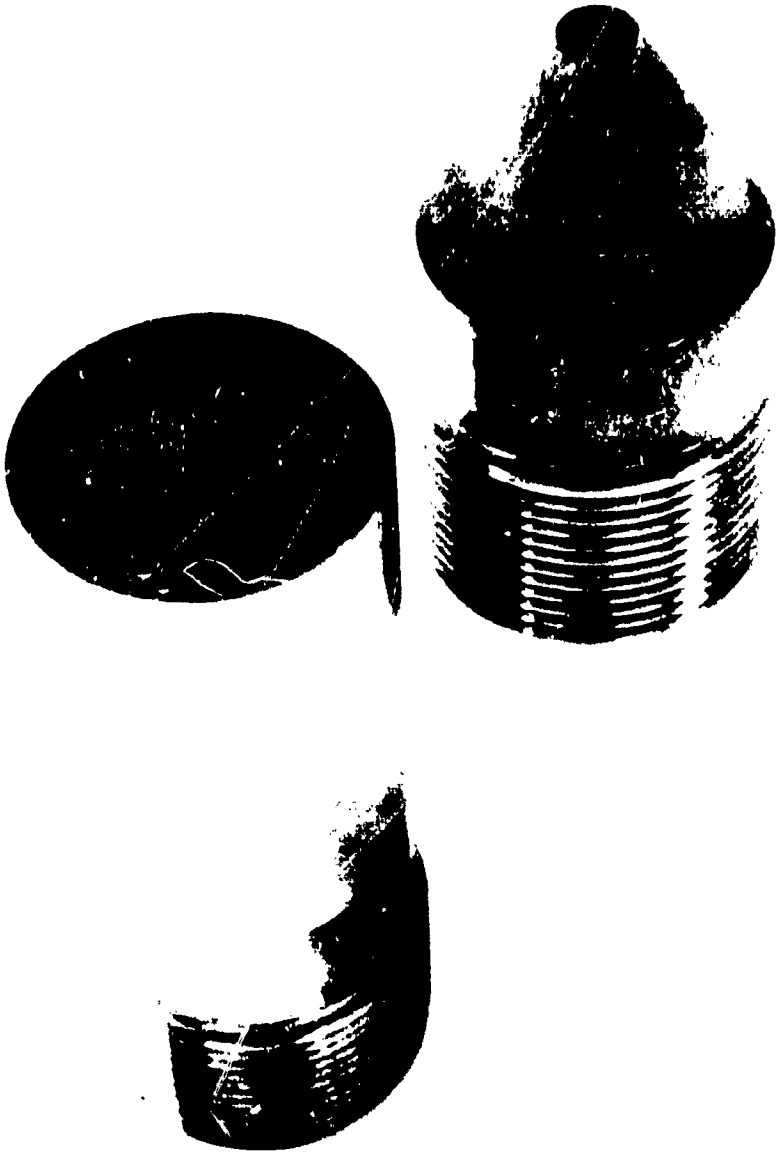


Figure 263. - Conical Tension Test Specimen PA6304144 After the H-7A Heat Treat and Tension Test to Failure.

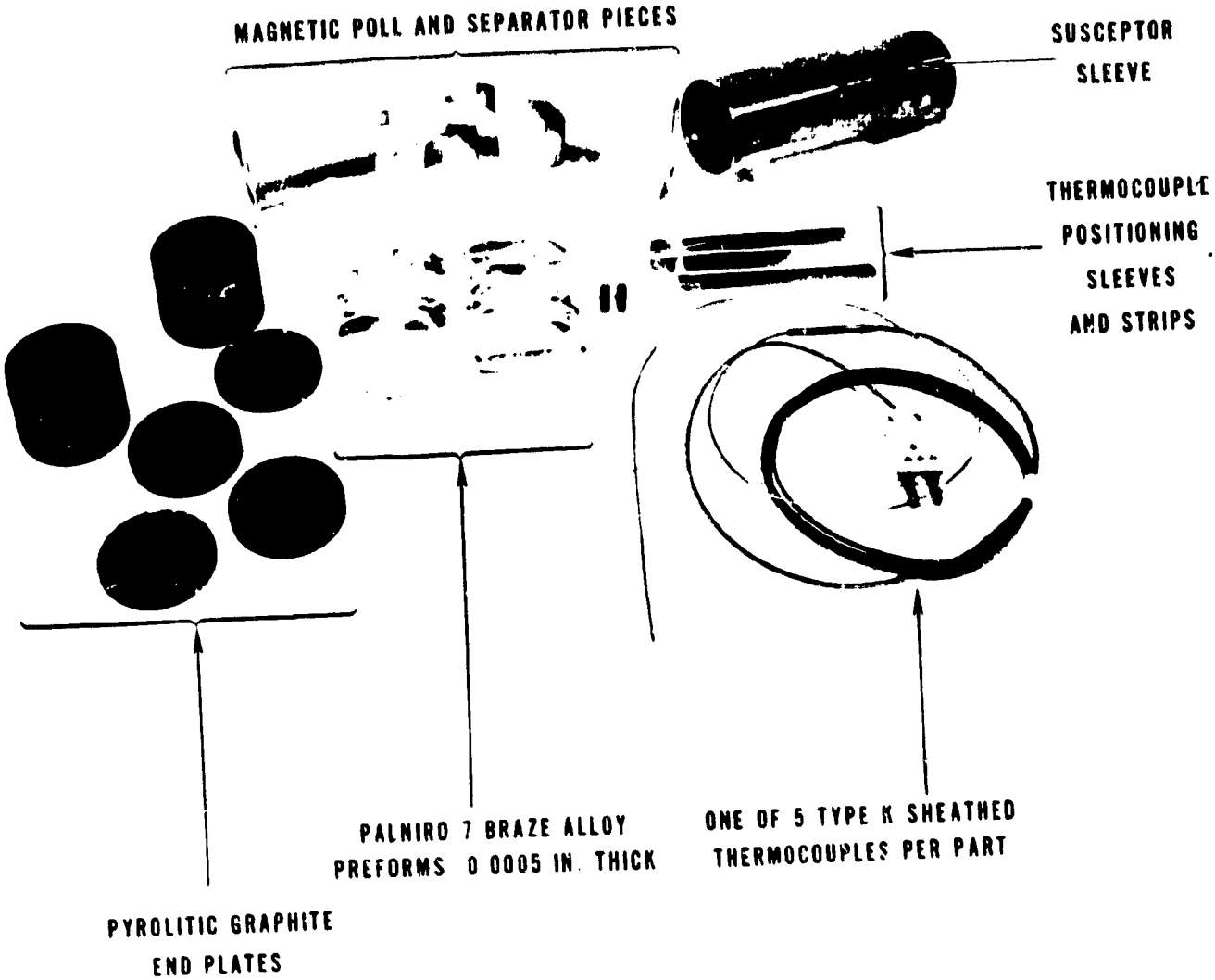


Figure 264. - Mini-BRU Alternator Rotor Assembly 30604369 Details.

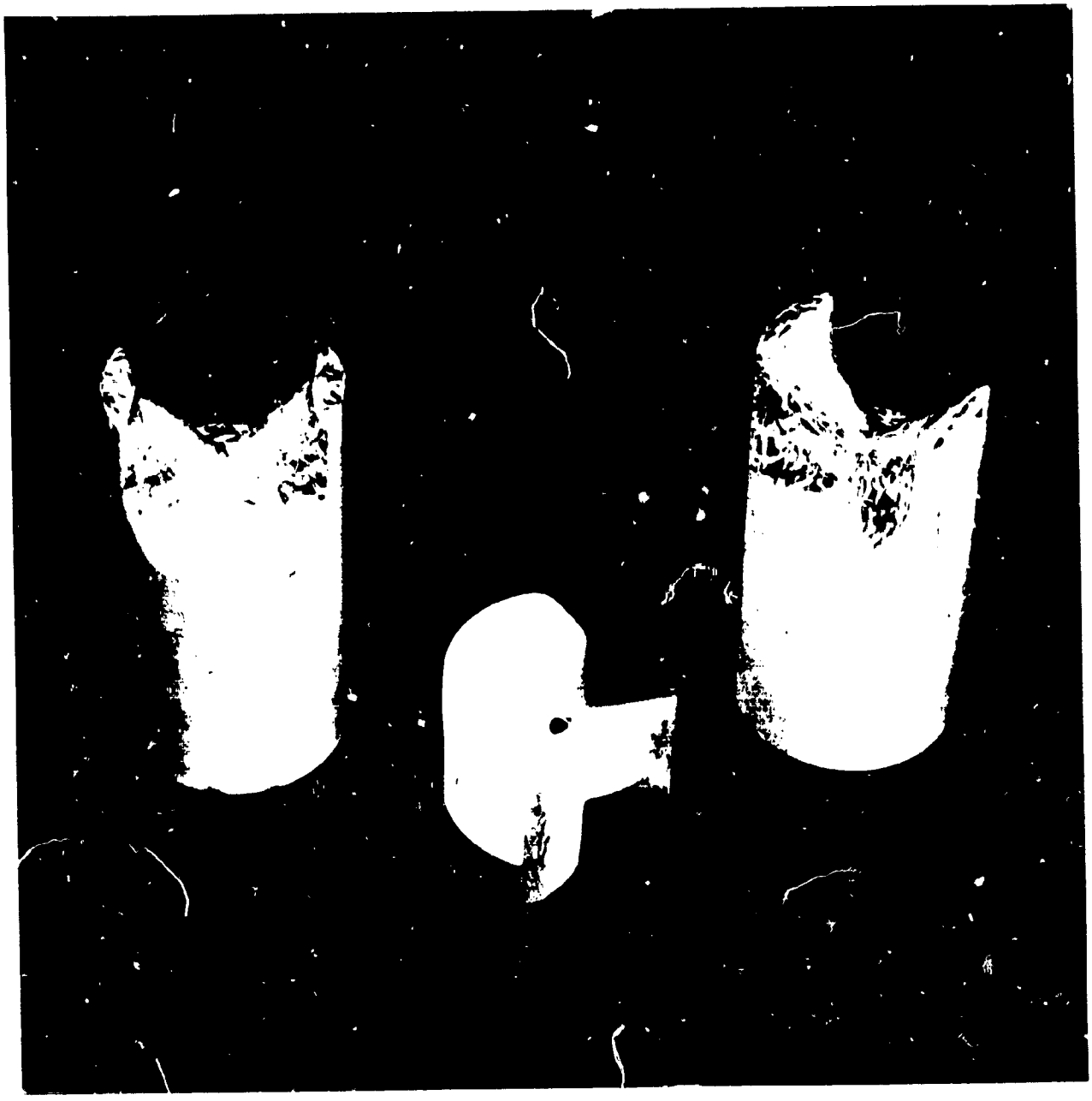


Figure 265. - Palniro 7 Braze Alloy Foil Application Prior to Bonding.

Figure 266. - Magnetic Configuration Rotor P N 3604309 Tension-Proof Test Specimen.

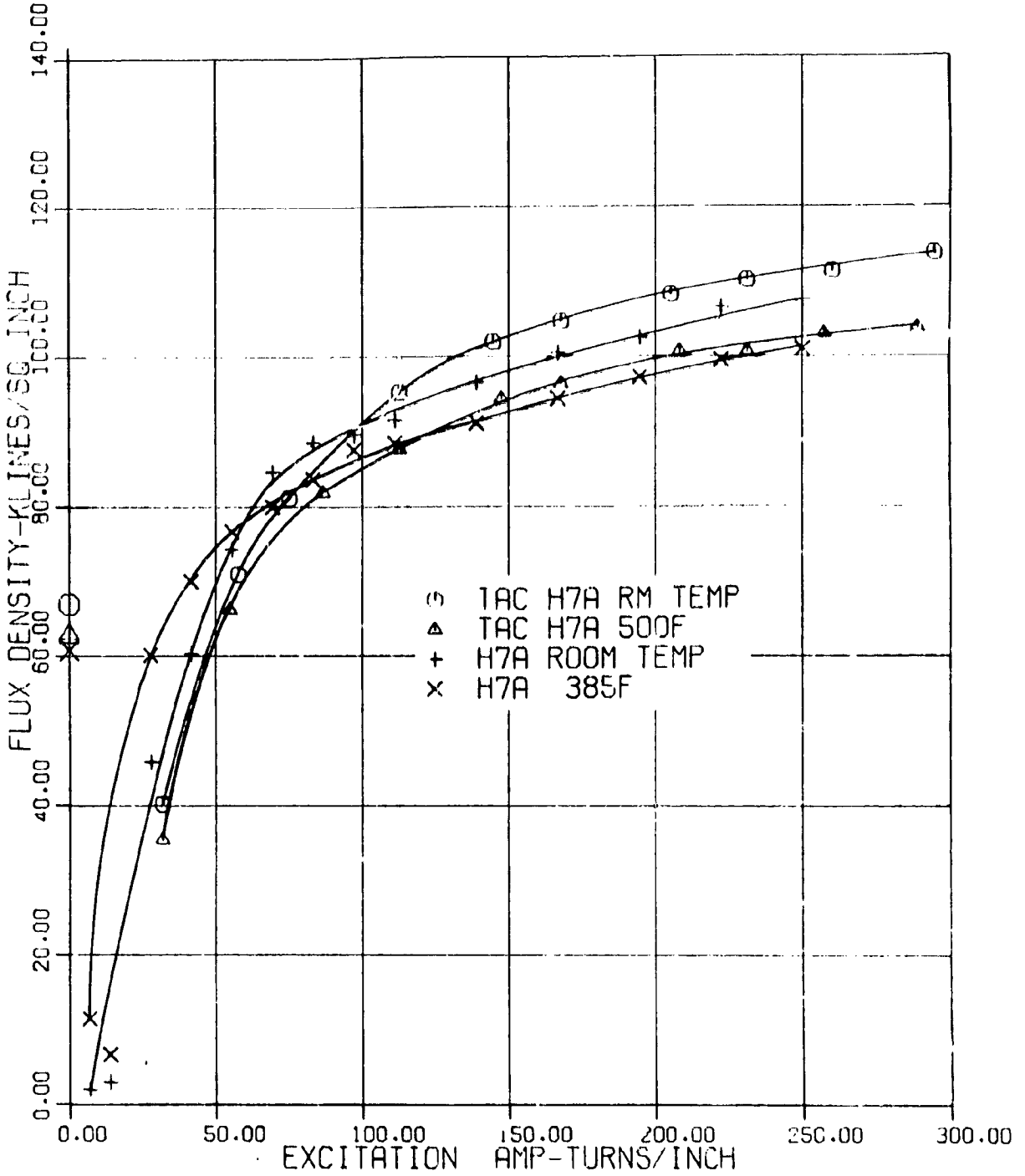


Figure 267. -- Comparison of Magnetic Test Data for TAC and Mini-BRU Rotor Heat Treat Processes.

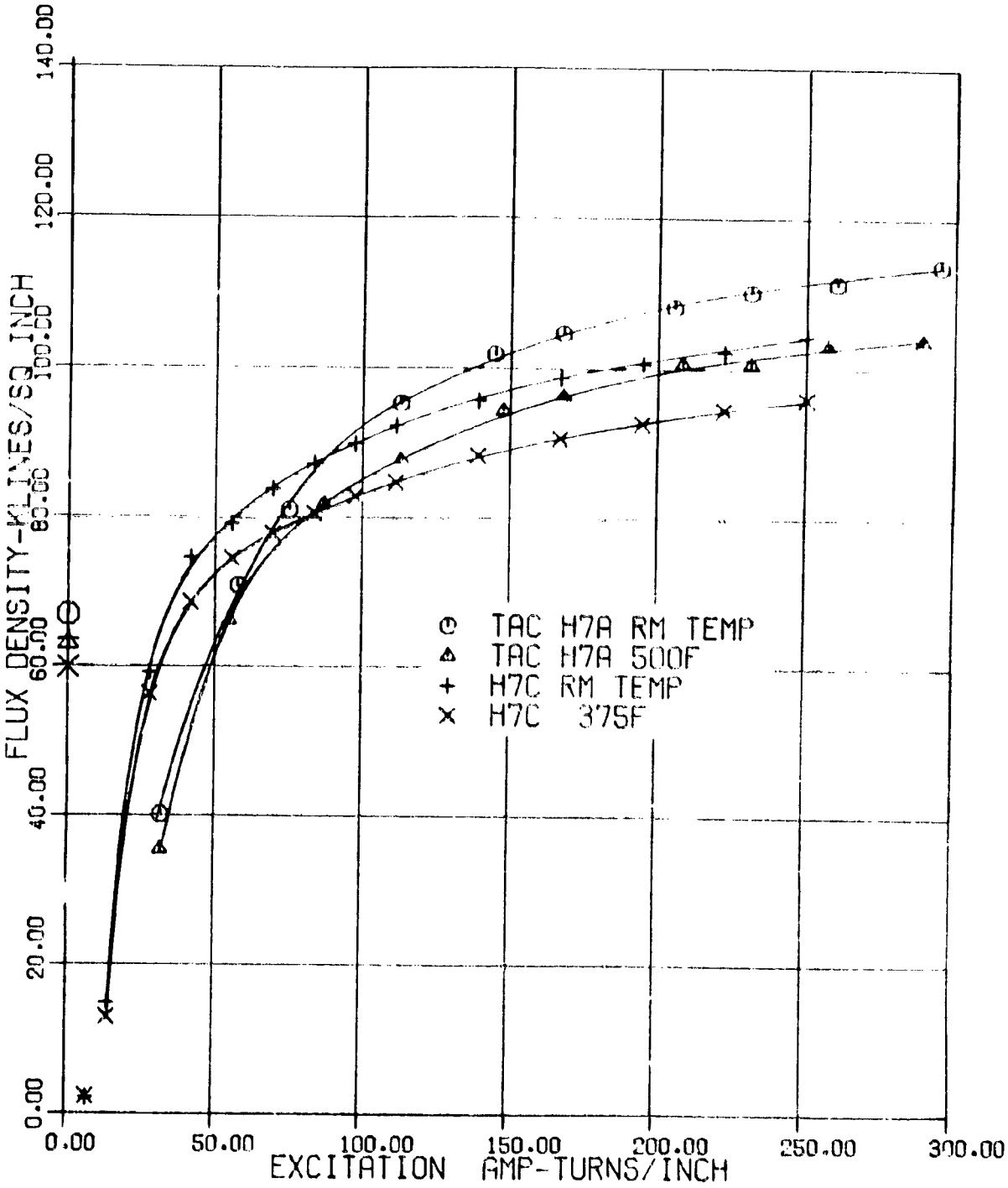


Figure 268. - Comparison of Magnetic Test Data for PAC and Final Mini-BRU Heat Treat Processes.

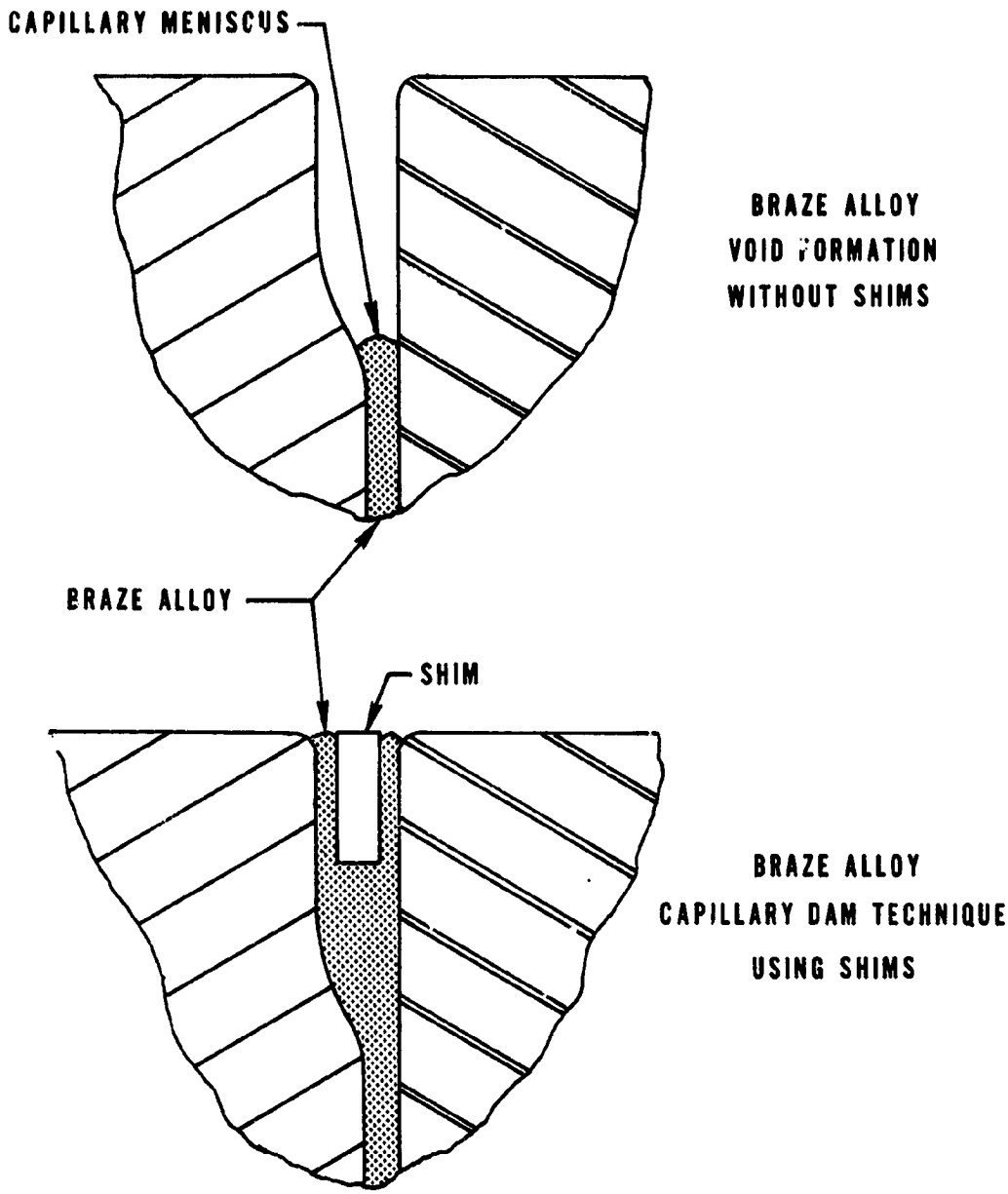


Figure 269. - Method of Trapping Braze Alloy in Joint Voids Using Shims.

C-4

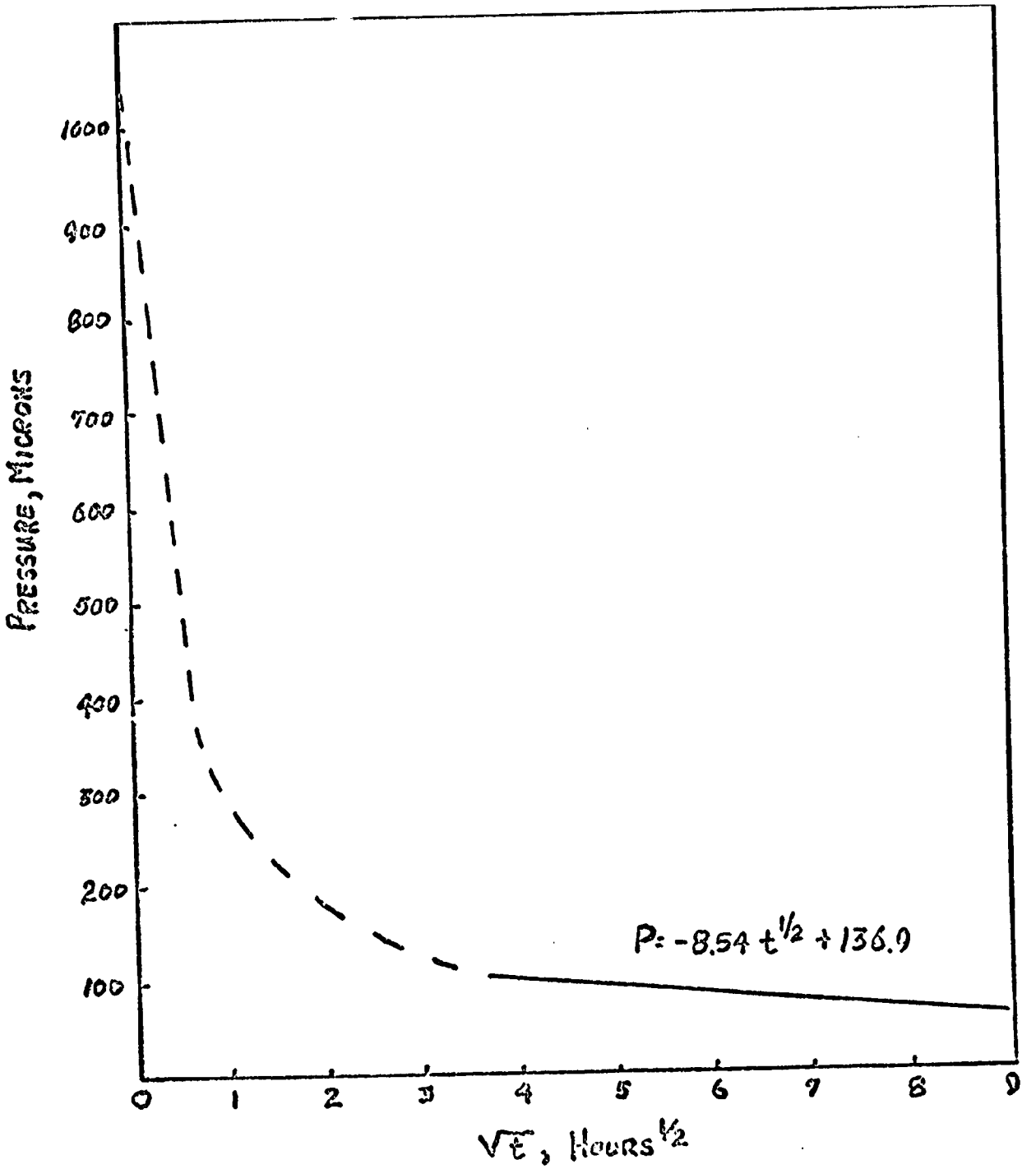


Figure 270. - Alternator Stator Vacuum Bake-Out 250°F.

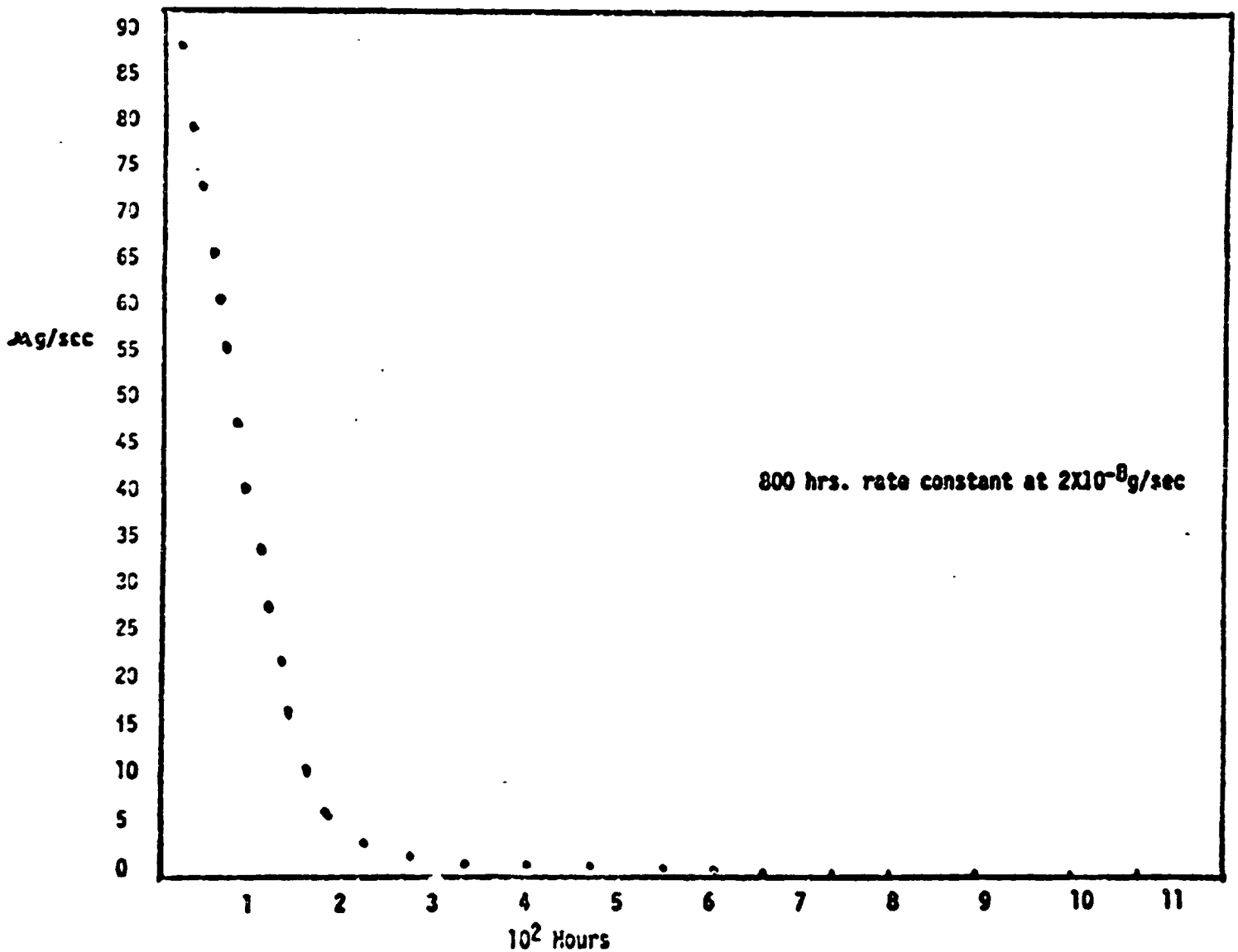


Figure 271. - Alternator Stator Out-Gassing at 165°C (330°F).

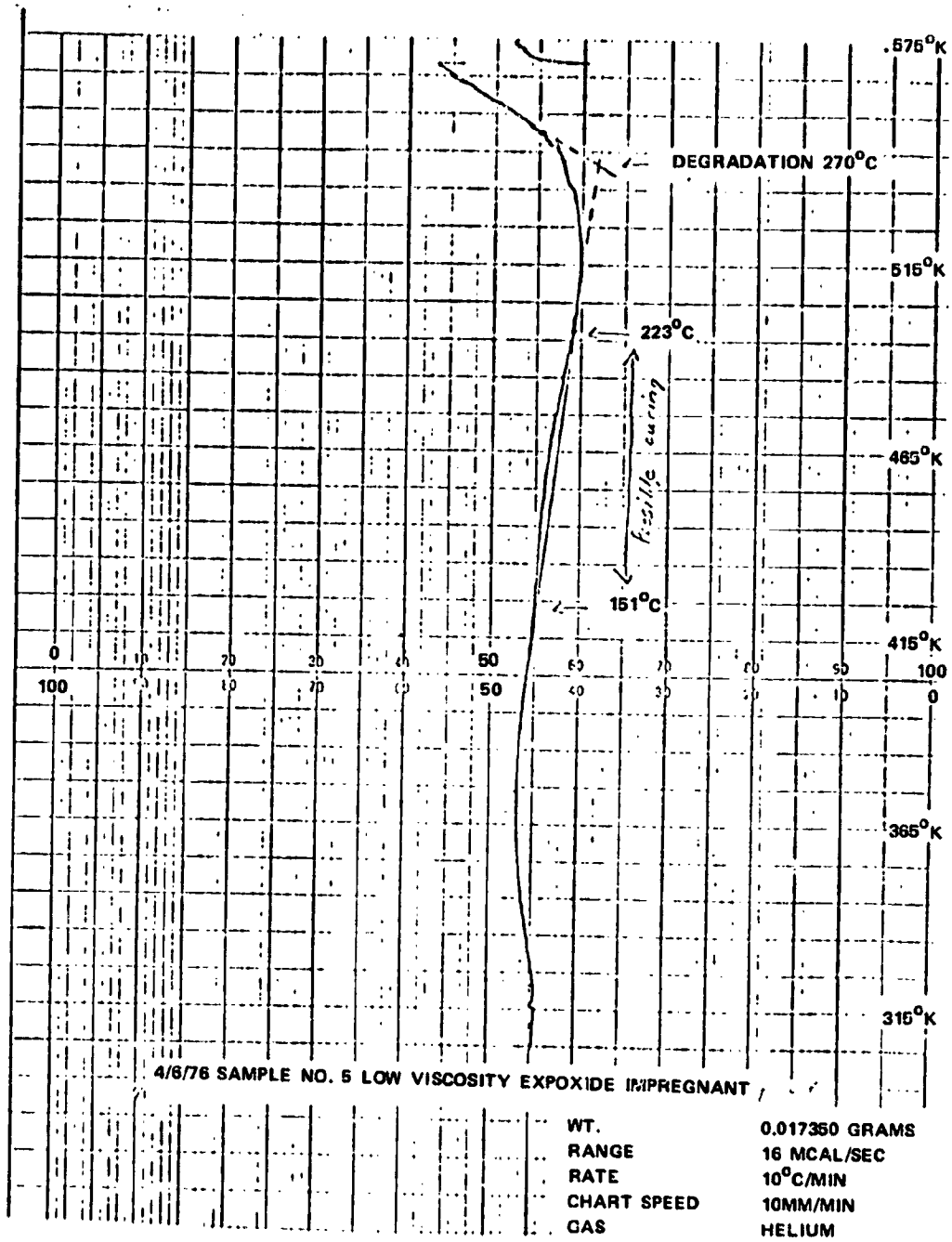


Figure 272.- Differential Scanning Calorimetry Results for Number 5.

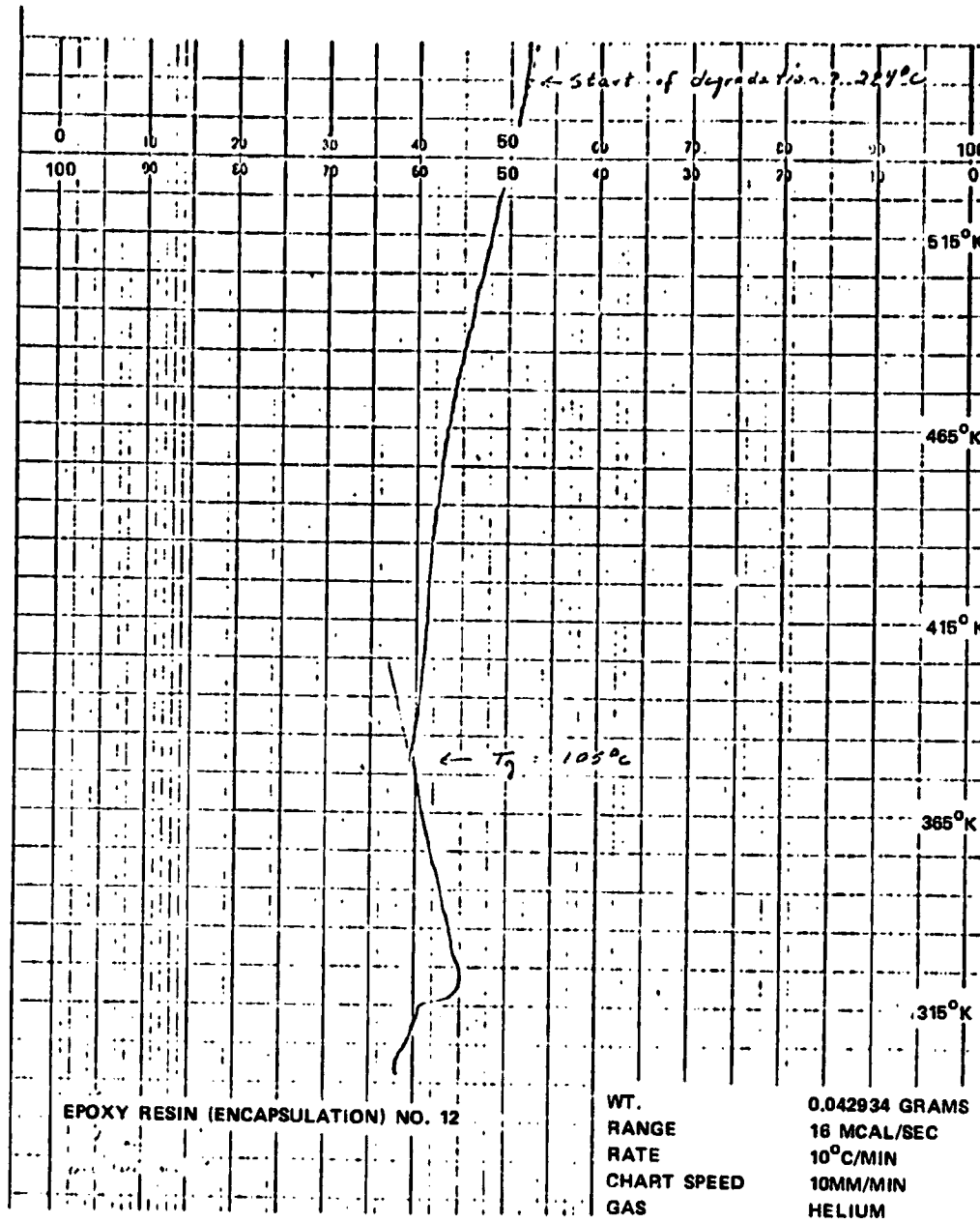


Figure 273. - Differential Scanning Calorimetry Results for Number 12.

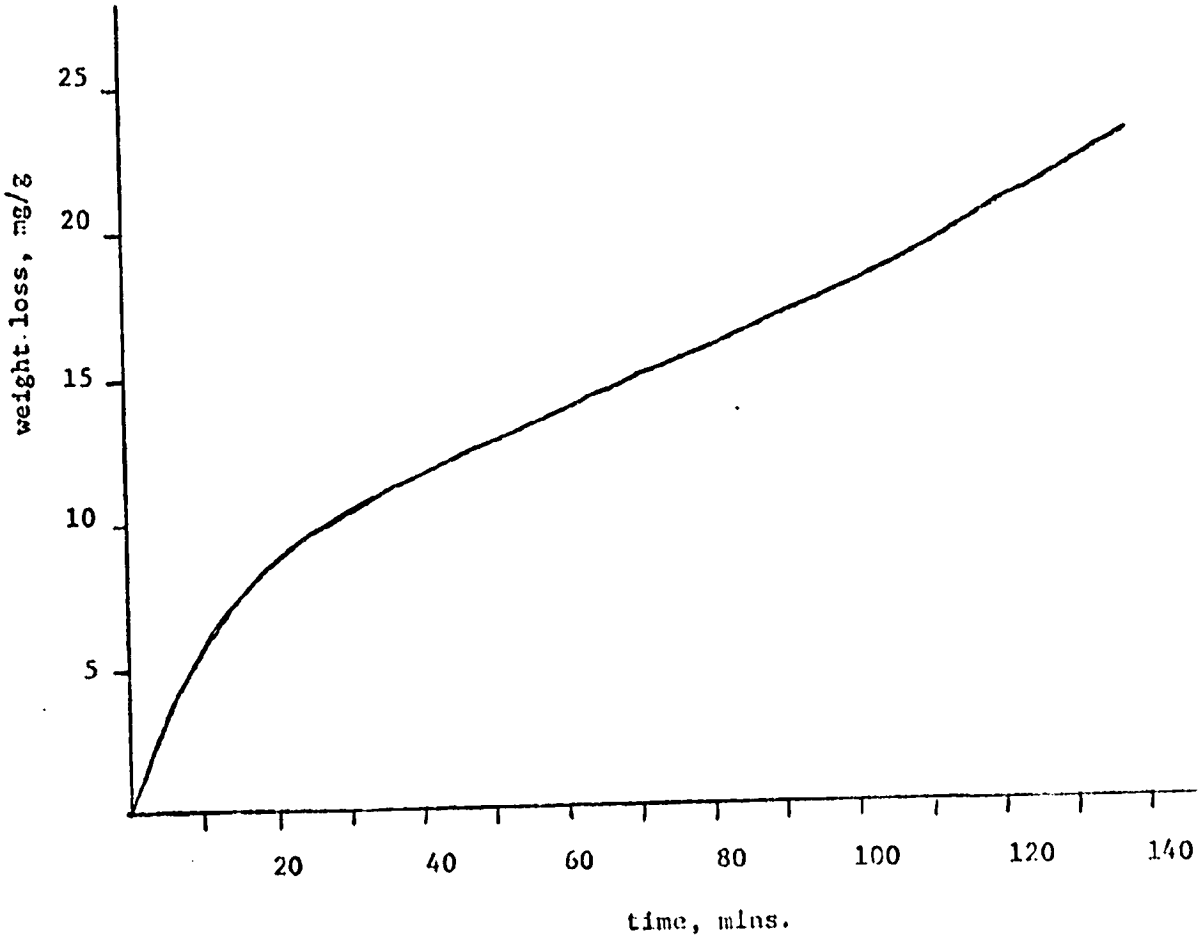


Figure 274. - Short Term Experiment of Sample 12C, 400°F.

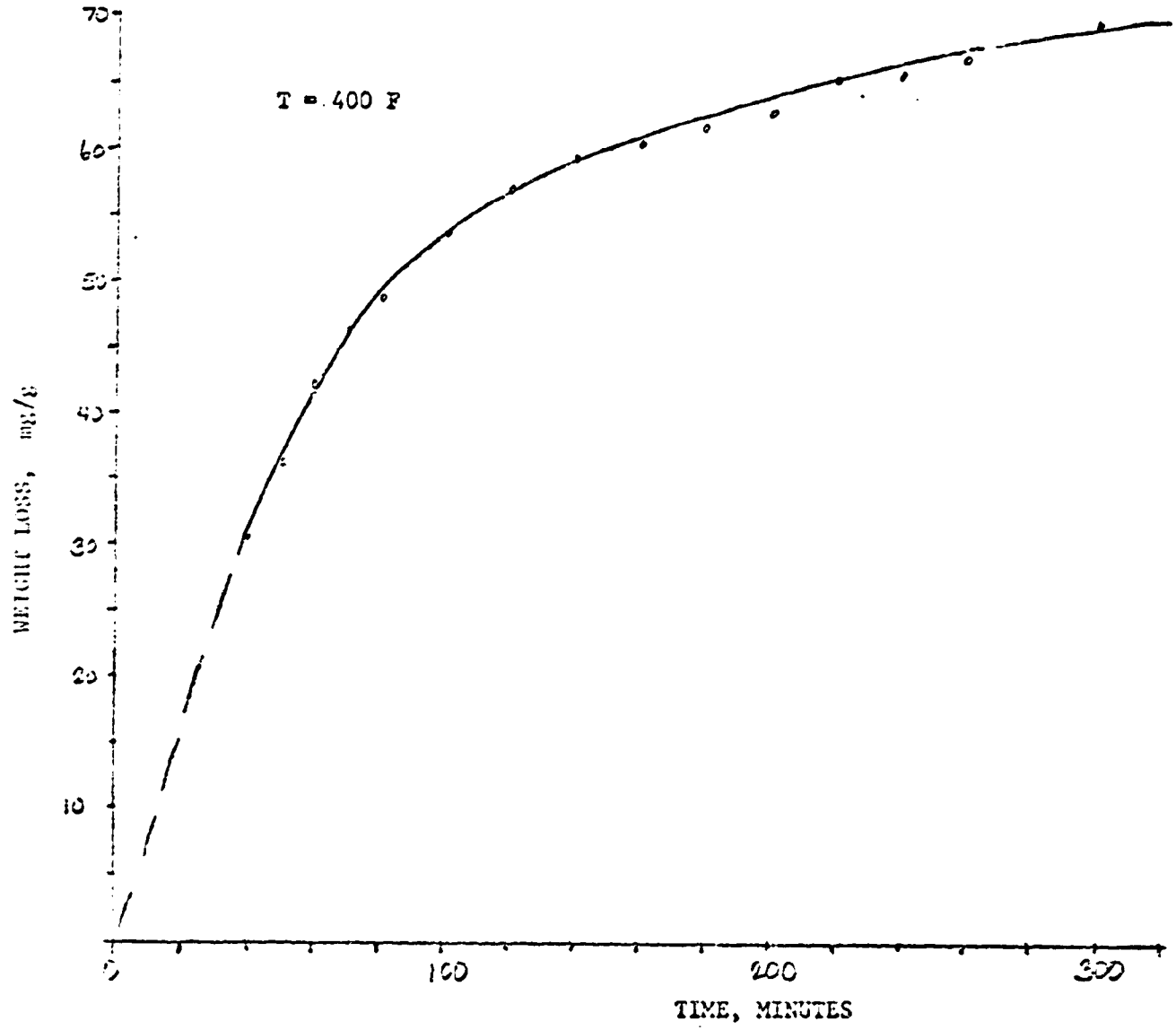


Figure 275. - Low Viscosity Epoxide Resin

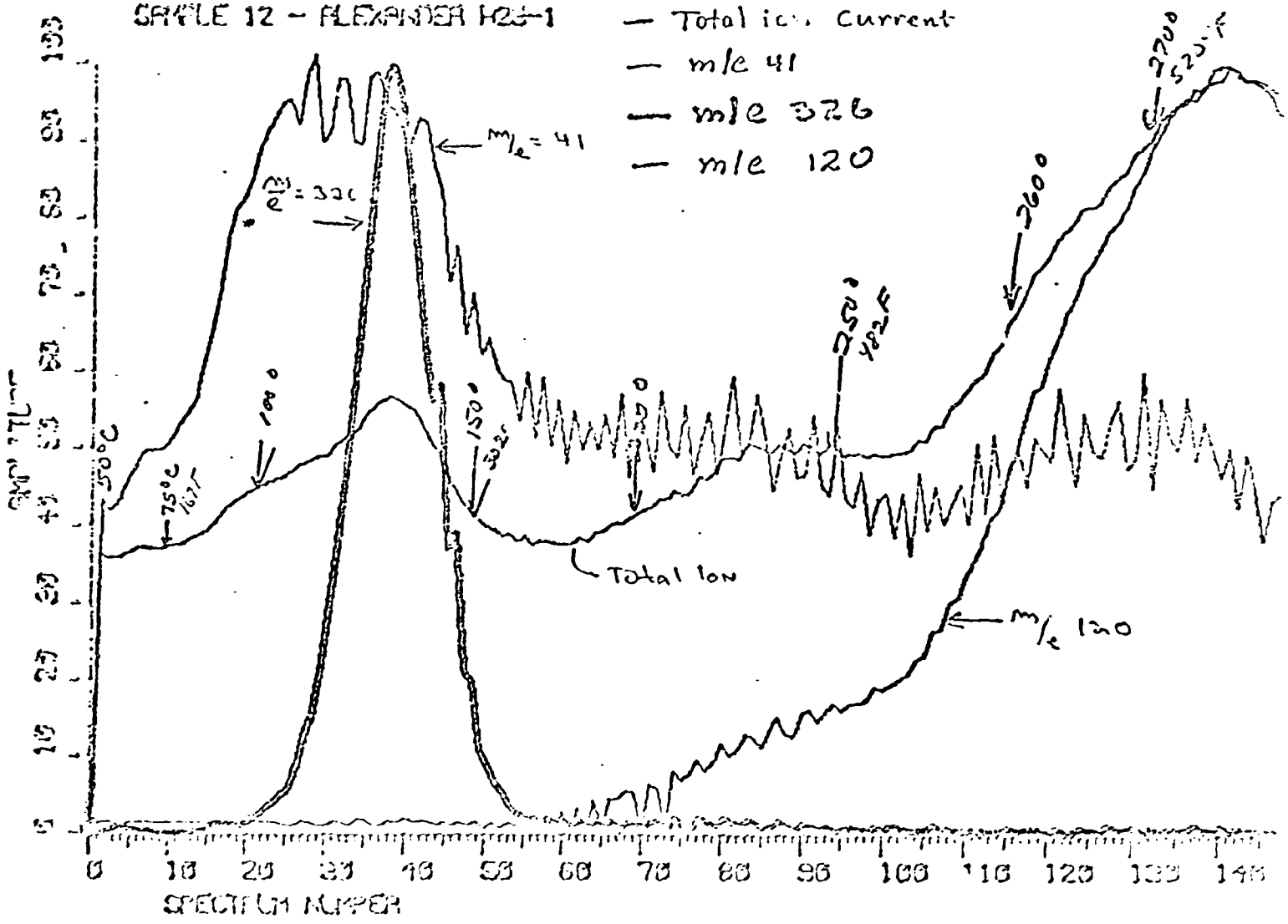


Figure 276. - GC-MS Experiment for Number 12.

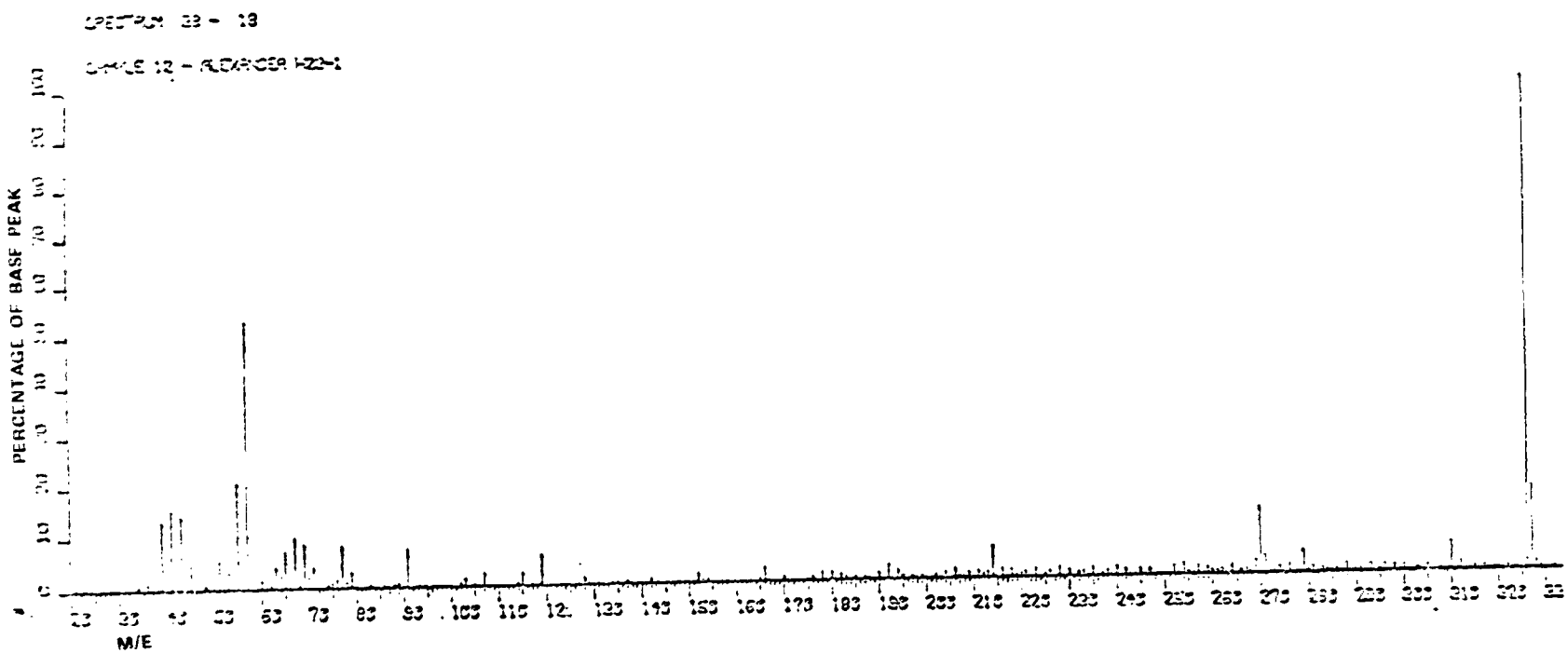


Figure 277. - Mass Spectrum for Number 12.

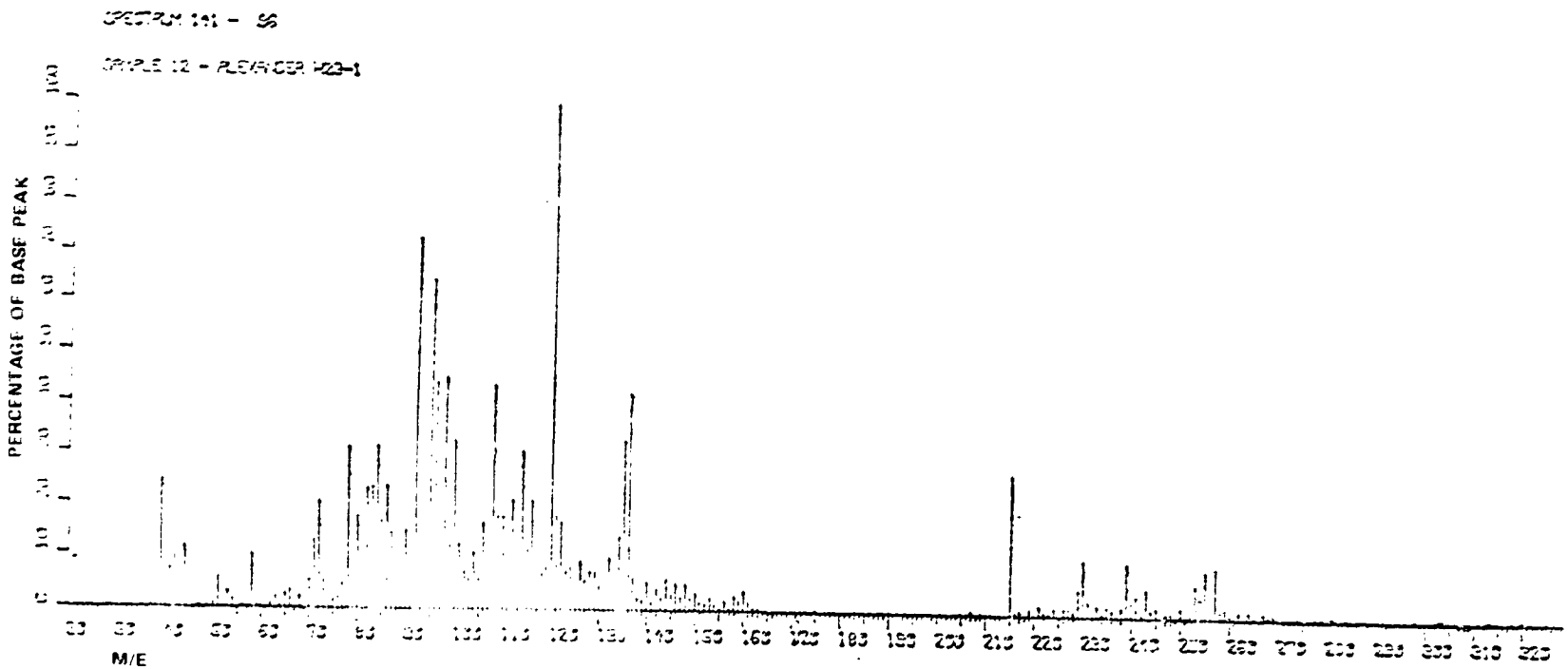


Figure 278. - Mass spectrum for Number 12.

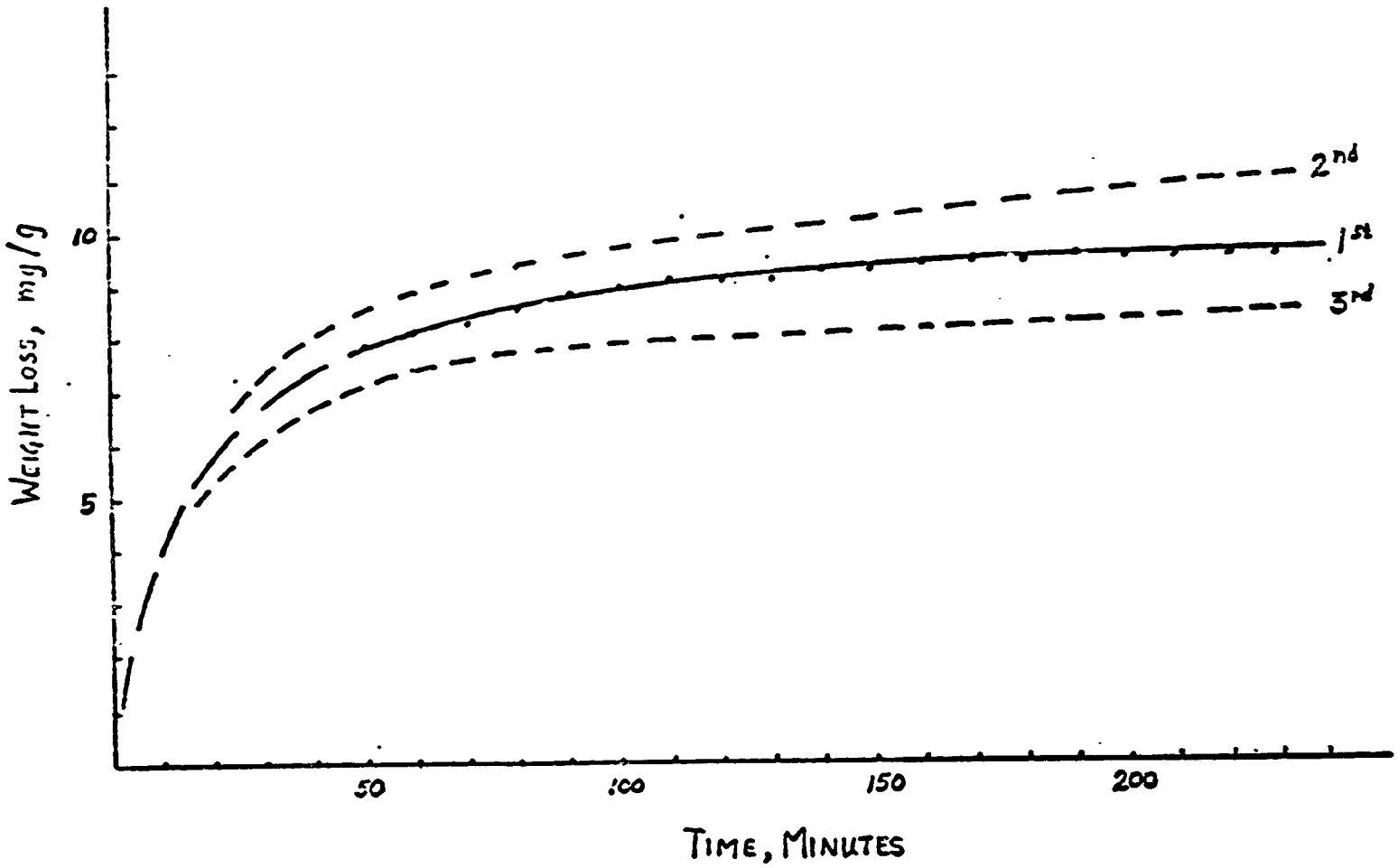


Figure 279. - Epoxy Resin Number 12 at 300°F (3 batches).

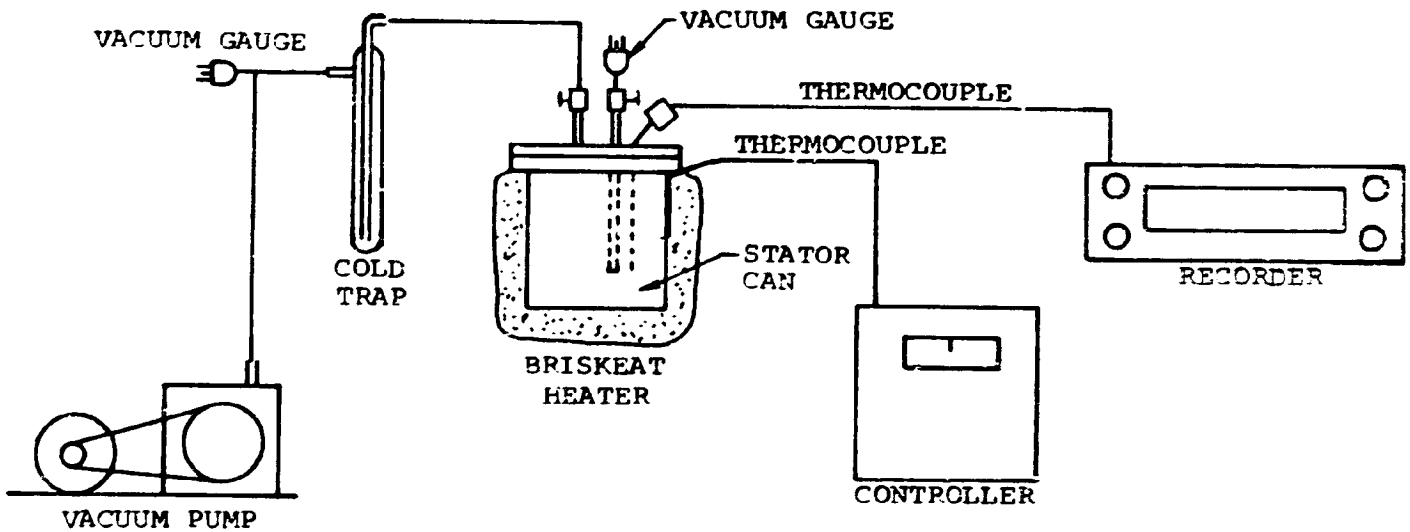


Figure 280. - Vacuum Bake-Out System.

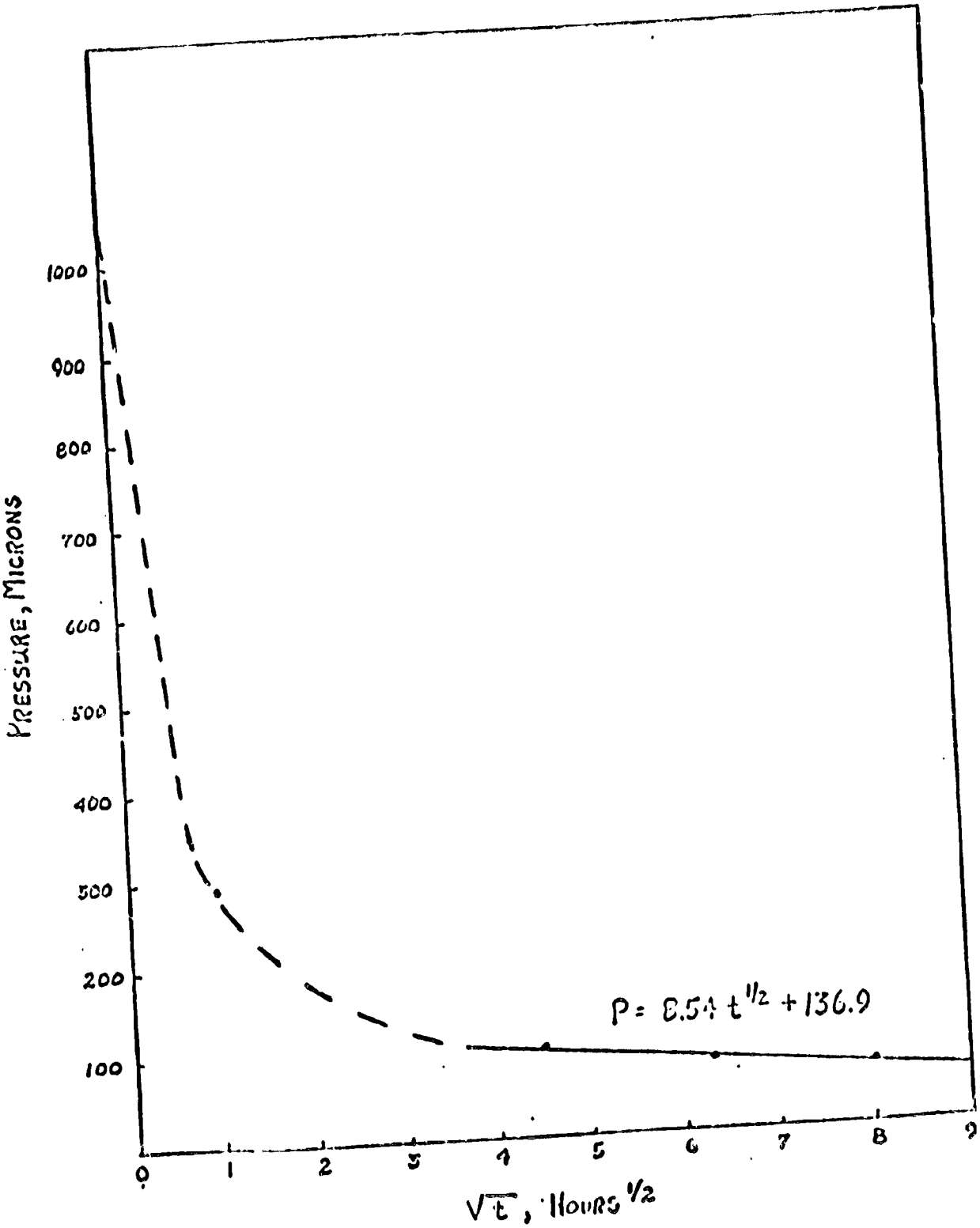


Figure 281. - Alternator Stator Vacuum Bake-out 250°F.

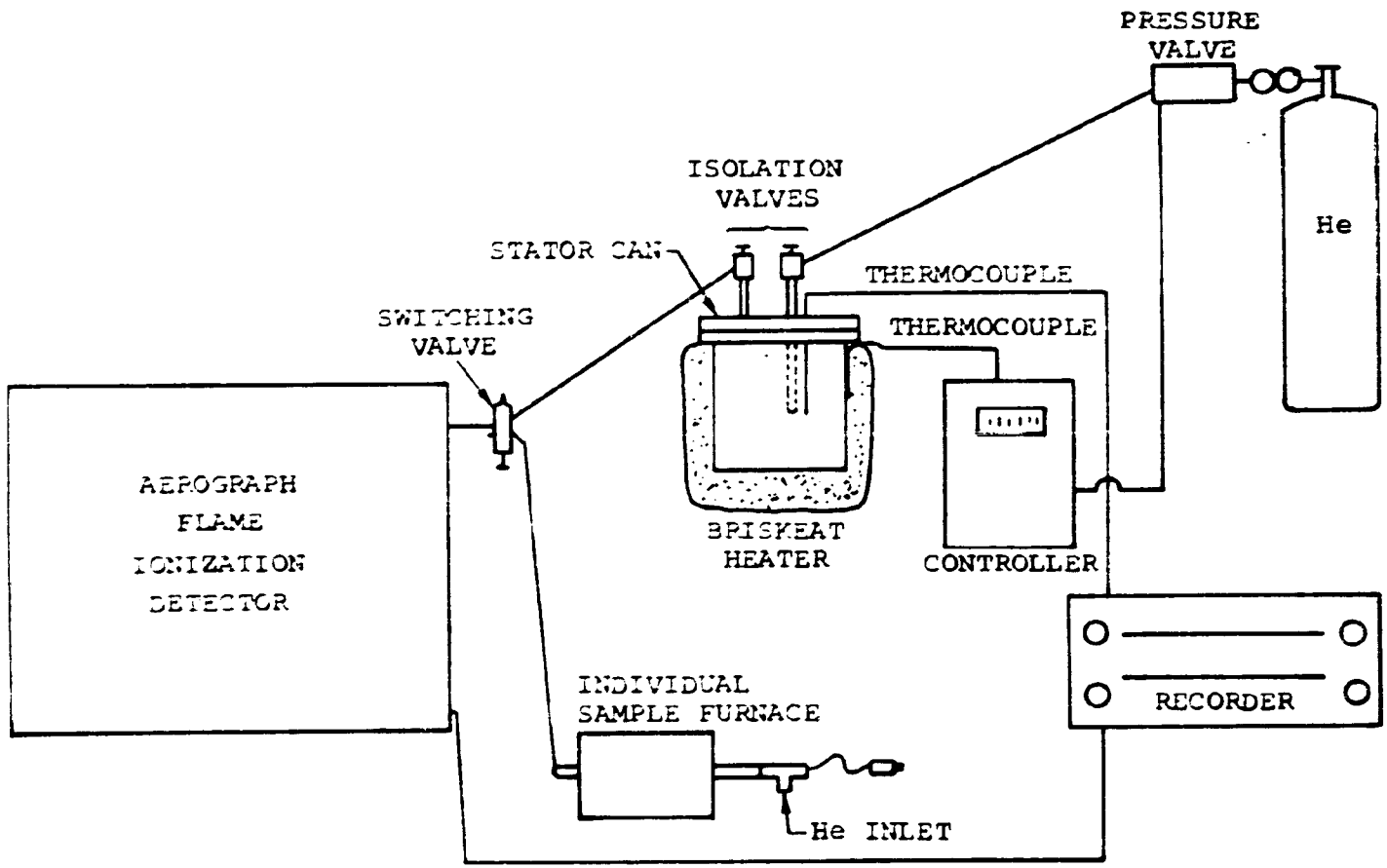


Figure 282. - Stator Bake-Out System.

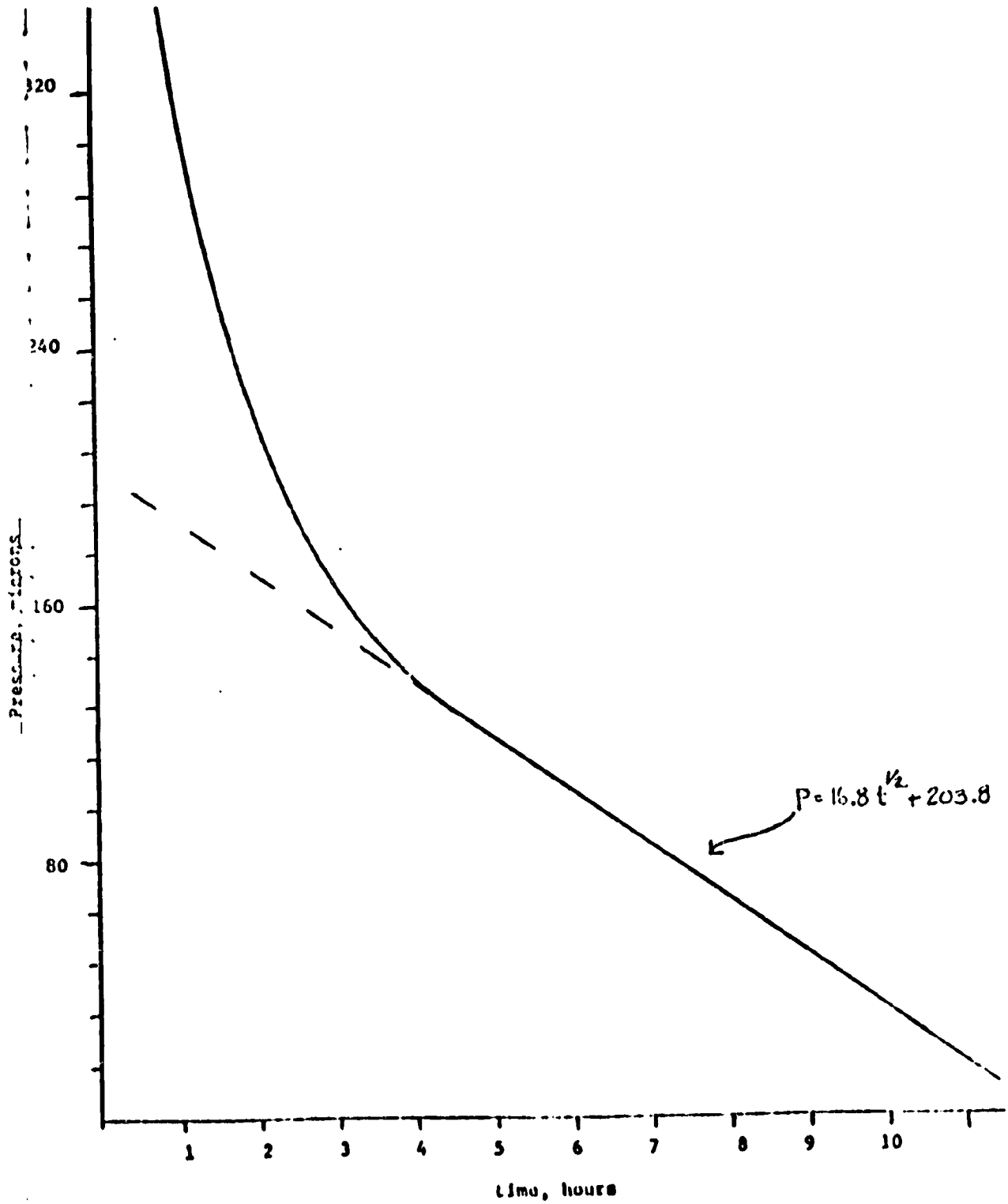


Figure 283. - Vacuum Bake-Out of Third Alternator-Stator.

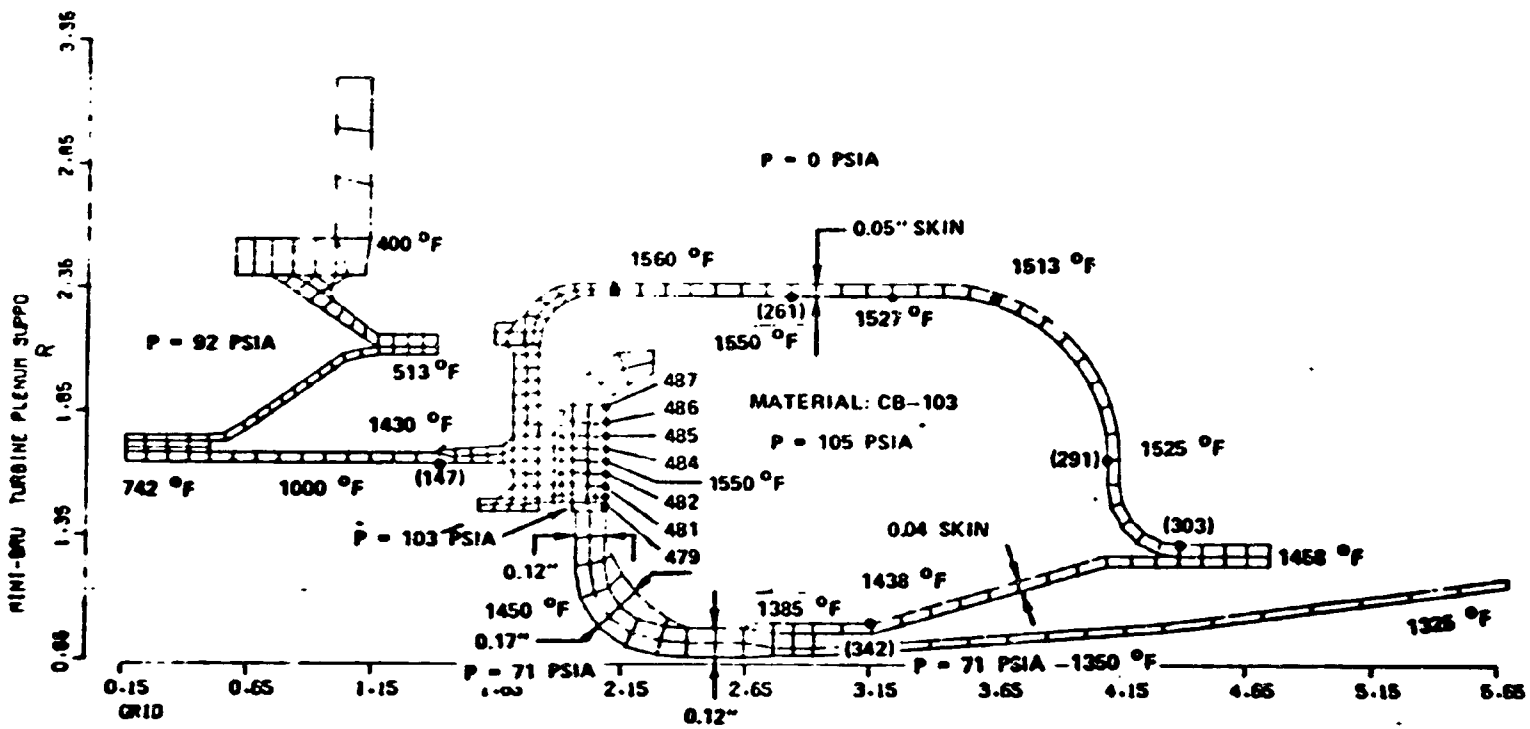


Figure 284. - Final Configuration of the Turbine Nozzle and Plenum.

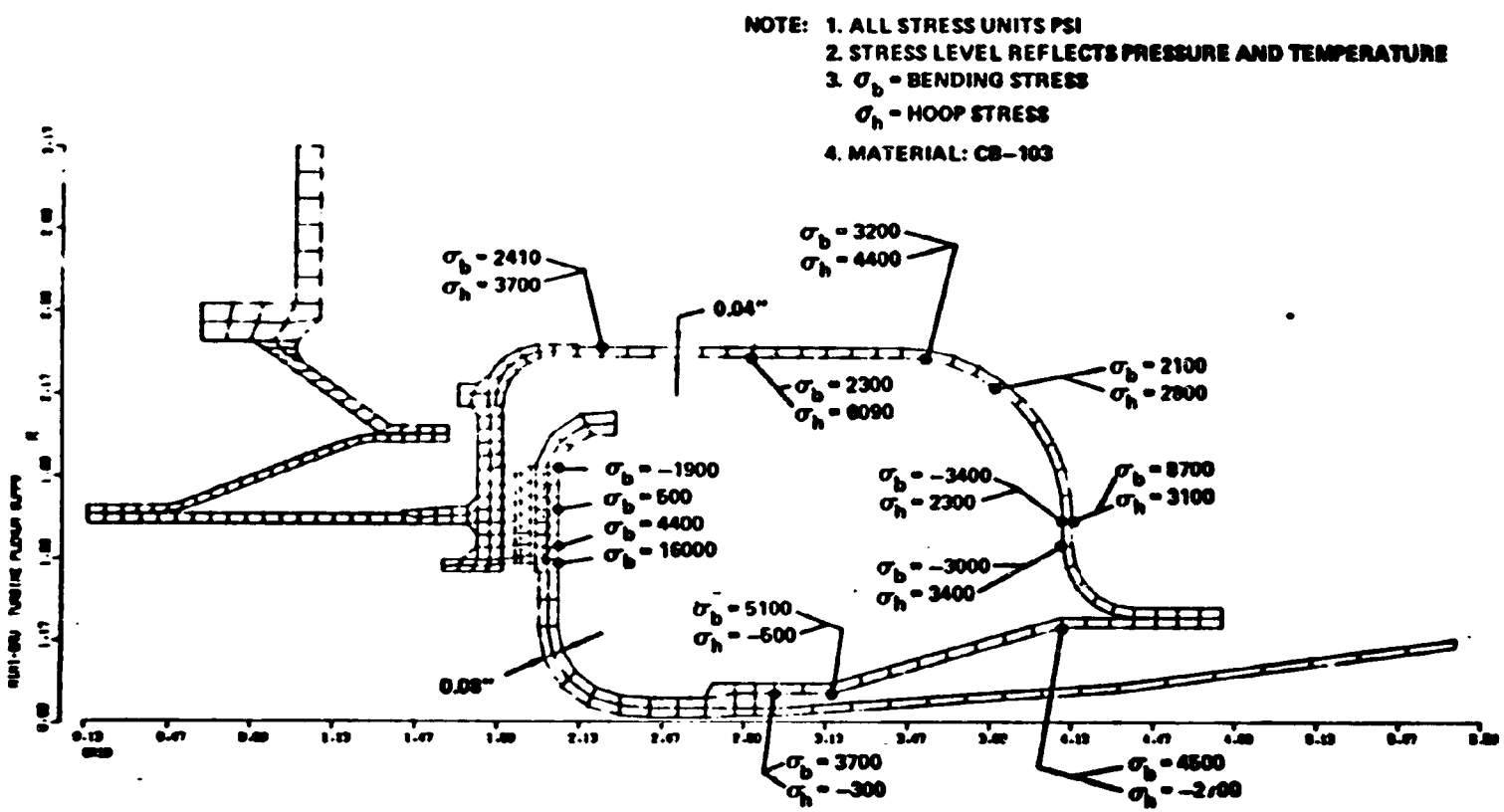


Figure 285. - Elastic Stress Level of the 0.04 in. Thick Plenum with Unstiffened Shroud.

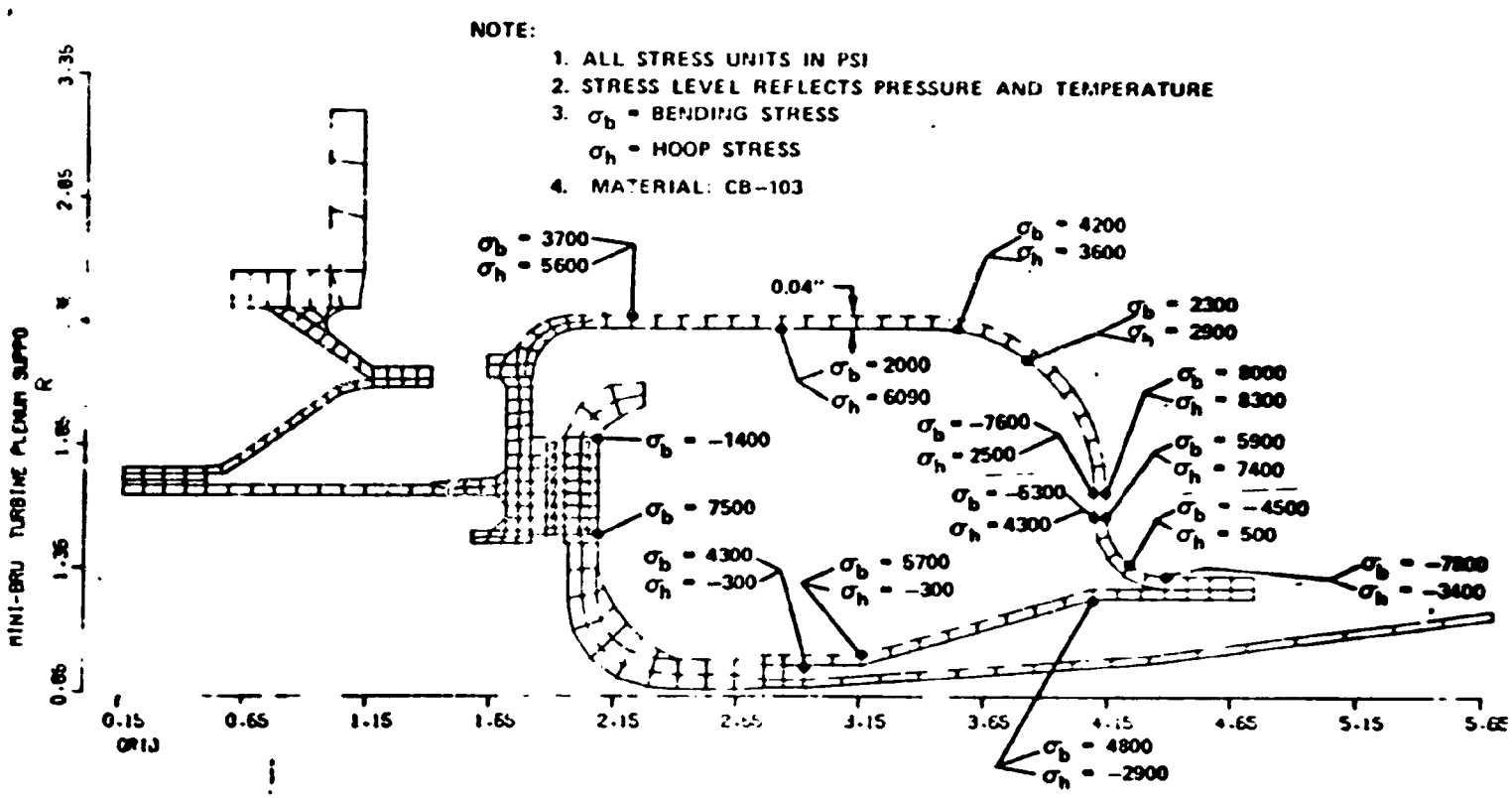


Figure 286. - Elastic Stress Level for 0.04 in. Plenum with Stiffened Shroud.

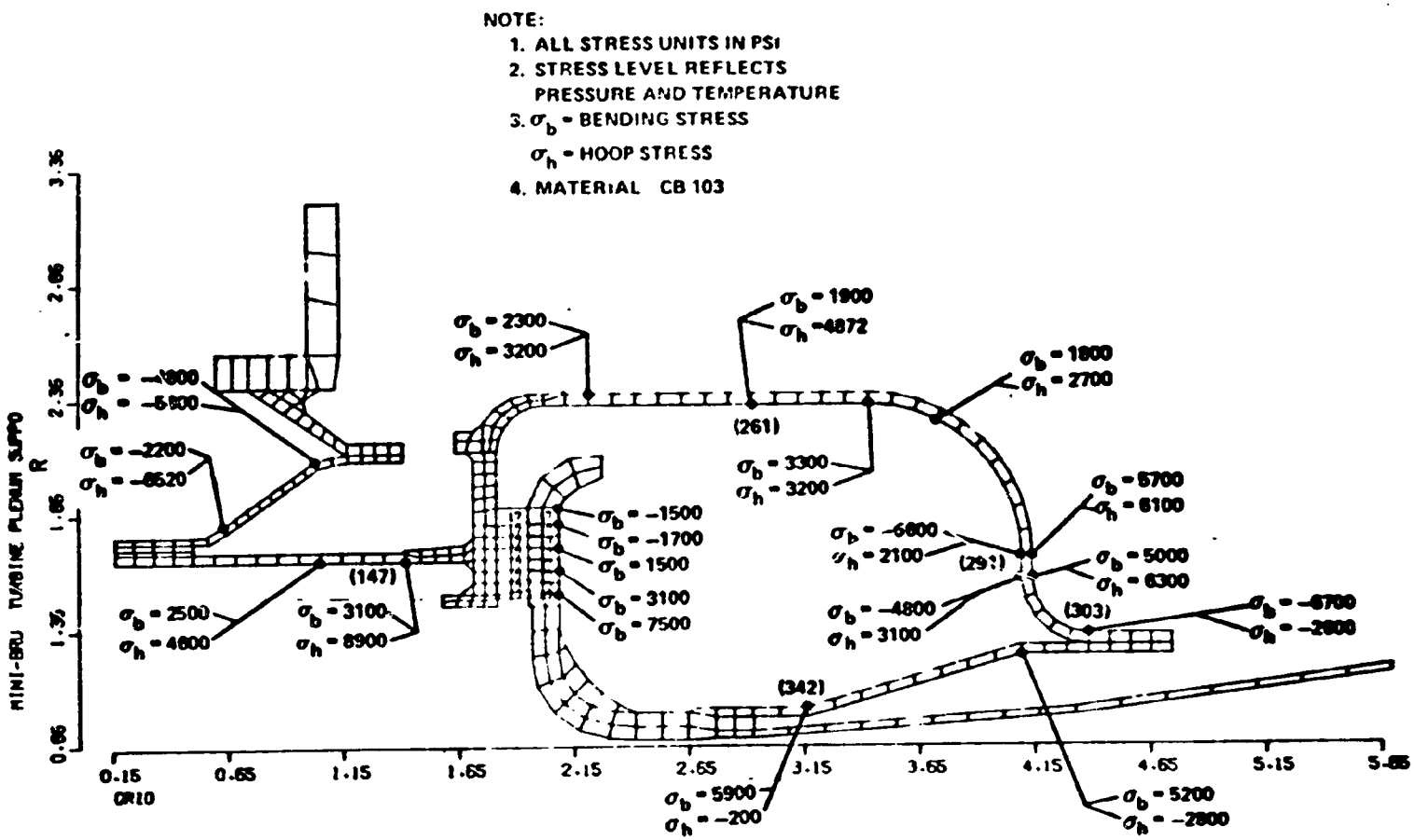


Figure 287. - Elastic Stress Level for 0.05 in. Thick Plenum and Stiffened Shroud.

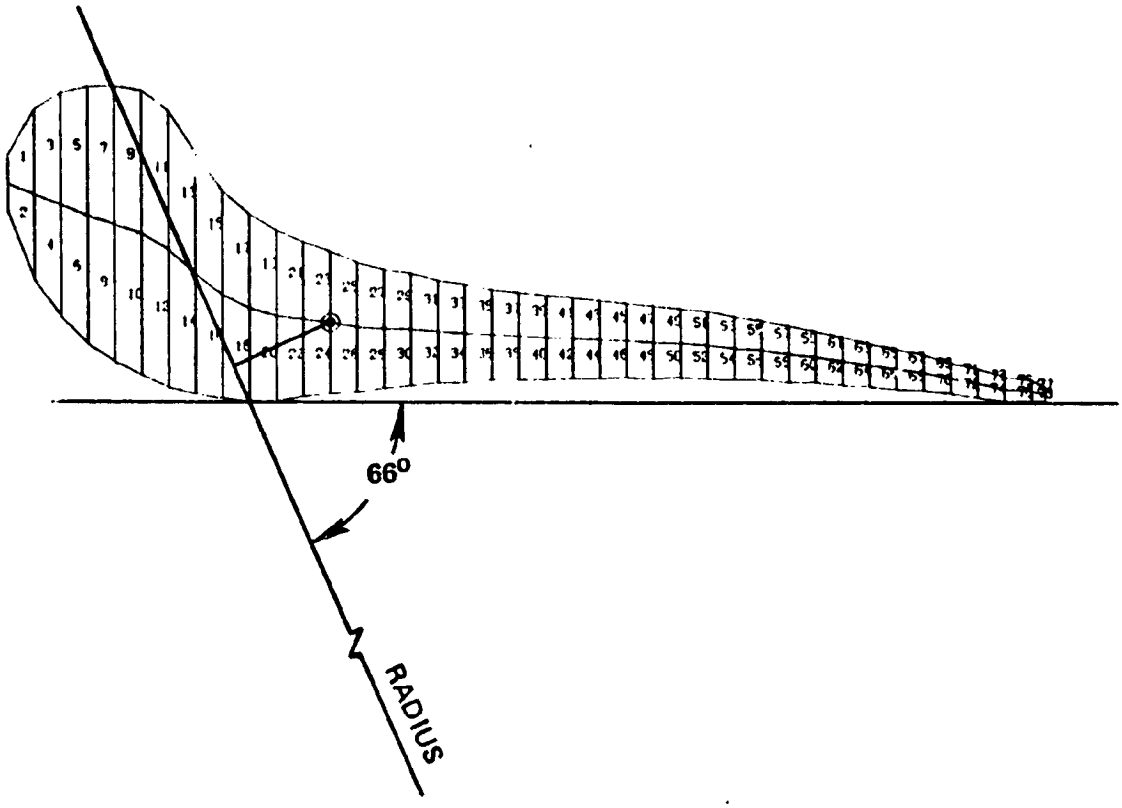


Figure 288. - Vane Cross Section Used in Creep Relaxation.

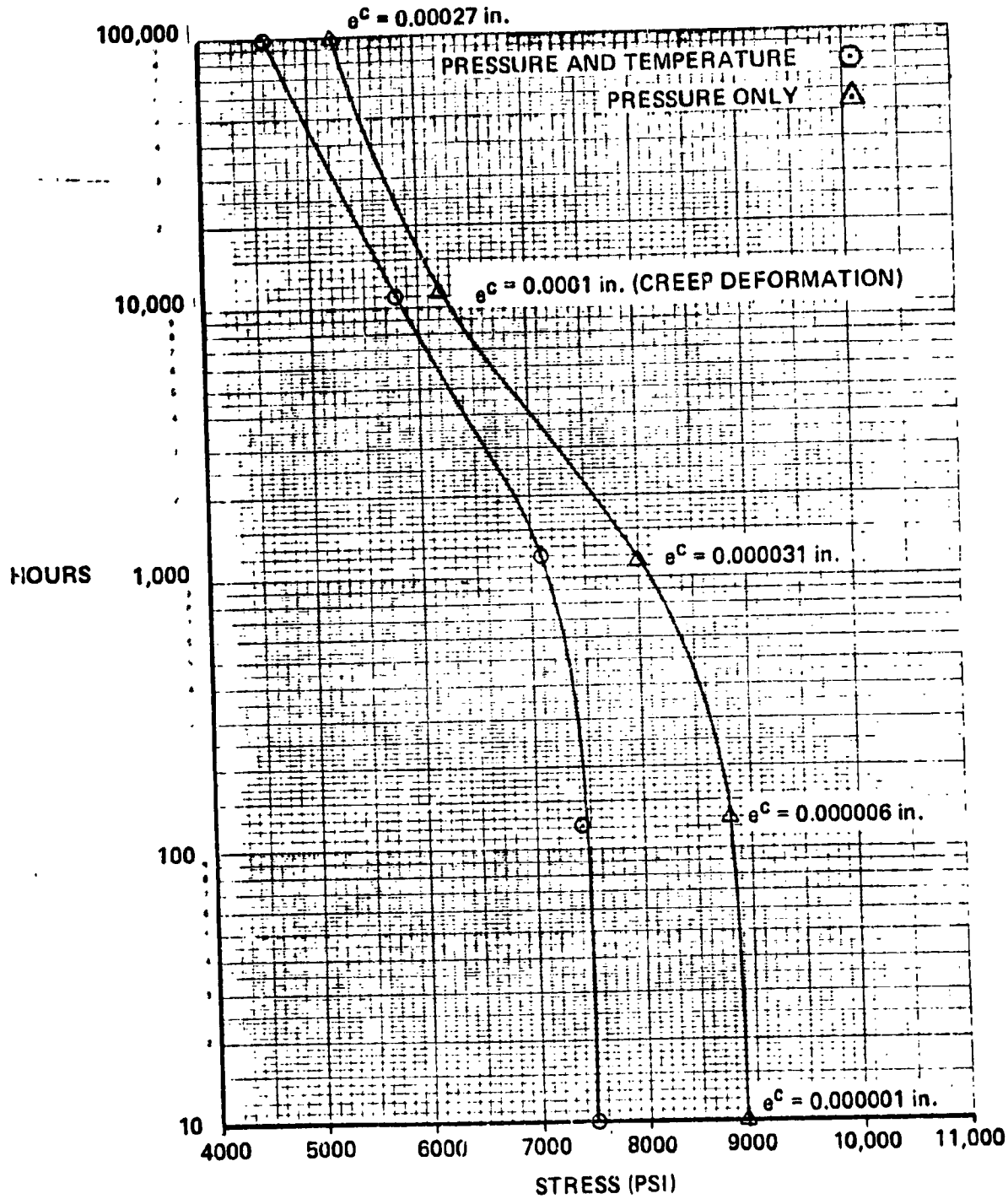


Figure 289. - Creep Relaxation at Vane T.E.

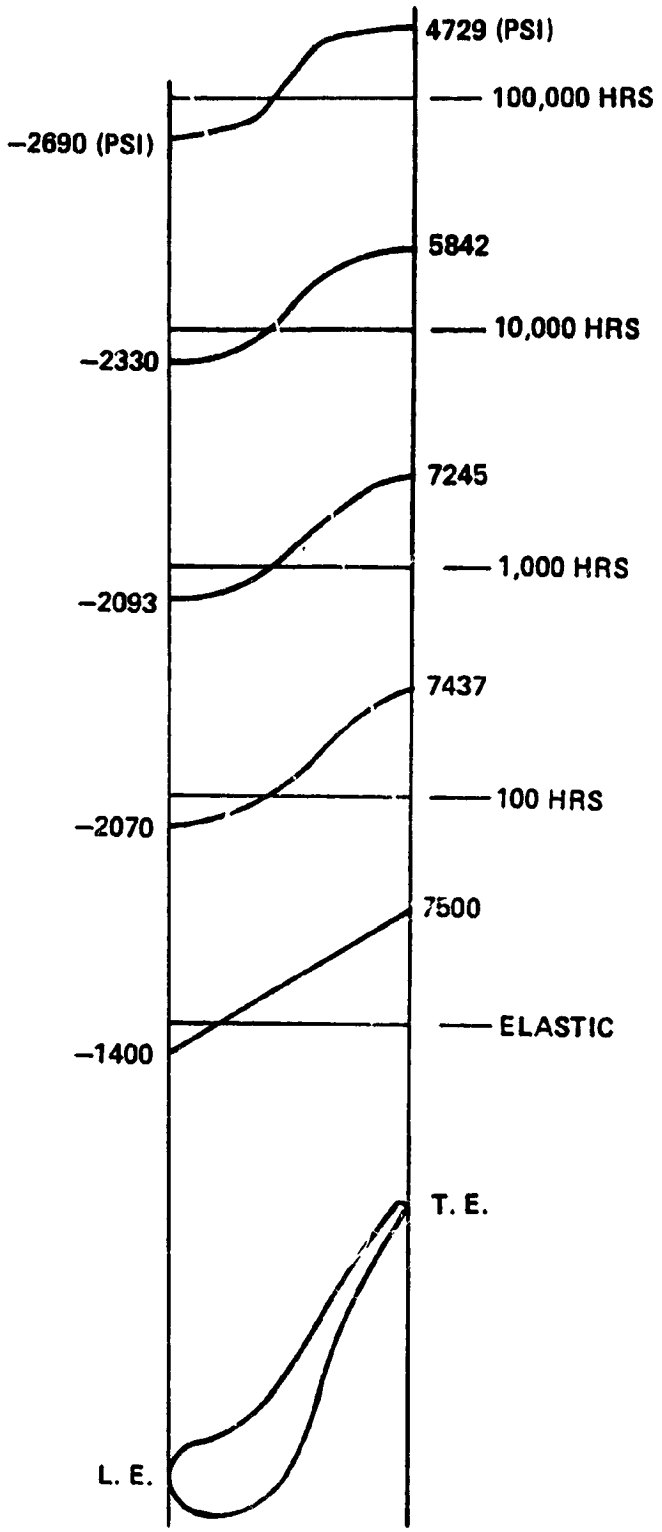


Figure 290. - Creep Relaxation at Vane Cross Section

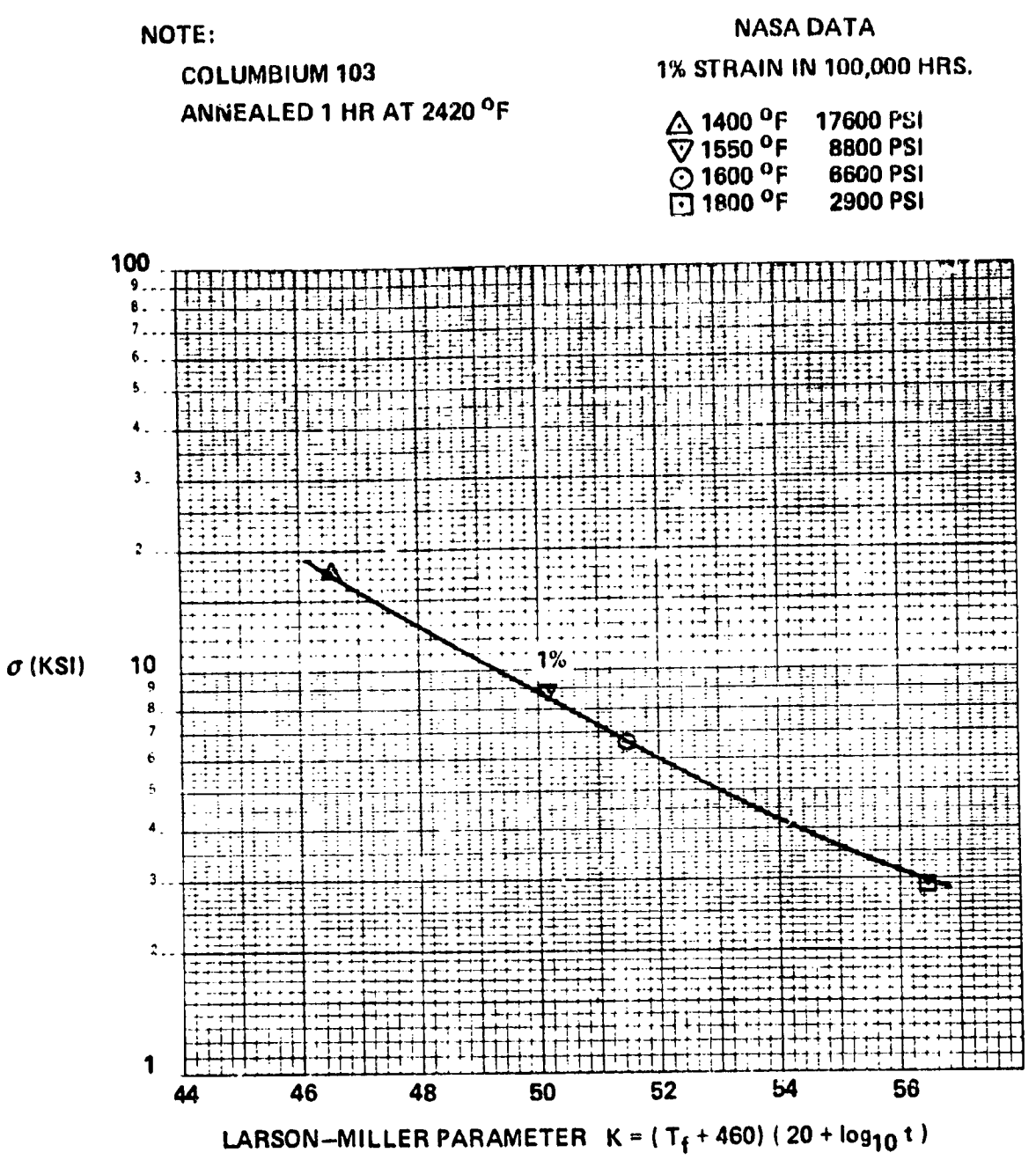


Figure 291. - Creep Data of CB-103 From NASA.

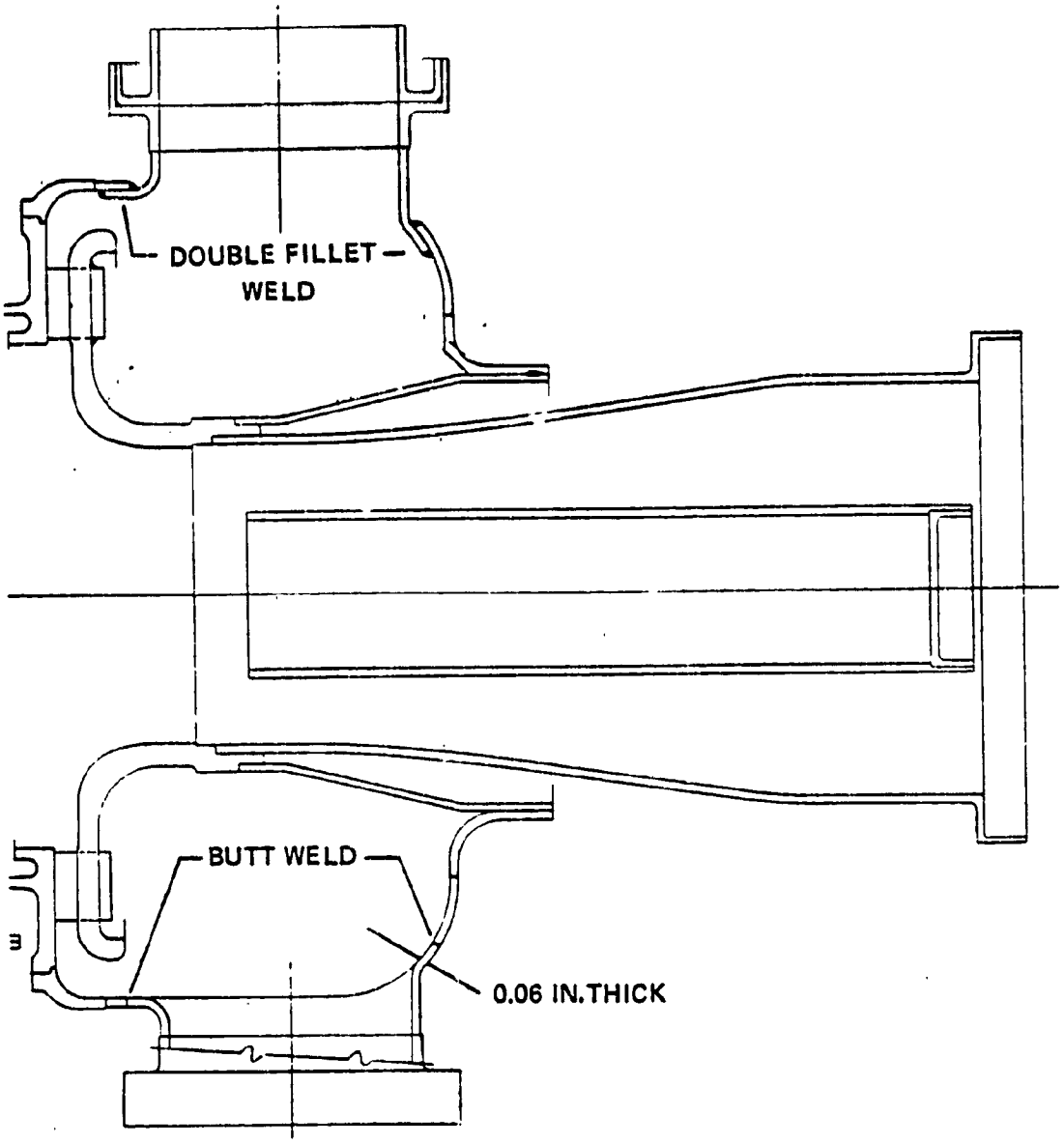


Figure 292. - Two Configurations for the Plenum Duct Juncture.

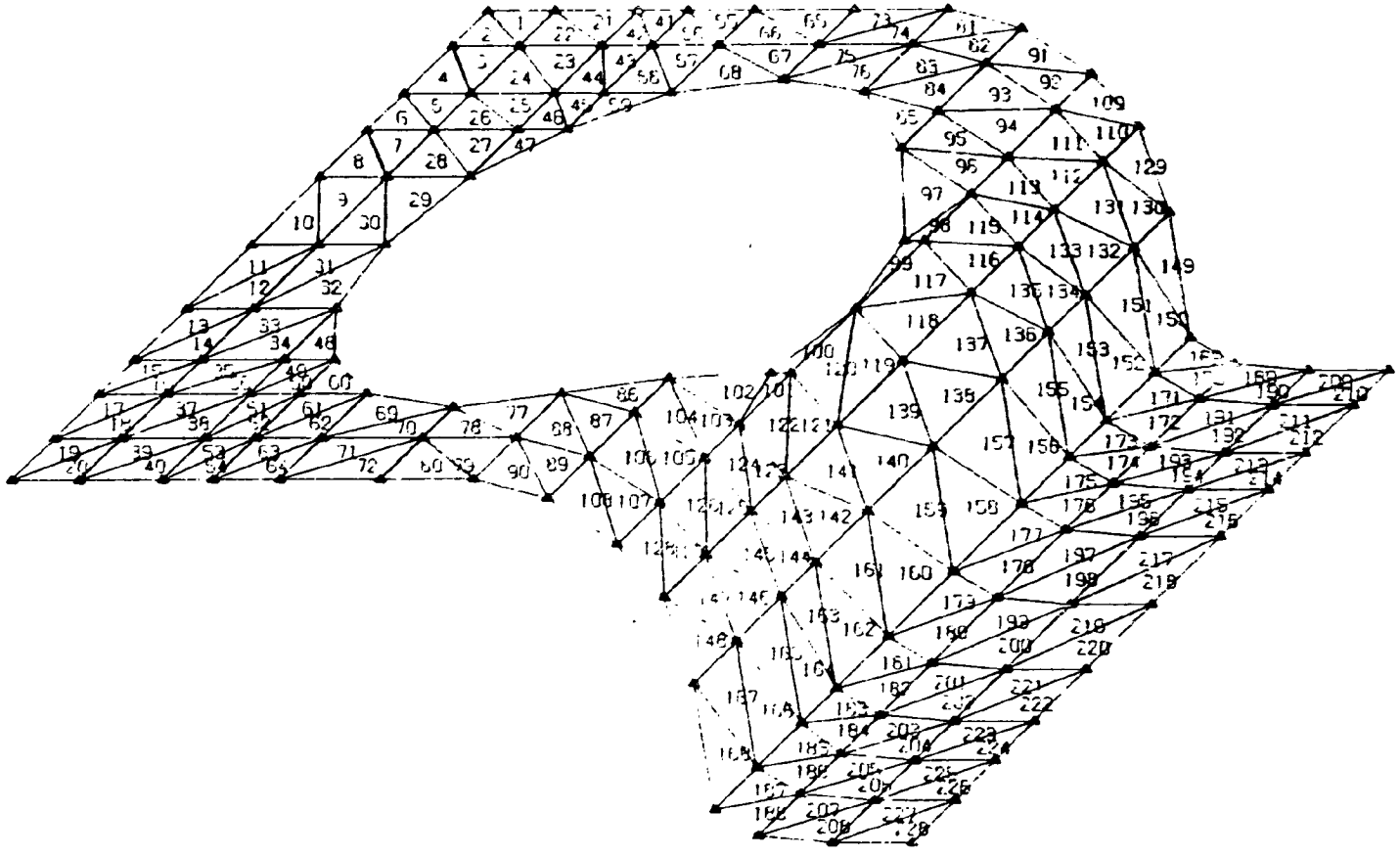


Figure 293. - Structural Model for the Plenum Cutout (boss 1).

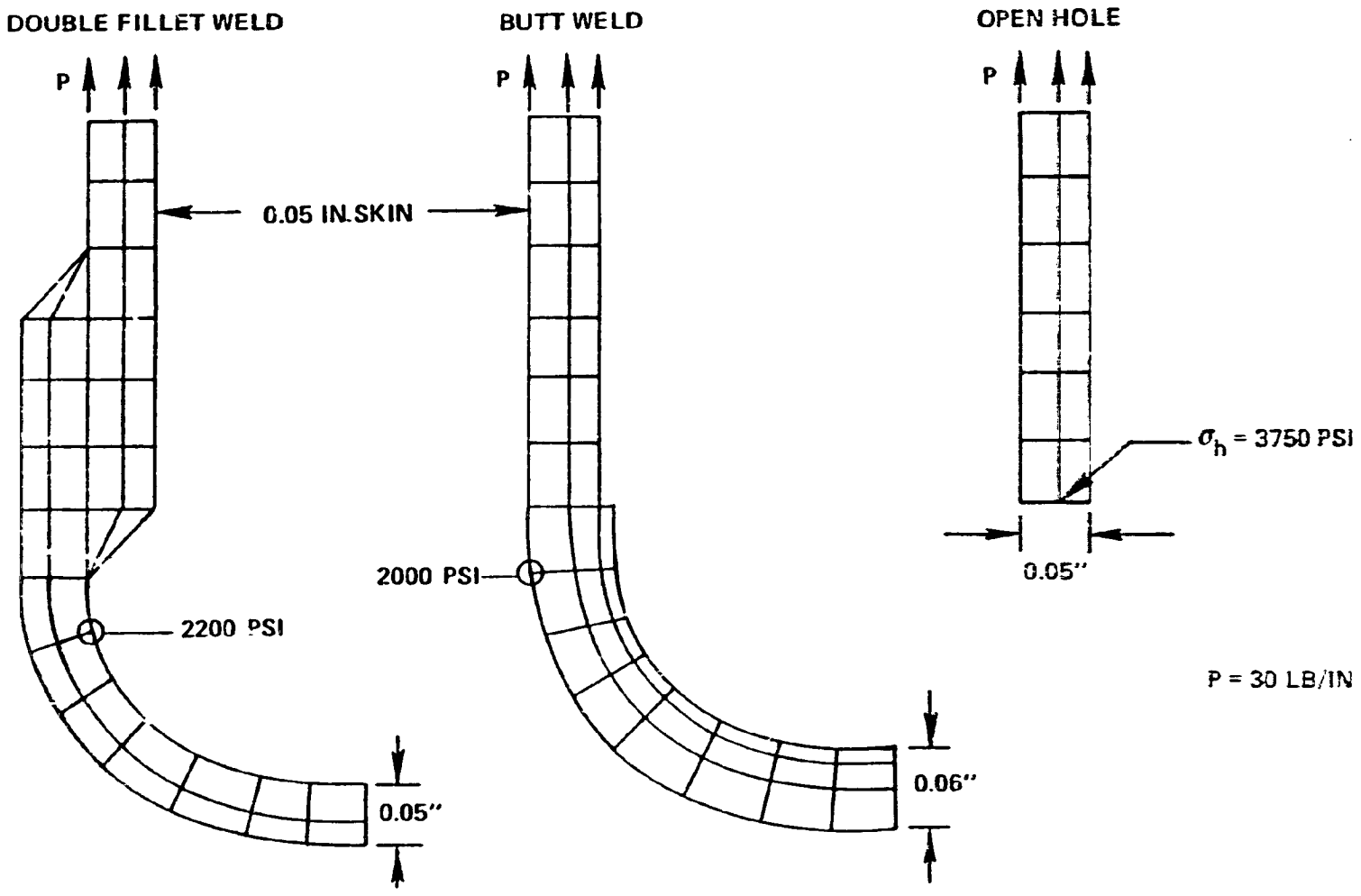


Figure 294. - Stress Levels in Welded and Open Hole Configurations.

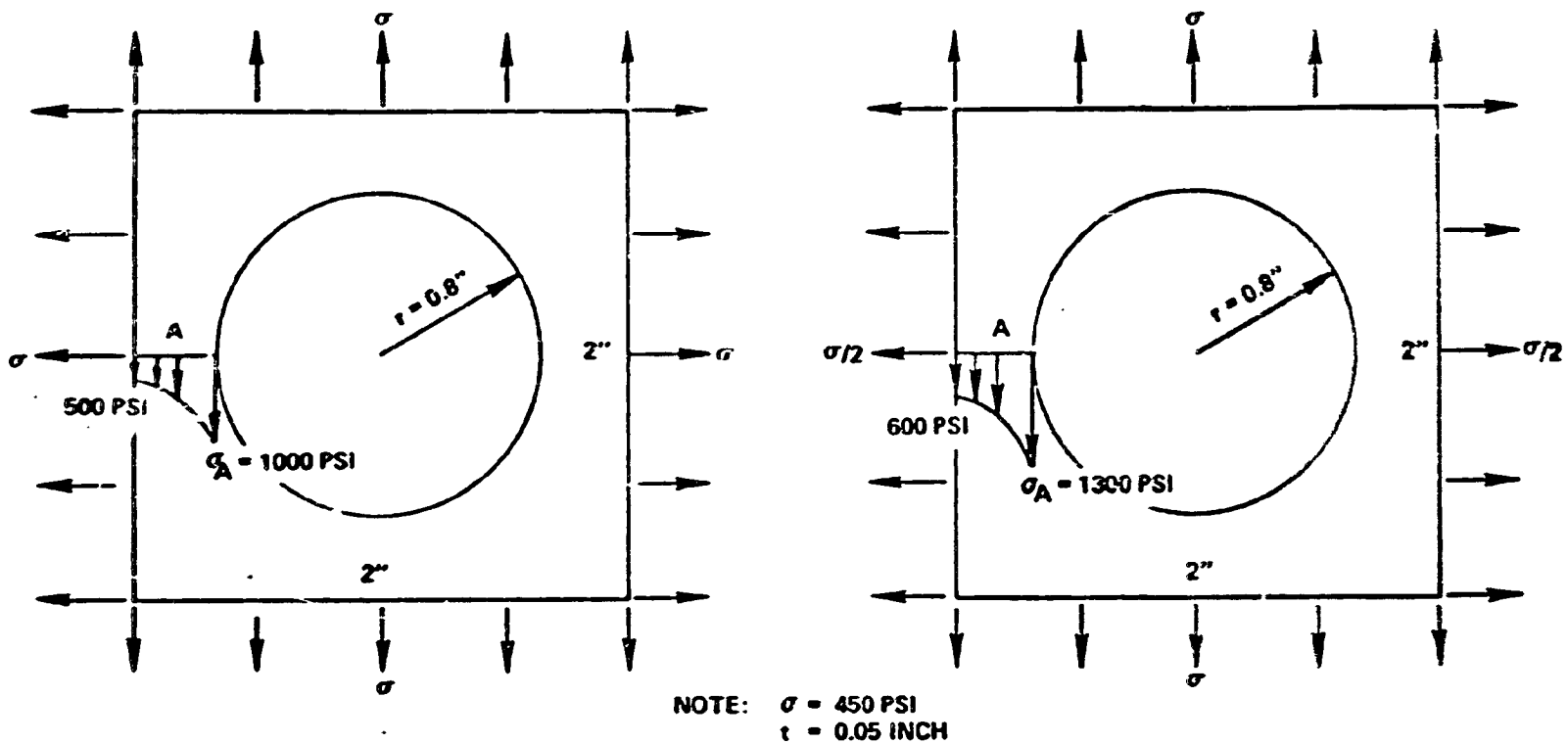


Figure 295. - Stress Levels Around the Flat Circular Cutout.

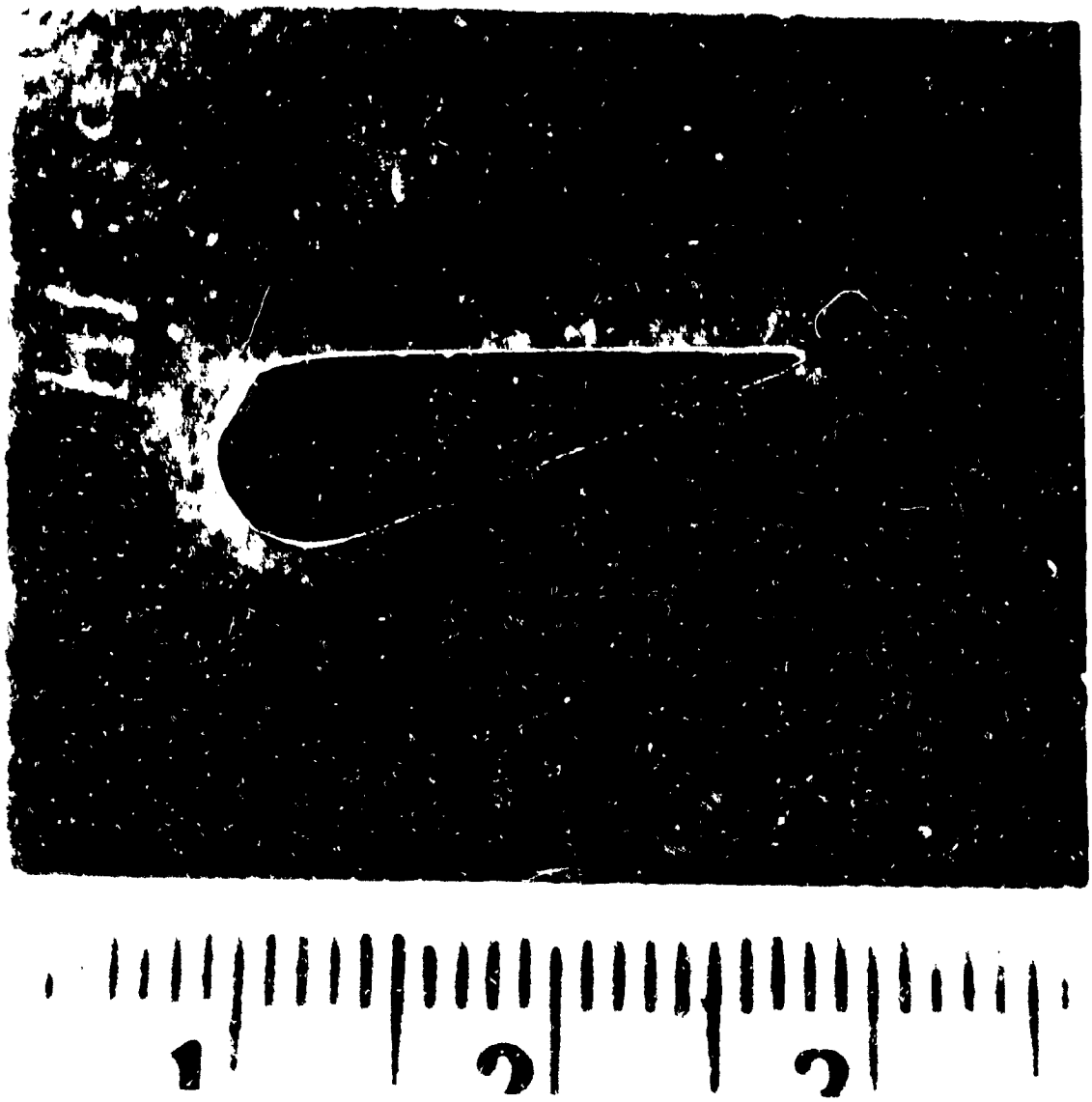


Figure 296. Sample Vane for Weld Penetration Evaluation.

Figure 297. - Sample Nozzle Vanes Welded to Various Depths of Penetration.

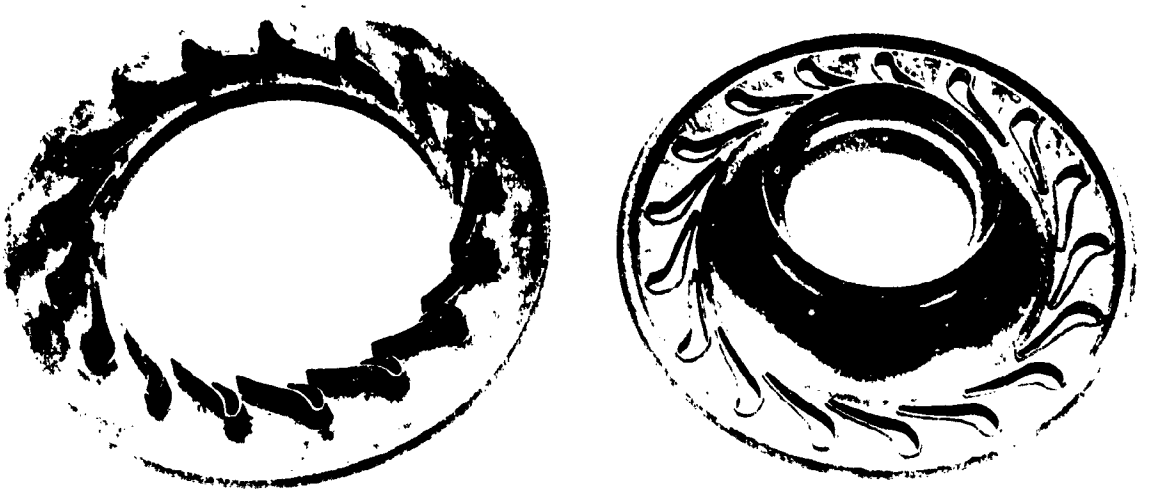


Figure 298. - Full Size C-103 Nozzle Plate.

Figure 299. - Full Size C-103 Nozzle Plate Assembled.

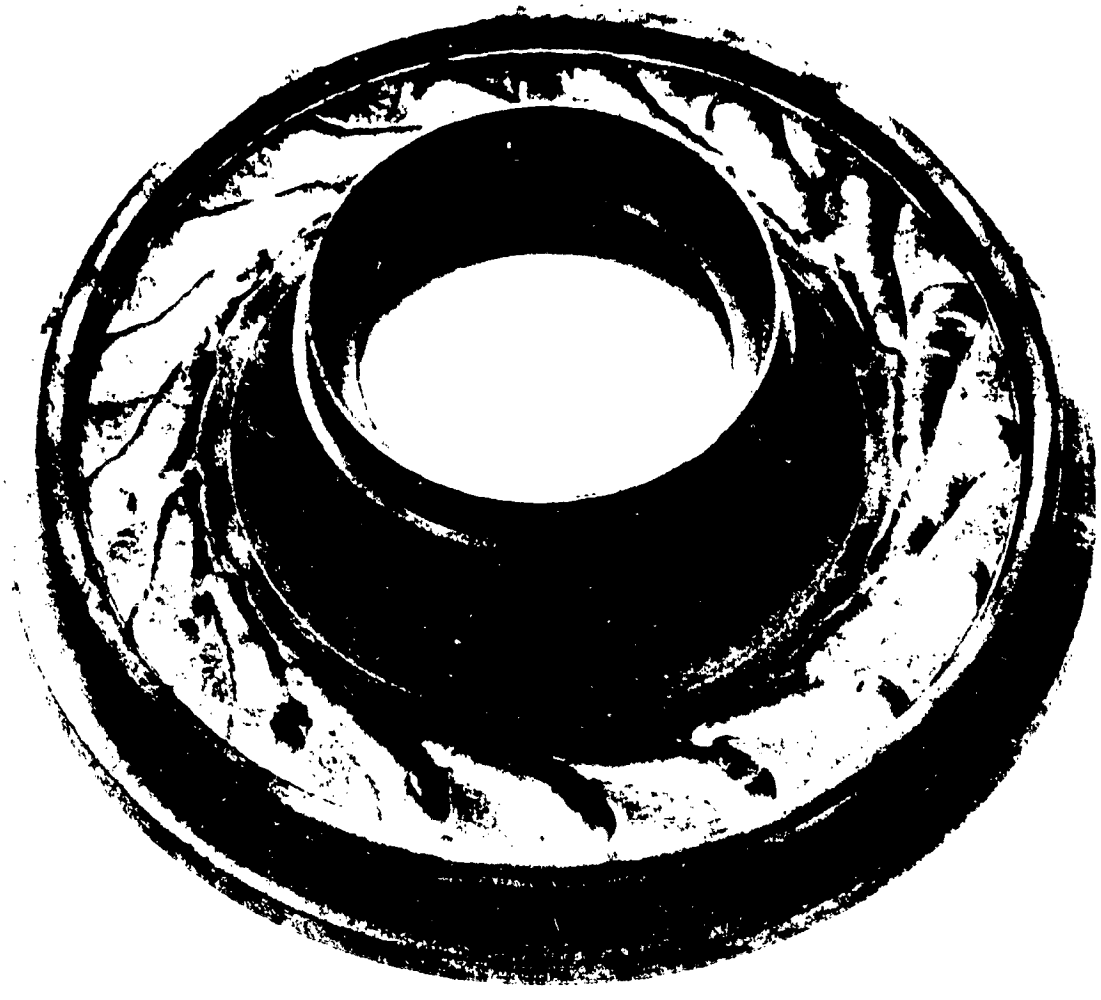


Figure 300. - Full Size C-103 Nozzle Plate Assembled and Welded Around Periphery of Blades.

Figure 301. - Interior View of C-103 Nozzle Plate Assembly.

Figure 302. - Exterior View of C-103 Nozzle Plate Assembly.

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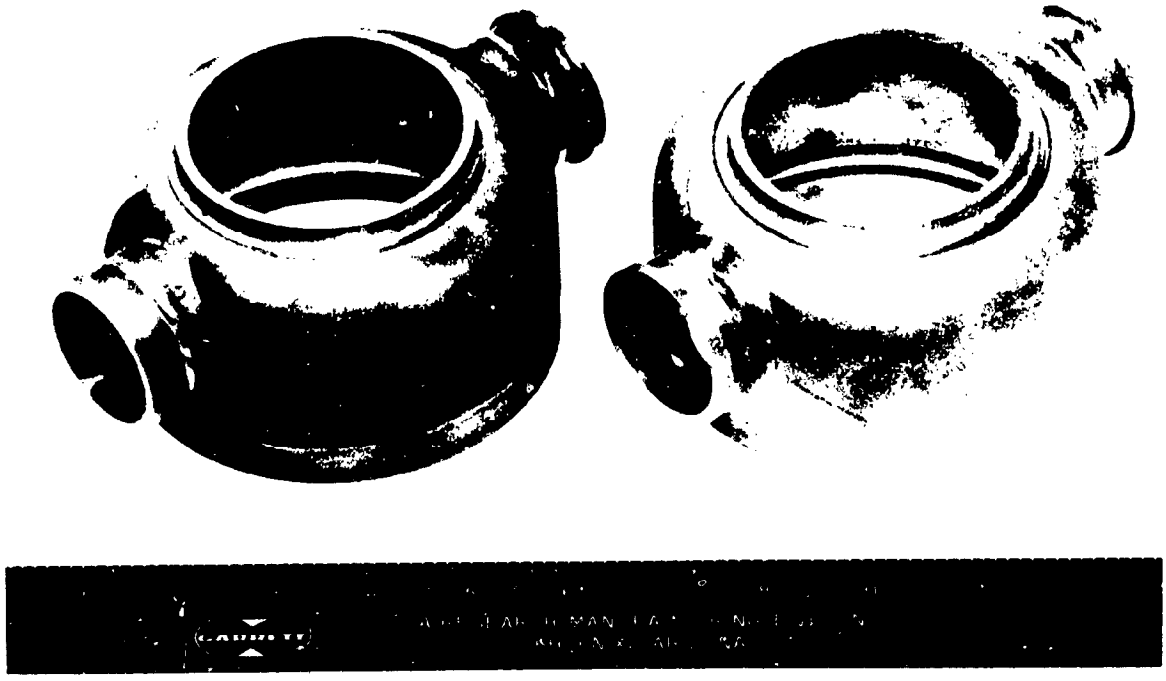


Figure 303. - C-103 Plenum Housings.

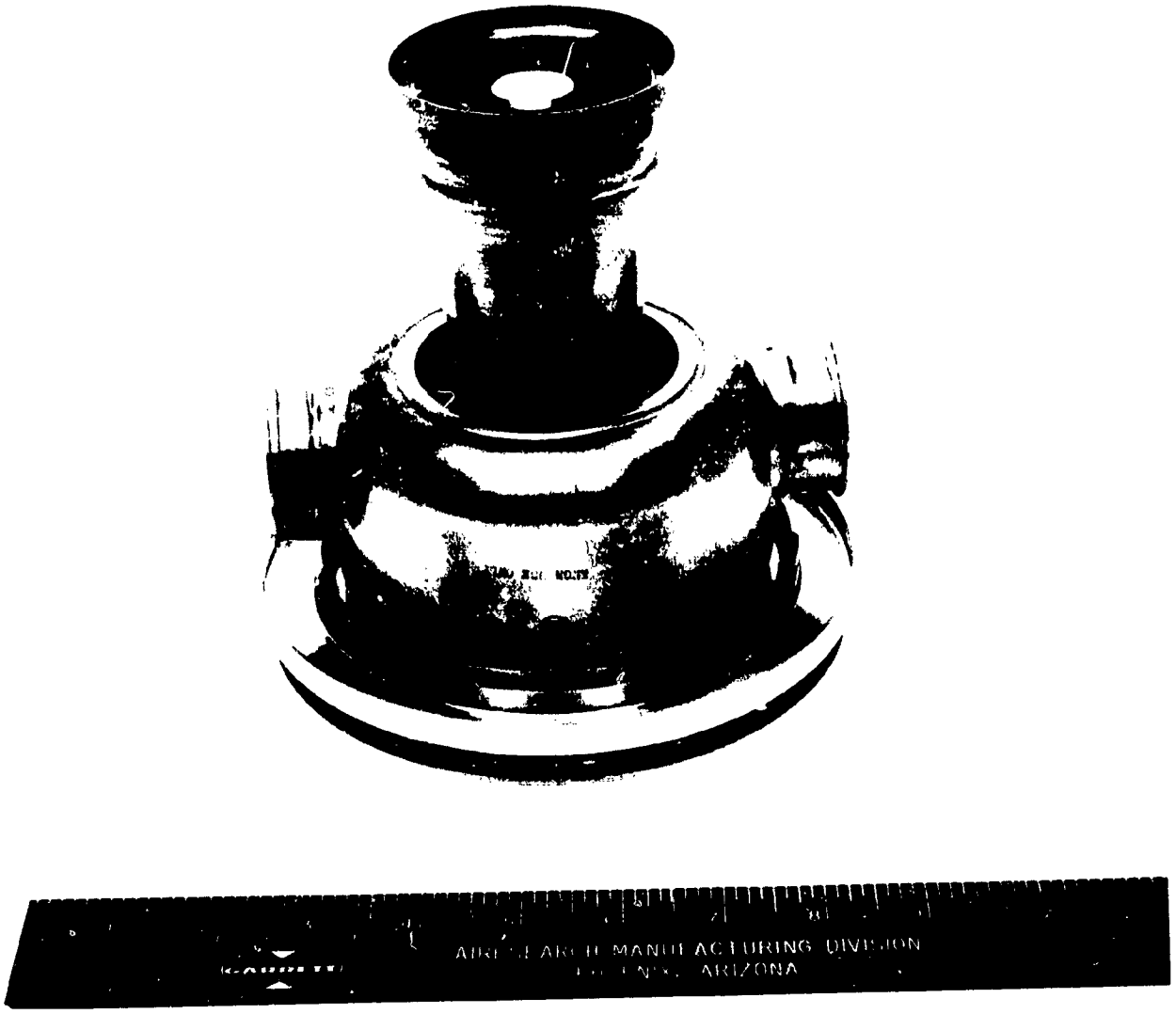


Figure 304. - Completed C-103 Plenum/Nozzle.

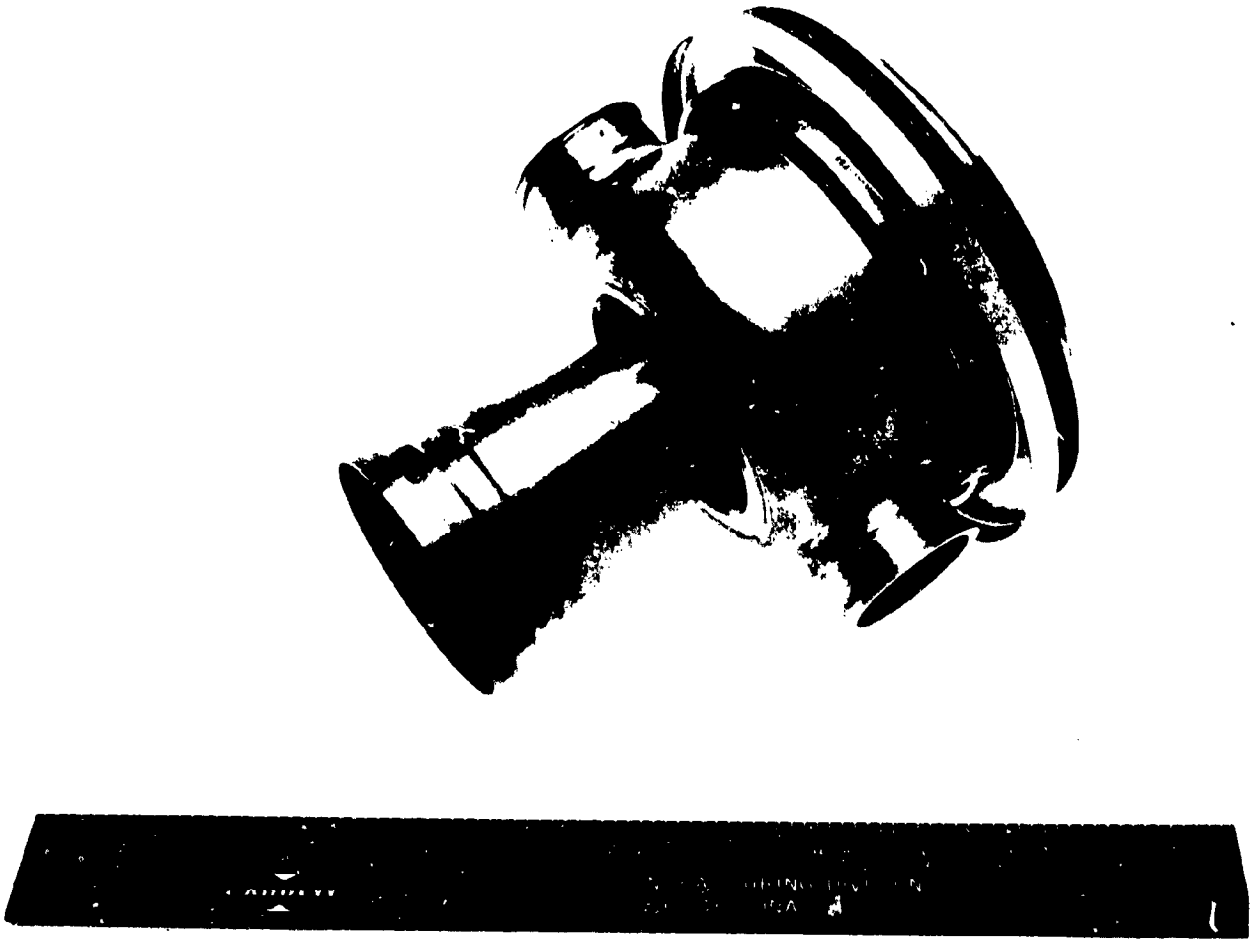


Figure 305. - Completed C-103 Plenum Nozzle Assembly.

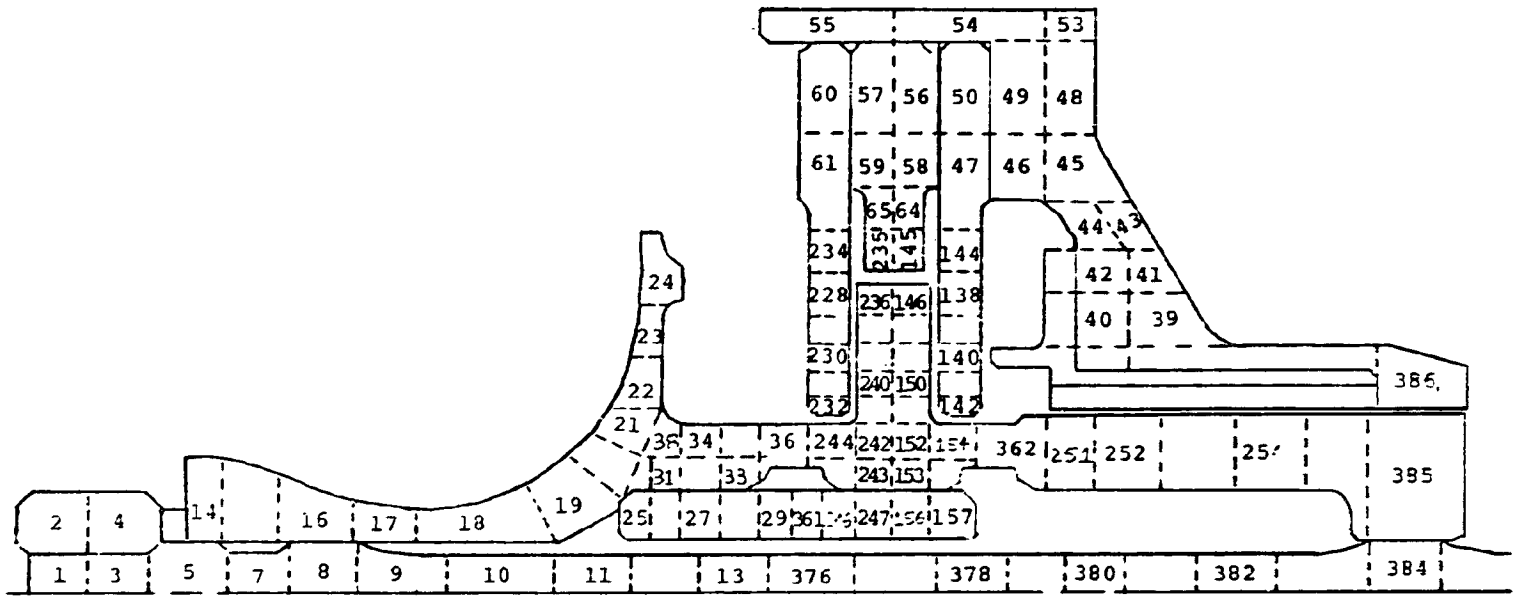


Figure 306. - Thermal Schematic of Model 1.

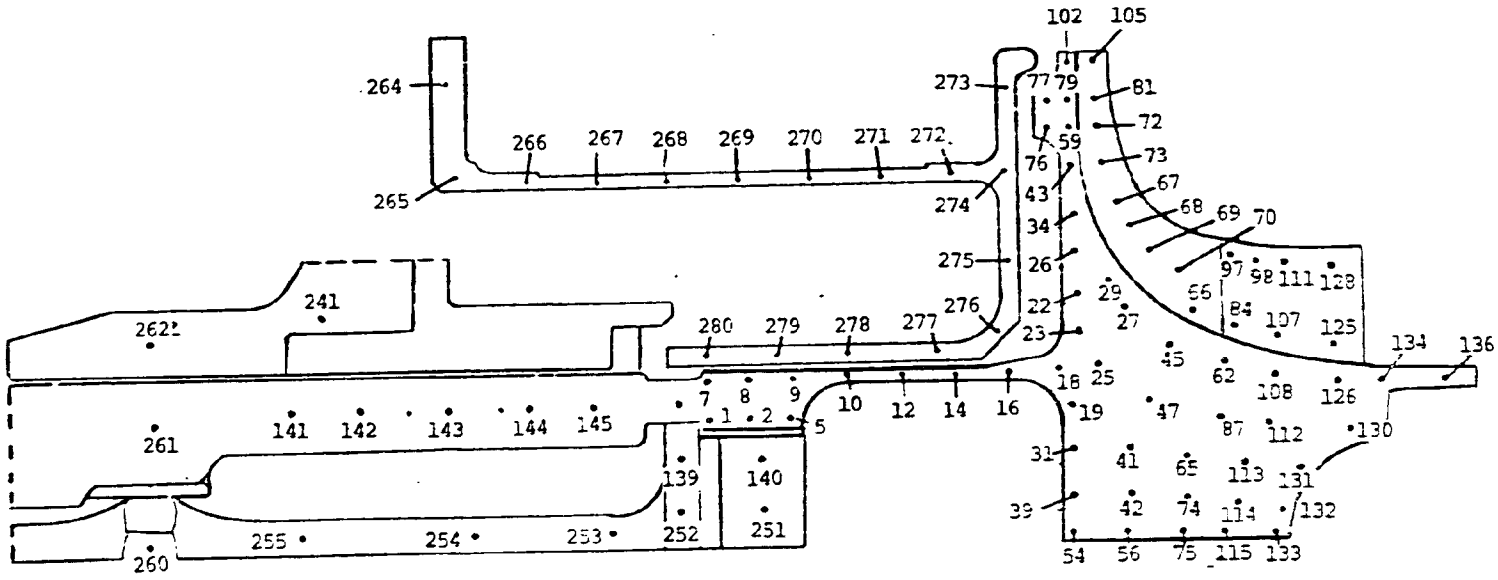


Figure 307. - Thermal Schematic of Model 2.

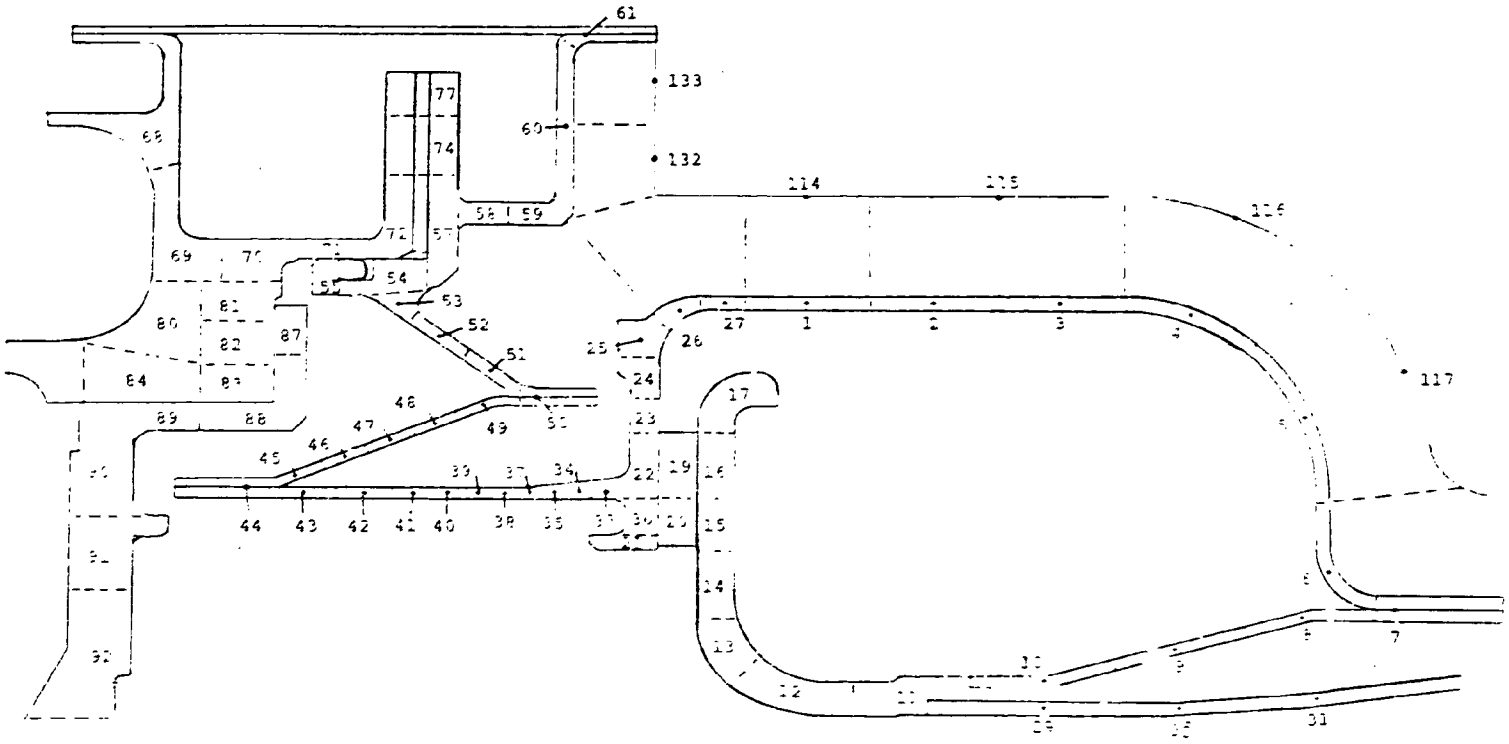
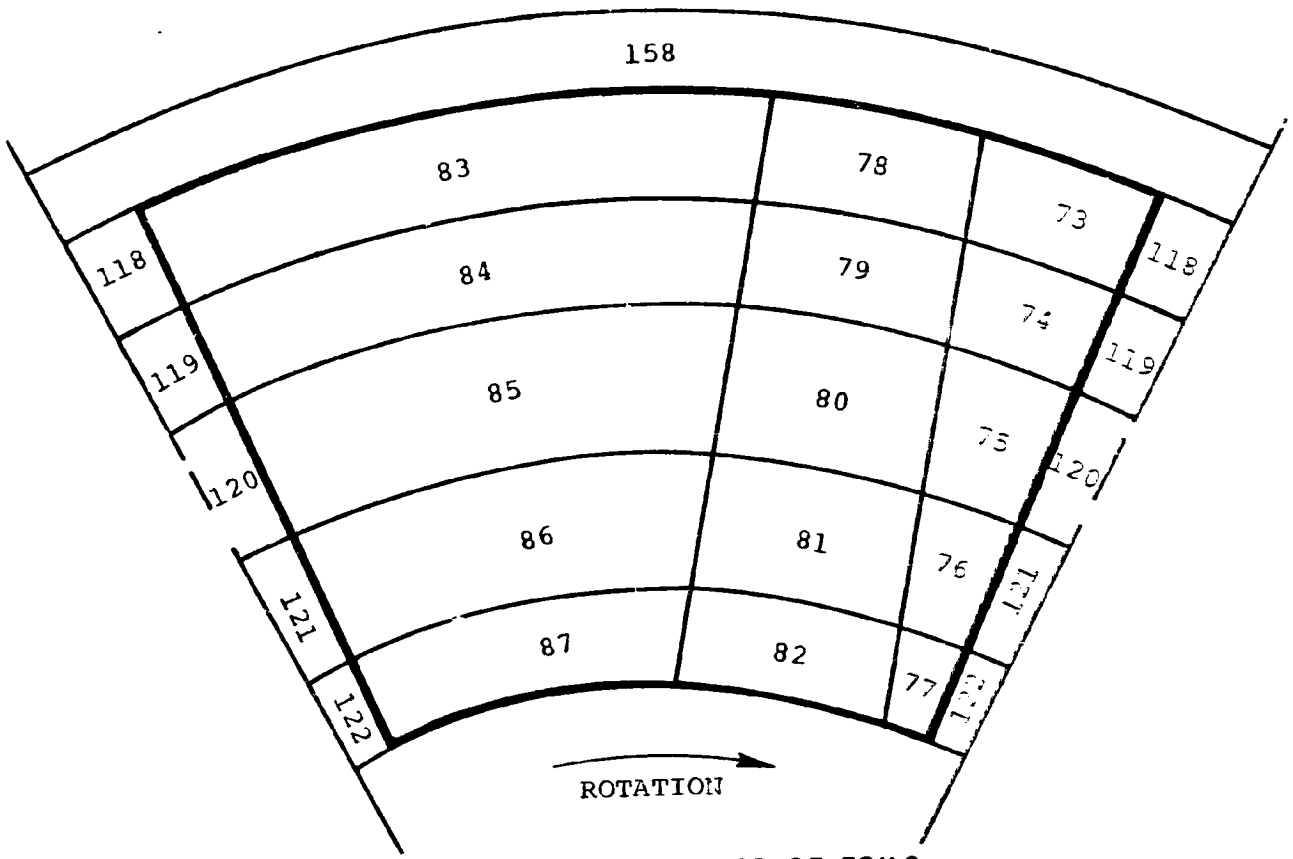


Figure 308. Thermal Schematic of Model 3.



(SHOWN WITHOUT SCALE IS ONE SECTOR OF FOILS FACING THE TURBINE SIDE OF THE THRUST RUNNER.)

Figure 309. - Thermal Schematic - Thrust Pad.

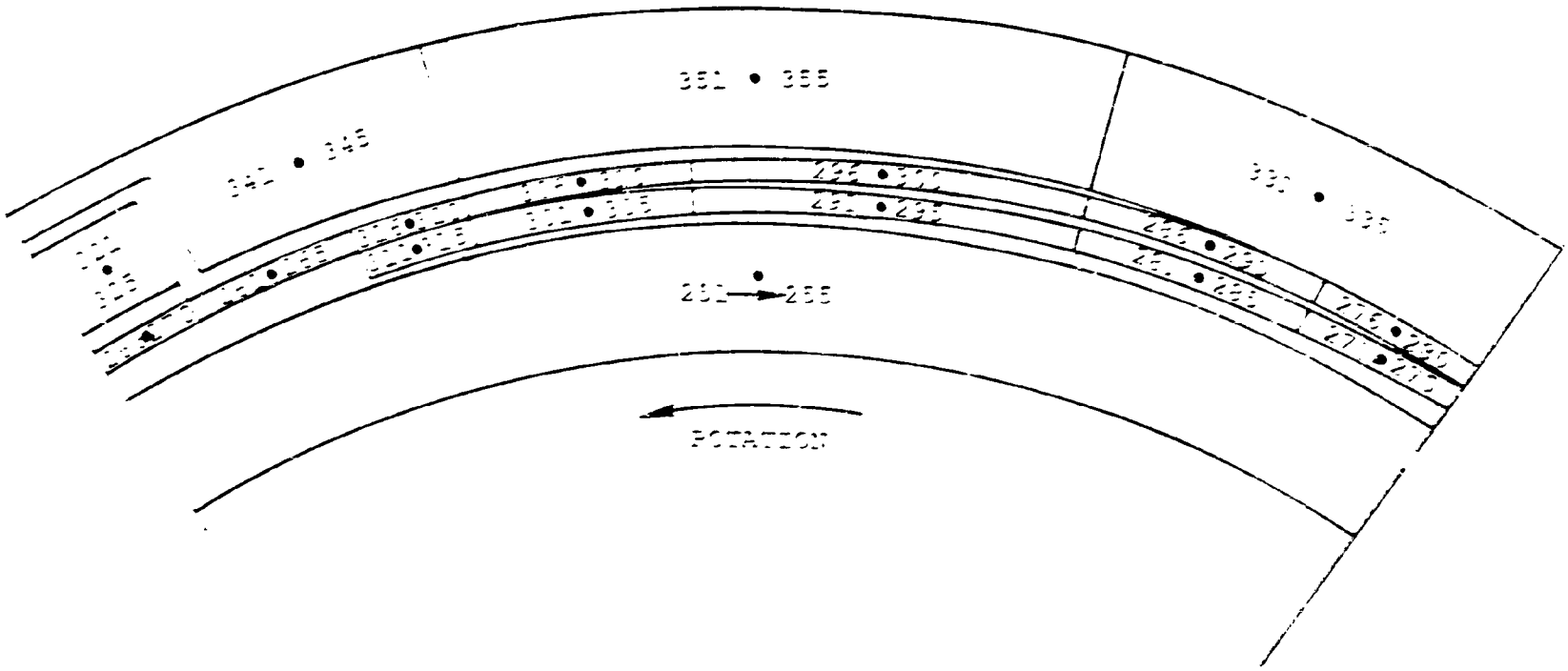


Figure 111. - Compressor - End Journal Bearing Schematic

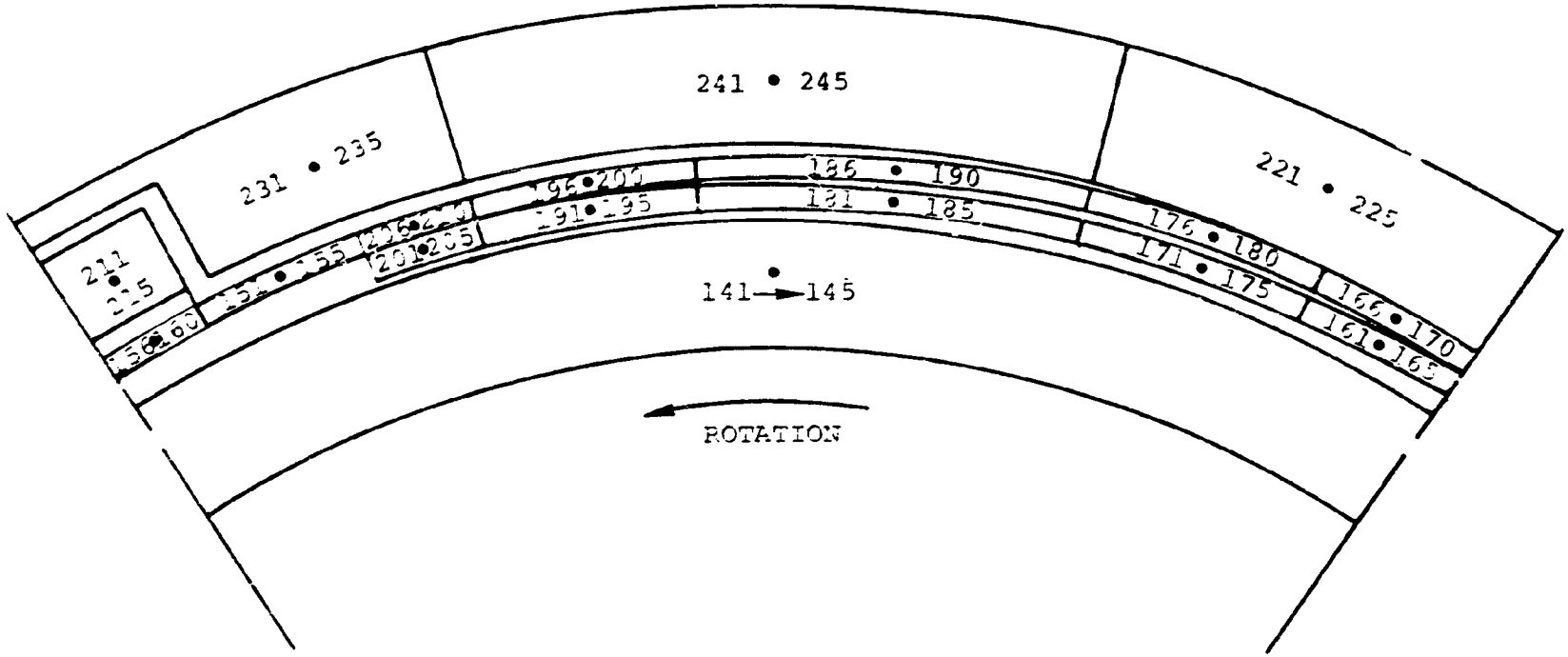
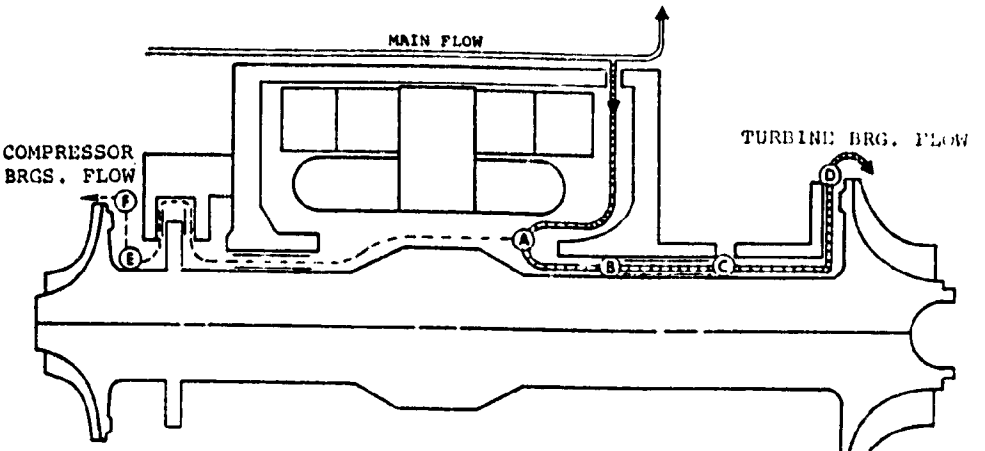


Figure 311. - Turbine - End Journal Bearing Schematic.



Gas Temperatures (°F)

	A	B	C	D	E	F
HIGH POWER	326	370	402	1214	295	260
LOW POWER	320	411	473	1133	260	234

Gas Pressures (psia)

	A	B	C	D	E	F
HIGH POWER	87.87	---	85.84	88.62	87.27	91.05
LOW POWER	17.565	---	16.047	16.592	17.50	18.30

Gas Flows (percent of main)	Turbine Brg.		Compressor Brgs.	
	HIGH	LOW	HIGH	LOW
Design Point (full turbine wheel)	2.06	2.00	0.12	0
Design Bearing and Bleed Ports, Scalloped Turbine Wheel, 1.2R	3.06	2.38	0.78	0.26
Modified Bearing, Design Bleed Ports, Scalloped Turbine Wheel, 1.2R	2.76	2.0	0.51	0
Design Bearing, Modified Bleed Ports Scalloped Turbine Wheel, 1.2R	2.74	2.0	-1.11	-0.45

Figure 312. Cooling Flow Diagram.

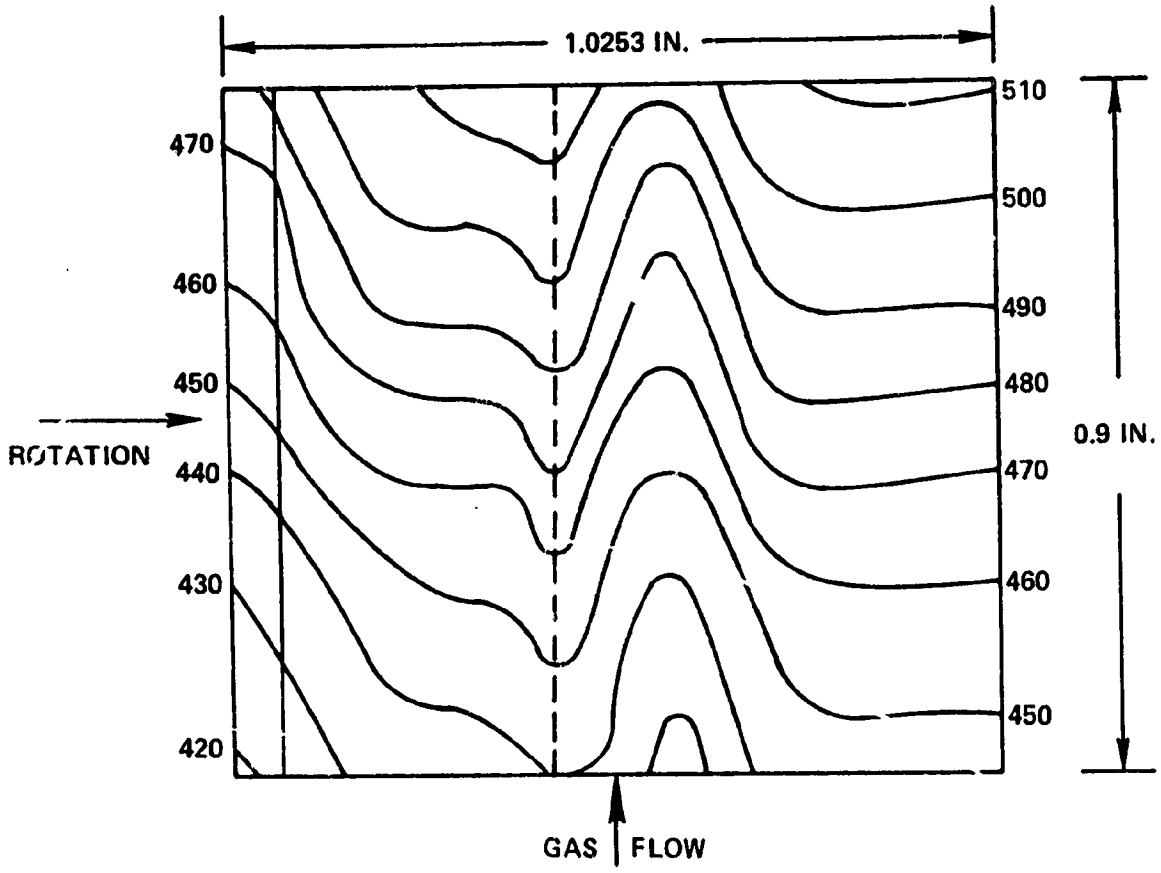


Figure 313. - Turbine - End Foil Bearing Isothermal Diagram of Unwrapped Foil Lower Power Level.

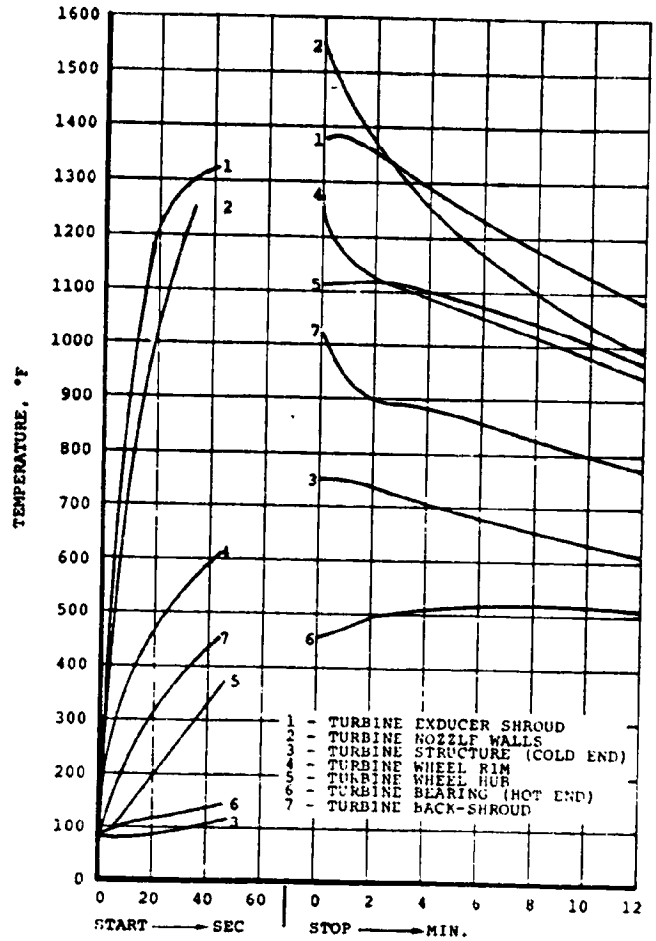


Figure 314. - Transient Metal Temperatures
Sudden Start and Stop at Maximum Power.

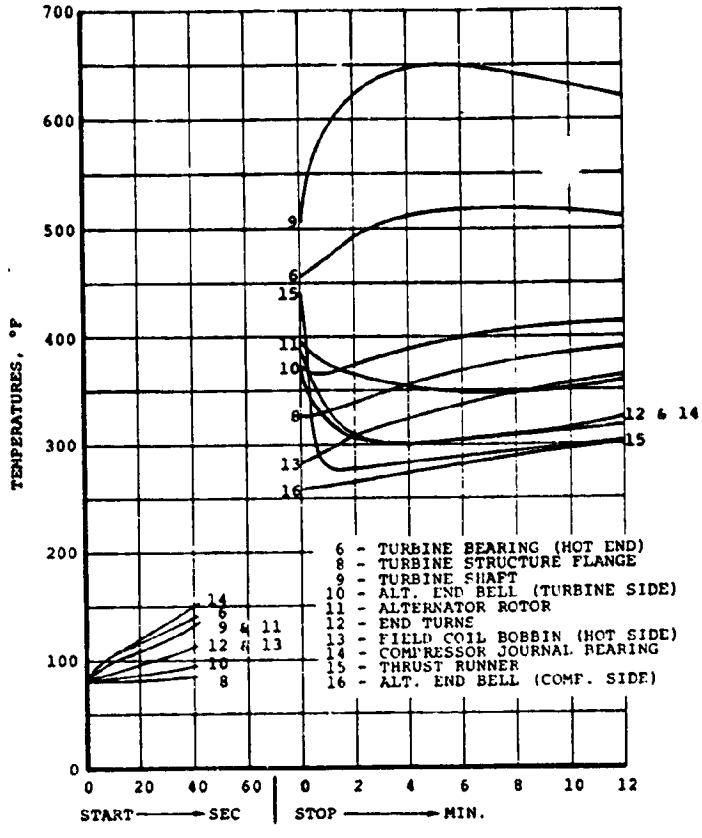


Figure 315. - Transient Metal Temperatures Sudden Start and Stop at Maximum Power.

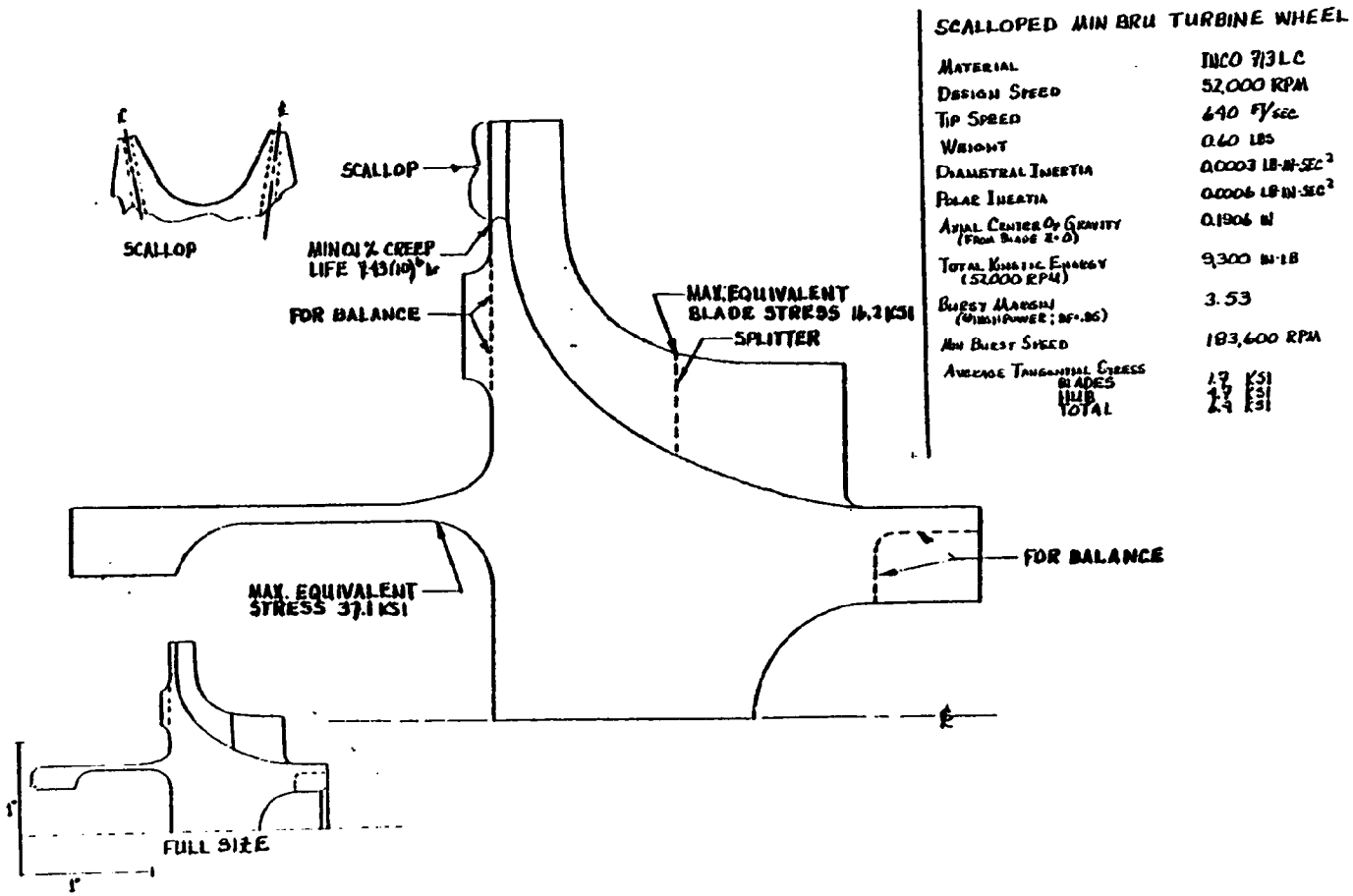


Figure 316. - Turbine Wheel Stress and Life Information For High Power Condition.

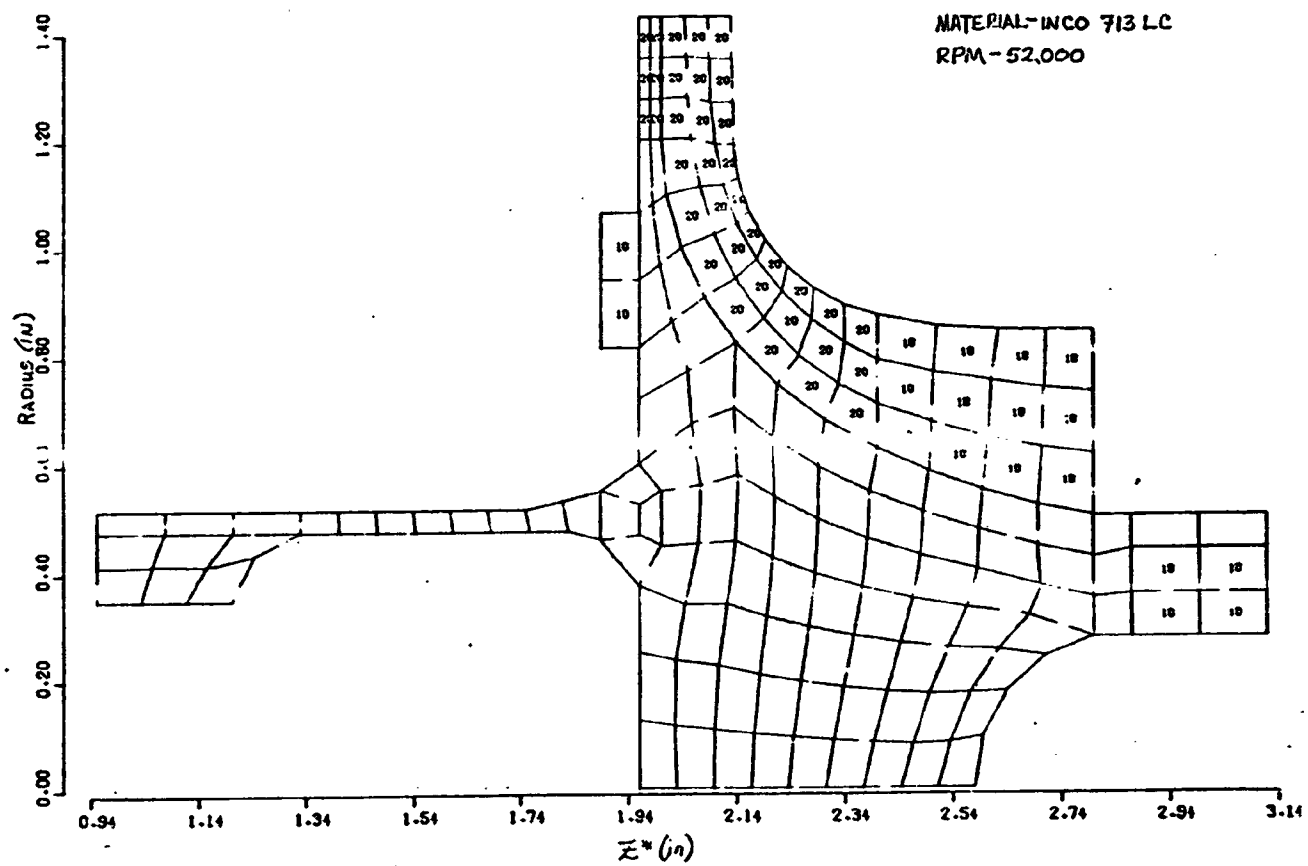


Figure 317. - Mini-BRU Scalloped Stress Model.

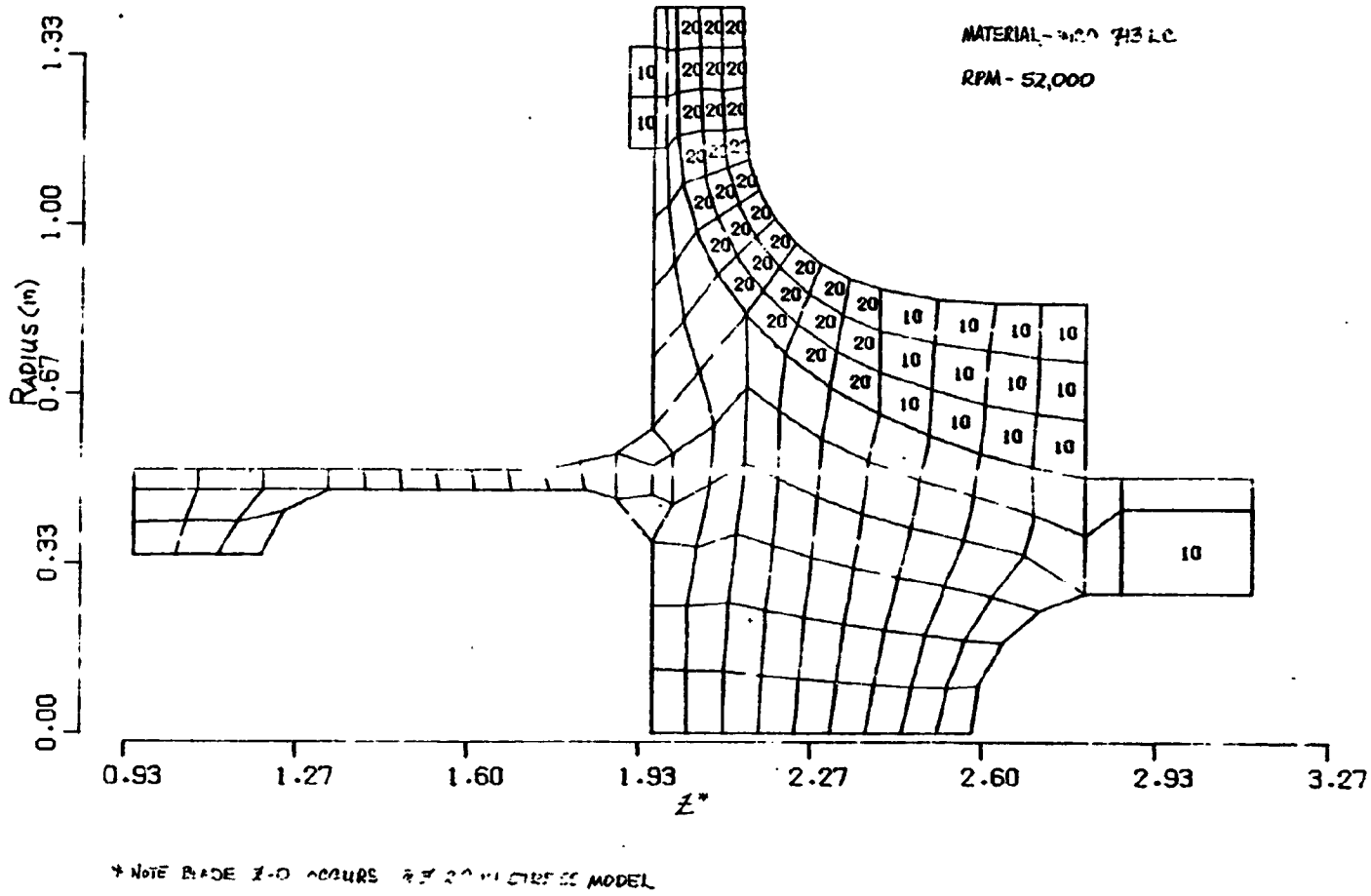


Figure 318. - Mini-BRU Unscalloped Turbine Wheel Stress Model.

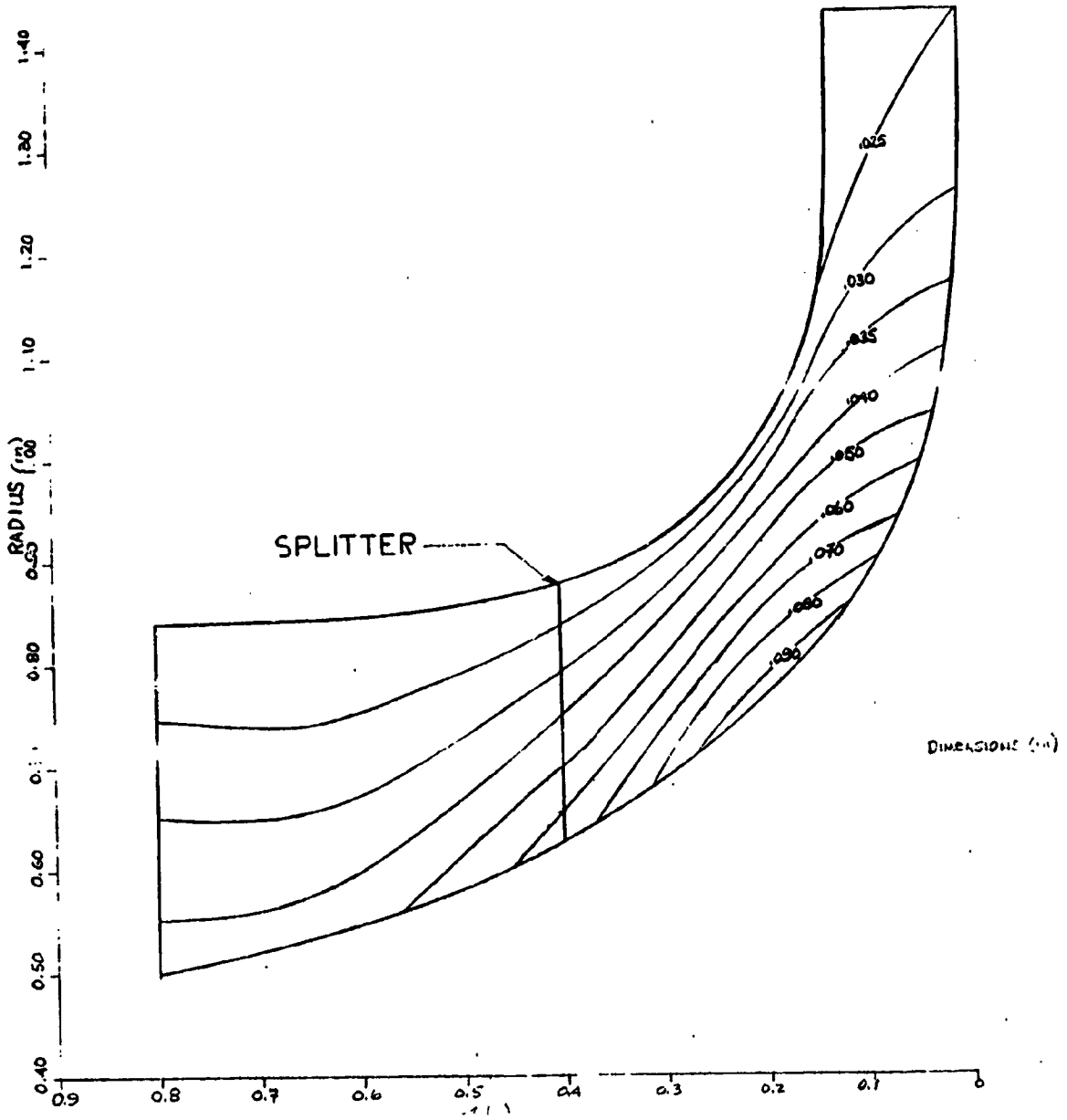


Figure 319. - Mini-BRU Turbine Blade Normal Thickness.

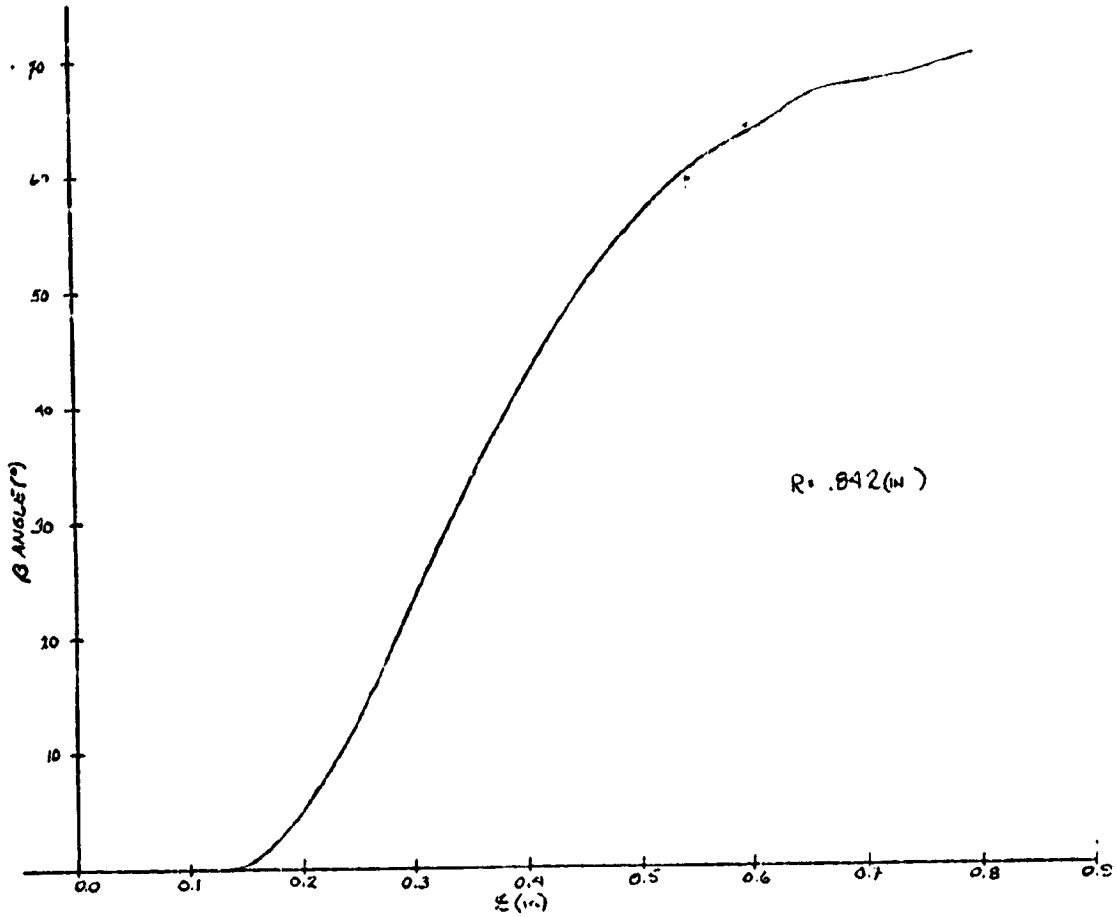


Figure 320. - Mini-BRU Blade Angle.

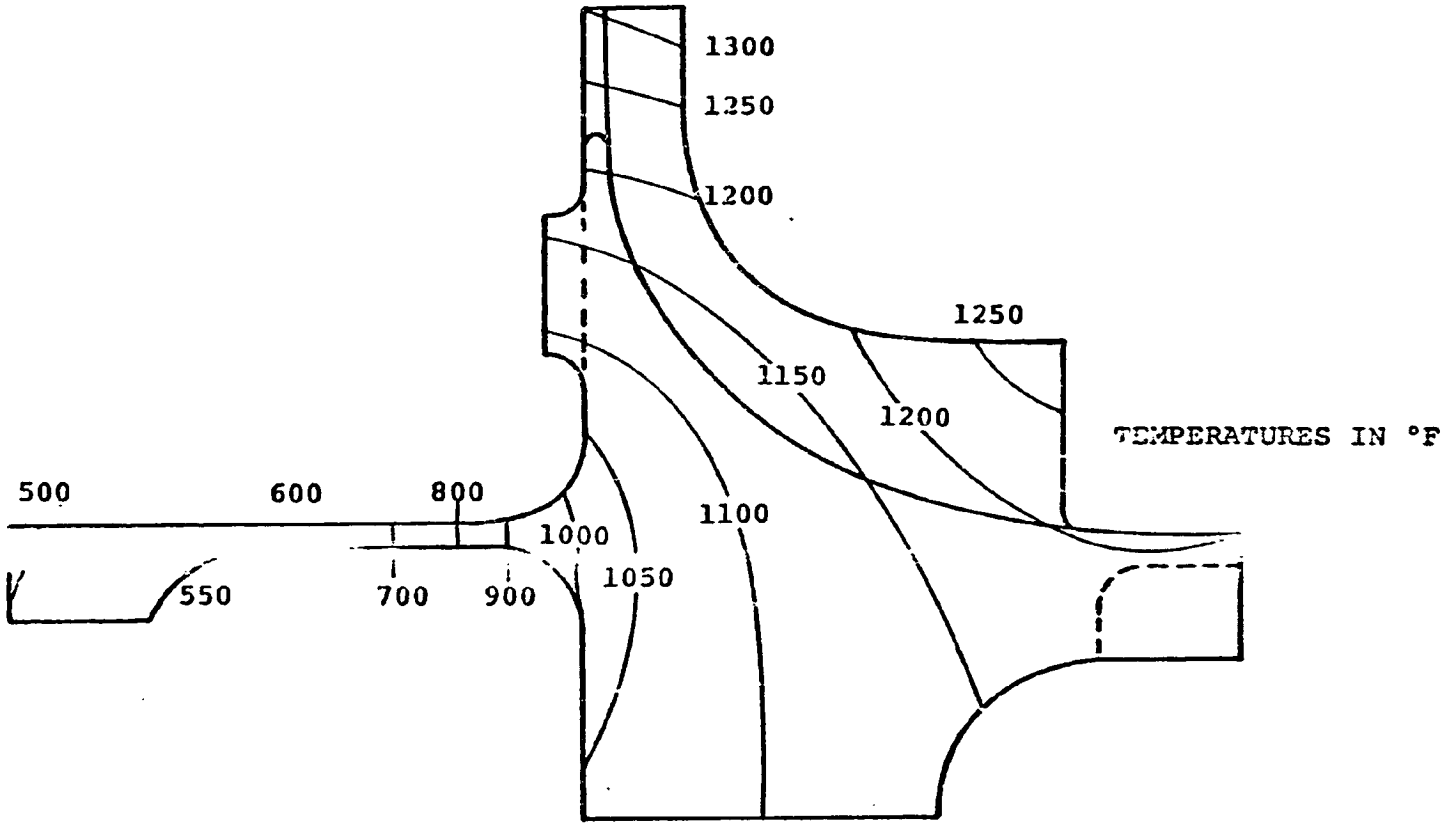


Figure 321. - Turbine Steady-State Temperature Distribution at High Power Condition, T_4 = 1600°F.

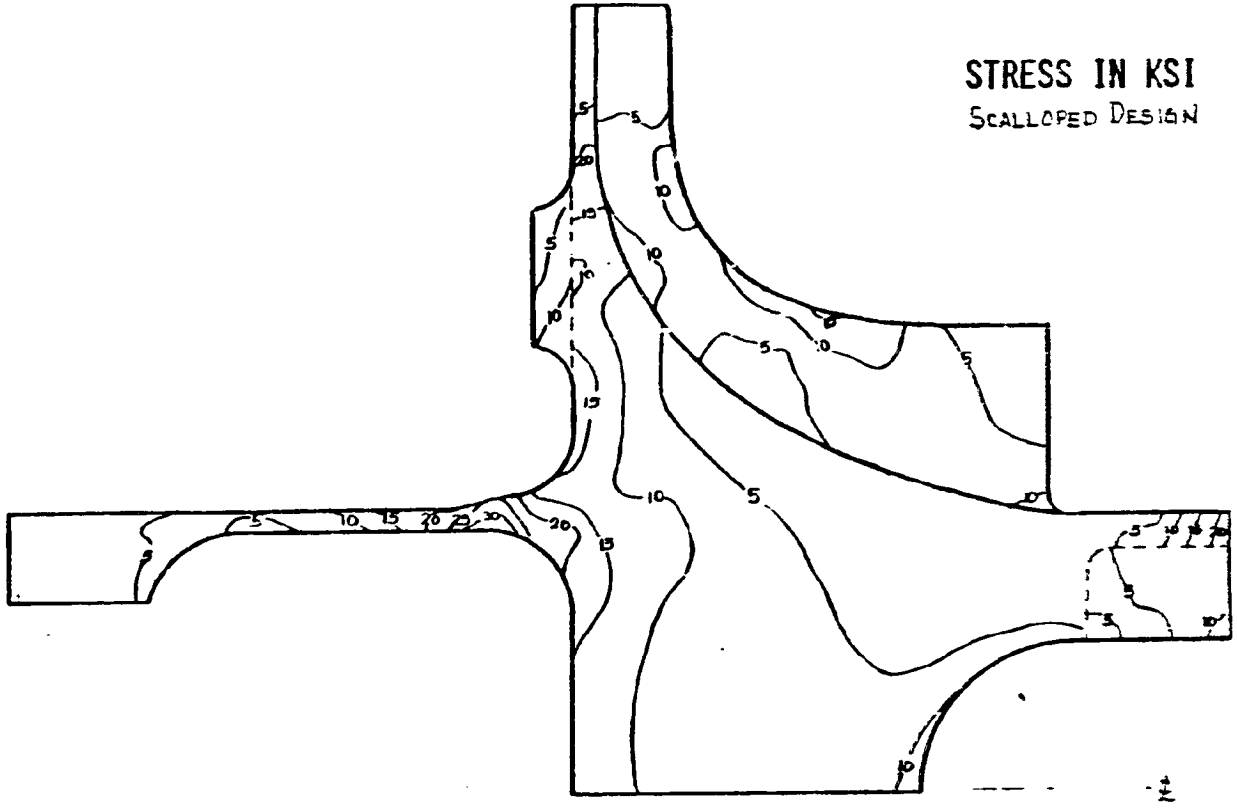


Figure 322. - Turbine Equivalent Stress Distribution at High Power Condition.

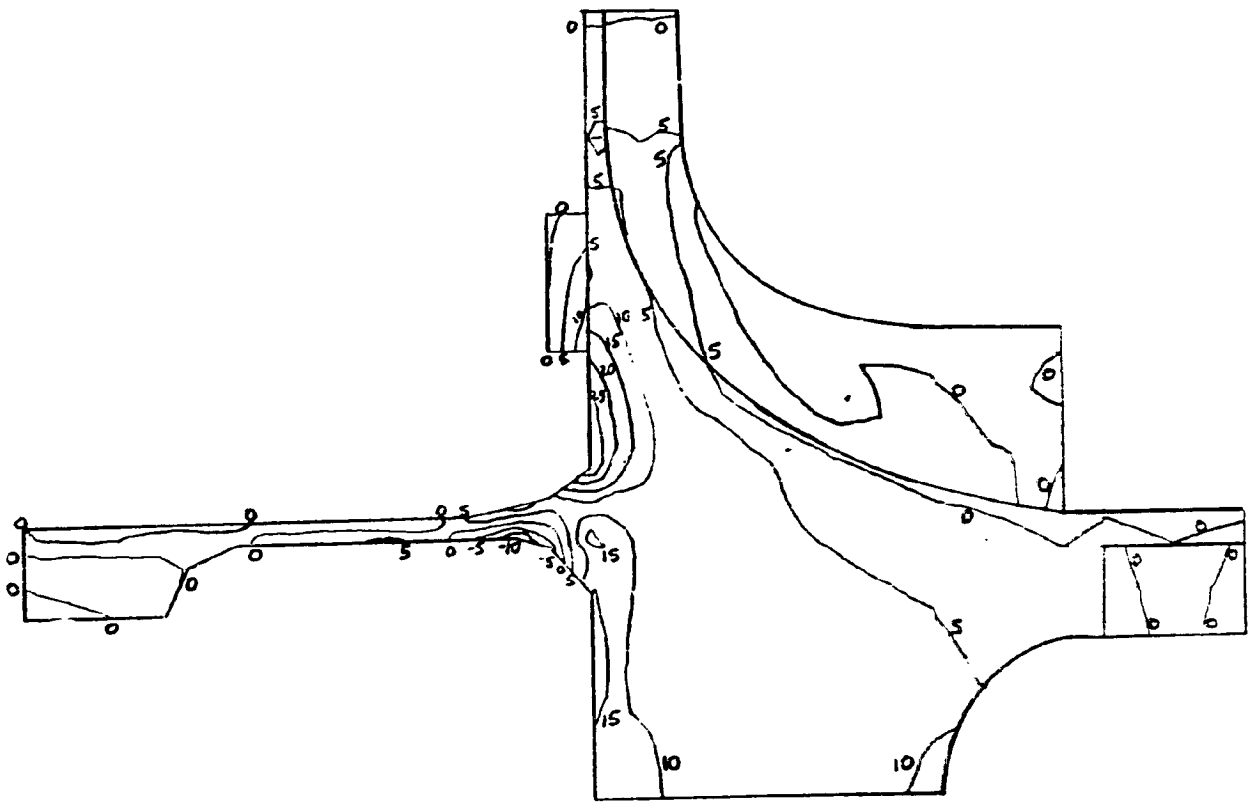


Figure 323. - Mini-BRU Radial Stresses Steady-State High Power Scalloped Wheel.

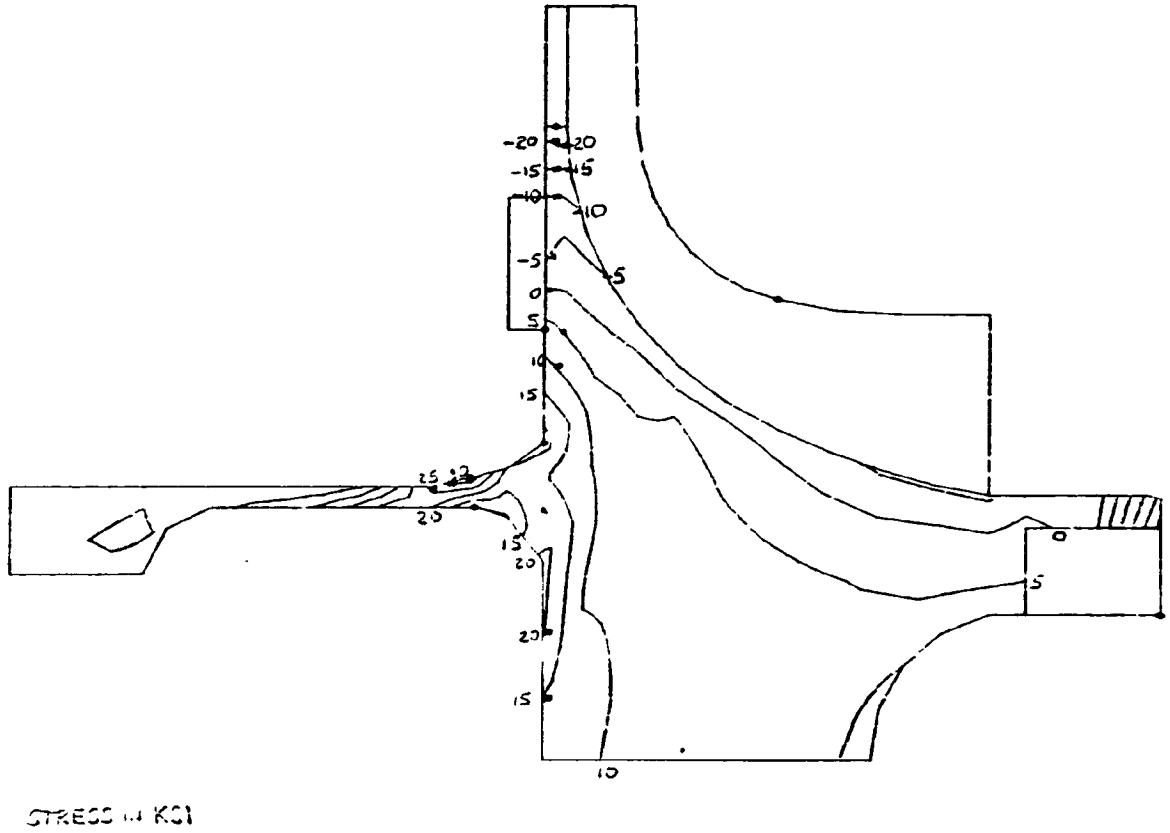


Figure 324. - Mini BRU Steady-State High Power Tangential Stresses Scalloped.

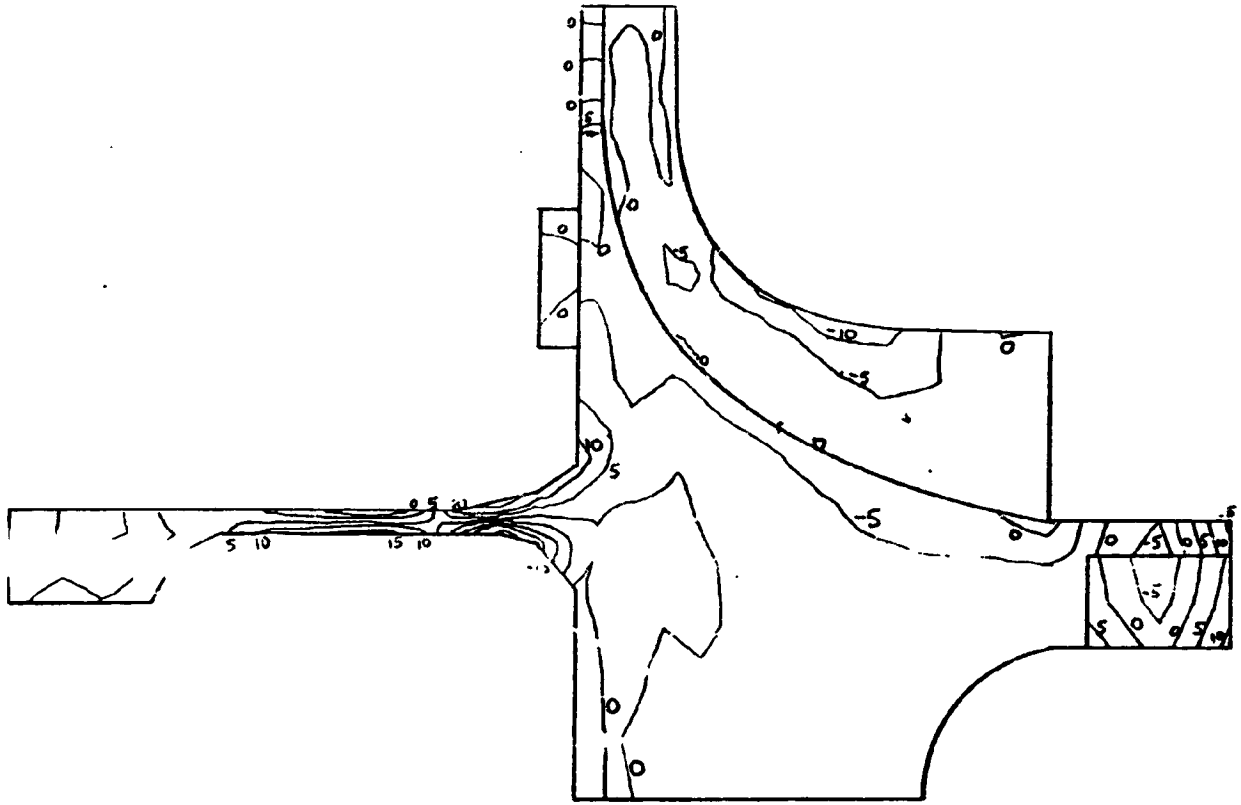


Figure 325. - Mini-BRU High Power Steady-State, Axial Stresses Scalloped Wheel.

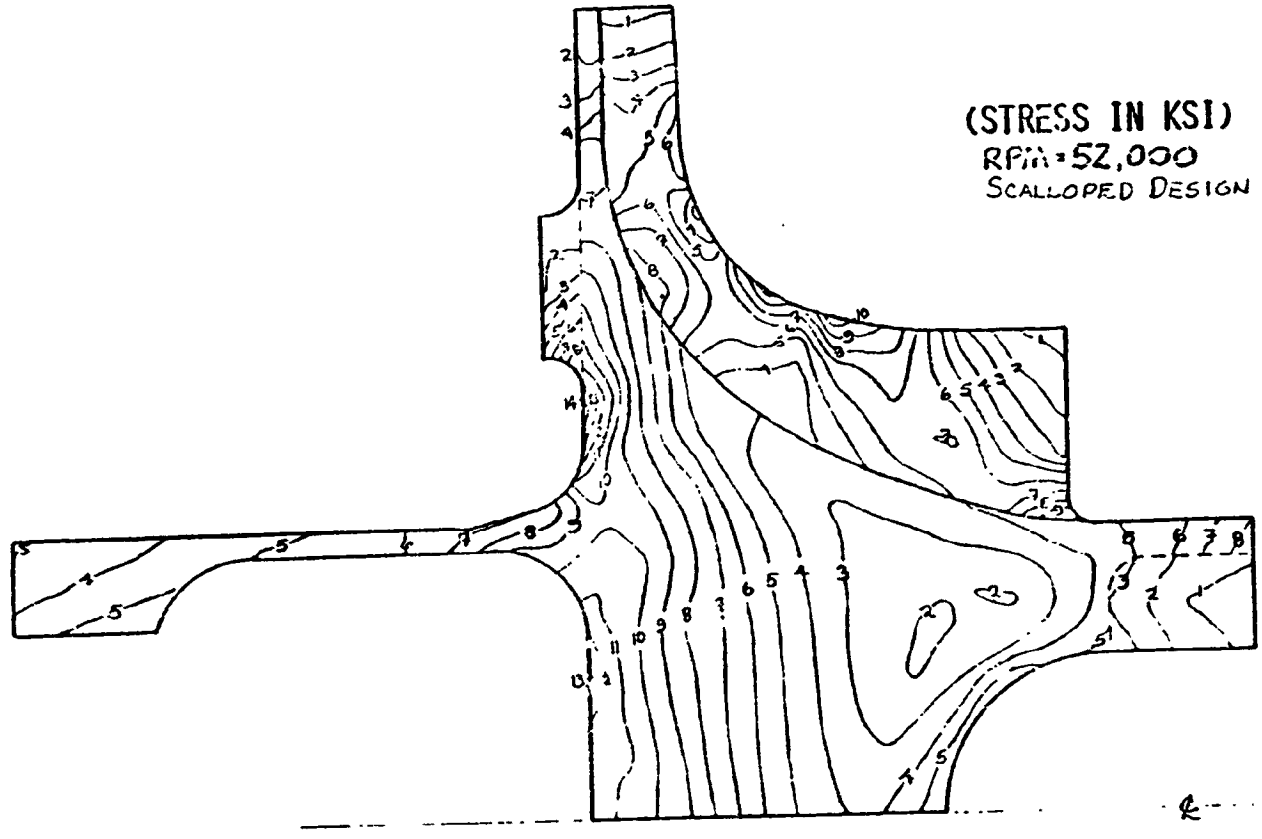


Figure 326. - Turbine Equivalent Stress Distribution at Room Temperature.

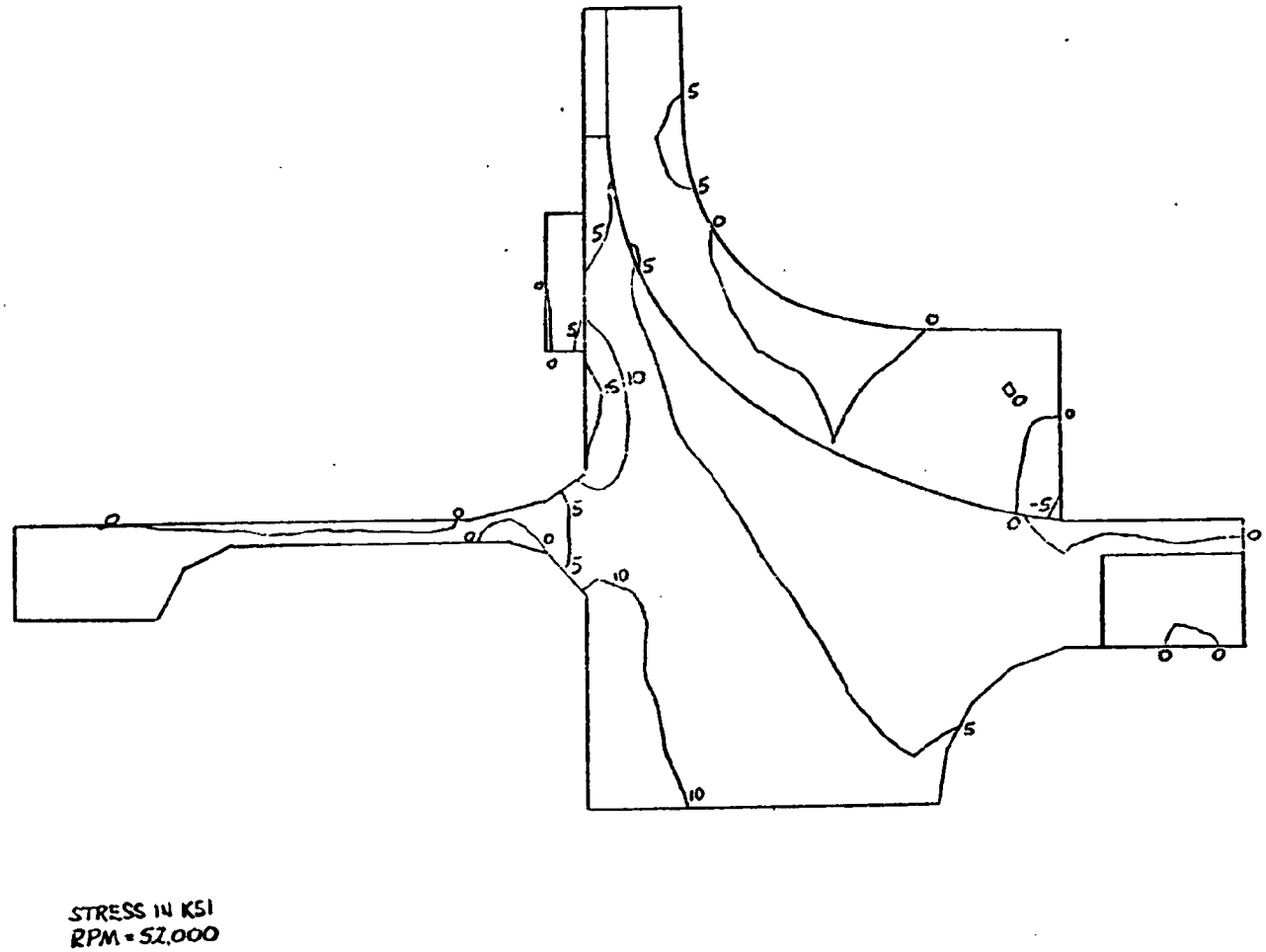


Figure 327. - Mini-BRU Radial Stresses 70°F Scalloped.

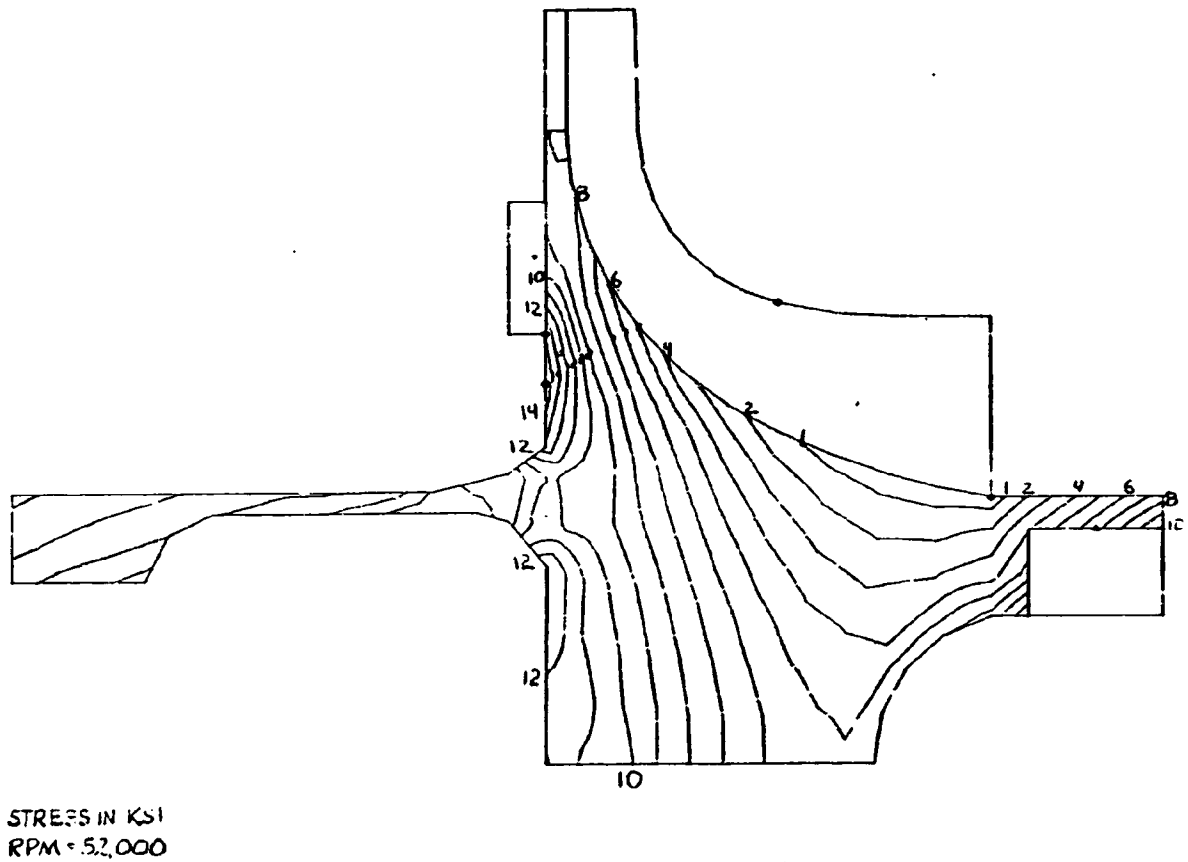


Figure 328. - Mini-BRU Scalloped 70°F Tangential Stresses.

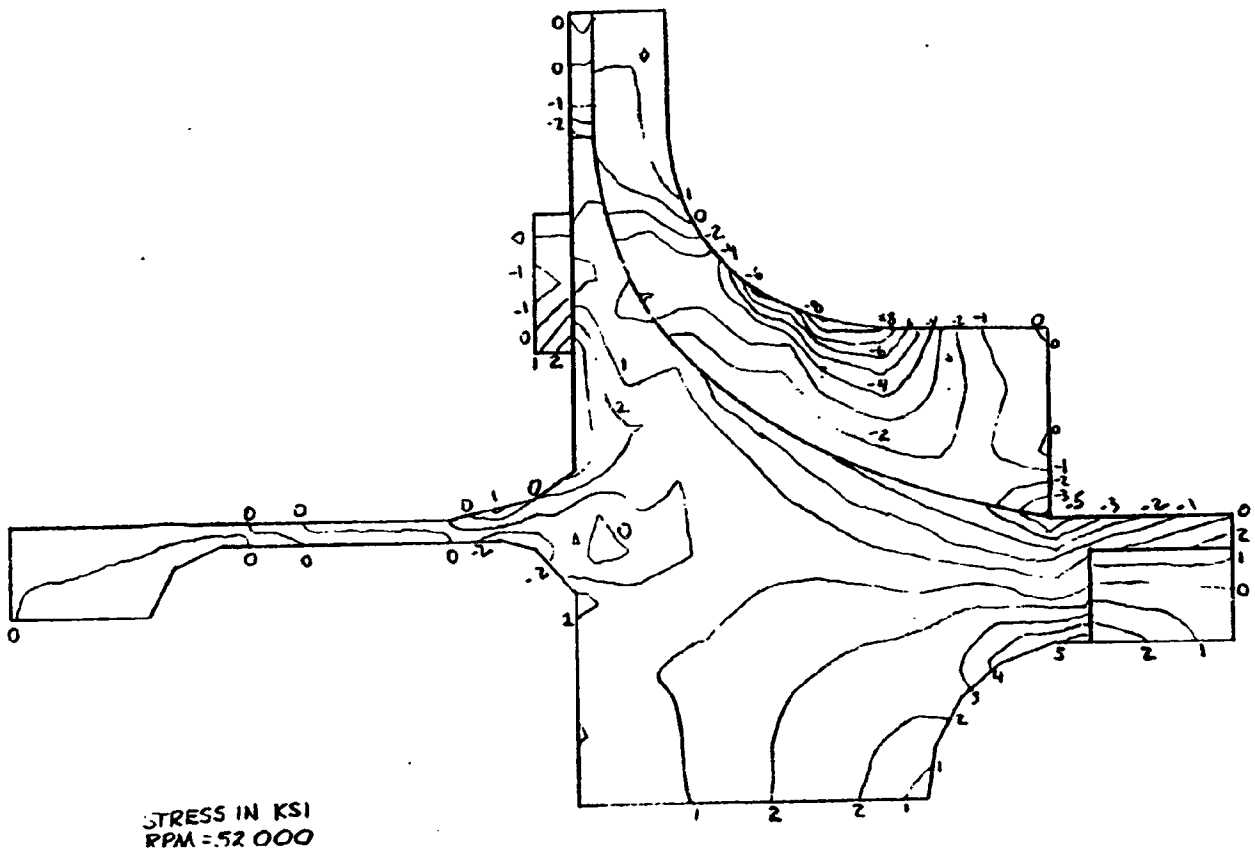
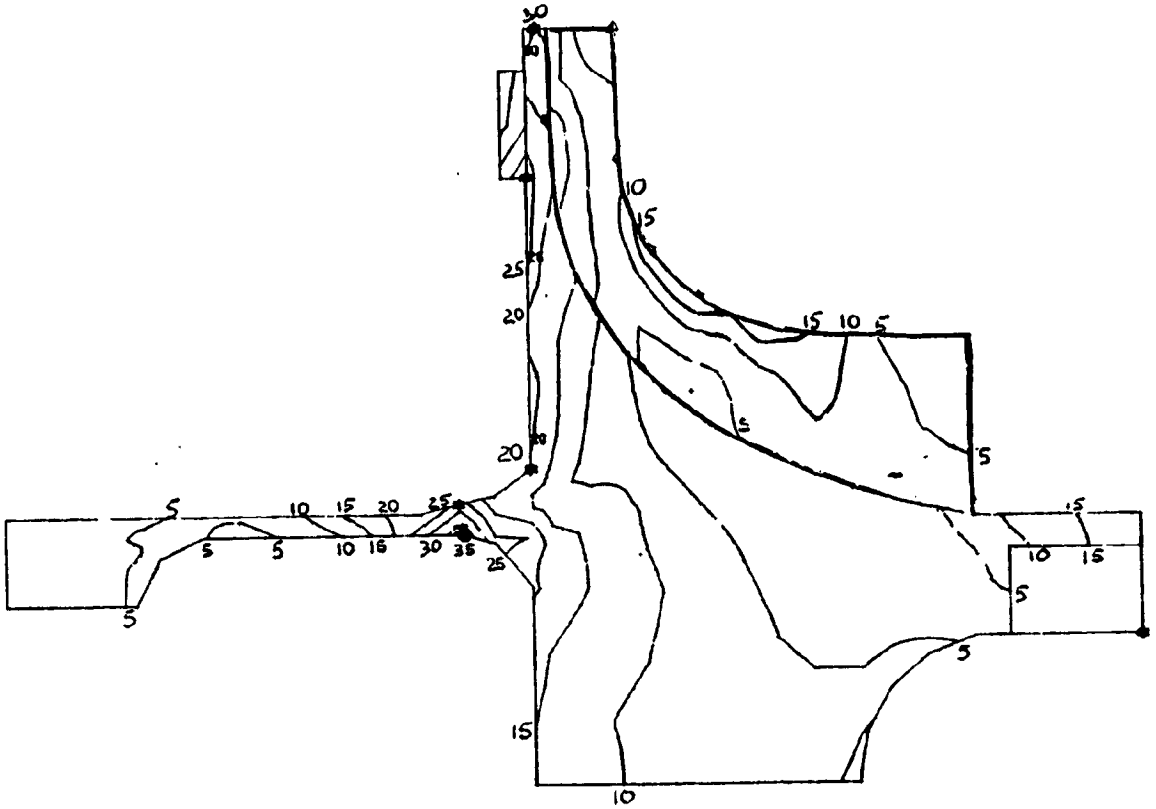


Figure 329. - Mini-BRU Axial Stresses 70°F Scalloped.



STRESS IN KSI

Figure 330. - Mini-BRU Unscalloped
High Power Equivalent Stresses.

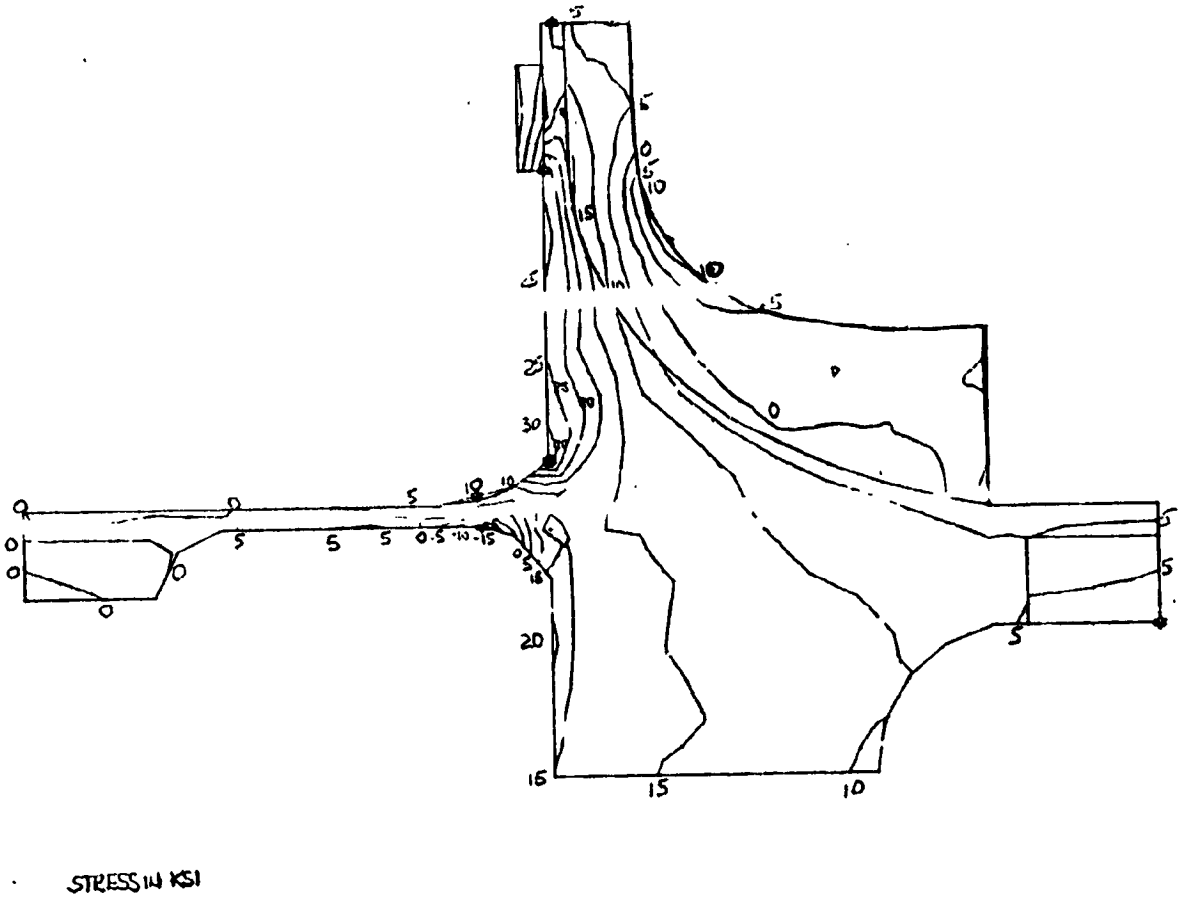


Figure 331. - Mini-BRU Unscalloped High Power Radial Stresses.

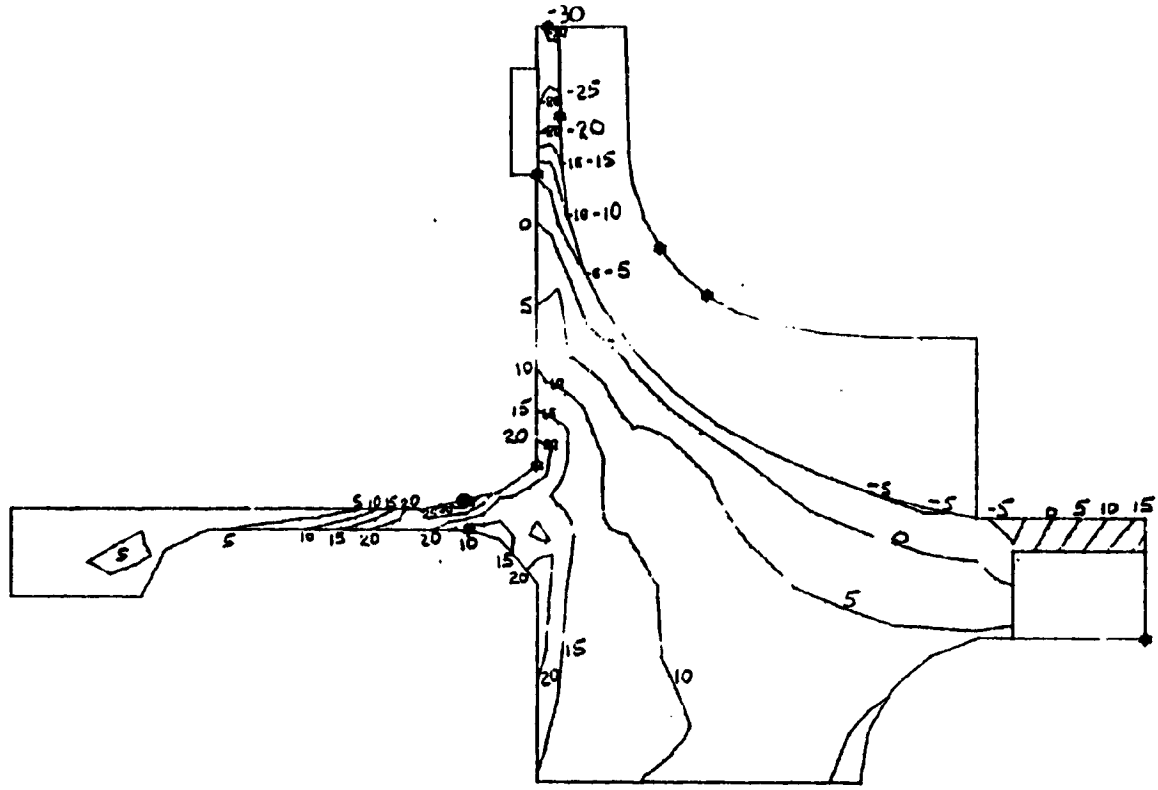
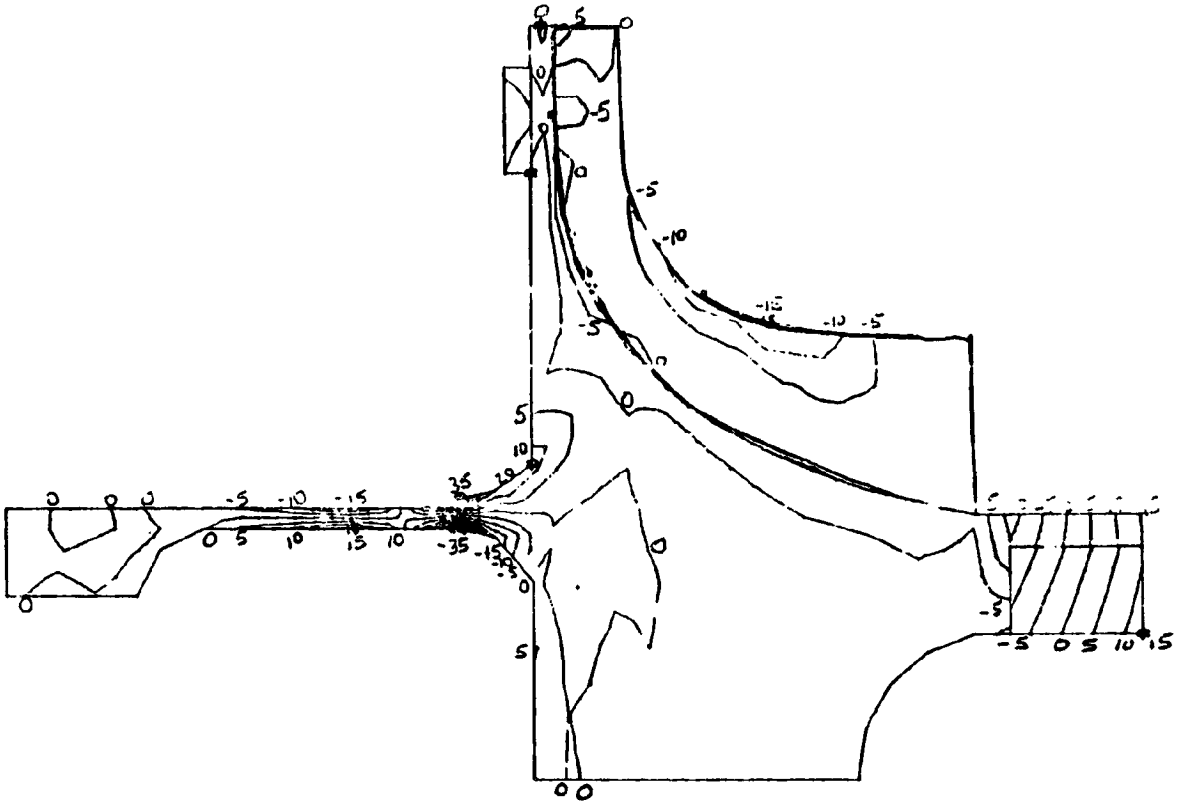
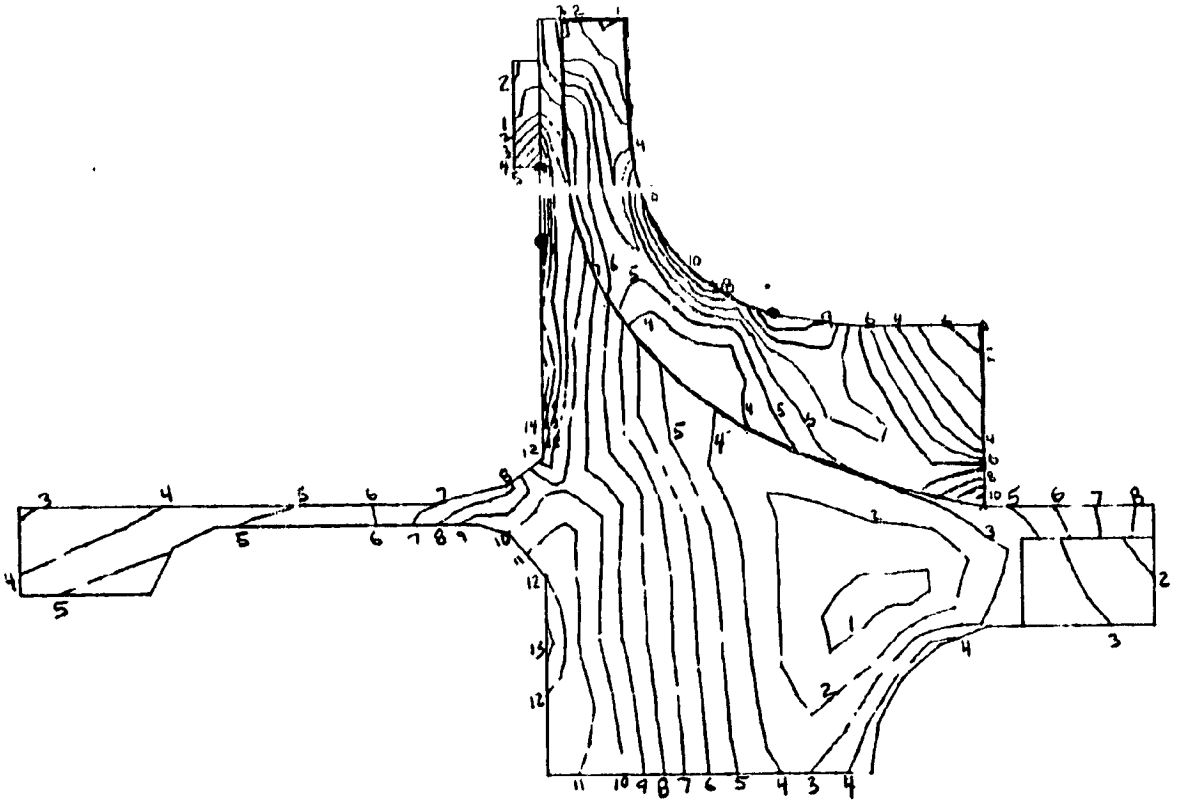


Figure 332. - Mini-BRU Unscalloped High Power Tangential Stresses.



STRESS IN KSI

Figure 333. - Mini-BRU Unscalloped High Power Axial Stresses.



STRESS IN KSI
RPM: 52,000

Figure 334. - Mini-BRU Unscalloped
T = 70°F Equivalent Stresses.

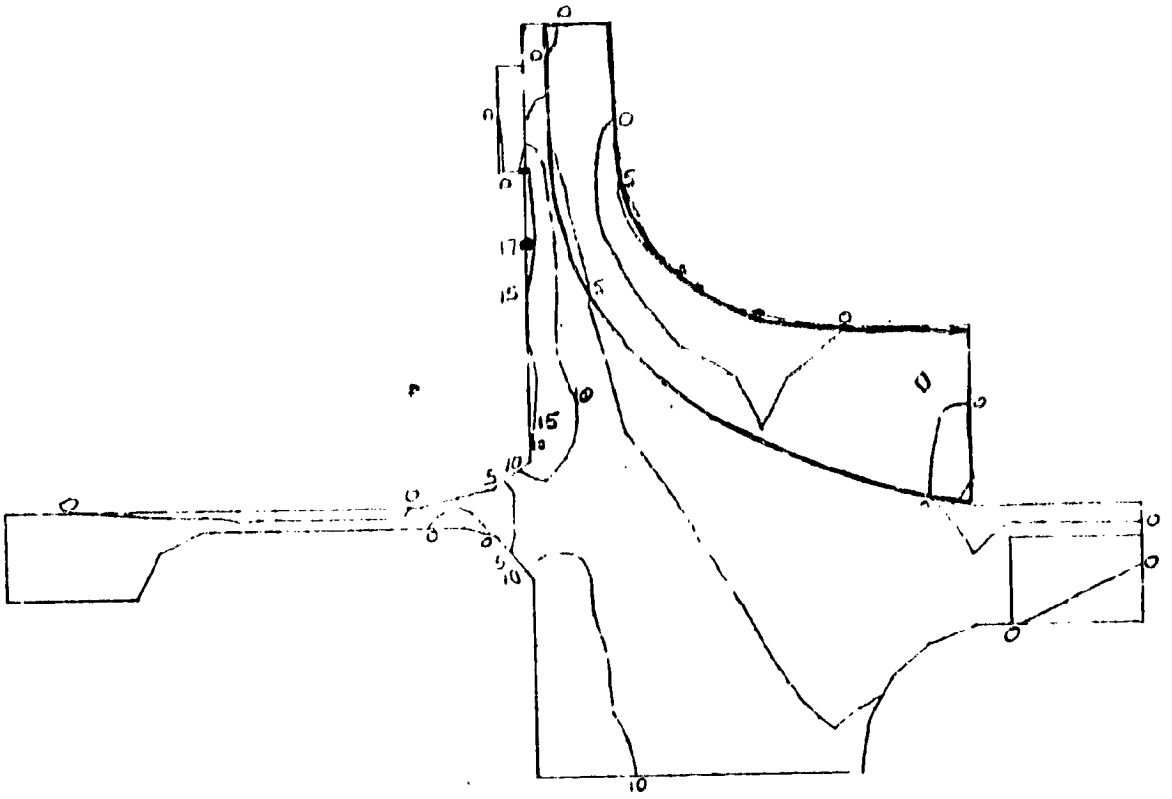
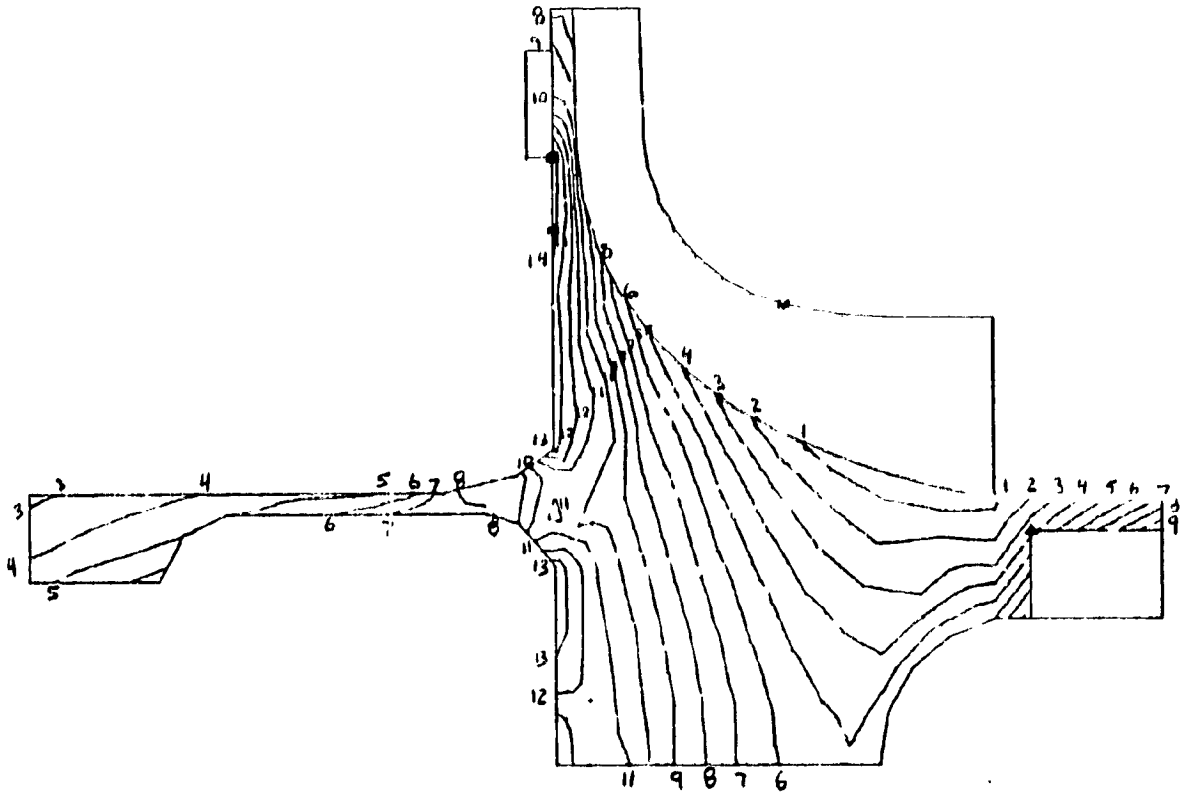
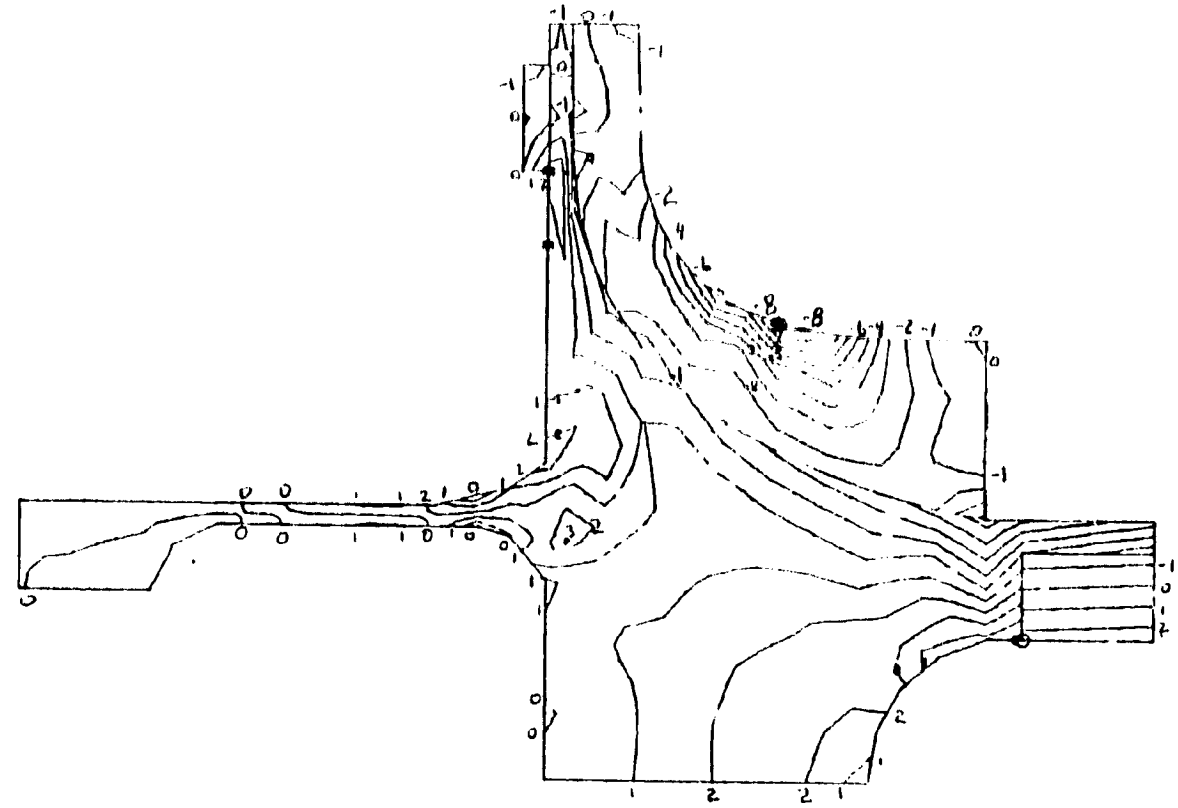


Figure 335. - Mini-BRU Unscalloped
T = 70°F Radial Stresses.



STRESS IN KSI
RPM = 52,000

Figure 336. - Mini-BRU Unscalloped
T = 70°F Tangential Stresses (ksi).



STRESS IN KSI
RPM = 52,000

Figure 337. - Mini-BRU Unscalloped
T = 70°F Axial Stresses (ksi).

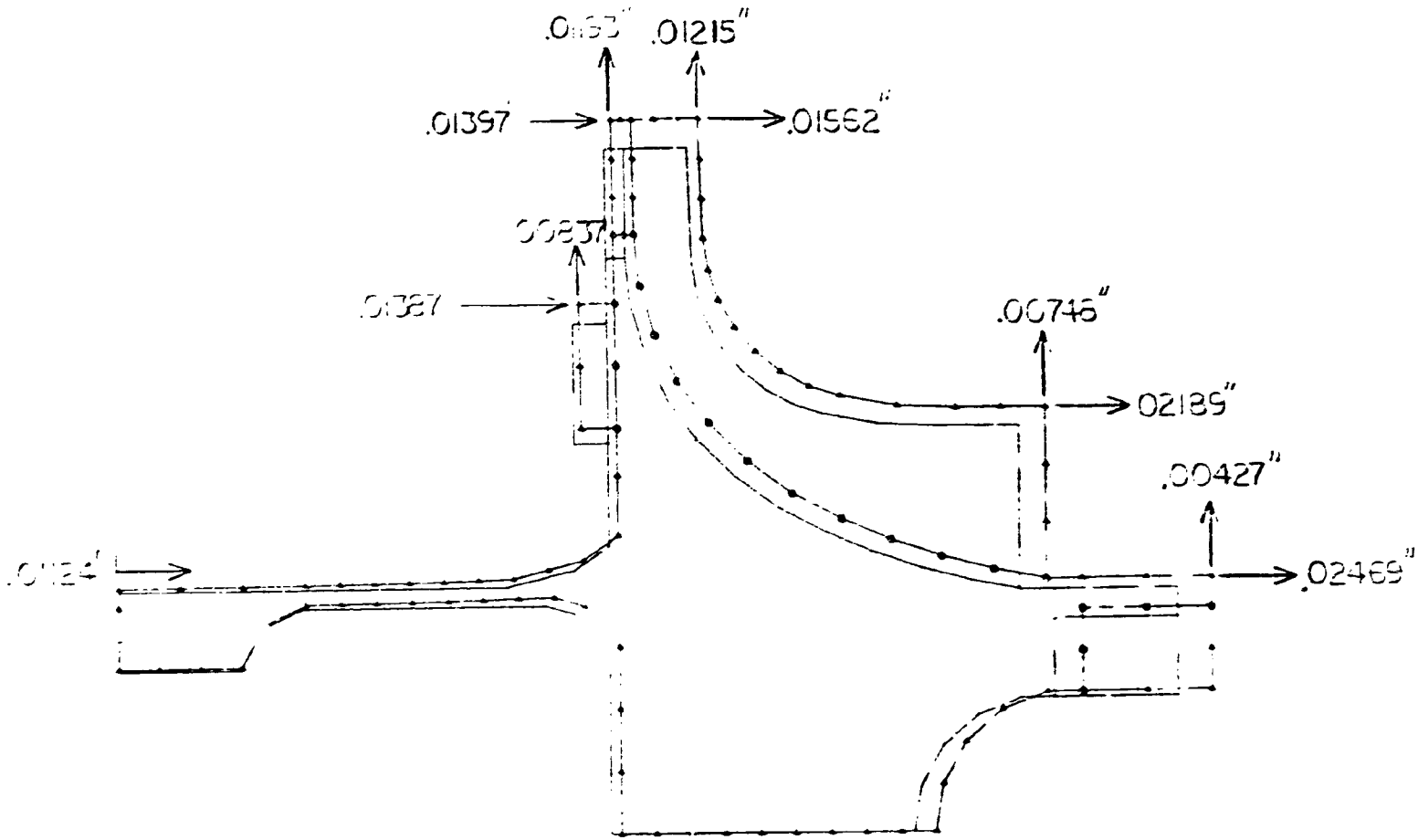


Figure 338. - Mini-BPU Turbine Displacements Relative to the Thrust Runner at Higher Power Condition Scalloped Design.

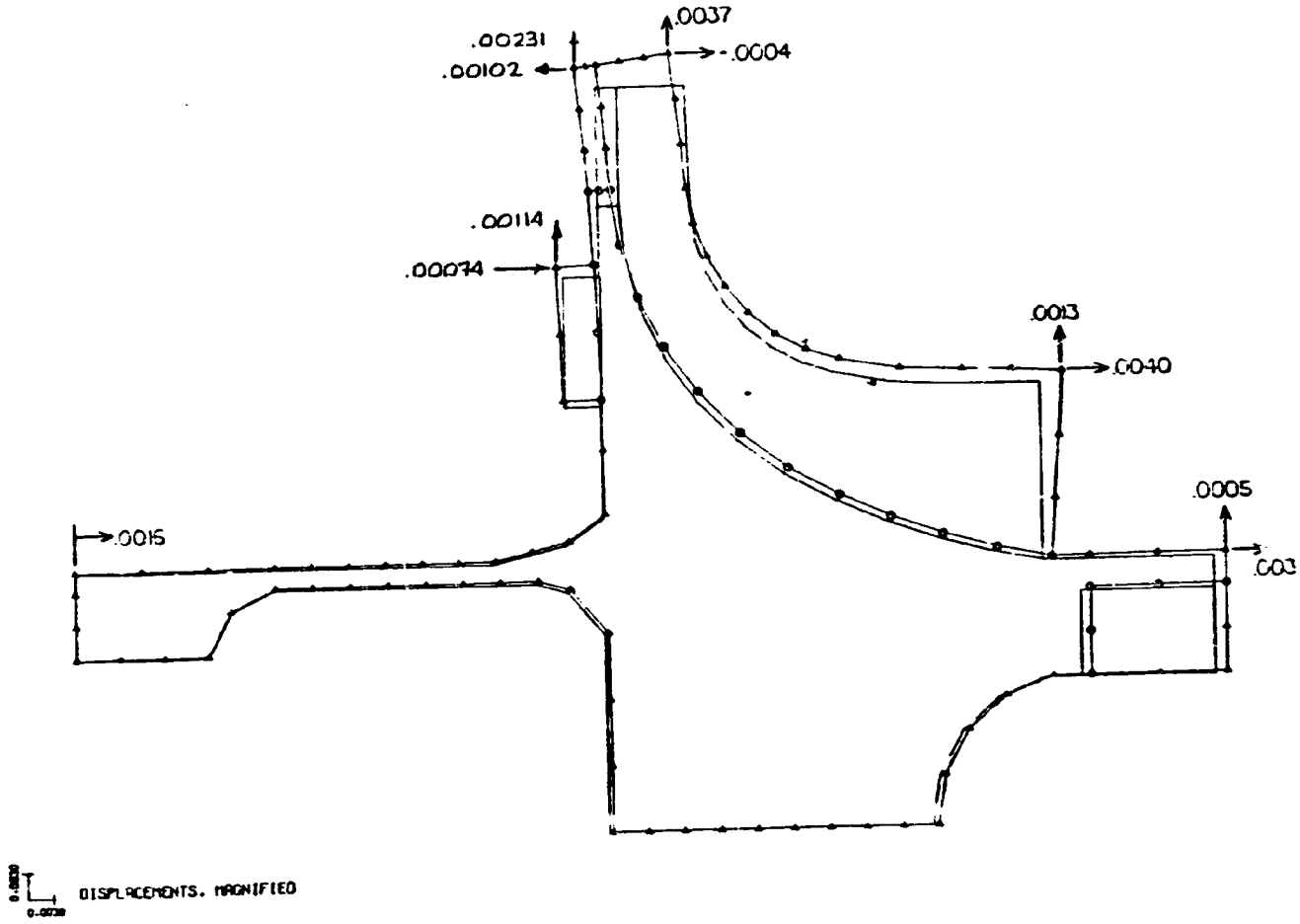


Figure 339. - Mini-BRU Acceleration Displacements T = 20 sec Scalloped Wheel.

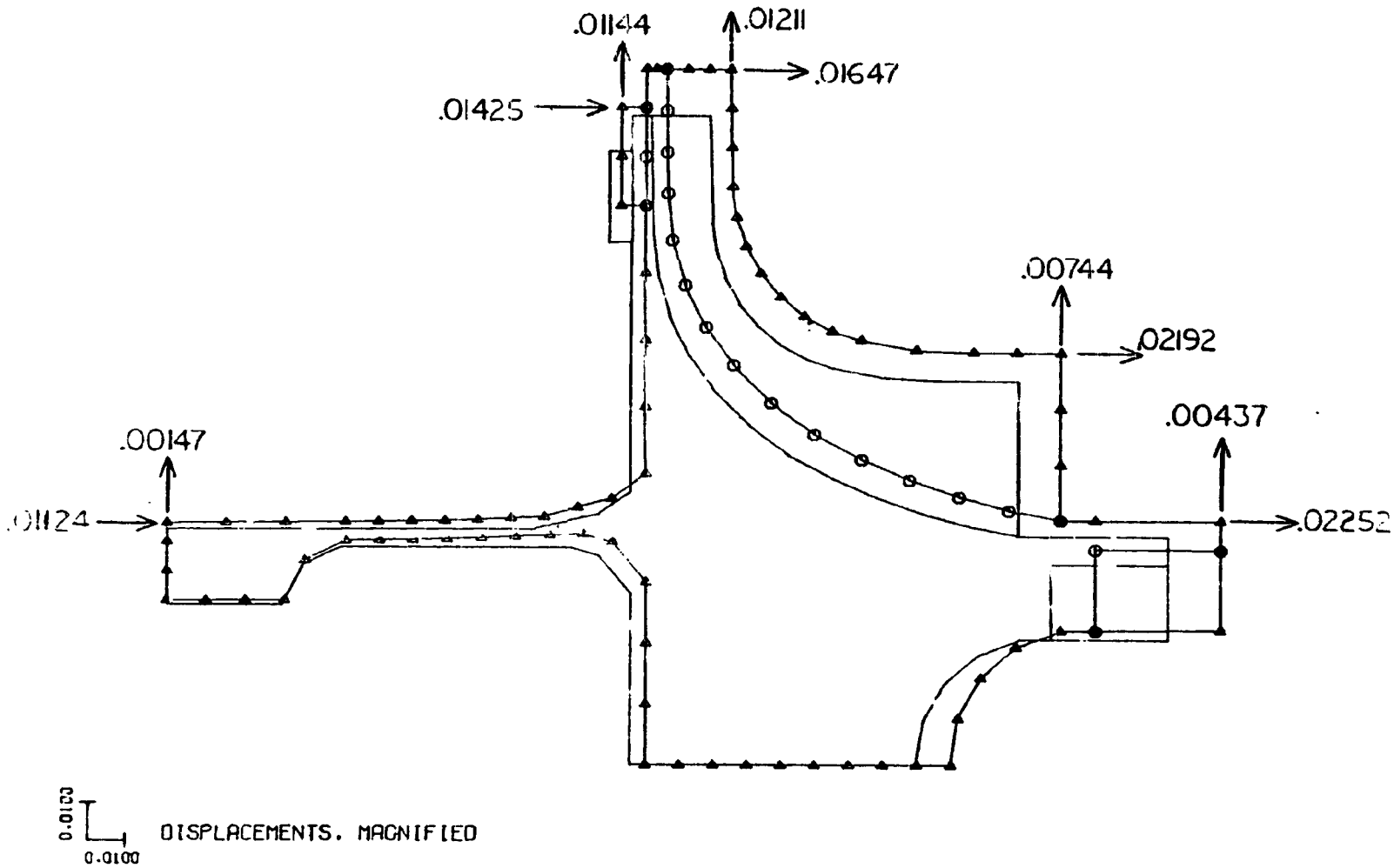


Figure 340. - Mini-BRU Unscalloped Turbine Wheel Deflections (high power).

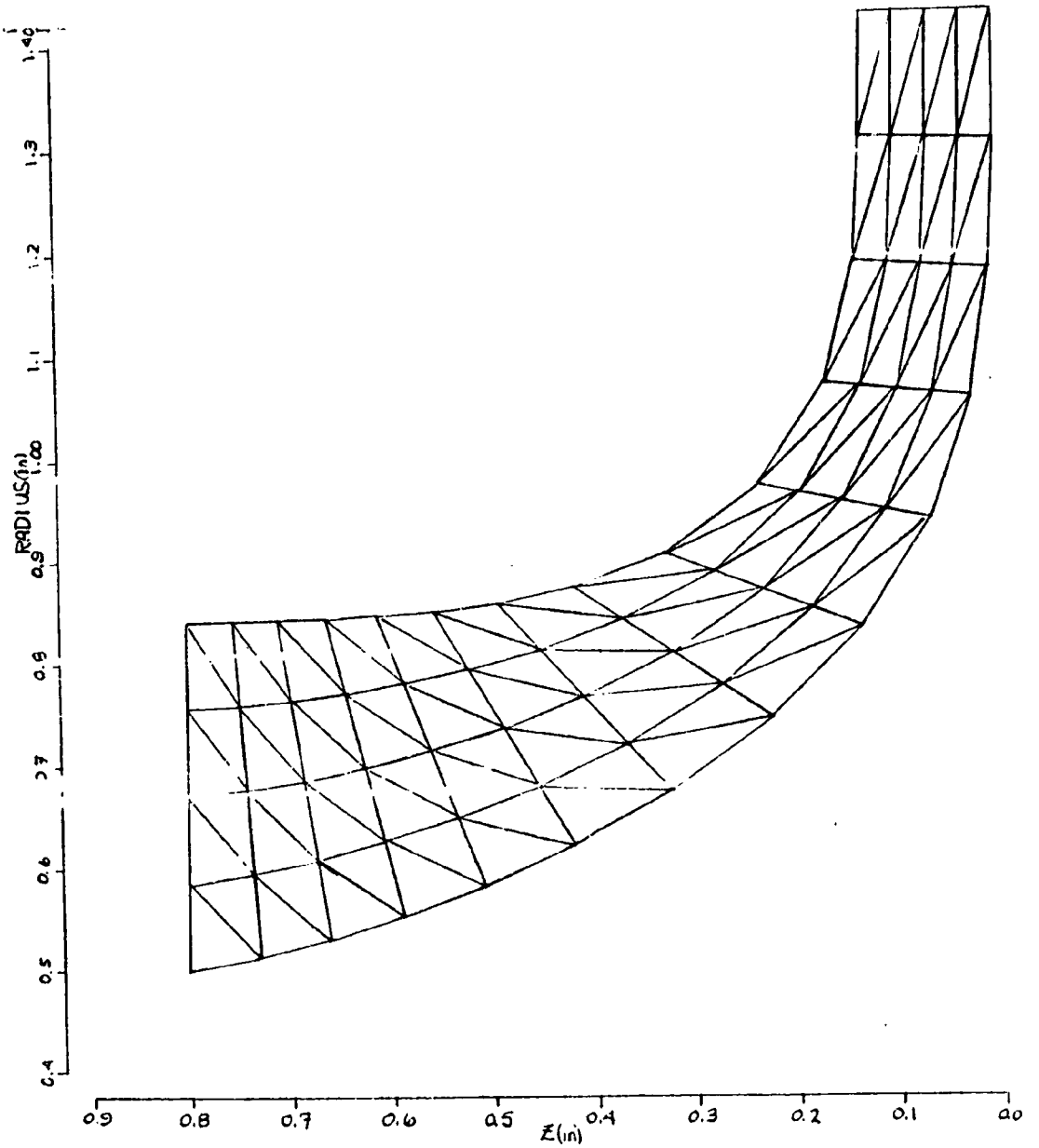


Figure 341. - Mini-BRU Blade Vib 1 Model (meridional view).

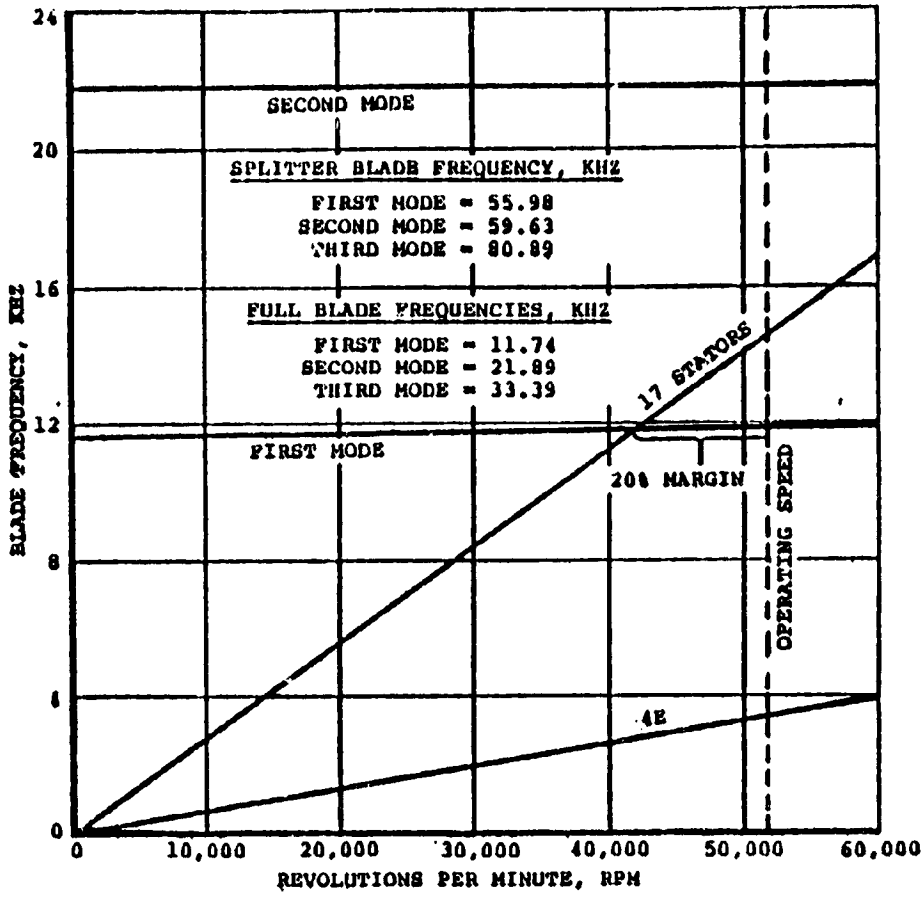


Figure 342. - Mini-BRU Turbine Blade Campbell Diagram.

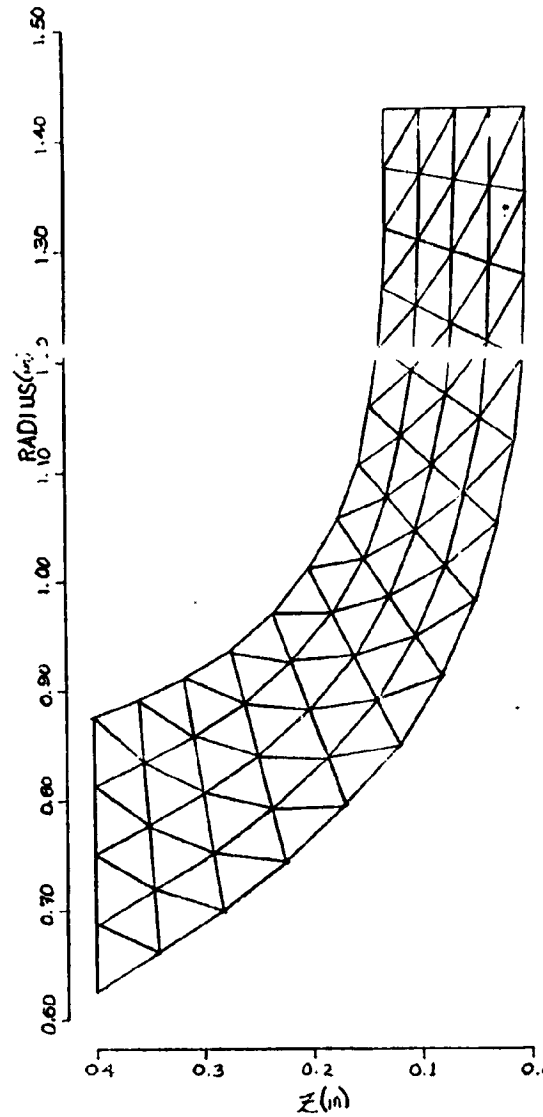


Figure 343. - Mini-BRU Splitter Vib 1 Model (meridional view).

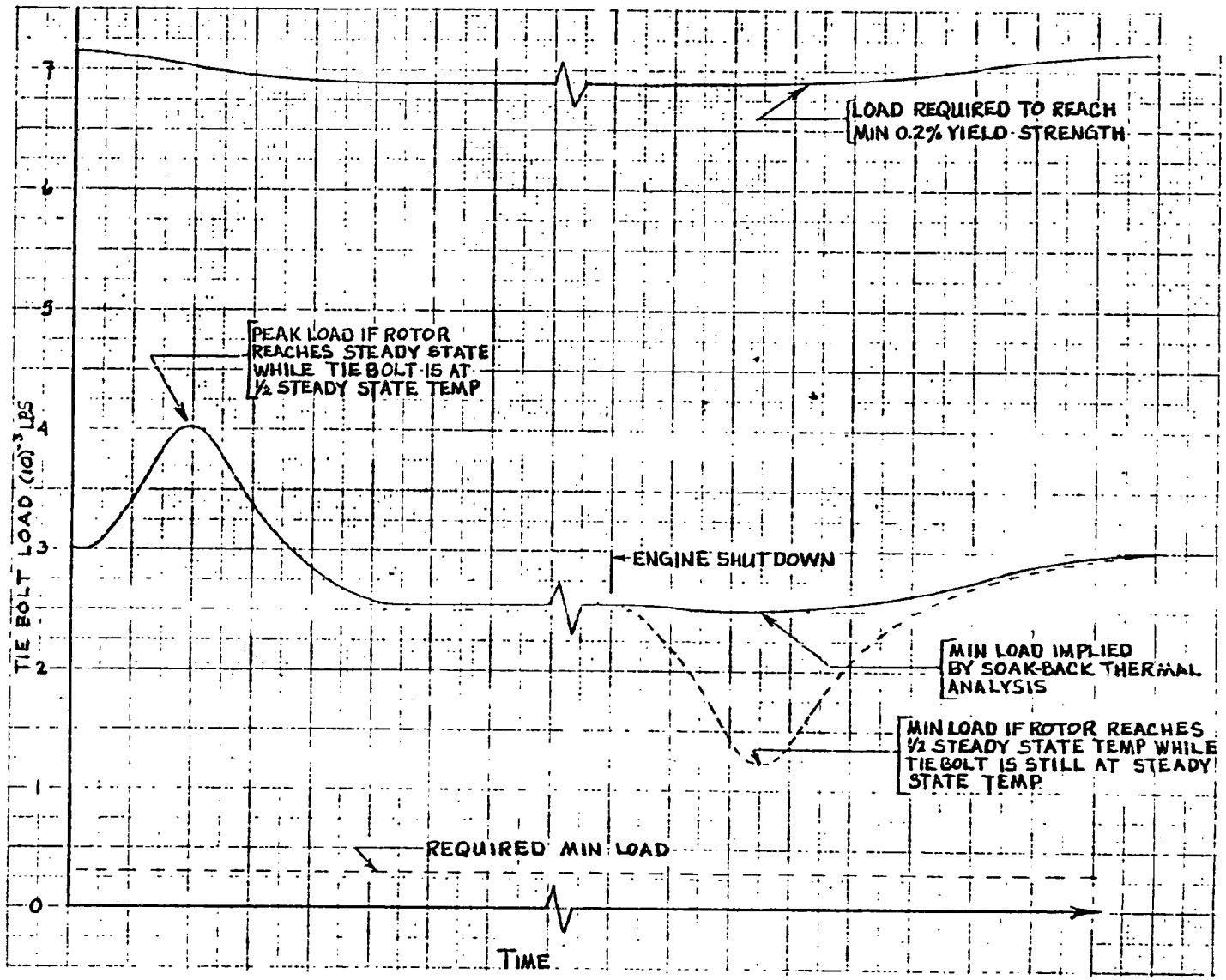


Figure 344. - Mini-BRU Tiebolt Load.

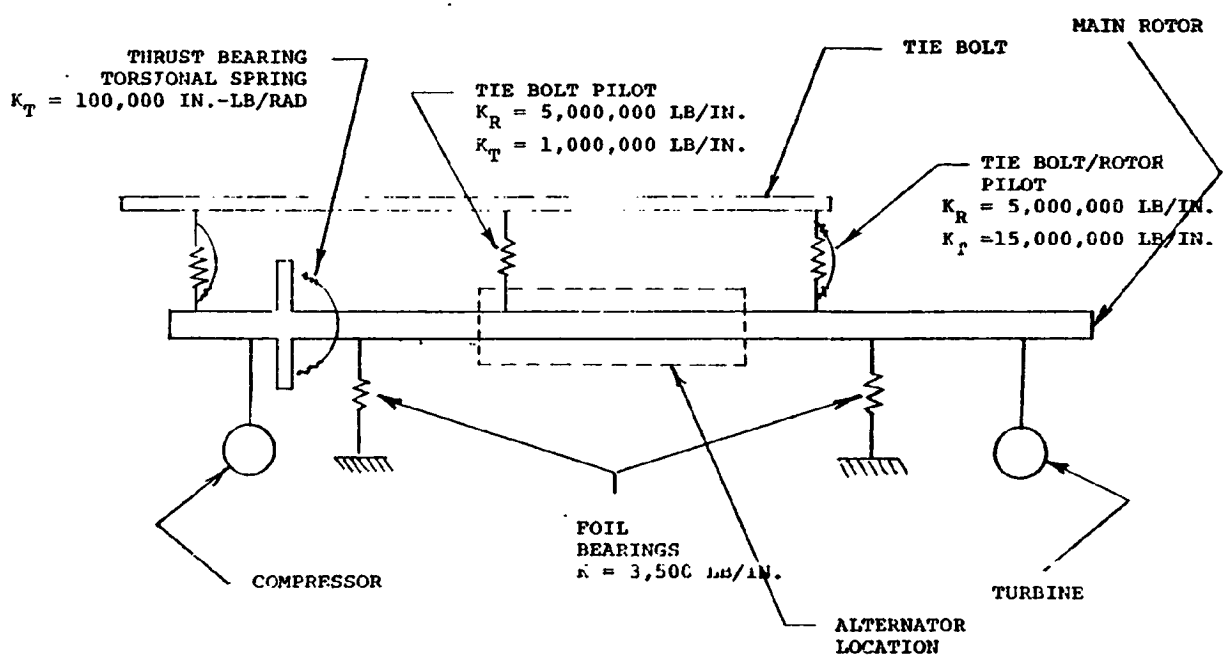


Figure 345. - Rotor Dynamics Model for Mini-BRU Turboalternator.

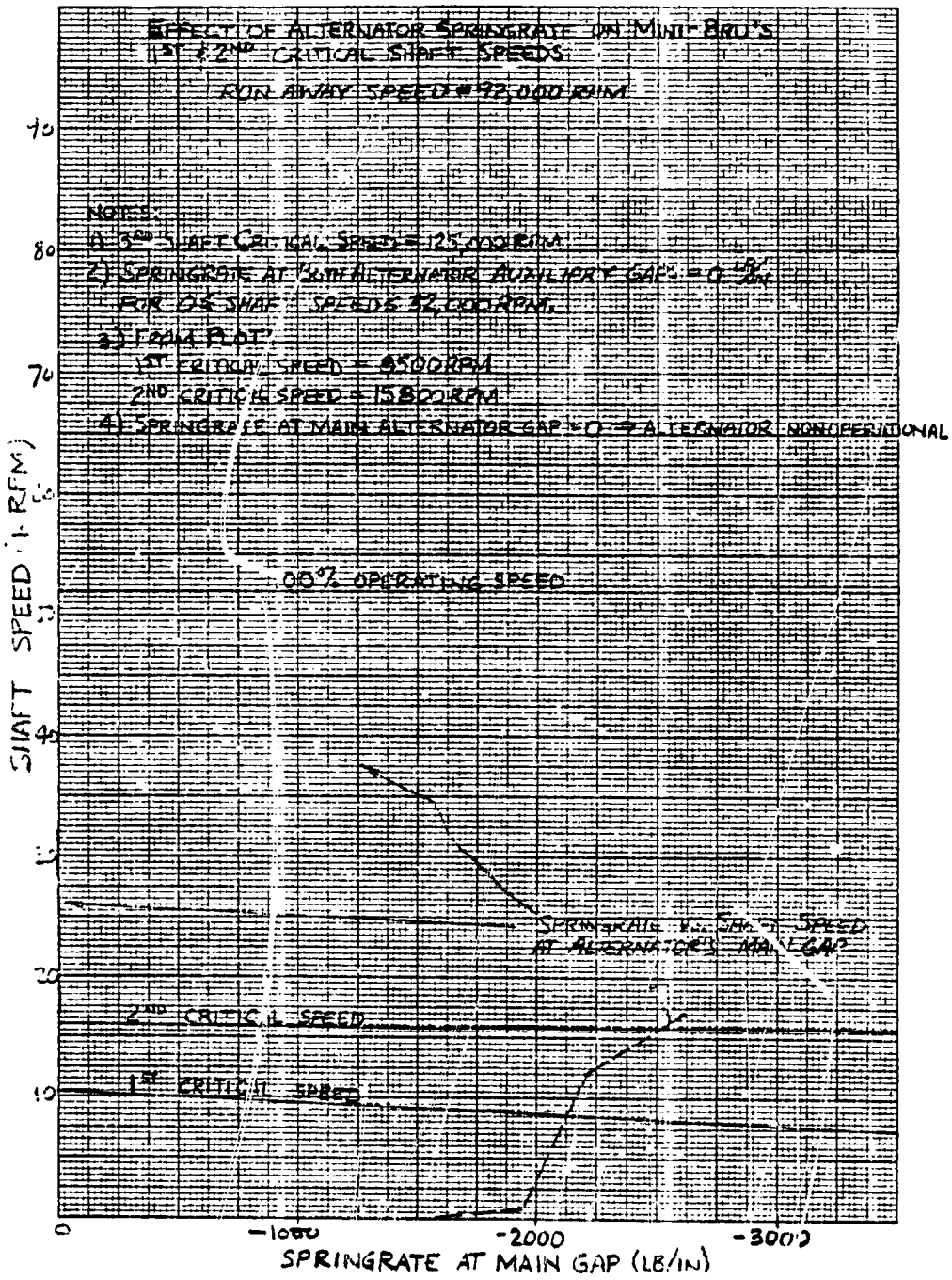


Figure 346. - Effect of Alternator Spring Rate on Mini-BRU's First and Second Critical Shaft Speeds.

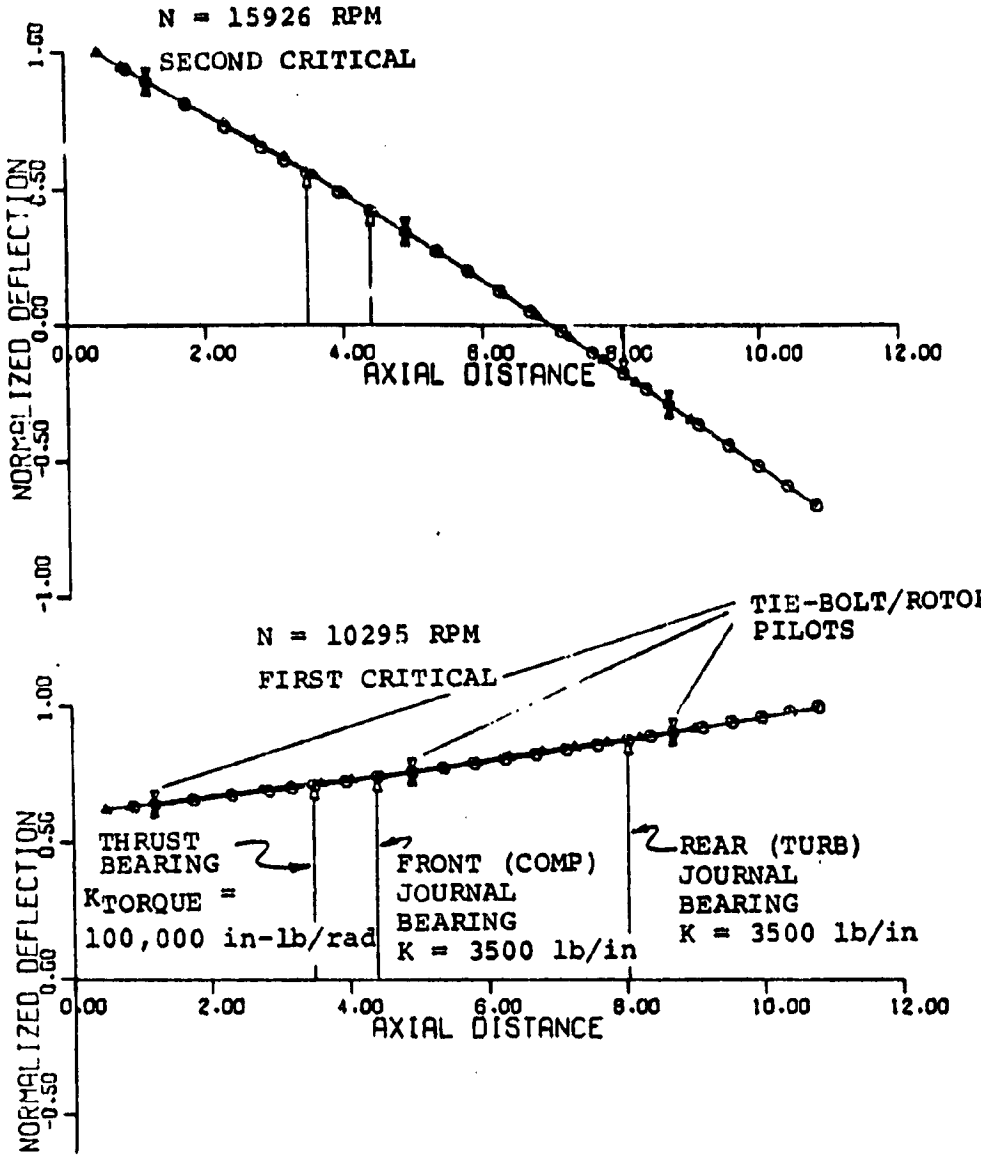


Figure 347. - Mode Shape of Rigid Body Criticals for Mini-BRU Foil Bearing Engine.

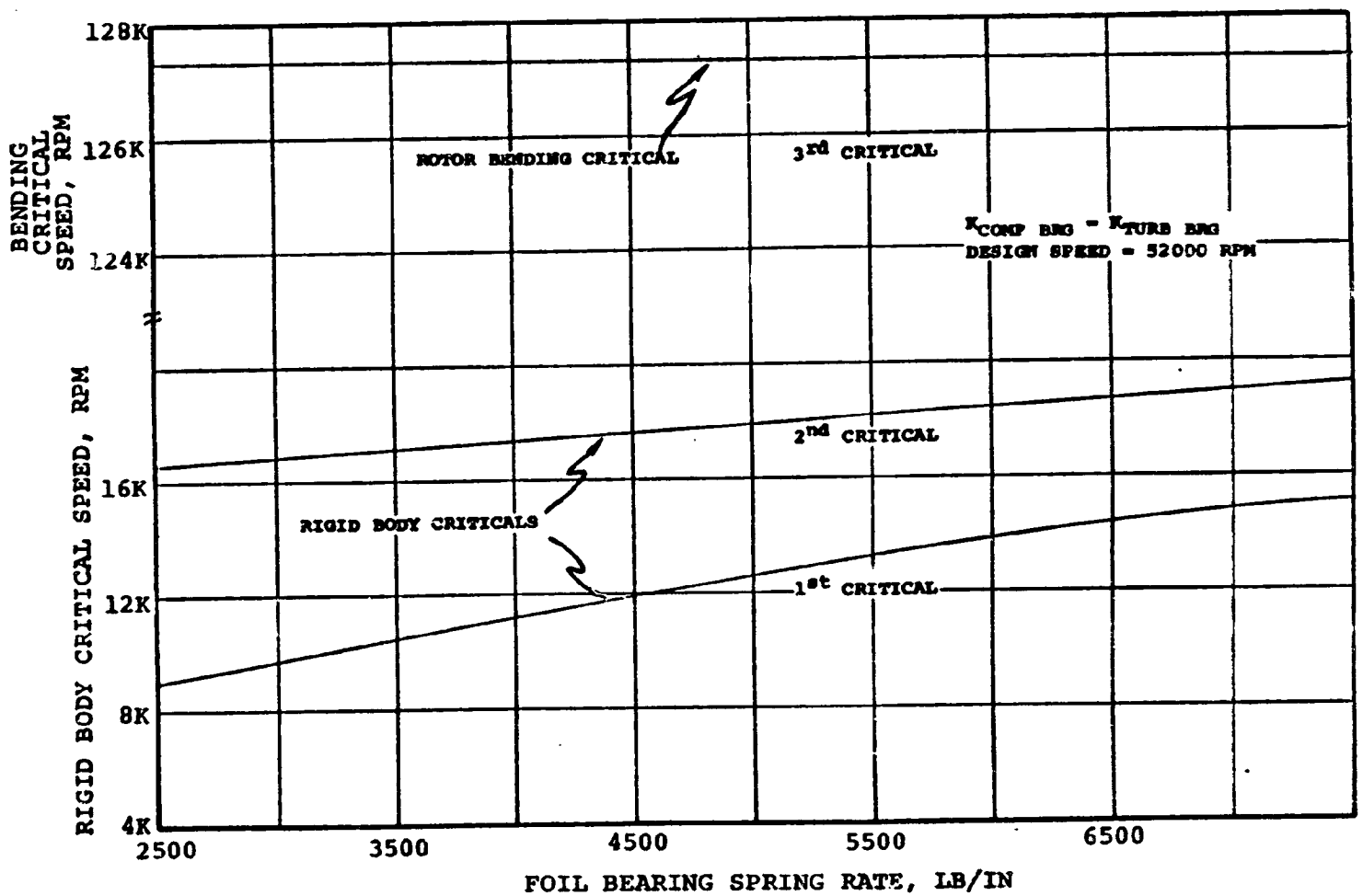


Figure 348. - Critical Speeds Versus Foil Bearing Spring Rate for Mini-BRU Turboalternator.

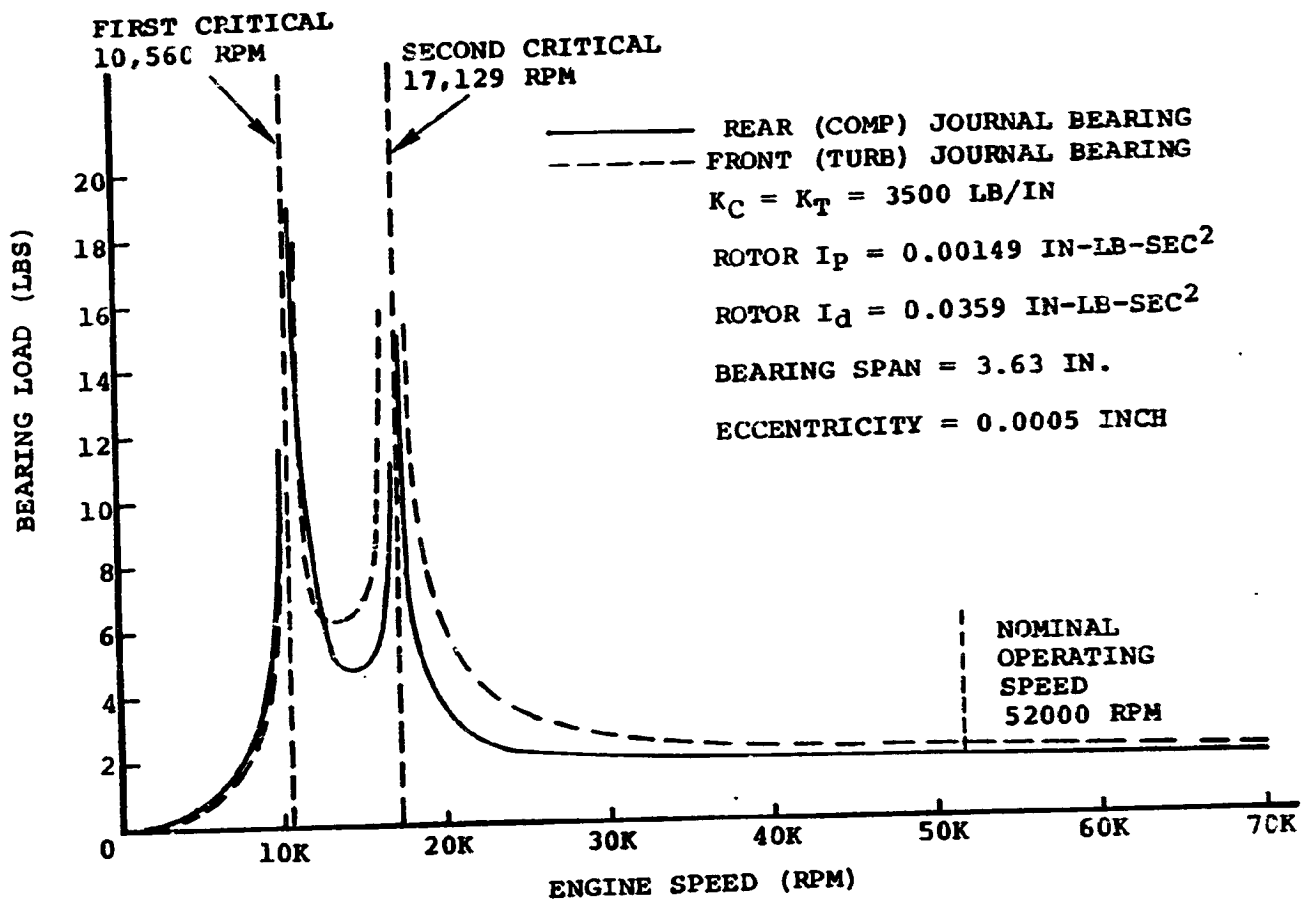


Figure 349. - "Absolute" Bearing Loads for Mini-BRU Rotor/Bearing System.

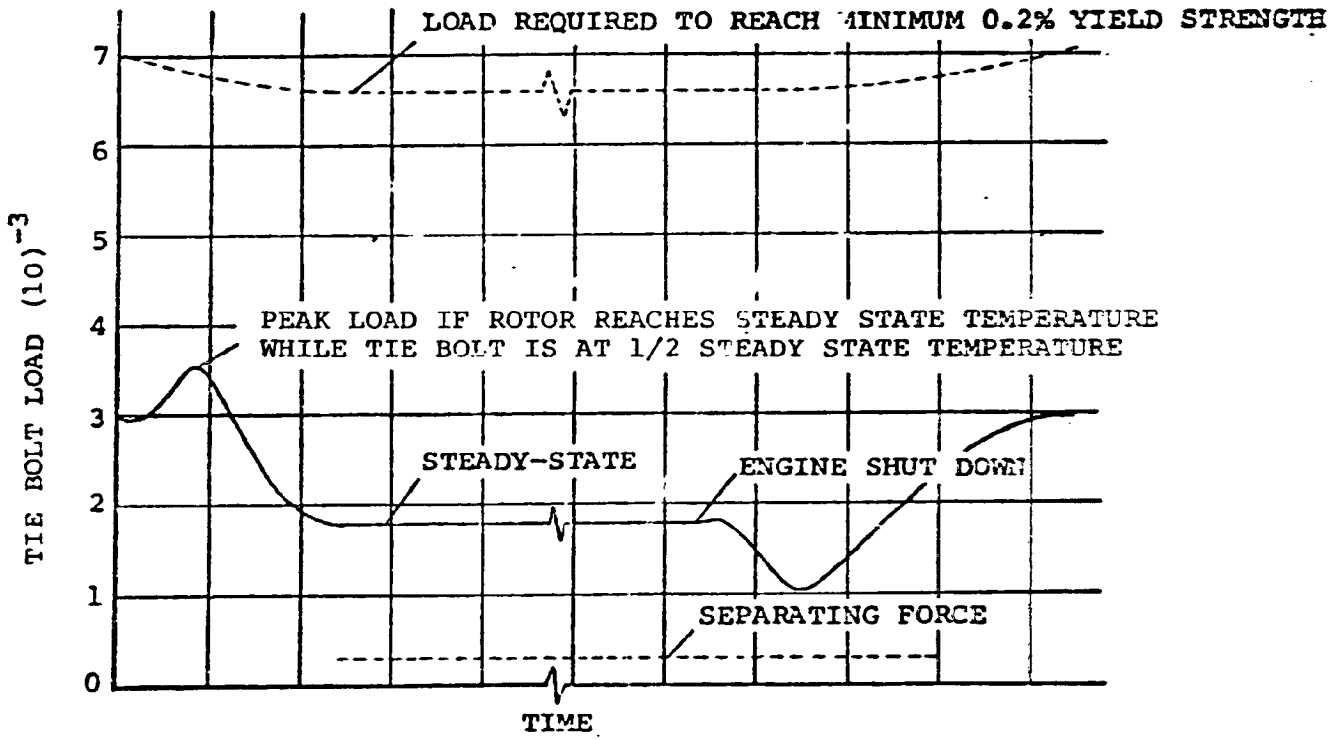


Figure 350. - Axial Tie Bolt Load.

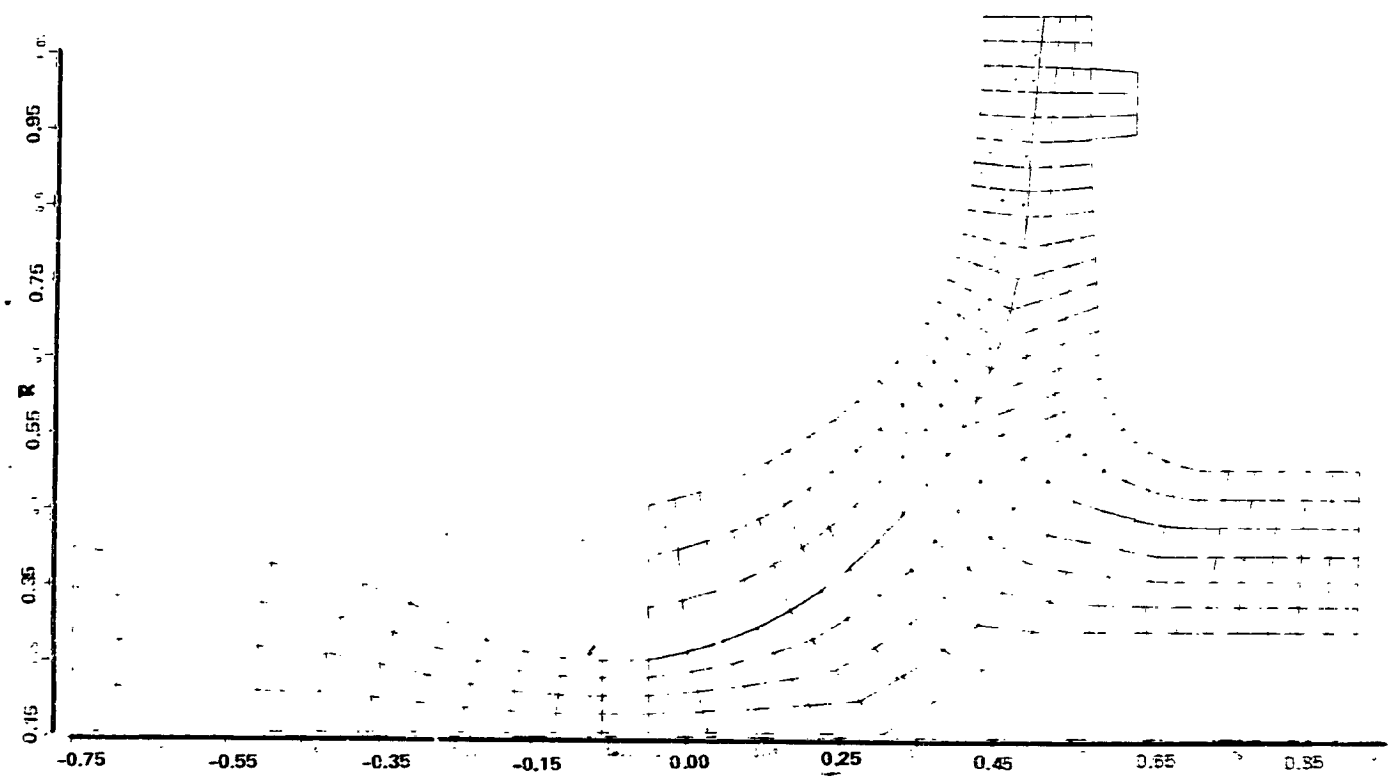


Figure 351. - Mini-BRU Compressor Impeller Finite Element Model.

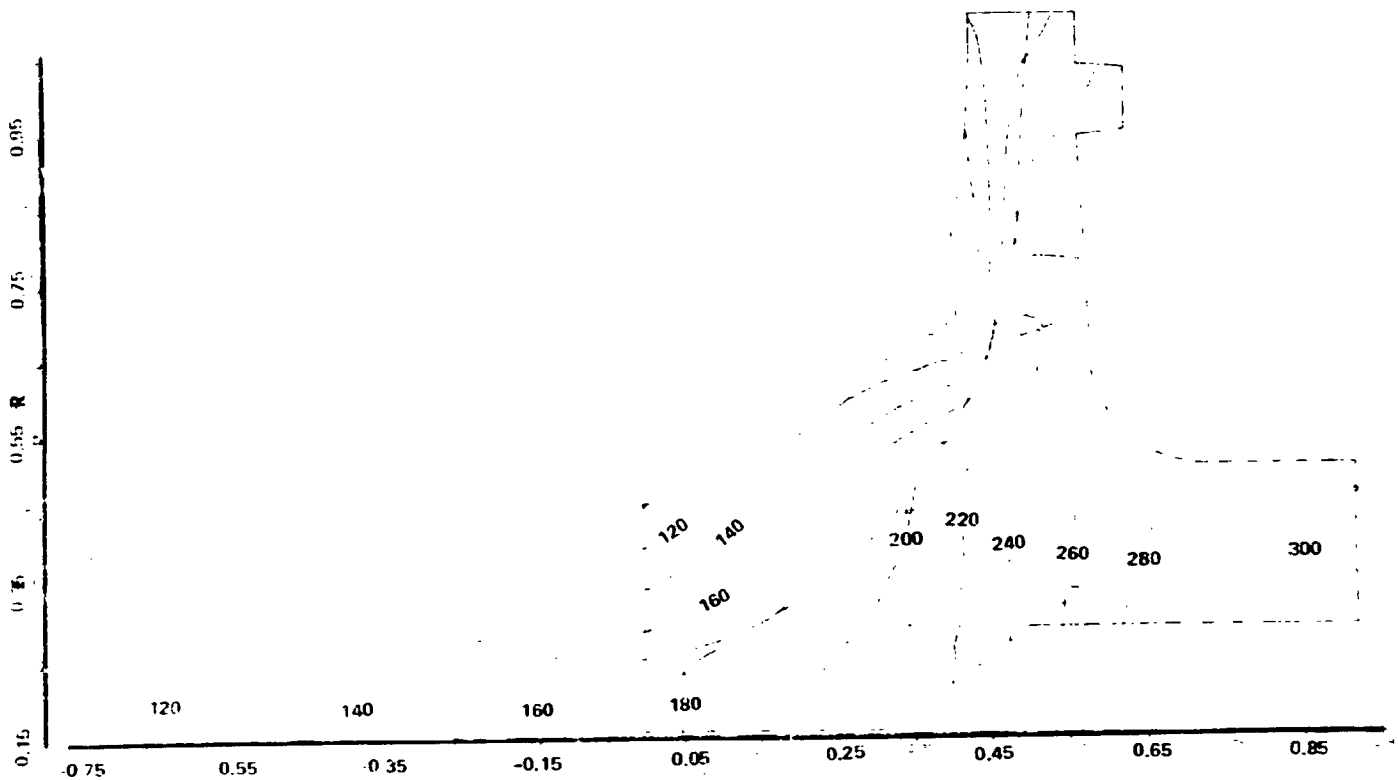


Figure [illegible] - Thermal Gradient for Mini-BRU Compressor Impeller.

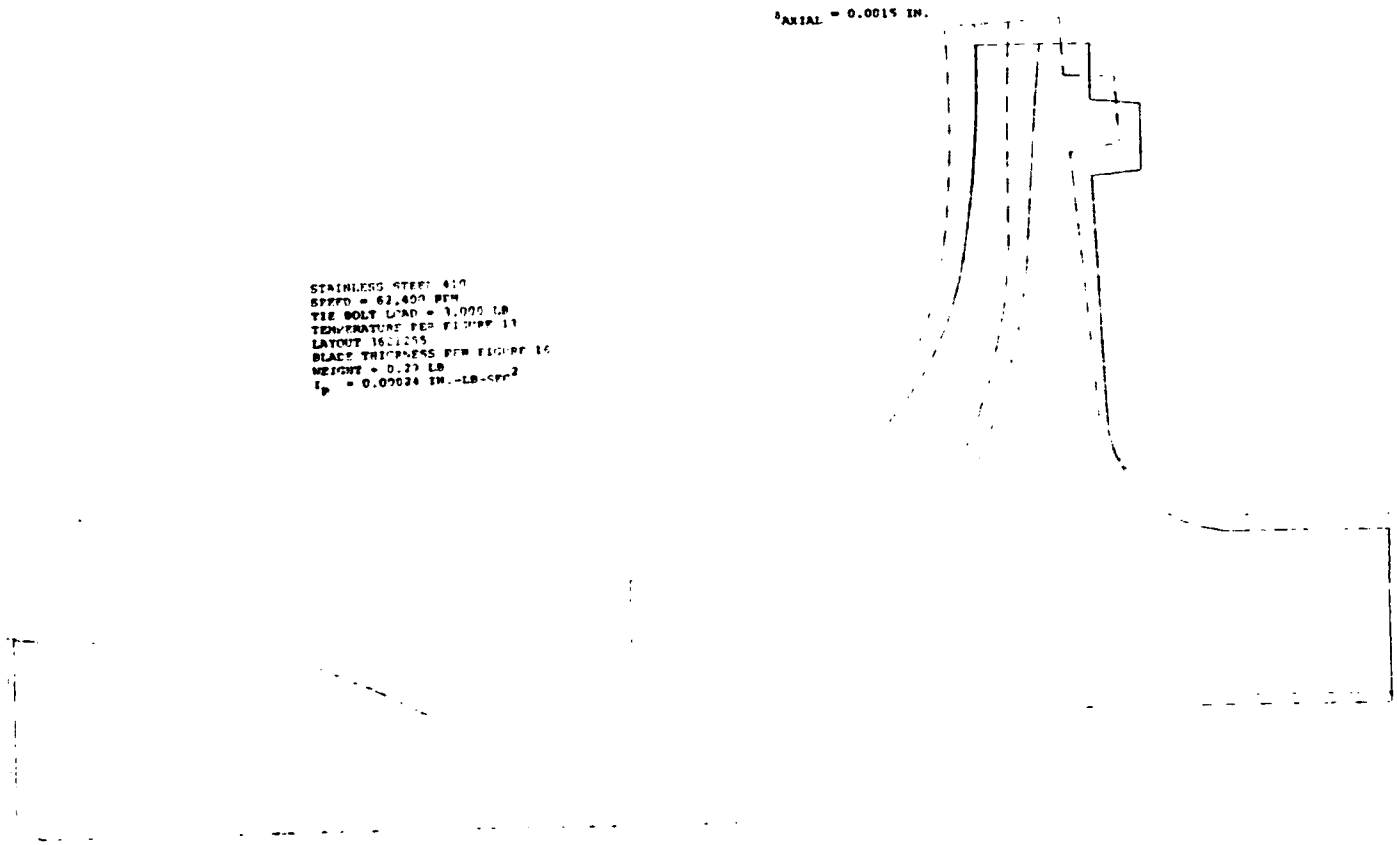


Figure 353. - Displacement Characteristics of the Mini-BFU Impeller Due to Rotation, Tie Bolt Loading, and Thermal Distribution.

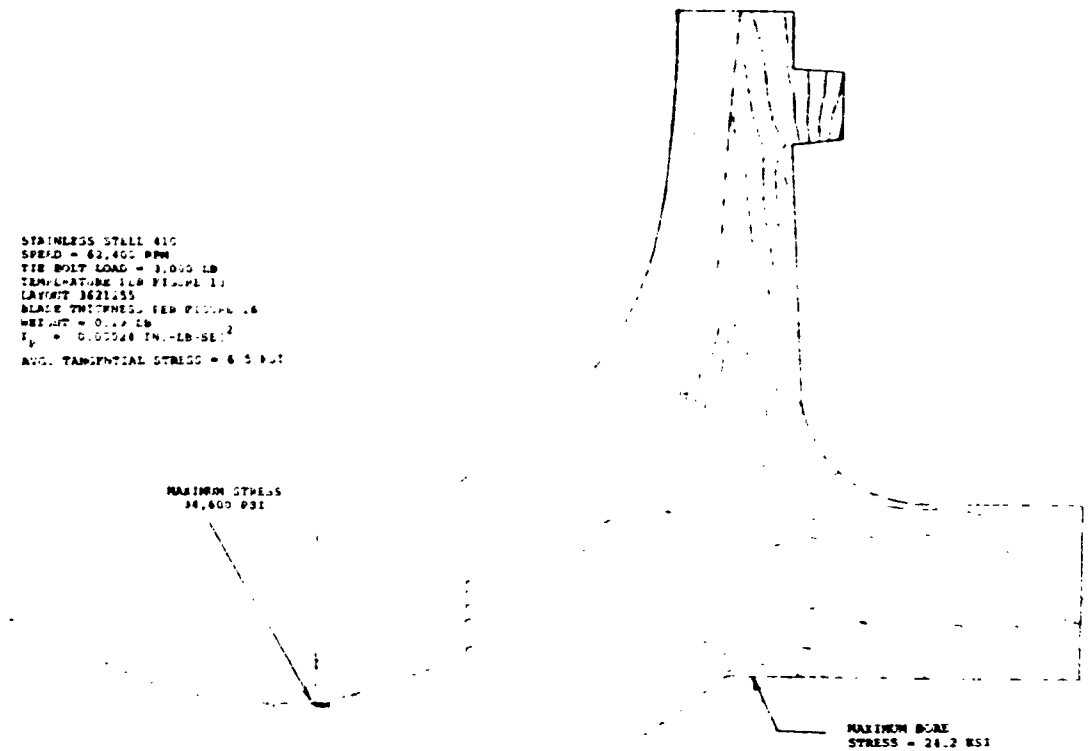


Figure 354. - Equivalent Stress Distribution for Mini-BRU SS410 Impeller.

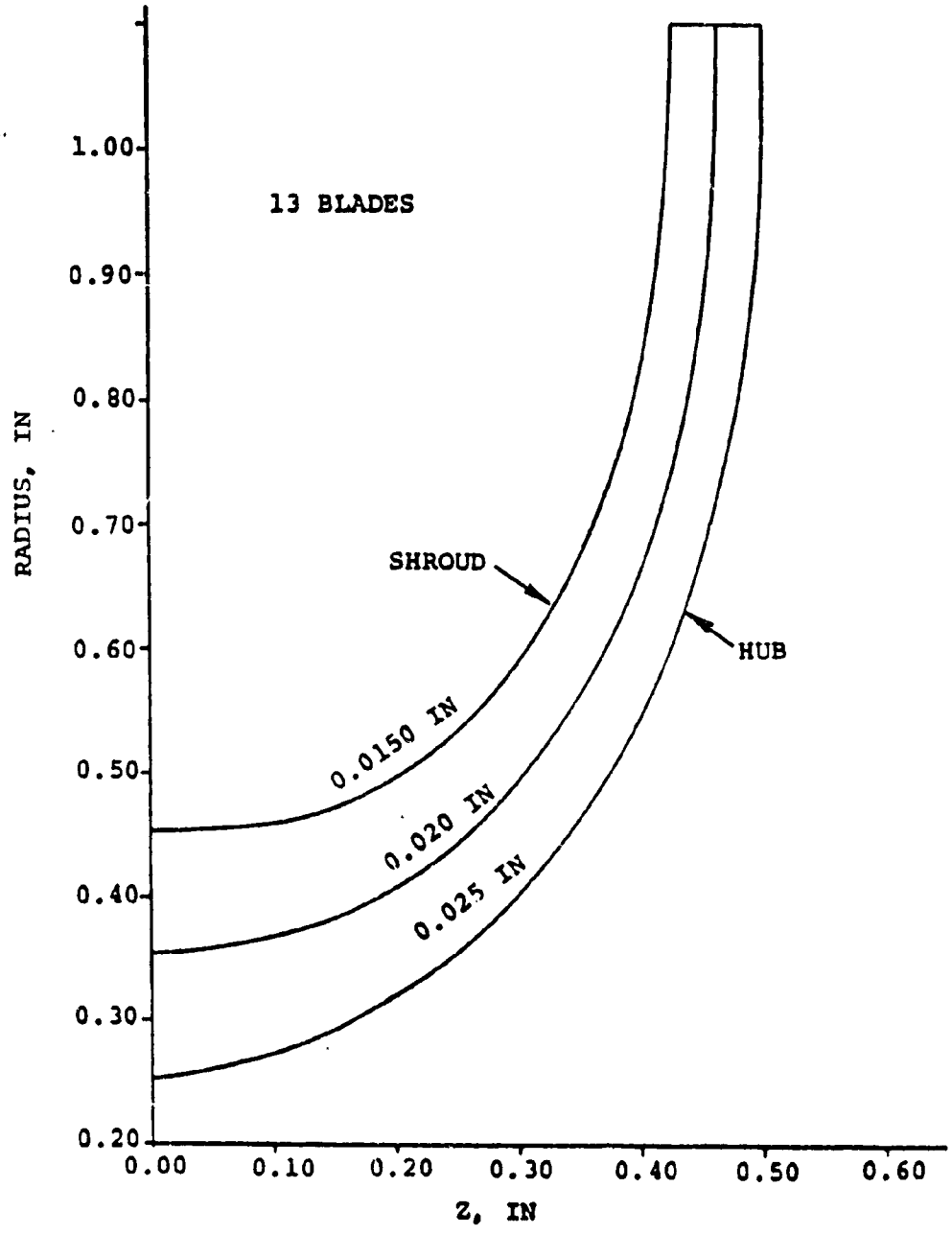


Figure 355. - Lines of Constant Thickness for Mini-BRU Compressor Blade.

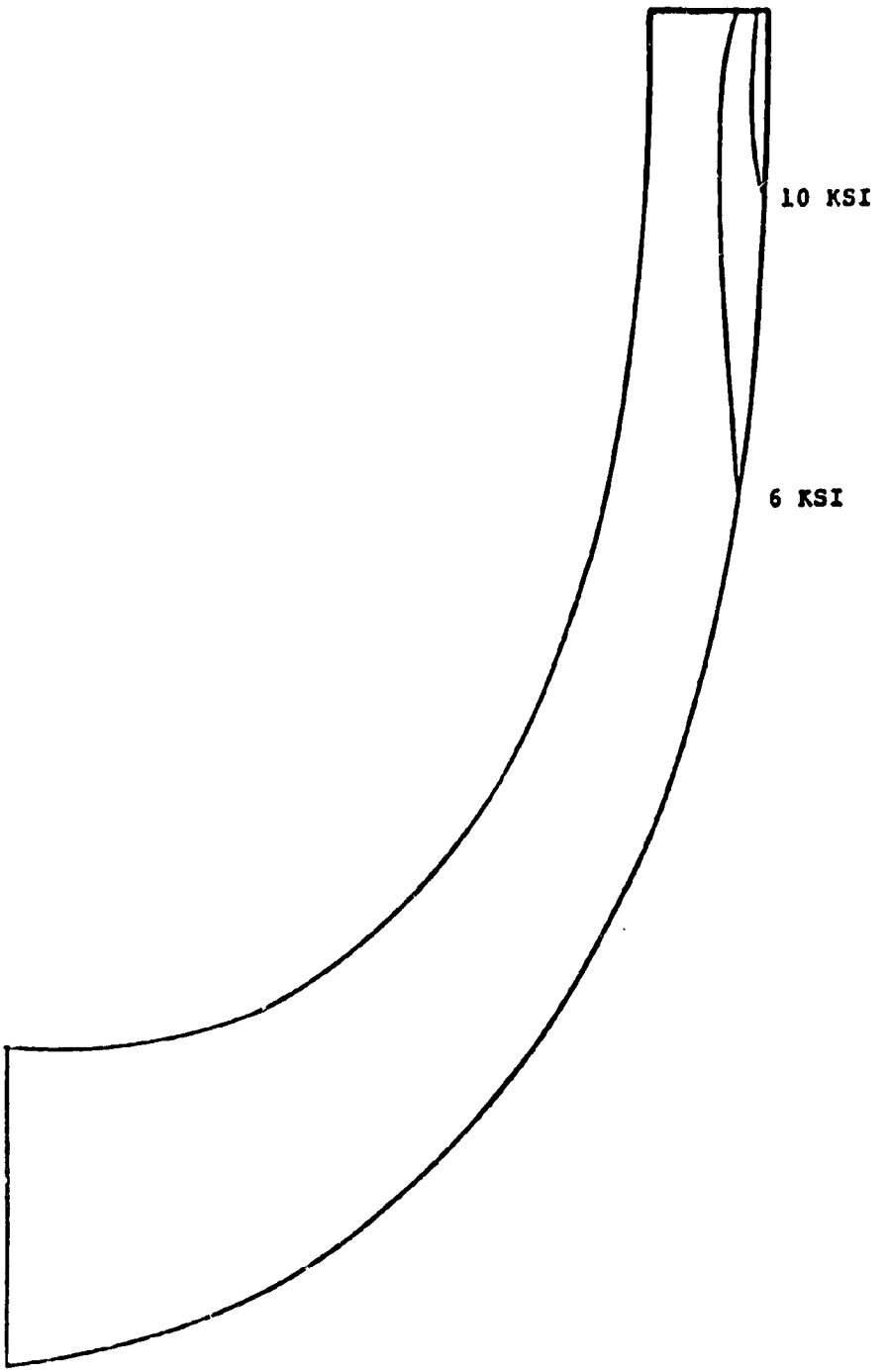


Figure 356. - Lines of Constant Stress for Mini-BRU Impeller Operating at 120 Percent Speed.

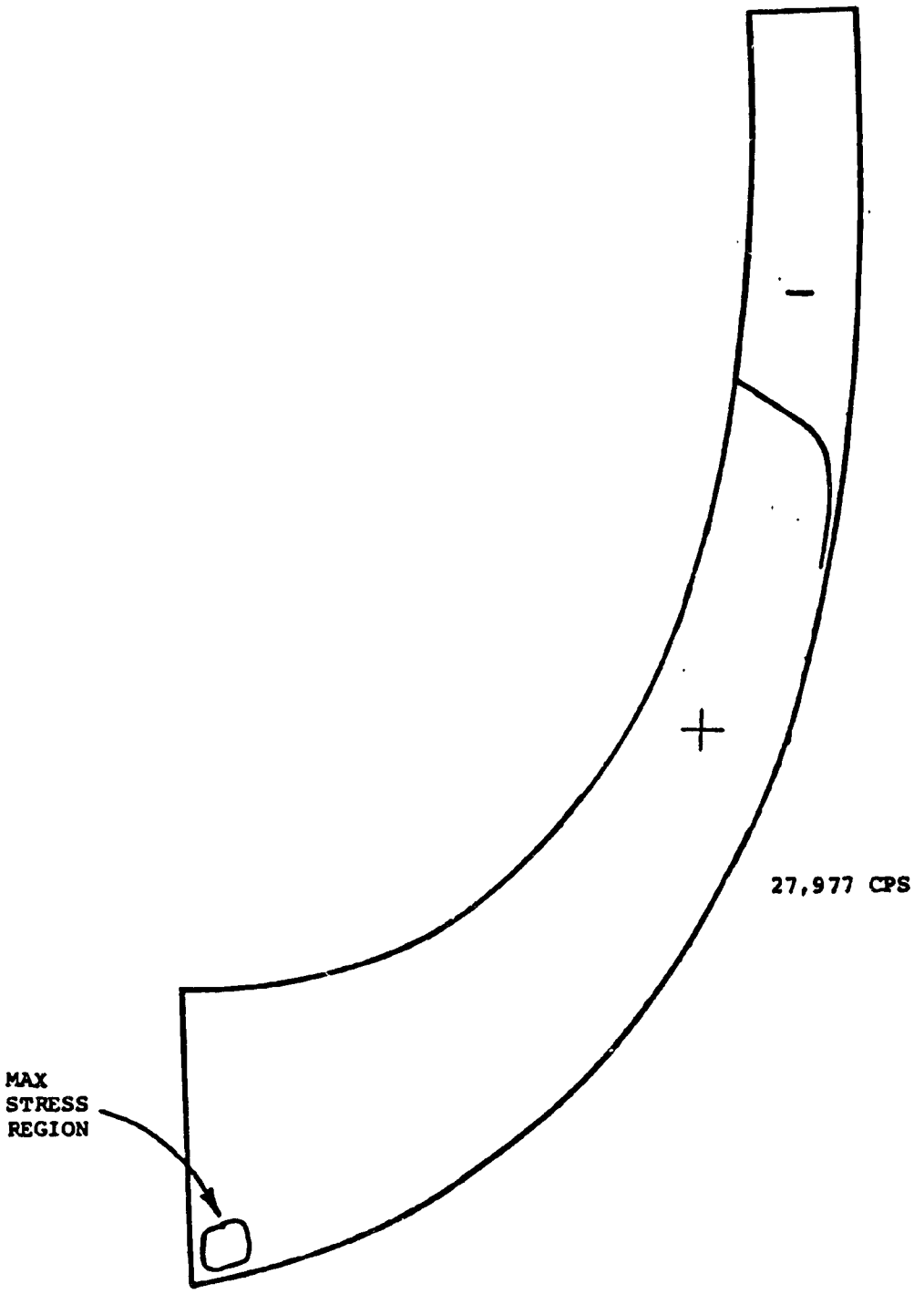


Figure 357. - First Mode Shape of Mini-BRU Compressor Blade.

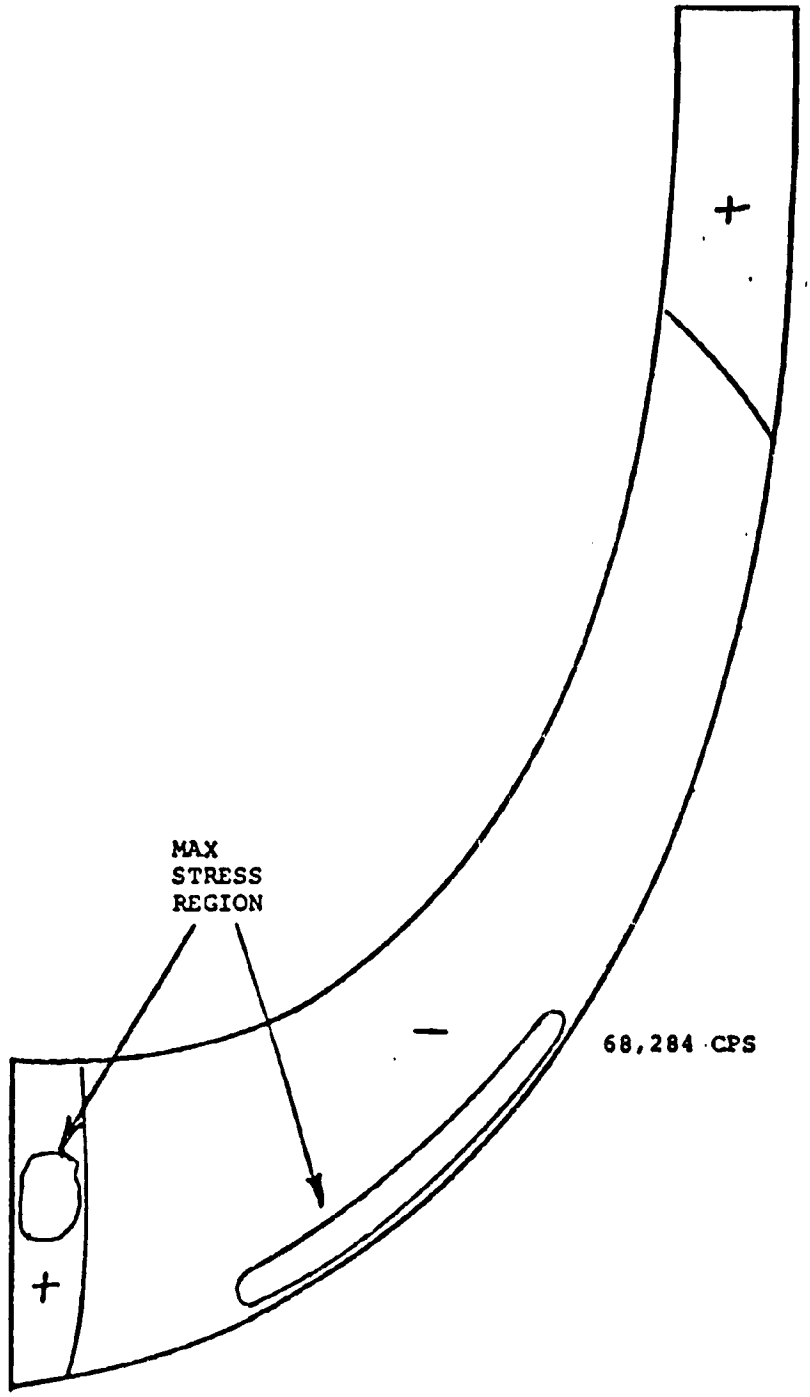


Figure 358. - Second Mode Shape of Mini-BRU Compressor Blade.

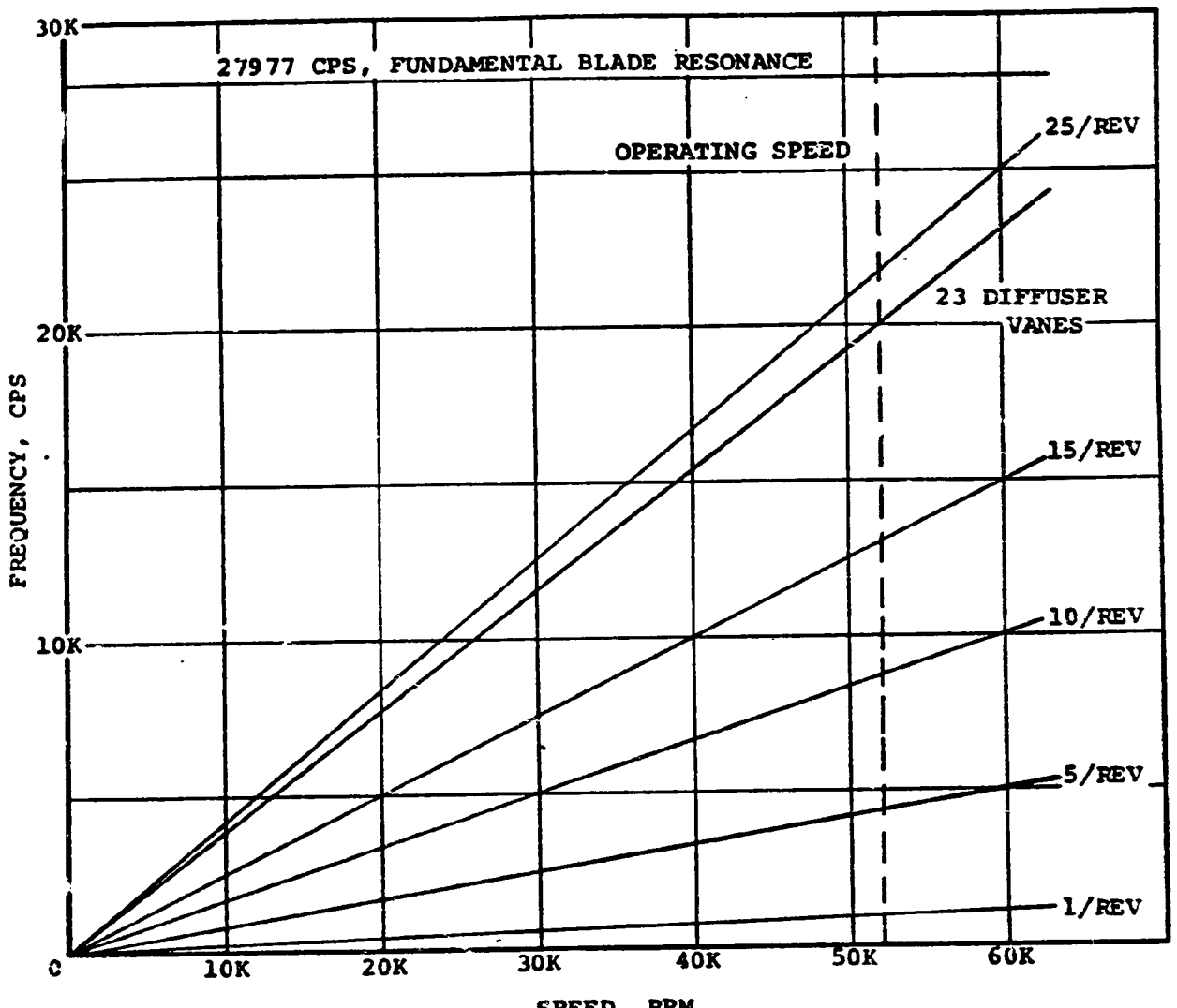


Figure 359. - Interference Diagram for Mini-BRU Compressor.

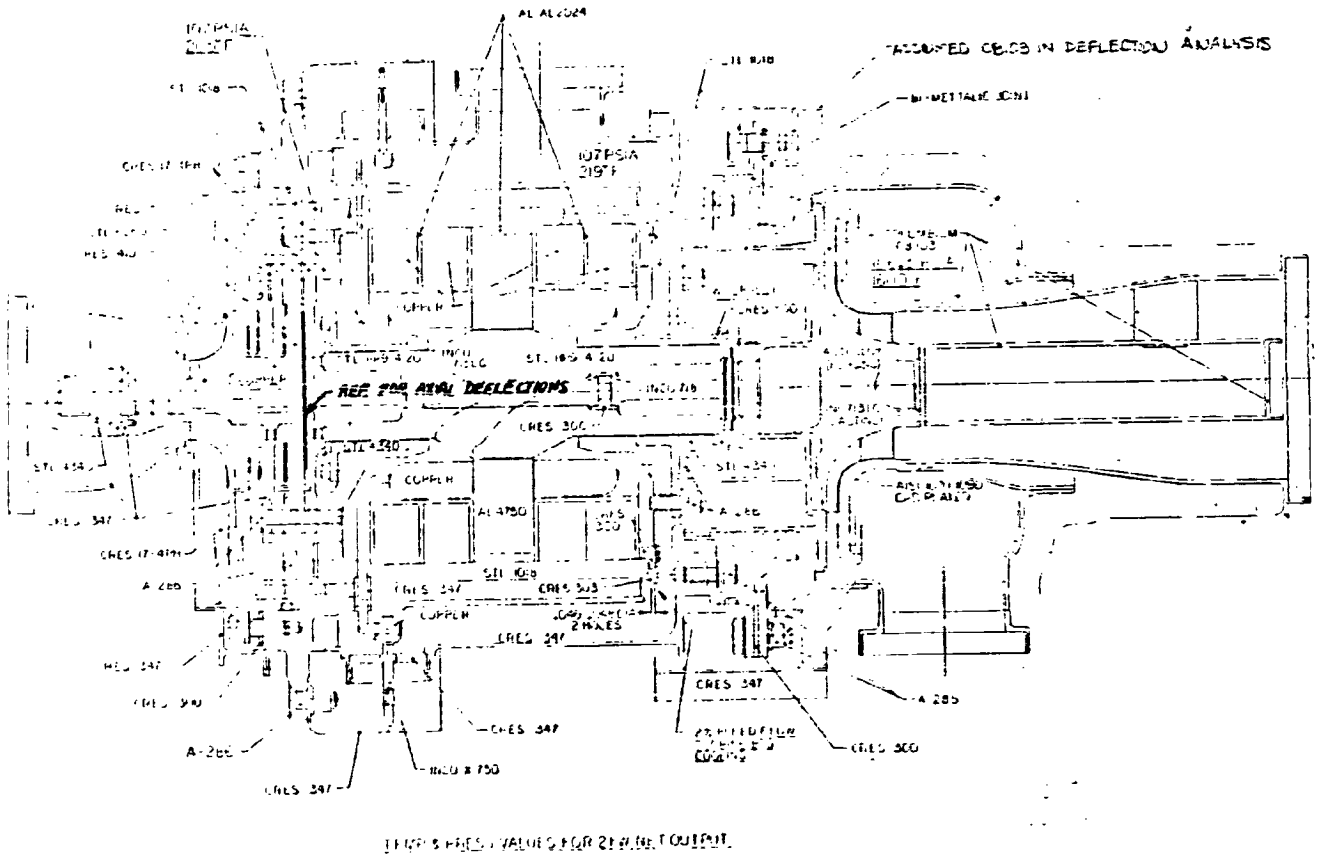


Figure 360. - Mini-BRU Materials Used in Deflection Analysis.

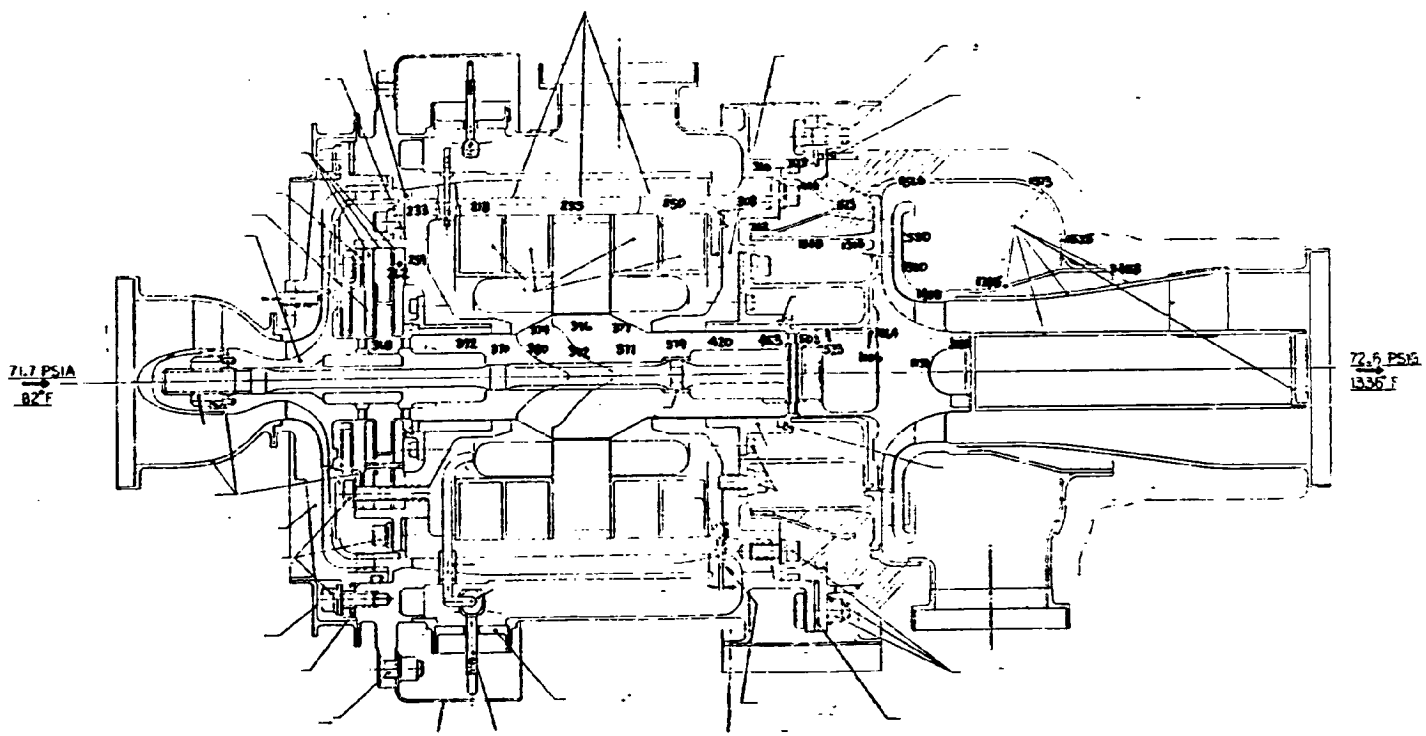


Figure 361. - Steady-State Temperatures Used in Deflection Analysis.

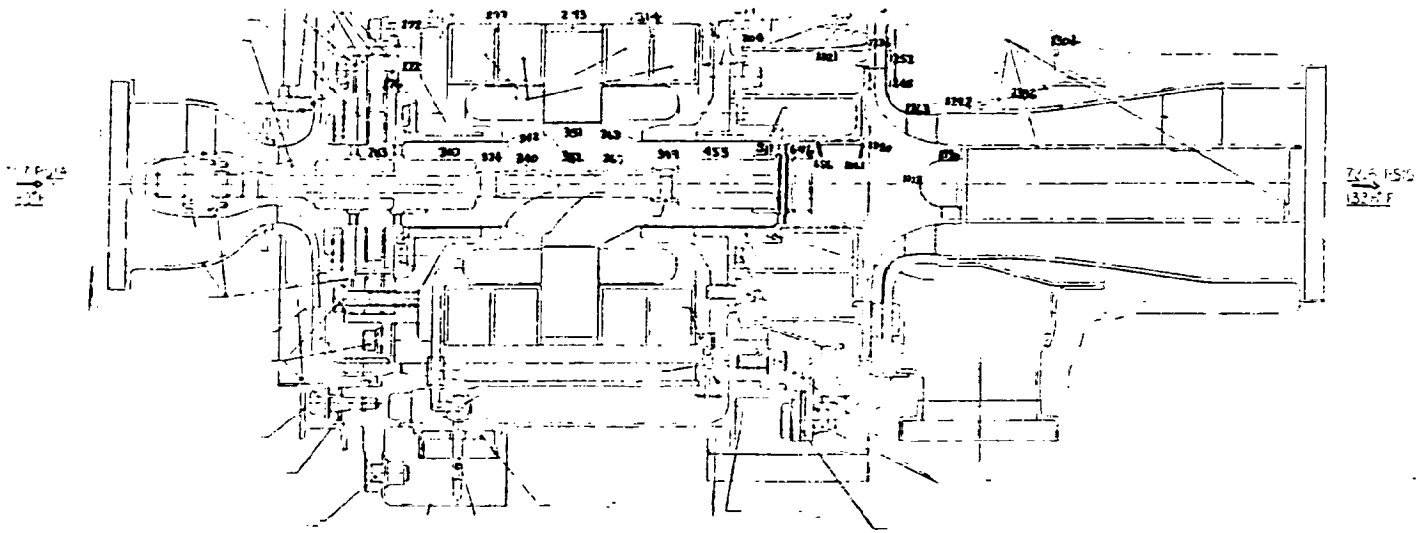


Figure 362. - Soakback Temperatures 4 Minutes Following Shutdown.

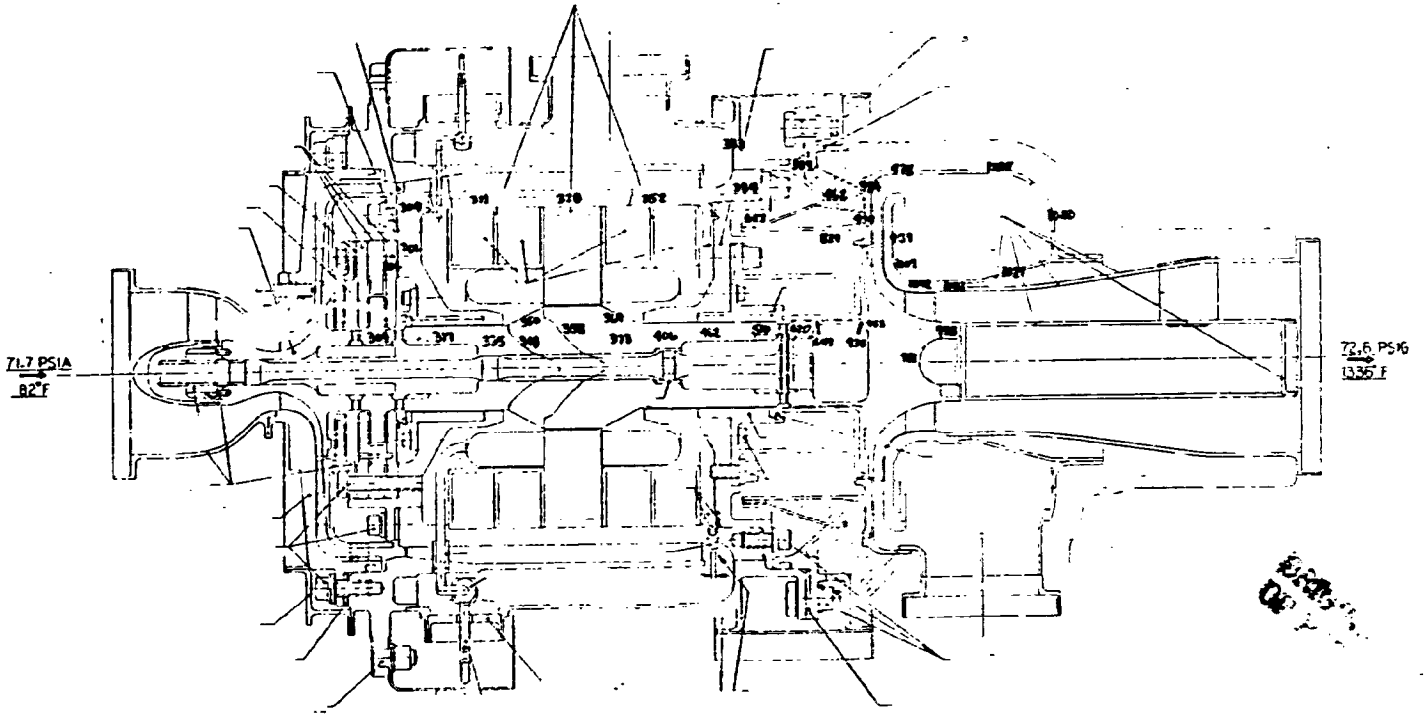


Figure 363. - Sockback Temperatures 12 Minutes Following Shutdown.

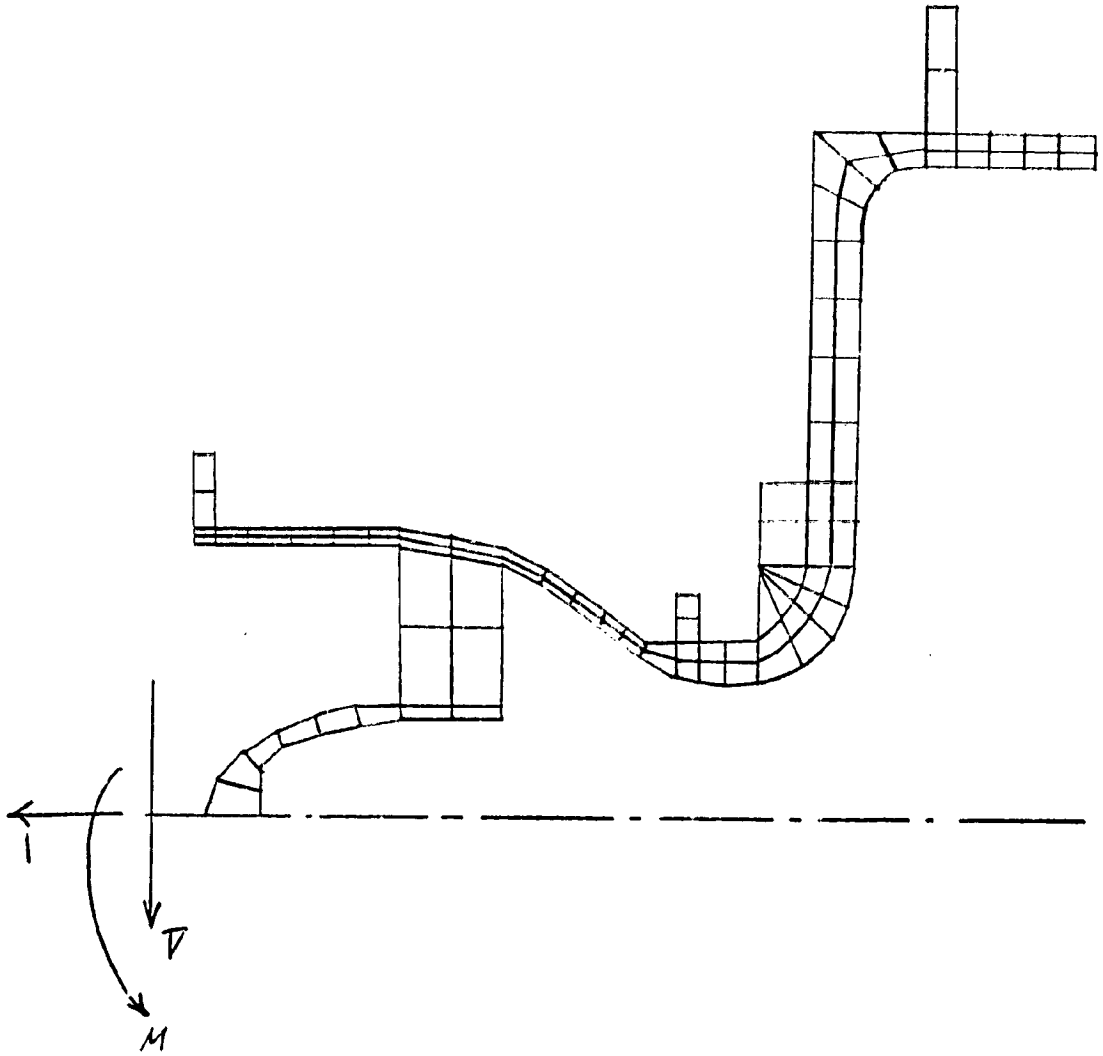
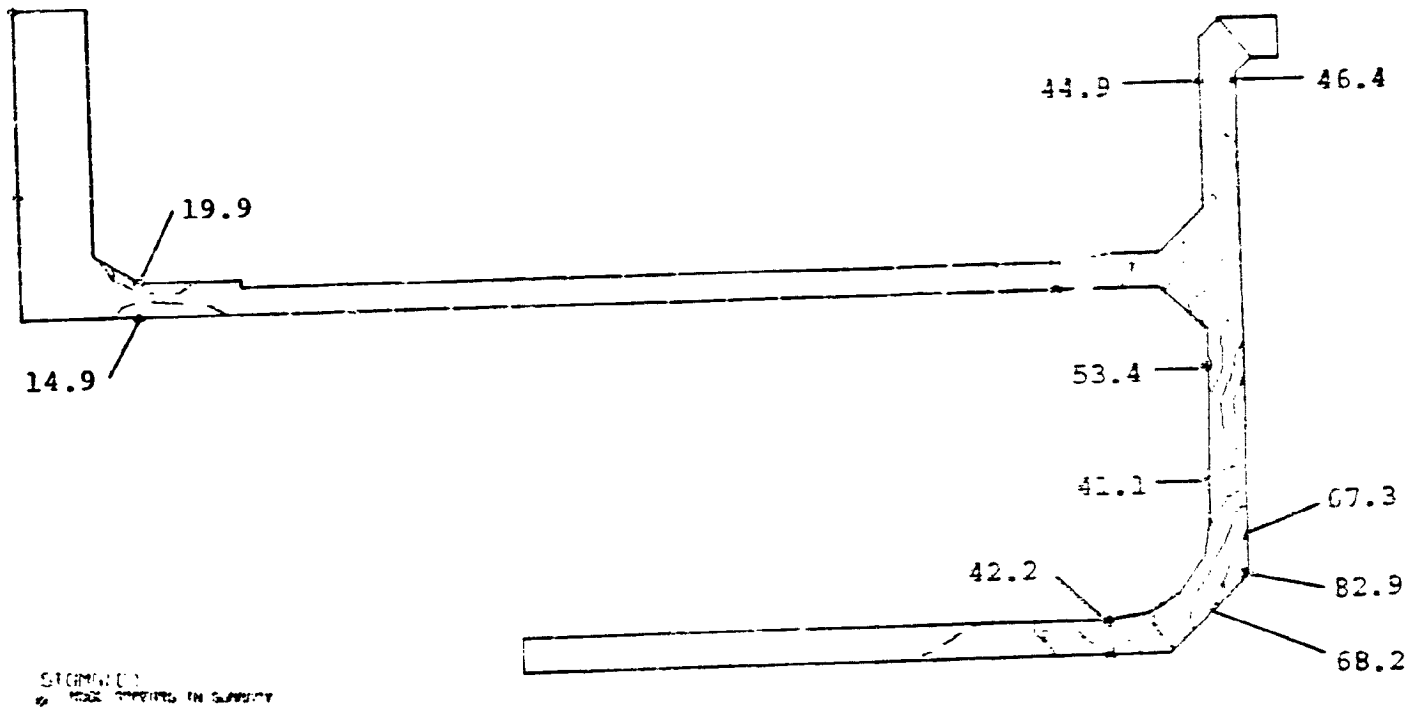


Figure 364. - Structural Model for the Compressor Inlet Flange Loads.



THERMAL EQUIVALENT STRESS, KSI

Figure 365. - Turbine Back Shroud - Mini-BRU.

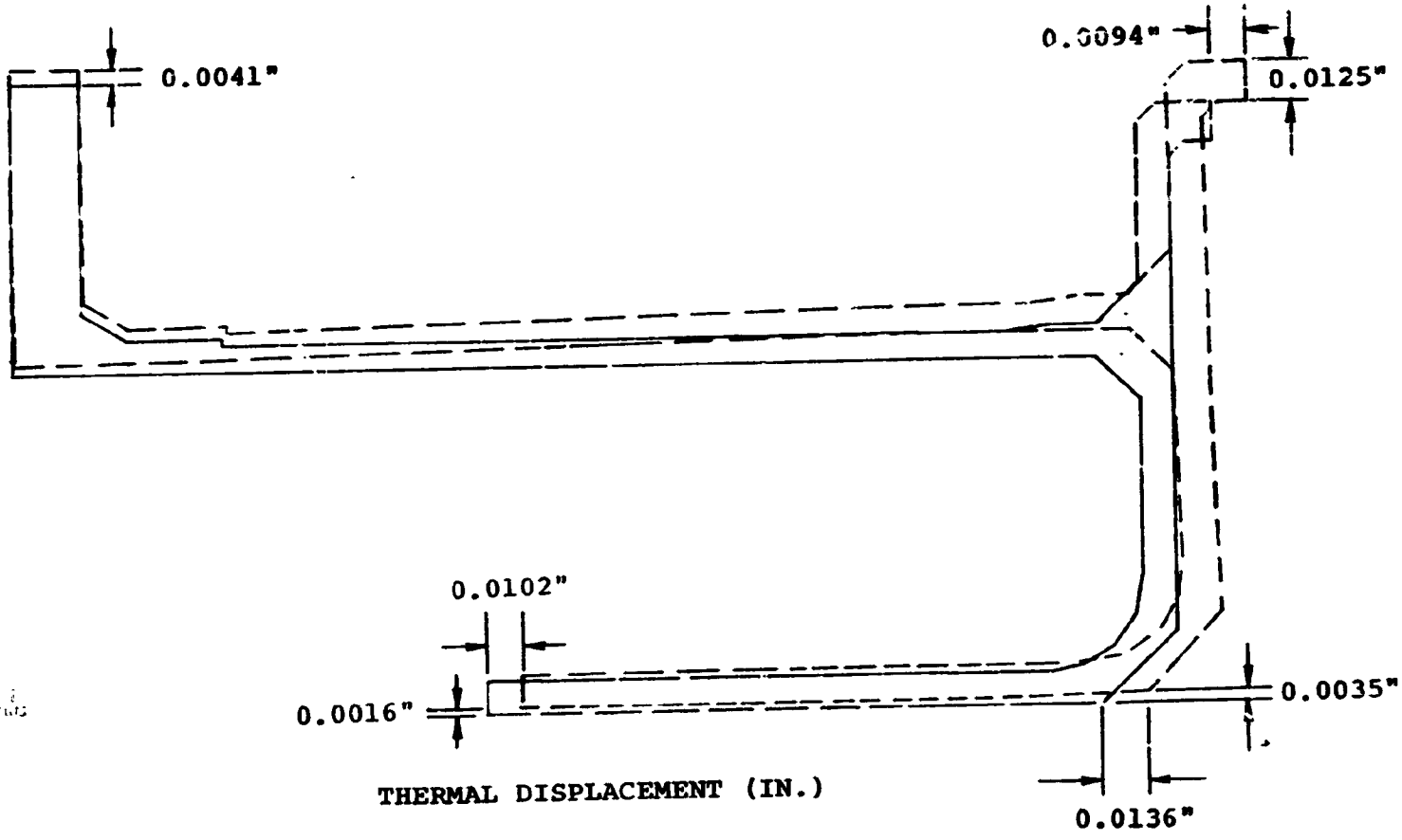
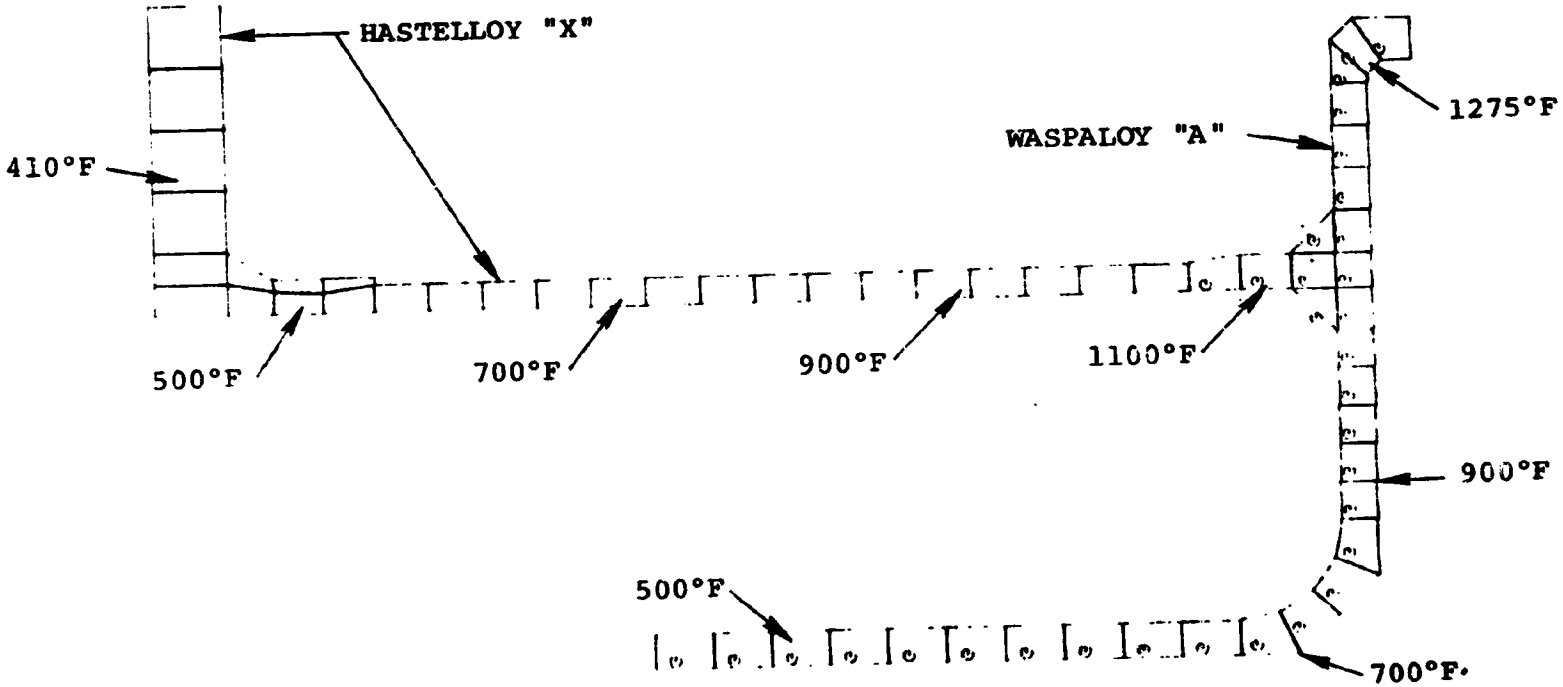


Figure 366. - Turbine Back Shroud - Mini-BRU.



MATERIAL SELECTION AND TEMPERATURE DISTRIBUTION
PRESSURE ONLY PRODUCE HYDROSTATIC STRESS, NEGLECTED

Figure 367. - Turbine Back Shroud - Mini-BRU.

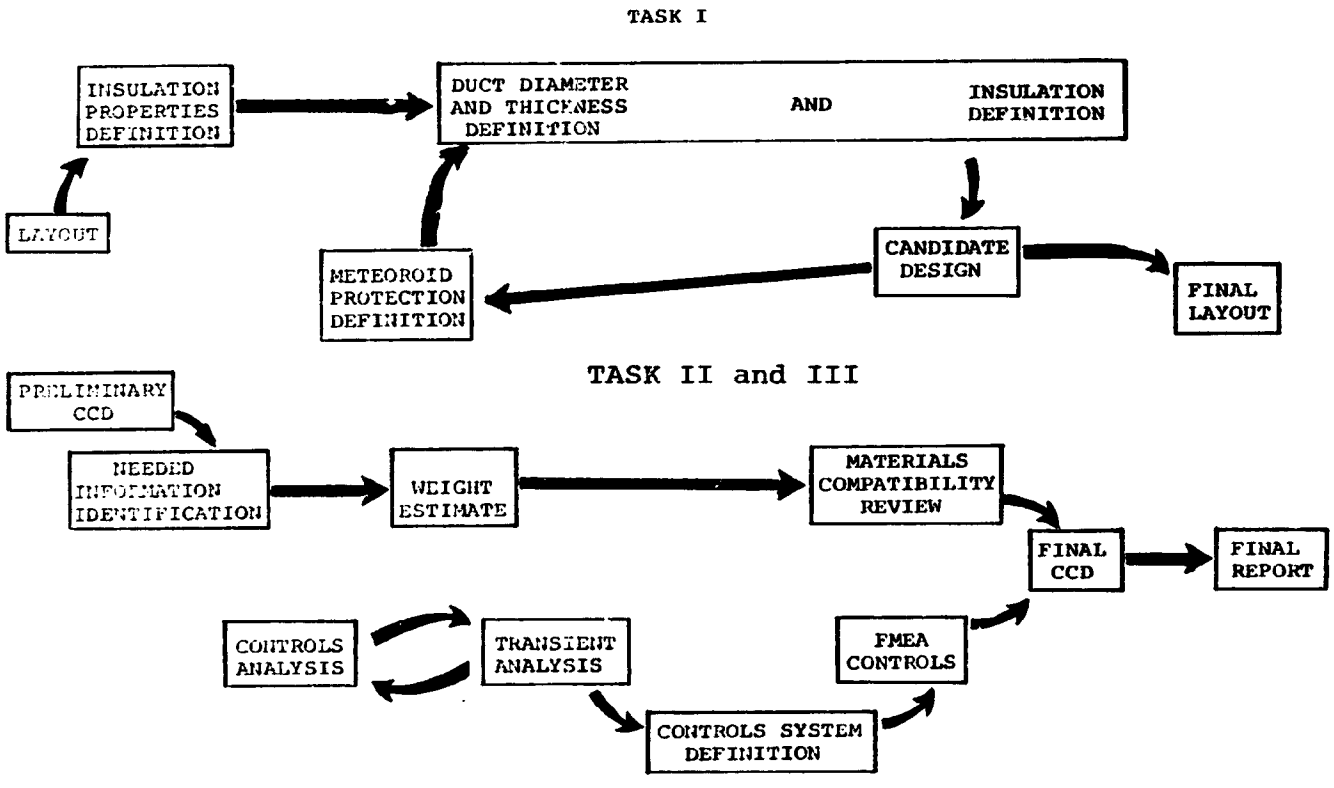


Figure 368. - Logic Network for Tasks I, II and III.

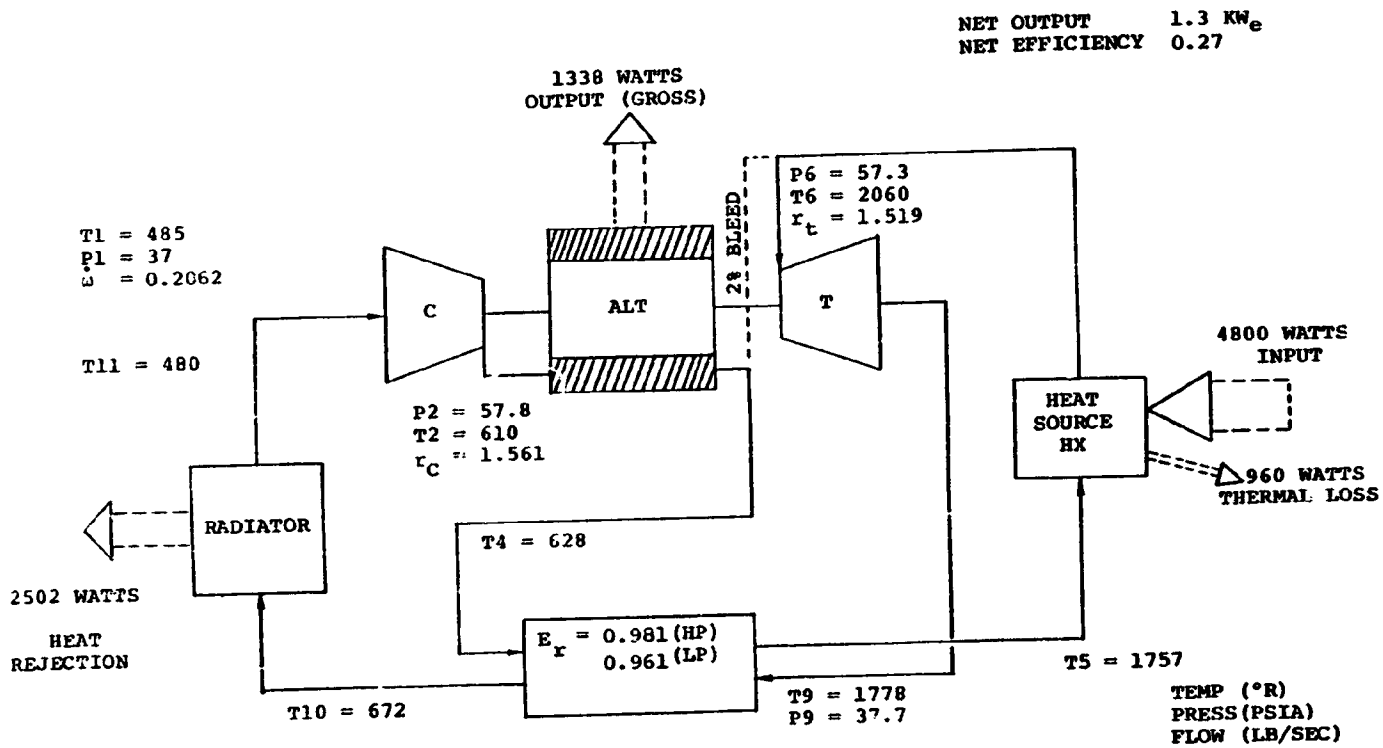
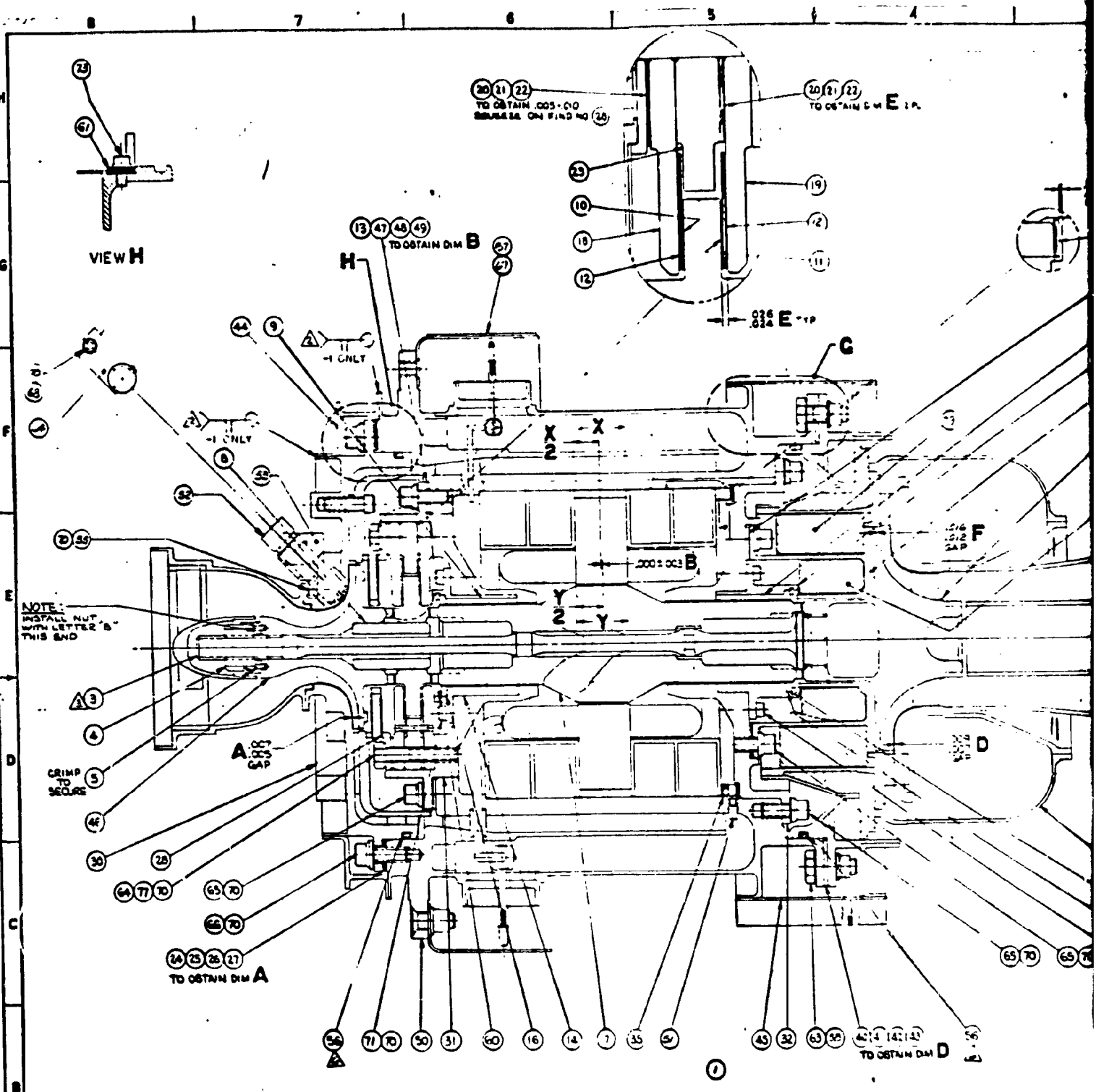


Figure 369. - GDS at 4800 w_t.



8. LEAKAGE FROM EACH WELD COMPLETED ON THIS ASSEMBLY NOT TO EXCEED 1 x 10⁻⁶ SCC/SEC OF HELIUM AT ROOM TEMP

9. RADIOGRAPHIC INSPECT WELDS PER MIL-STD-453 RADIOGRAPHIC SENSITIVITY (2-2T) FOR PORES UNDER 0.010 INCH IN SIZE WITH A MAXIMUM INDICATION SIZE NOT GREATER THAN 10% OF METAL THICKNESS OR 0.04 INCH WHICHEVER IS LESS. INCLUSION SPACING SHALL NOT BE LESS THAN THREE (2) TIMES THE METAL THICKNESS AND TO TOUCH THAN THREE (3) INCLUSIONS PER INCH

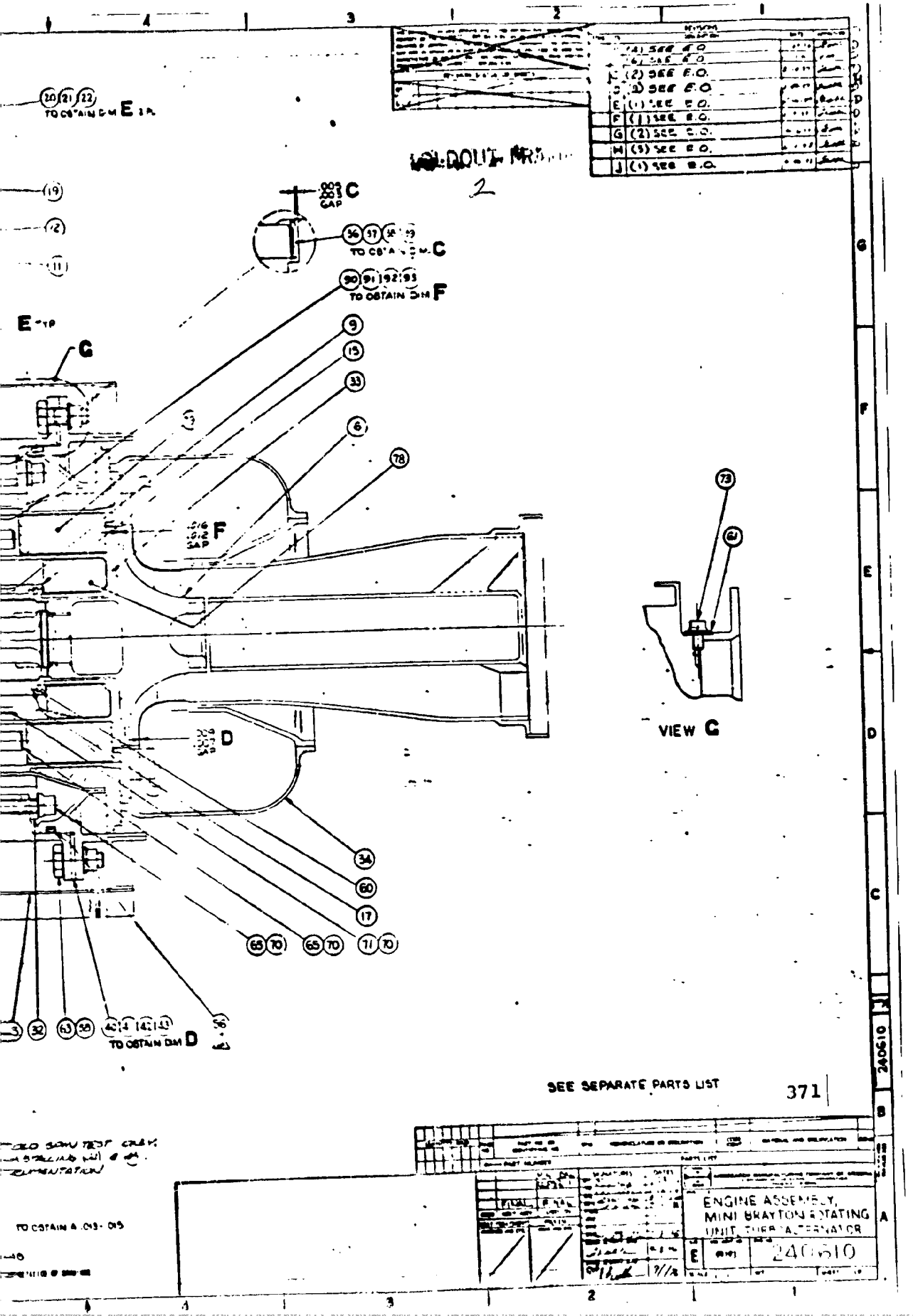
FIND (A) USED FOR COLD SPIN TEST ONLY. REMOVE (A) PRIOR TO INSTALLING (A) & (B).

4. SEE ABOVE FOR INSTRUMENTATION SCHEMATIC.

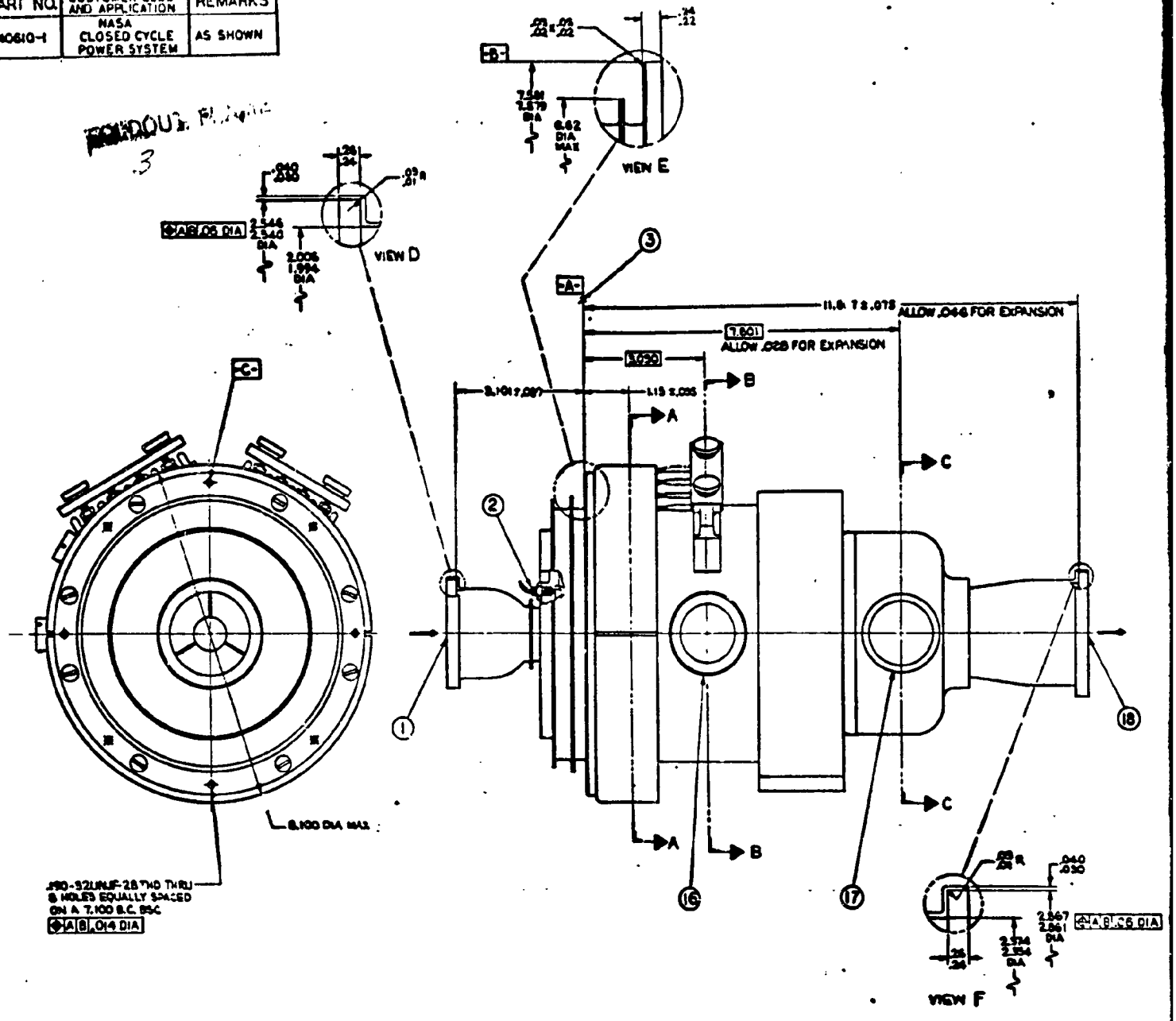
3. APPLY A SOLID TIE BOLT LOAD TO OBTAIN A .013-.015 STRETCH OF FIND NO. (3)

7. WELD PER AIRESEARCH WES 5018

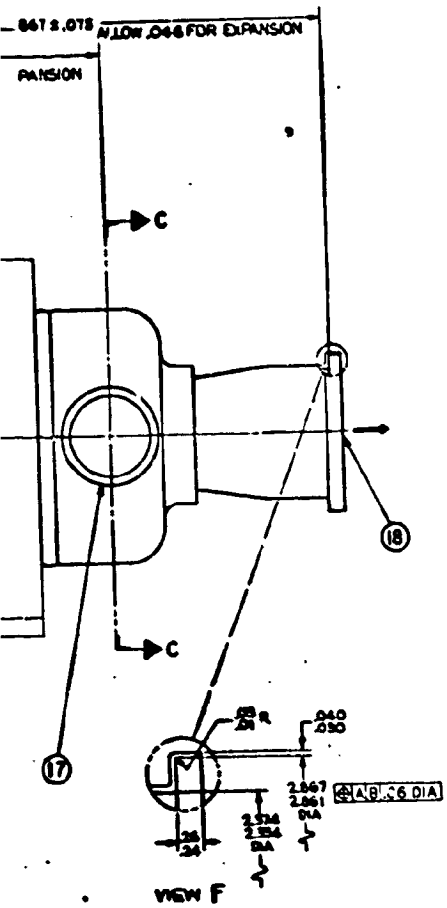
1. [illegible]


TO OBTAIN DIM E
TO OBTAIN DIM C
TO OBTAIN DIM F
TO OBTAIN DIM D
VIEW C
SEE SEPARATE PARTS LIST
371
ENGINE ASSEMBLY, MINI BRAYTON ROTATING UNIT THERMOELECTRIC ALTERNATOR
240610

PART NO.	CUSTOMER CODE AND APPLICATION	REMARKS
2406610-1	NASA CLOSED CYCLE POWER SYSTEM	AS SHOWN



1. ALL TERMINALS LOCATED A B C .10 DIA
2. MAXIMUM ENGINE WEIGHT AS SHOWN 36.10 LBS. (CALC.)
3. OVERALL ENGINE SIZE:
   LENGTH 15.65 MAX COLD
   WIDTH 8.30 MAX COLD
   HEIGHT 8.90 MAX COLD
4. MOUNT SURFACE SHALL BE USED FOR HANDLING
5. SEE 3604380 FOR INSTRUMENTATION SCHEMATIC
6. SEE PL 2406610 FOR ENGINE ASSEMBLY PART NUMBER
7. ALL DIMENSIONS ARE COLD UNLESS OTHERWISE SPECIFIED
8. FORM/POSITION TOLERANCING PER A RESEARCH SC 6000



ITEM	NAME	DESCRIPTION	ZONE
18	TURBINE EXHAUST	SEE VIEW F	1/D3
17	TURBINE INLET	2 PORTS SEE SECTION C-C	1/C5
16	COMPRESSOR DISCHARGE	2 PORTS SEE SECTION B-B	1/C5
15	TB2-4 TERMINAL	NO. 6-32 STUD SEE WIRING DIAGRAM	2/F5
14	TB2-3 TERMINAL	↕	2/F4
13	TB2-2 TERMINAL	↕	2/F4
12	TB2-1 TERMINAL	NO. 6-32 STUD	2/E4
11	TB1-4 TERMINAL	NO. 8-32 STUD	2/E6
10	TB1-3 TERMINAL	↕	2/F6
9	TB1-2 TERMINAL	↕	2/F5
8	TB1-1 TERMINAL	NO. 8-32 STUD SEE WIRING DIAGRAM	2/F5
7	PS2 STATIC PRESSURE	SEE SECTION A-A	2/F7
6	PS1 STATIC PRESSURE	SEE SECTION A-A	2/C8
5	J2 THERMOCOUPLE CONNECTOR 4	CONN. CONFORMING TO MS3113-12C10PW MOD. (ALUMEL-CHROMEL PINS) SEC A-A	2/D8
4	J1 THERMOCOUPLE & FLUX COIL CONN. 4	CONN CONFORMING TO MS3113-22C10P MOD. (ALUMEL-CHROMEL PINS) SEC A-A	2/F8
3	ENGINE MOUNT SURFACE	SEE VIEW E	1/G5
2	SHAFT SPEED SENSORS	3 EQUALLY SPACED	1/E6
1	COMPRESSOR INLET	SEE VIEW D	1/D7

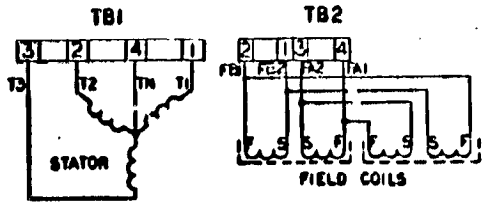
INSTALLATION CONNECTIONS

.10 DIA
OWN 36.10 LBS. (CALC)

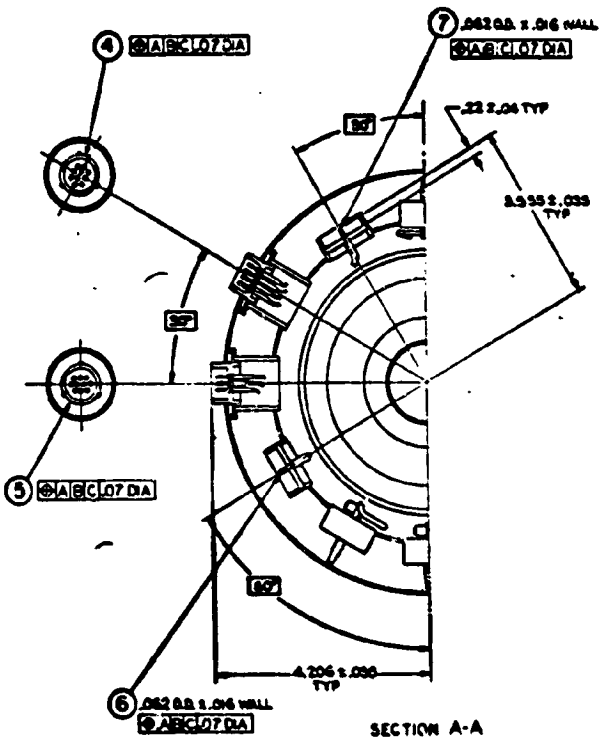
FOR HANDLING
TION SCHEMATIC
MBLY PART NUMBER
OTHERWISE SPECIFIED
AIRESEARCH SC 6000

ENGINE INSTALLATION, MINI BRAYTON ROTATING UNIT, TURBOALTERNATOR

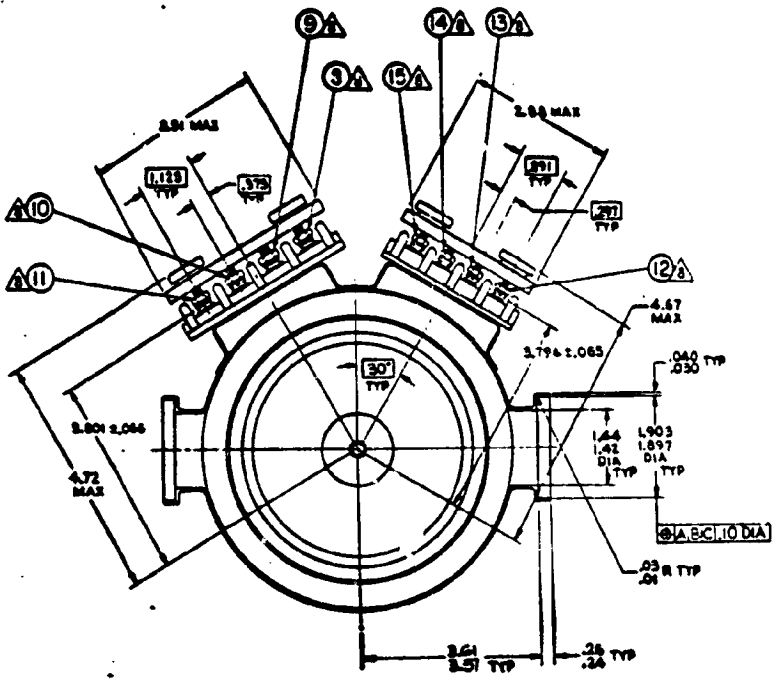
E | 240611



WIRING DIAGRAM

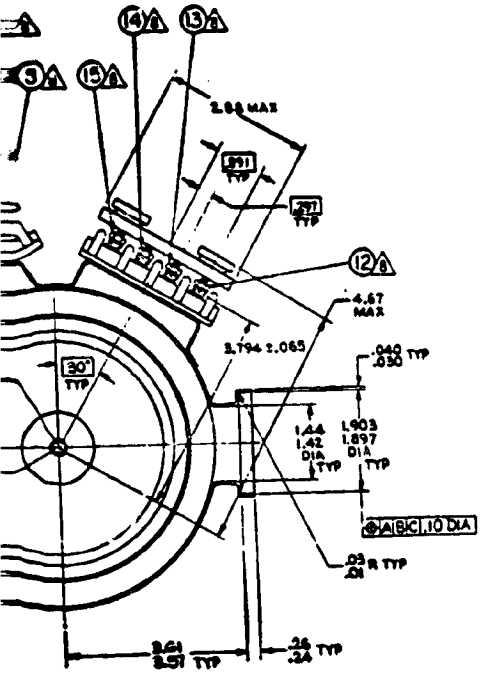


SECTION A-A

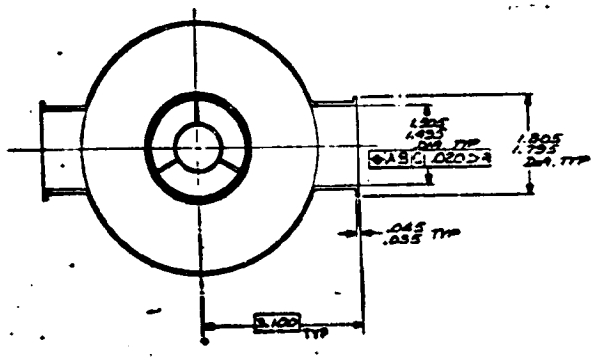


SECTION B-B

6

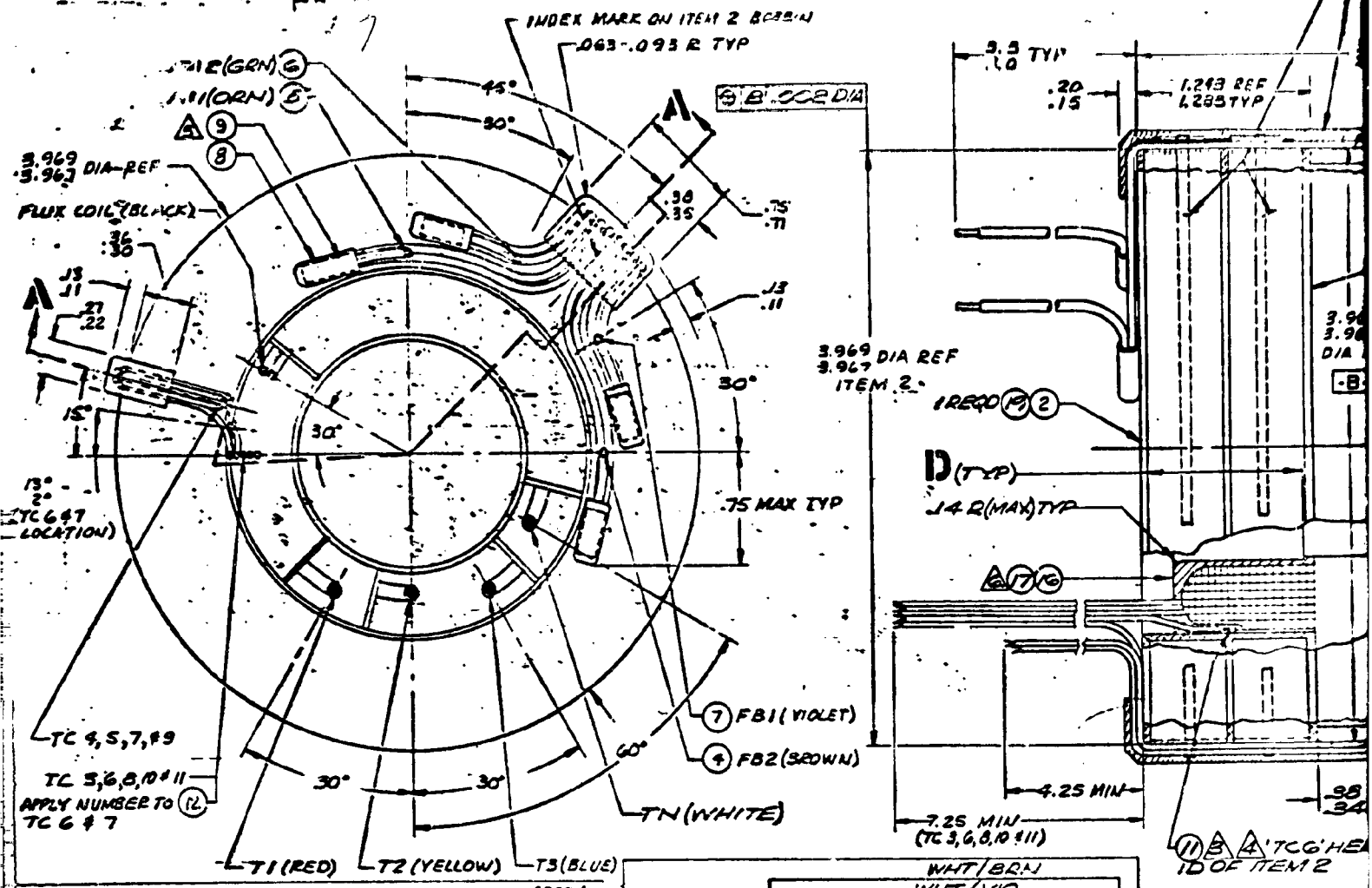


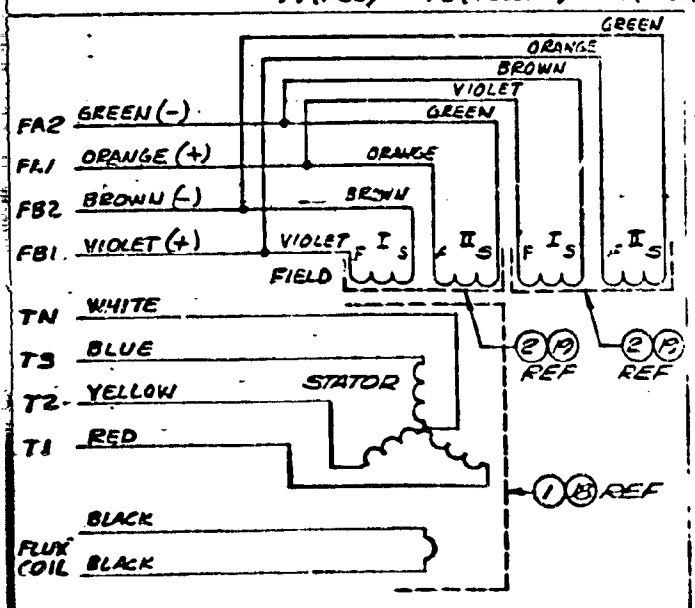
SECTION B-B



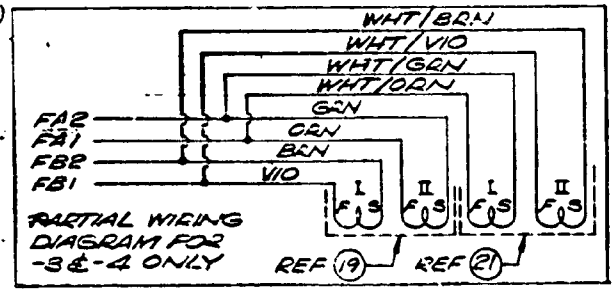
SECTION C-C

240611





WIRING DIAGRAM
STATOR FOR -1,-2,-3 & -4 FIELD FOR -1 & -2 ONLY

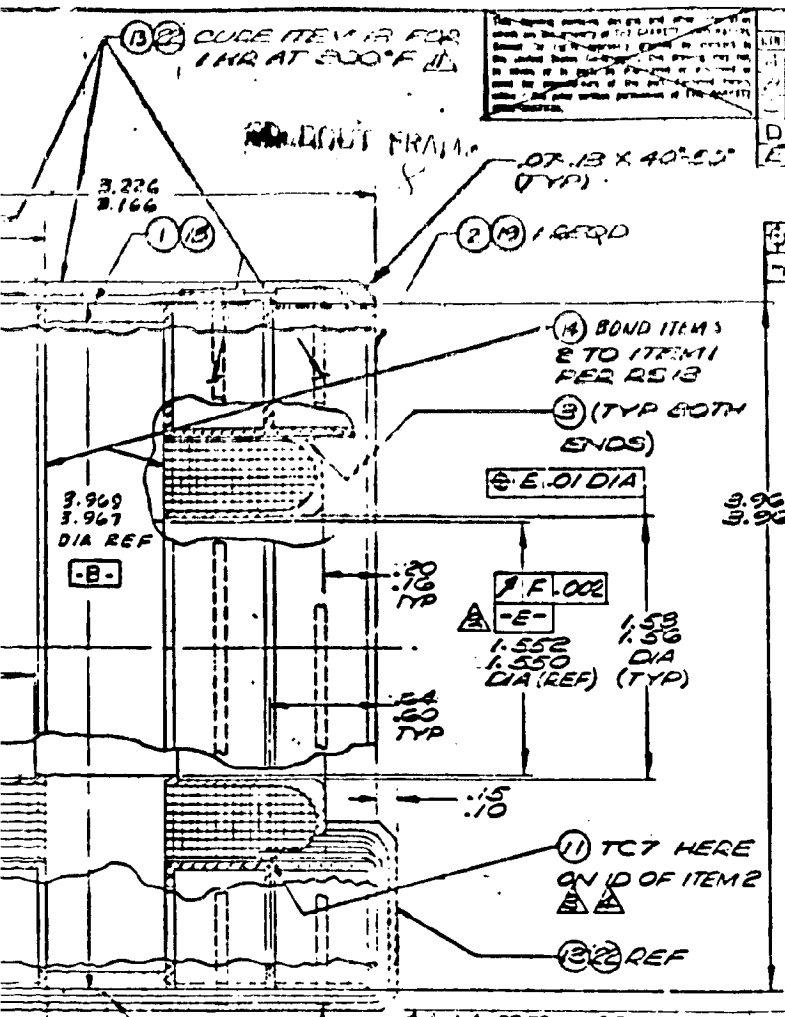


PARTIAL WIRING DIAGRAM FOR -3 & -4 ONLY

3. DATUM DIA -E- MUST BE FREE OF ALL PROCESS (ITEM 16) RESIDUE
3. BAKE COMPLETED FIELD & STATOR ASSY FOR 1 HOUR AT 450° ± 10°F (SEE TAB.)
4. INSULATION SIZE OPTIONAL BASIC CALLOUT FOR MATL PROCUREMENT PURPOSES ONLY
6. ENCAPSULATE PER AIRESEARCH SPEC RS171
5. CRIMP ITEM 9 ONTO WIRES TO MAKE ELECT. SPLICE.

4. ADHESIVE BOND TC JUNCTION TO SURFACE OF ITEMS 2 WITH ITEM 15 & 2
3. INSULATE BARE TC JUNCTION BY HALF-LAP WRAP WITH ITEM 10
2. THERMO-ELECTRIC CO, SADDLEBROOK, N.J.
1. VENDOR ITEM - SEE SPEC OR SOURCE CONTROL DRAWING.

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
D	SEE E.O.		
C	SEE ENGINEERING CHANGE		

PART NUMBER	D	PROCESS
2045425-1	1.14-1.17	6 & 8
2045425-2	1.243	
2045425-3	1.233	
2045425-4		6 & 10

TORRANCE

QTY REQD	ITEM NO	CODE IDENT NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SYM
	23	2401	29-22-9001	COMPOUND (RELEASE AGENT - RAM 225)	
	22		SPR-017900N	FAVES	
1	21		2045431-3	FIELD ASSY	
	20			LACING TAPE MILT-43435, TYPE V, FINA, SIZE 3	
1	19		2045431-2	FIELD ASSY	
1	18		2045432-2	STATOR ASSY	
	17		243-002-9001	CATALYST (NO. 11)	6
	16		29116-9001	COMPOUND (STYCAST 2850FT)	6
	15		RS 184 C01	ADHESIVE (RTV)	
	14		105-070-9001	ADHESIVE (2214 ECOTHANELD)	
	13		RS 85 E 03	COMPOUND, POTTING	
	12		493-001-9301	LABEL	
	11	99195	MFD-30-K	WIRE, THERMOCOUPLE NO 30 CA DUPLEX KAPTON	
	10		722-022-0 01	TAPE (KAPTON)	
	9		672 503-9001	SPLICE	
	8		59051-19-003	INSULATION SLEEVING	
1	7		5833G-5-42A	WIRE (WHITE) NO. 20 AWG	
1	6		5833G5S-42A	WIRE (GRN)	
1	5		5833G5E-42A	WIRE (GRN)	
1	4		5833G15-42A	WIRE (GRN) NO. 20 AWG	
2	3		SCREW HEX OUT	(NOT SHOWN)	
	2		[illegible]	FIELD ASSY	
	1		[illegible]	STATOR ASSY	

← ASSY

PARTS LIST

UNLESS OTHERWISE SPECIFIED (NOT CONTROL PER SCHD)
DEMAGNETIZATION MARKING PER
STD INTERPRETATIONS PER PHDS

AIRESEARCH MANUFACTURING COMPANY OF CALIFORNIA
A DIVISION OF THE GARRETT CORPORATION
TORRANCE, CALIFORNIA

FIELD & STATOR ASSY, ALTERNATOR, MINI-BRU

SIZE	CODE IDENT NO	DWG NO
D	70210	2045425

SCALE 2/1 SHEET 1 OF 1

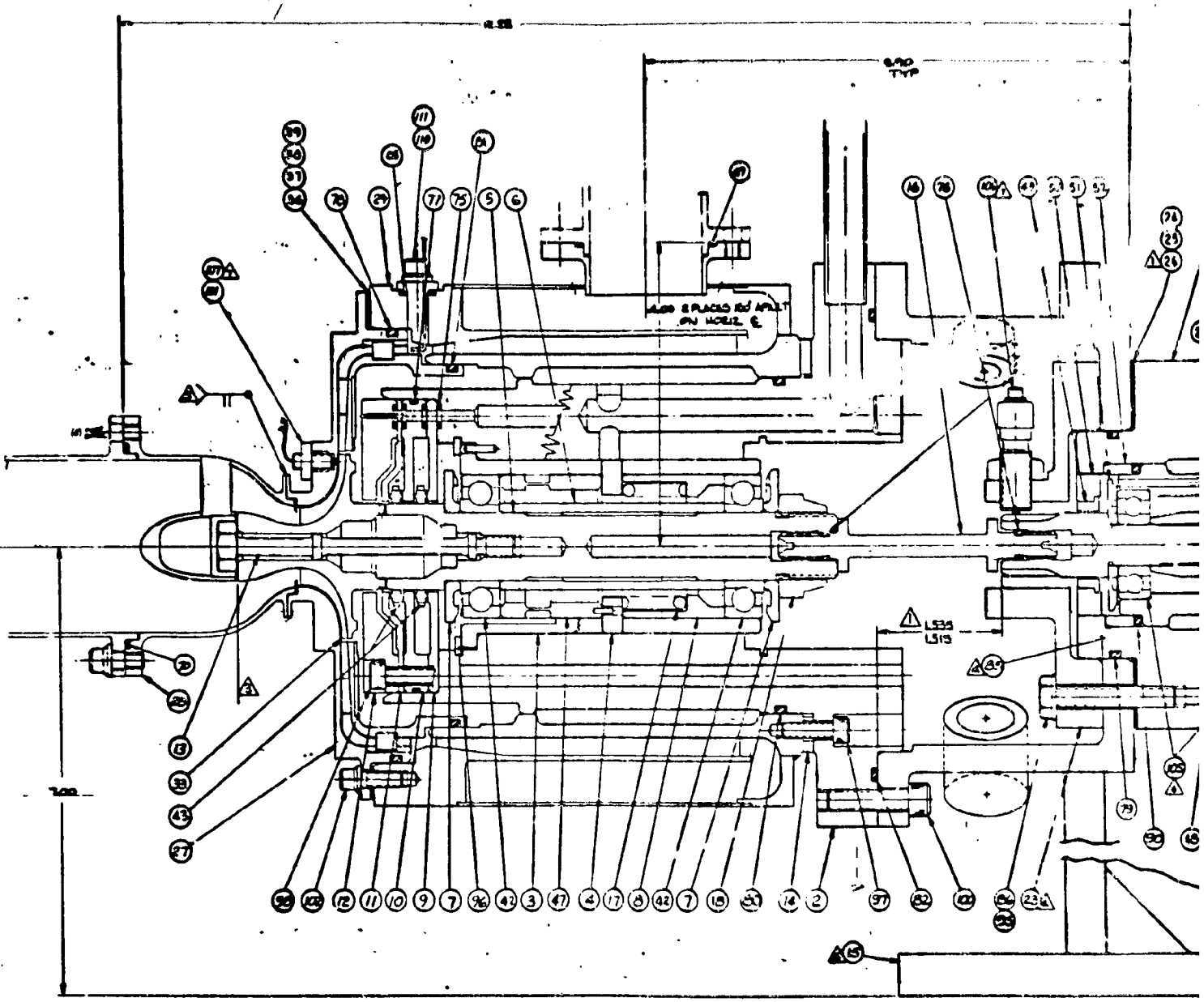
REQD	NEXT ASSY	USED ON

APPLICATION

TABULATED

MICROFILMED REDUCED SIZE

2045425



MACHINE NOTED SURFACE TO OBTAIN .050 REF DIMENSION

MAY BE PURCHASED FROM: AEROQUIP CORP. 12 HEXPOSITION BLVD., LOS ANGELES, CA 90064

MAY BE PURCHASED FROM: ELECTRO PRODUCTS LABORATORIES INC., 6125 W. HOWARD CHICAGO, IL 60645

MAY BE PURCHASED FROM: BARDEN CORP., 200 PARK AVE. DANBURY, CT 06810

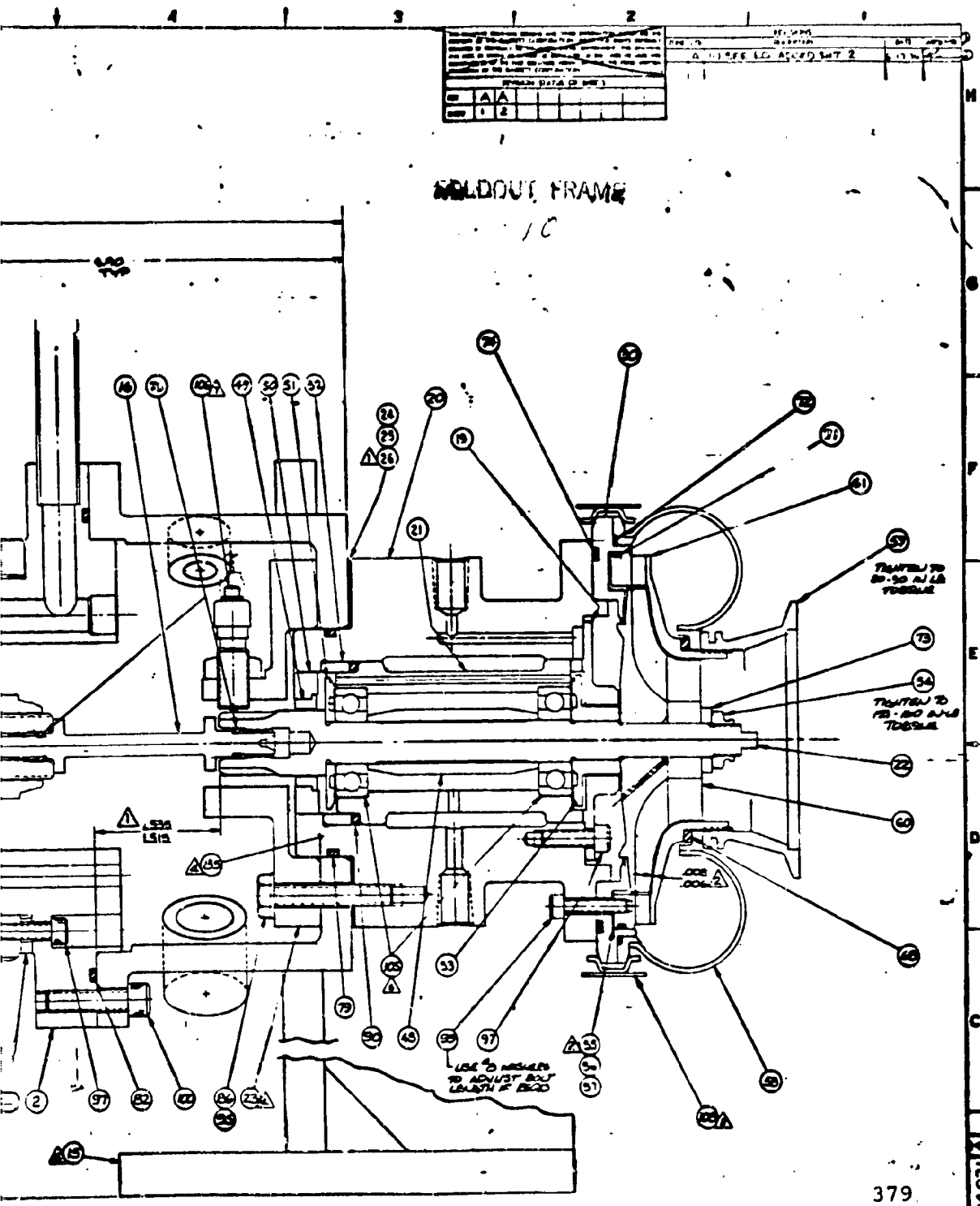
WELD PER AIRESEARCH WBS 9018

APPLY (13) COMPOUND TO FAYING SURFACES OF (19) STAND AND (20) SUPPORT PER AIRESEARCH RBS134

LUBRICATE UNDERSIDE OF HEX OF (13) TIE BOLT AND FACE OF (38) WHEEL PRIOR TO ASSEMBLY.

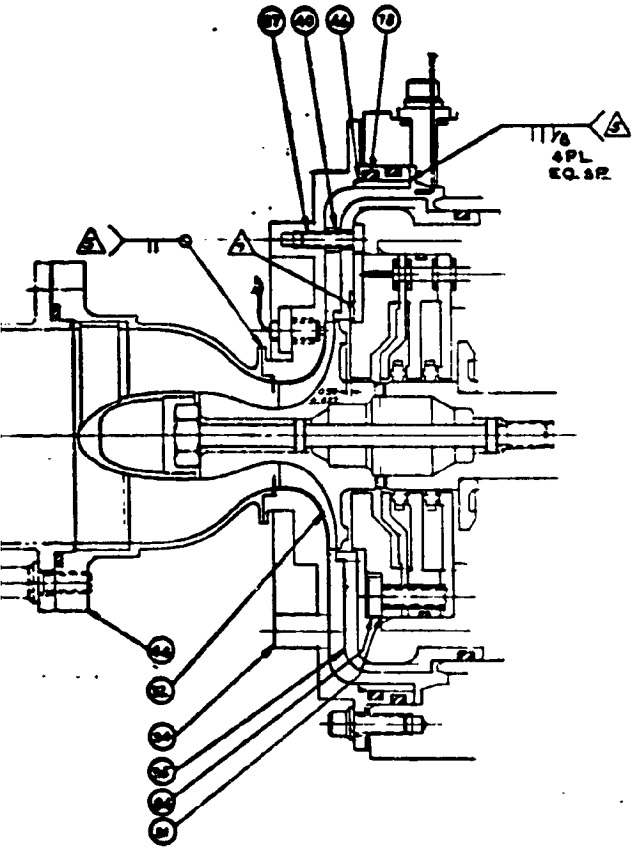
INSTALL (40) THRU (59) SHIMS TO OBTAIN .007 (REF) GAP BETWEEN (40) WHEEL AND (60) SHROUD.

INSTALL (24) (25) & (26) SHIMS TO OBTAIN 1.525 (REF) DIM FROM FACE OF (15) STAND TO END OF (22) SHAFT.


MOLDOUT FRAME
1C
379
SEE SEPARATE PARTS LIST
COMPRESSOR TEST RIG
ASSEMBLY - MINI BRU
3604021

FOLDOUT FRAME

12



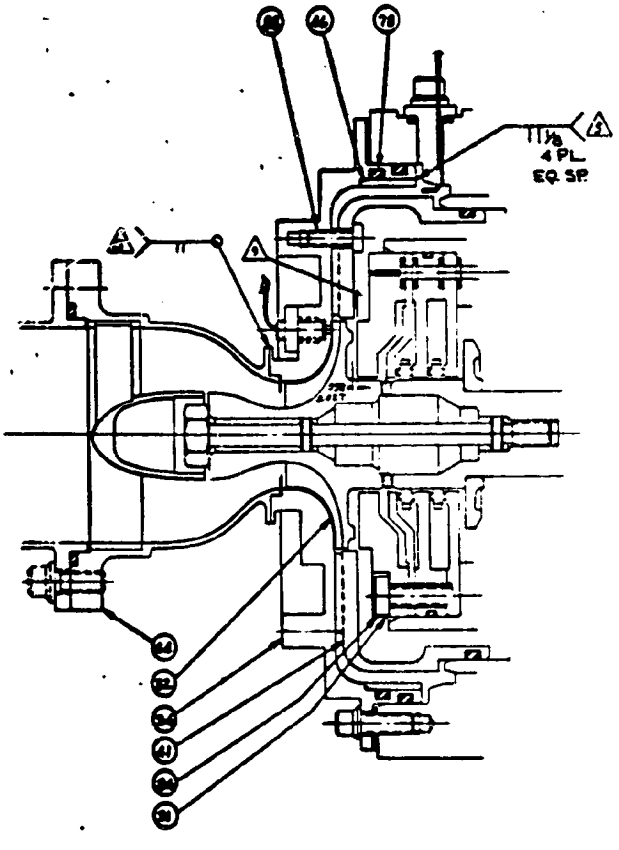
VANELESS DIFFUSER

3604021-2

SAME AS -1 EXCEPT AS SHOWN

ASSEMBLE VANELESS DIFFUSER (3605367-1) TO DIFFUSER SHROUD (3605366-1) WITH 2 1/8 REF DIA OF DIFFUSER [illegible] ON SHROUD

CIRCULAR



VANE DIFFUSER

3604021-3

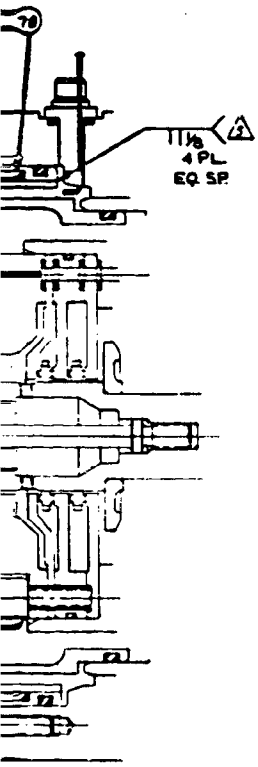
SAME AS -1 EXCEPT AS SHOWN

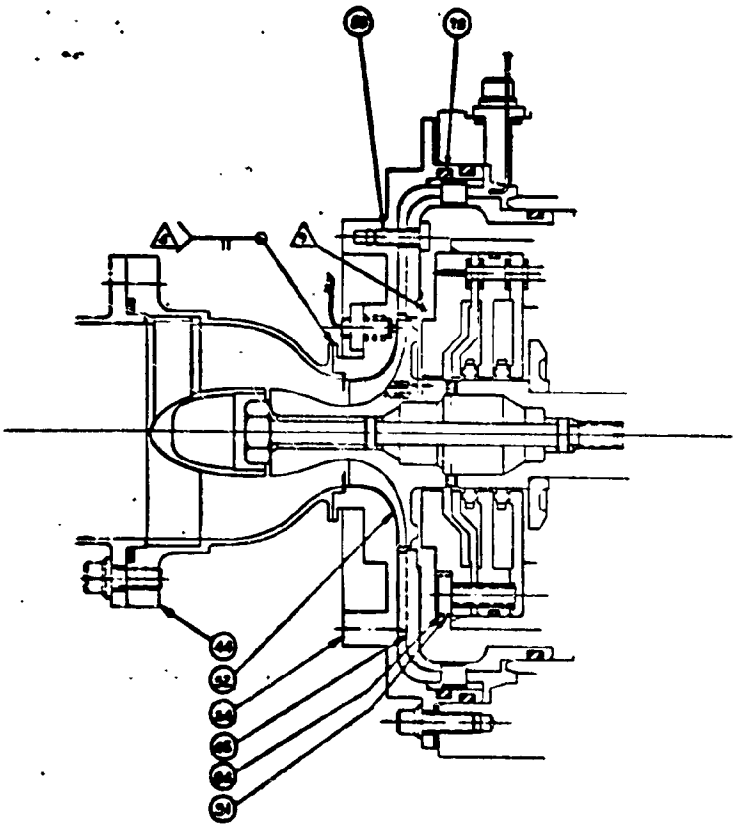
ASSEMBLE VANE DIFFUSER (3605366-1) TO DIFFUSER SHROUD (3605366-1) WITH 2 1/8 REF DIA OF DIFFUSER [illegible] ON SHROUD

CIRCULAR

FOLDOUT FRAME

13





DIFFUSER

3021-3

AS -1 EXCEPT AS SHOWN

VANE DIFFUSER WITH DESWIRL VANES

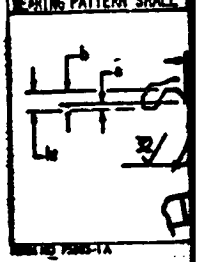
3604021-4

SAME AS -1 EXCEPT AS SHOWN

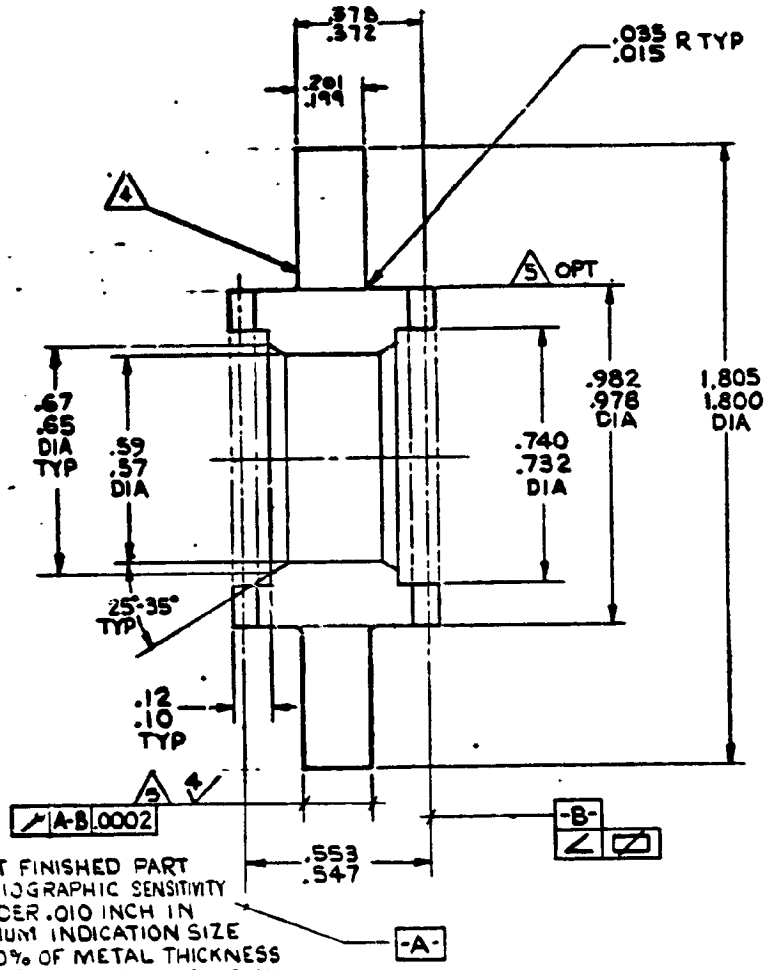
3604021

PART NUMBER
3604334-1

FIXED CURVIC® CO
NUMBER OF TEETH
PRESSURE ANGLE
DIAMETRAL PITCH
ADDENDUM
DEDENDUM
WHOLE DEPTH AT DEEPEST
TOOTH THICKNESS AT OD
THICKNESS AT MIDPOINT
HEIGHT OF TOOTH CHAMF
ROOT FILLET RADIUS
WHEN STACKED BETWEEN P
RUNOUT BETWEEN CONTROL
RUNOUT BETWEEN CONTROL
TOOTH BEARING PATTERN SHALL BE VISIBLE ON BOT BEARING PATTERN SHALL



14



8. RADIOGRAPHIC INSPECT FINISHED PART PER MIL-STD-453. RADIOGRAPHIC SENSITIVITY (2-2T) FOR PORES UNDER .010 INCH IN SIZE WITH A MAXIMUM INDICATION SIZE NOT GREATER THAN 20% OF METAL THICKNESS OR 0.04 IN. WHICHEVER IS LESS. INCLUSION SPACING SHALL NOT BE LESS THAN THREE (3) TIMES THE METAL THICKNESS AND NO MORE THAN THREE (3) INCLUSIONS PER INCH.

7. IDENTIFICATION AND TRACEABILITY REQUIRED. LOT CONTROL TO BE ESTABLISHED WITH RAW MATERIAL PER AIRESEARCH MC-5014.

6. IDENTIFY PACKAGING WITH AIRESEARCH PART NO., LOT NO. AND ACCEPTANCE STAMP.

5. CARBURIZE NOTED SURFACES PER AIRESEARCH HT 5042, TYPE II, CL 3. CASE DEPTH .015-.020 CORE HARDNESS R_C 33-43.

4. MARK PART NO., AND LOT NO. PER AIRESEARCH MC 5014, CLASS II A.

3. CLEAN PER AIRESEARCH AF 5465

2. 125 ALL OVER

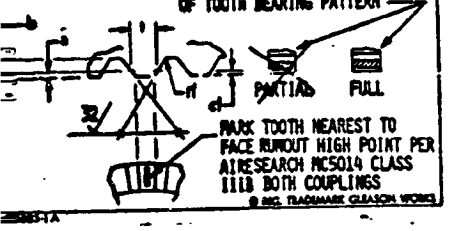
1. SHALL CONFORM TO AIRESEARCH SC5001 MACHINED FEATURES

CRITICAL ITEM

XED CURVIC® COUPLING DATA		A CONCAVE	B CONVEX
TEETH		10	
ANGLE		30°	
PITCH		10.20000P	
	a	.092.096	
	b	.053 REF	REF
TH AT DEEPEST POINT	h	.084.090	
ICKNESS AT OD	t	.1549 REF	—
S AT MIDPOINT OF TOOTH		—	REF
F TOOTH CHAMFER	d	.005 MAX	
LET RADIUS	d	.005:.015	
CKED BETWEEN MATING CONTROL COUPLINGS			
TWEEN CONTROL COUPLING DIAMETERS		.0002 TOTAL	
ETWEEN CONTROL COUPLING FACES		.0002 TOTAL	
ARING PATTERN AS SHOWN		FULL	

VISIBLE ON BOTH SIDES OF 9 TEETH MIN. LACK OF PATTERN SHALL NOT OCCUR ON ANY TWO ADJACENT TEETH.

APPROXIMATE SHAPE AND LOCATION OF TOOTH BEARING PATTERN



® REG. TRADEMARK GLEASON WORKS

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REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPROVED
A	(4) SEE EO	11-5-70	

WHEEL CUT FINISH

15

SEE TABULATION BLOCK (UPPER LEFT CORNER) FOR PART NUMBER.

383

QUANTITY REQD	FIND NO	PART NO OR IDENTIFYING NO	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
						STL AMS 6260	
	← PART NUMBER			PARTS LIST			

		MIN BRU	
		CCPS 2-1	
1(-1)	FINAL	364297	
1(-1)	240611-1	240610-1	
REQD	NEXT ASSY	USED ON	

HEAT TREATMENT	PROCESS
HARDNESS AND SPEC	NAME AND SPEC
5	

SIGNATURES	DATES
DFT Boeing	8-19-74
CHK	8-27-74
WT ENG	8-27-74
WT PROJ	8-27-74
TRIFIT	
MRB	
MRB	
MFG ENGINEERING	9-6-74
DESIGN ENGINEERING	9-4-74
OTHER ACTIVITY AND CODE	4/2/76

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX ARIZONA

DWG TITLE

ROTOR, THRUST

SIZE	CODE IDENT NO	DWG NO
D	99193	3604334

SCALE 4/1 | WT | SHEET — OF —

3604334 A

MICROFILMED REDUCED BLK

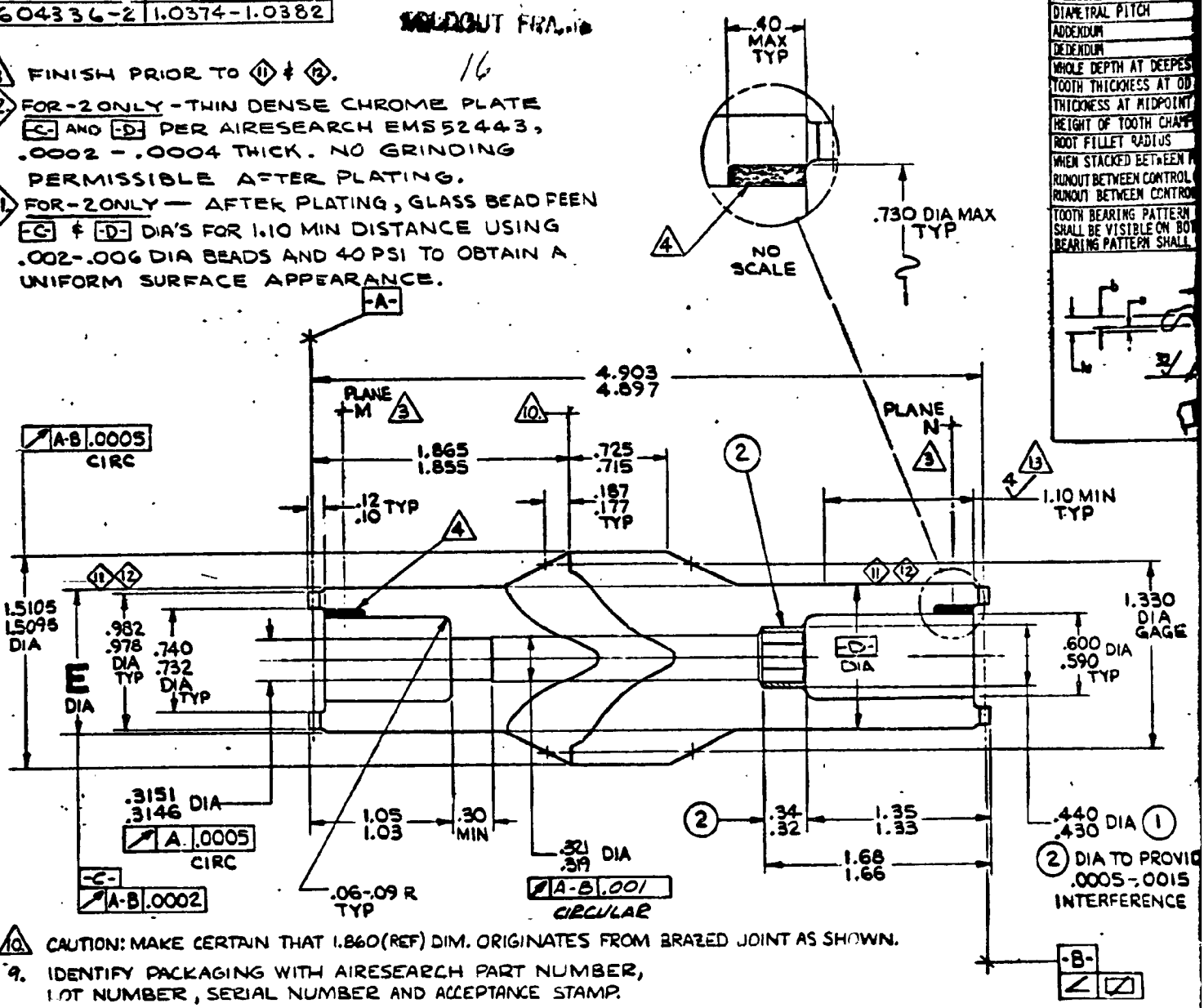
PART NUMBER	E
3604336-1	1.0378-1.0382
3604336-2	1.0374-1.0382

LAYOUT FRAME 16

13. FINISH PRIOR TO 11 & 12.

12. FOR-2 ONLY - THIN DENSE CHROME PLATE -C- AND -D- PER AIRESEARCH EMS52443, .0002 - .0004 THICK. NO GRINDING PERMISSIBLE AFTER PLATING.

11. FOR-2 ONLY — AFTER PLATING, GLASS BEAD PEEN -C- & -D- DIA'S FOR 1.10 MIN DISTANCE USING .002-.006 DIA BEADS AND 40 PSI TO OBTAIN A UNIFORM SURFACE APPEARANCE.



10. CAUTION: MAKE CERTAIN THAT 1.860(REF) DIM. ORIGINATES FROM BRAZED JOINT AS SHOWN.

9. IDENTIFY PACKAGING WITH AIRESEARCH PART NUMBER, LOT NUMBER, SERIAL NUMBER AND ACCEPTANCE STAMP.

8. CLEAN PER AIRESEARCH C5041. PACKAGE IN CLEAN DRY CONTAINER.

7. IDENTIFICATION AND TRACEABILITY REQUIRED. LOT CONTROL TO BE ESTABLISHED WITH RAW MATERIAL AND USE SERIALIZATION PREVIOUSLY ESTABLISHED ON FIND NO. 1.

6. SIMILAR TO 3604295.

5. MARK PART NUMBER, LOT NUMBER AND SERIAL NUMBER PER AIRESEARCH MC5014, CLASS IIB.

4. ALL AREAS WHERE MATERIAL HAS BEEN REMOVED FOR BALANCING MUST FAIR SMOOTHLY AND HAVE 63 CORNERS MUST HAVE .015 R MIN. DO NOT REMOVE MATERIAL DEEPER THAN SHADED AREAS.

3. DYNAMICALLY BALANCE ON -C- & -D- TO AN ACCURACY OF .0021 OZ. IN. IN PLANE M ACCURACY OF .0020 OZ. IN. IN PLANE N

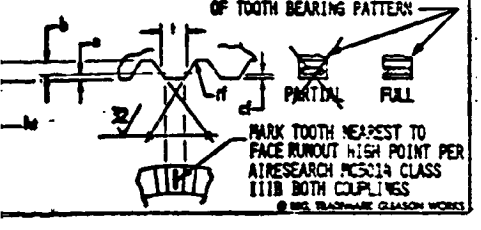
2. 125 ALL OVER

1. SHALL CONFORM TO AIRESEARCH SC6001 MACHINED FEATURES

CRITICAL ITEM

FIXED CURVIC COUPLING DATA		CONCAVE	CONVEX
BER OF TEETH			10
SSURE ANGLE			30°
ETRAL PITCH			10.20408
NDUM	a		.032-.036
NDUM	b	REF	.053 REF
E DEPTH AT DEEPEST POINT	hs		.084-.090
TH THICKNESS AT OD	t	REF	—
KNESS AT MIDPOINT OF TOOTH		—	.1352 REF
GHT OF TOOTH CHAMFER	cf		.005 MAX
T FILLET RADIUS	rf		.005-.015
N STACKED BETWEEN MATING CONTROL COUPLINGS			
OUT BETWEEN CONTROL COUPLING DIAMETERS		.0006	
OUT BETWEEN CONTROL COUPLING FACES		.0002	
N BEARING PATTERN AS SHOWN			FULL

L BE VISIBLE ON BOTH SIDES OF 9 TEETH MIN. LACK OF RING PATTERN SHALL NOT OCCUR ON ANY TWO ADJACENT TEETH.

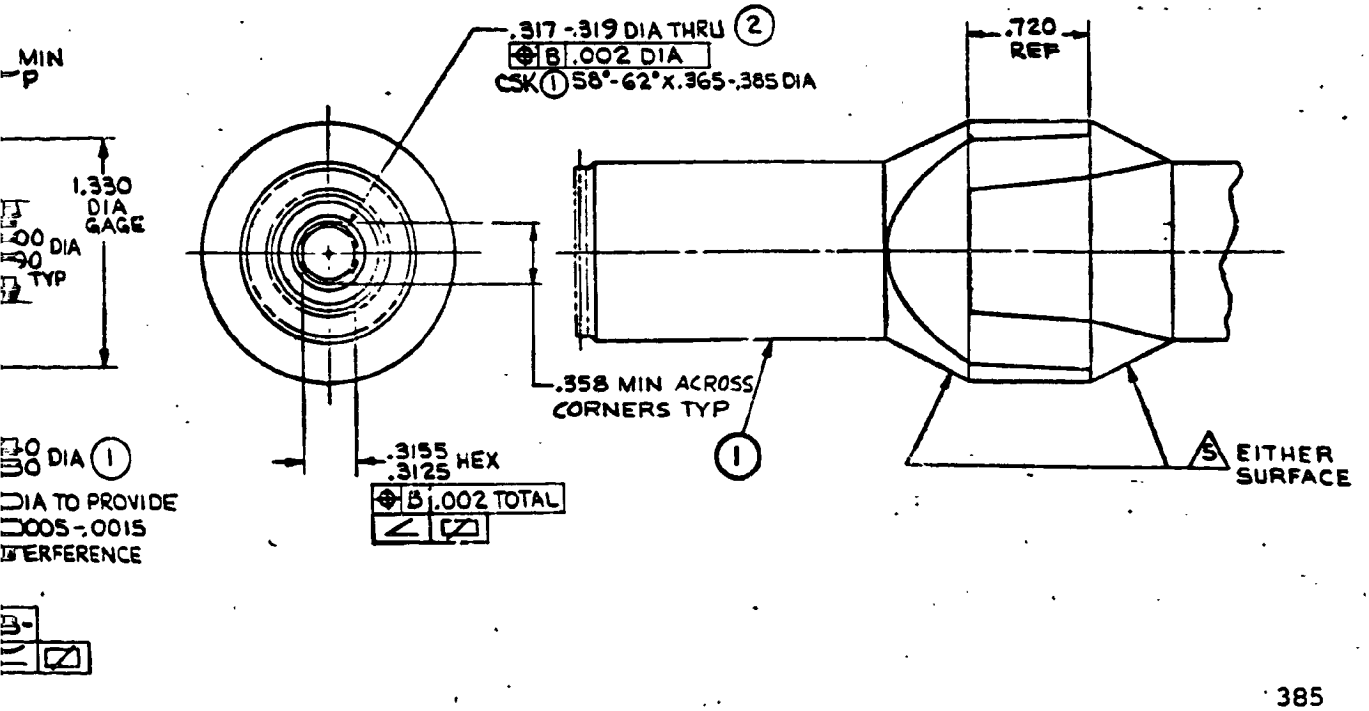


THE GARRETT CORPORATION

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
B8	A	(1) SEE E.O.	11-20-74	[illegible]
	B	(3) SEE E.O.	1-4-75	[illegible]
B6	C	(1) SEE E.O.	1-14-75	[illegible]
	D	(7) SEE E.O.	2/19/75	[illegible]
B2	E	(1) SEE E.O.	6/20/75	[illegible]
	F	(2) SEE E.O.	1-7-76	[illegible]
	G	(7) SEE E.O. ADDED - 2 PART	3/7/77	[illegible]
	H	(1) SEE E.O.	4-18-78	[illegible]

BLOWOUT FRAME

17



385

QUANTITY REQD		FIND NO.	PART NO OR IDENTIFYING NO.	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
1	1	2			INSERT		CRES 300 SERIES/QQ-S-763	
1	1	1			ROTOR		MAKE FROM 3604369-1	

-2-1 ← PART NUMBER

PARTS LIST

		MINI BRU
		CCPS 2-1
1(-1)	2406 10-1	2406 10-1
REQD	NEXT ASSY	USED ON
HEAT TREATMENT		PROCESS
HARDNESS AND SPEC		NAME AND SPEC

SIGNATURES	DATES
DFT Ewing	8-20-74
CHK [illegible]	9-13-74
MFG BY	9-20-74
MATL	
PROJECT	9-20-74
APPD	
APPD	
DESIGN ENGINEER	9-16-74
APPD	
APPD	9-3-74

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

ROTOR, ALTERNATOR

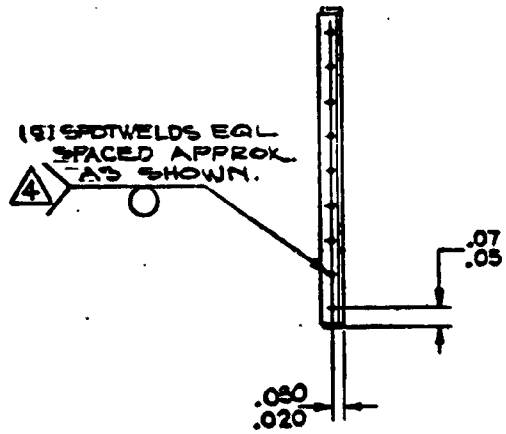
SIZE	CODE IDENT NO.	DWG NO.
D	99193	3604336

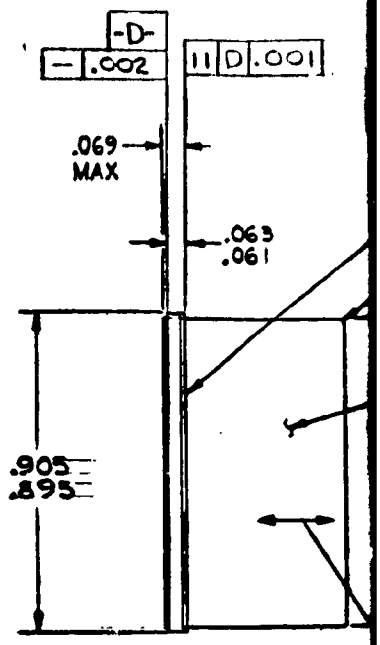
3604336

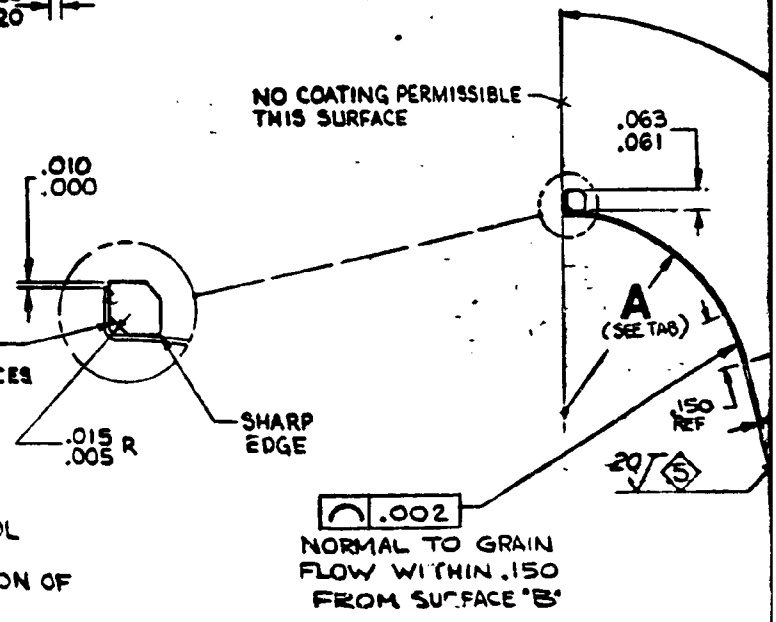
PART NUMBER	A RADIUS
3604338-1	.56-.58
3604338-2	.60-.62
3604338-3	.58-.60

[redacted]

18







11. CONTROL REQUIRED PER FABRICATION AND INSP. SPEC 31-2767.

10. SEE TL 3604338-901 REV. N/C. FOR FLAT PATTERN DATA WHEN PHOTO ETCH FABRICATION PROCESS IS USED.

9. VISUALLY INSPECT WELDS UNDER 20 x MAGNIFICATION. PITS, EXPULSIONS, CRACKS OR LINEAR INDICATIONS SHALL BE CAUSE FOR REJECTION.

8. IDENTIFICATION AND TRACEABILITY REQD. LOT CONTROL TO BE ESTABLISHED WITH MATERIAL. SERIALIZATION TO BE ESTABLISHED WITH COMPLETION OF PART. SERIALIZE SETS OF 8 AS S/N-1A, 1B, ETC.

7. HANDLING, INSPECTION & CLEANING SHALL BE IN ACCORDANCE WITH AIRESEARCH AF5465 AND PACKAGE IN COMPARTMENTED RIGID PLASTIC OR CARDBOARD CONTAINERS IN SETS OF 8.

6. MATERIAL TO BE TYPE 302, CONDITION 3/4 HARD MIN. 2D SURFACE FINISH PER MIL-S-5059.

5. COAT THIS SURFACE ONLY WITH TEFLON "S" .0009-.0012 THK PER AIRESEARCH AF5467 SURFACE FINISH APPLICABLE AFTER COATING.

4. WELD PER AIRESEARCH WBS5052, CL. A ANY CLEANING REQD SHALL BE IN ACCORDANCE WITH AIRESEARCH AF5453.

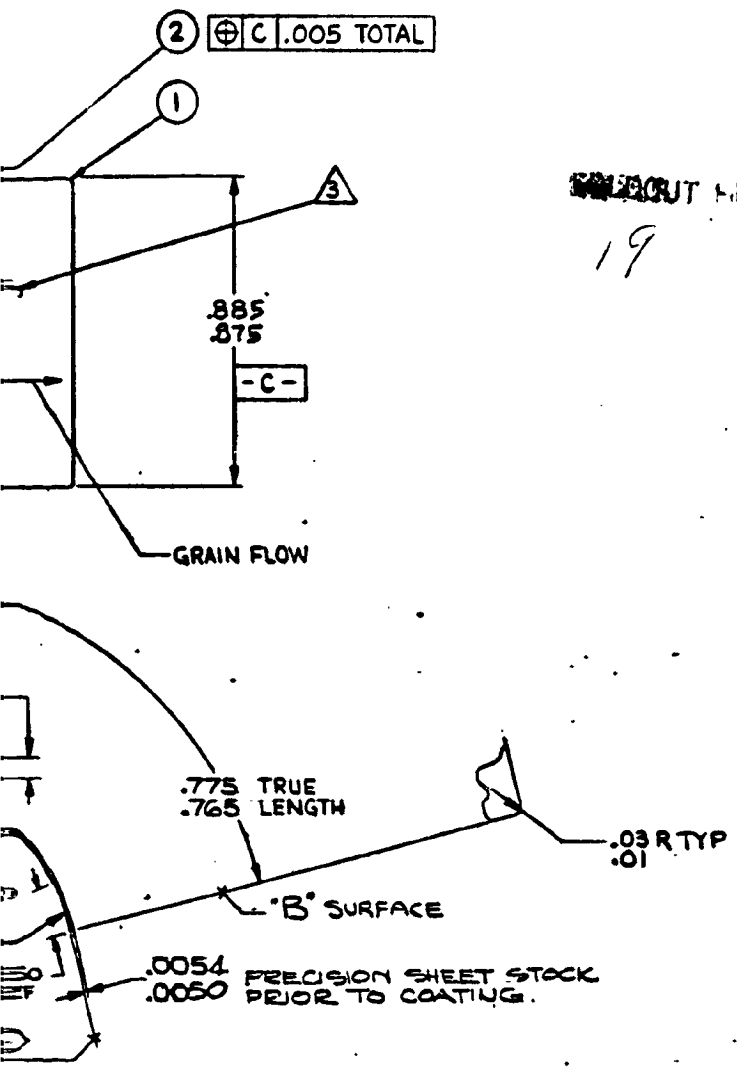
3. PART NO., LOT NO. AND SERIAL NO. PER AIRESEARCH MC5014, CL II A

2. 125 ALL OVER FOR FIND NO. 2

1. SHALL CONFORM TO AIRESEARCH SC5001 MACHINED FEATURES SC5002 SHEET METAL PARTS

CRITICAL ITEM

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
BB	A	SEE E.O. (2)	10-23-70	[illegible]
	B	(4) SEE E.O.	10-9-77	[illegible]
	C	(1) SEE E.O.	2-17-77	[illegible]
	D	(16) ADDED -2; SEE E.O.	2-15-71	[illegible]
	E	(1) ADDED -3; SEE E.O.	3-15-72	[illegible]
	F	(1) SEE E.O.	3-22-78	[illegible]
	G	(2) SEE E.O.	5-15-73	[illegible]



FALLOUT

19

387

QUANTITY REQD				FIND NO	PART NO OR IDENTIFYING NO.	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
	1	1	1	2			BAR		CRES 347 QQ-S-763	
	1	1	1	1			BEARING		6	

-3-2-1 ← PART NUMBER

PARTS LIST

		MINI BRU
		CCPS2-1
16(-1)	240610-1	240610-1
REQD	NEXT ASSY	USED ON
HEAT TREATMENT		PROCESS
MAKEUP AND SPEC		NAME AND SPEC

5

7

SIGNATURES	DATES
[illegible]	11-1-74
[illegible]	8-24-76
[illegible]	9-22-76
[illegible]	9-21-76
[illegible]	9-20-76
[illegible]	9-21-76
B C Heath	8-30-76
[illegible]	9/[illegible]/76

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

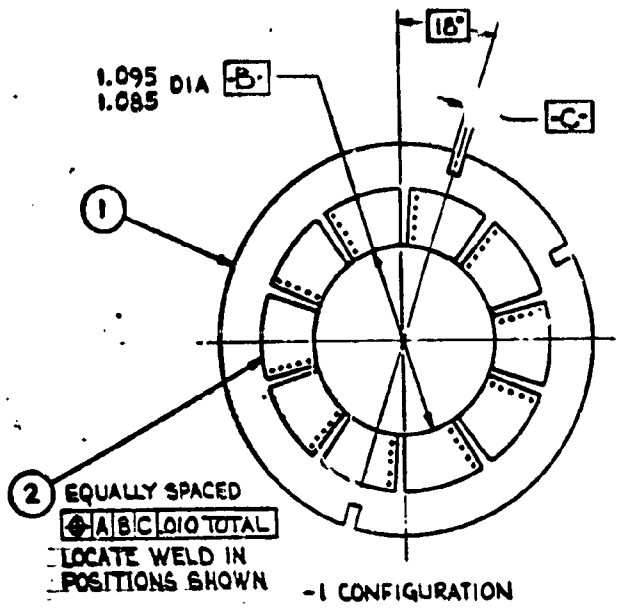
BEARING, FOIL

D | 99193 | 3604338

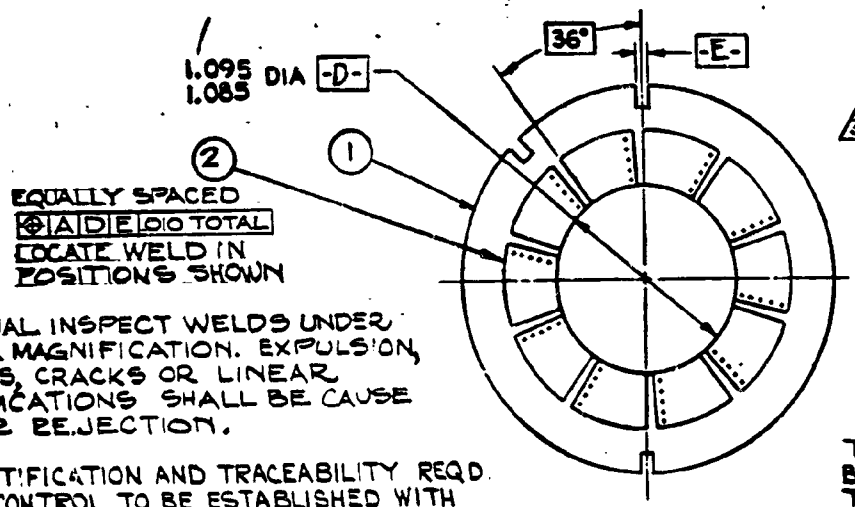
3604338

FOLDOUT FRAME

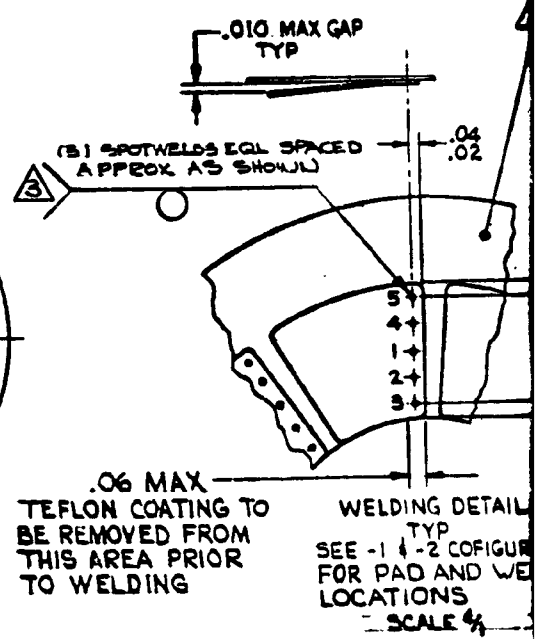
20

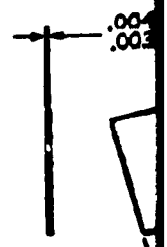


-1 CONFIGURATION



-2 CONFIGURATION





9. VISUAL INSPECT WELDS UNDER 20 x MAGNIFICATION. EXPULSION, PITS, CRACKS OR LINEAR INDICATIONS SHALL BE CAUSE FOR REJECTION.

8. IDENTIFICATION AND TRACEABILITY REQD. LOT CONTROL TO BE ESTABLISHED WITH VENDOR MATERIAL. SERIALIZATION TO BE ESTABLISHED WITH COMPLETION OF PART.

7. SEE TL 3604339-901 REV. N/C FOR FLAT PATTERN DATA WHEN PHOTO ETCH FABRICATION PROCESS IS USED.

6. CLEAN PER AIRESEARCH AF5465 AND PACKAGE IN CLEAN COMPARTMENTED RIGID PLASTIC OR CARDBOARD CONTAINER

5. MATERIAL TO BE CRES 302 PRECISION SHEET STOCK (±5% THICKNESS TOLERANCE) MINUMUM 1/2 HARD CONDITION

4. COAT ONE SURFACE ONLY OF (2) WITH TEFLON "S" .0009-.0012 THK PER AIRESEARCH AF5467 SURFACE FINISH APPLICABLE AFTER COATING

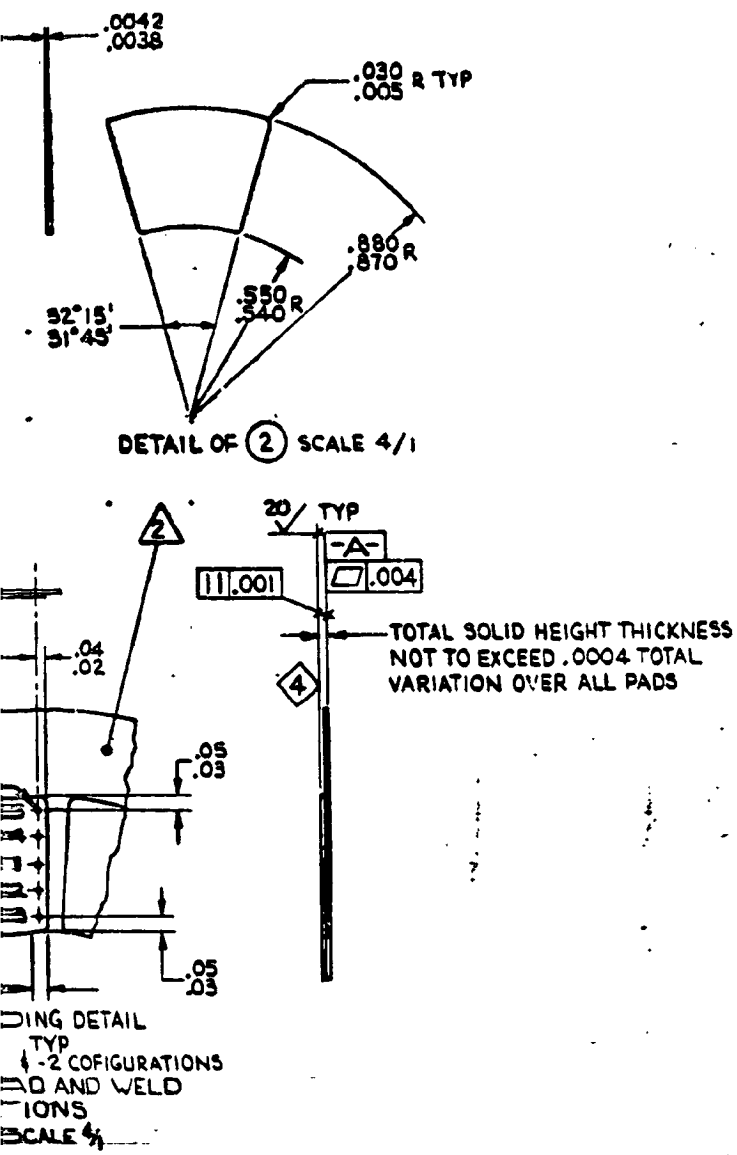
3. WELD PER AIRESEARCH WBS 5052, CL A. ANY CLEANING SHALL BE IN ACCORDANCE WITH AIRESEARCH AF 5453.

2. PART NUMBER, LOT NO. AND SERIAL NO PER AIRESEARCH MC5014, CL II A

1. SHALL CONFORM TO AIRESEARCH SC6002 SHEET METAL PARTS

CRITICAL ITEM

REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPROVED
A (1) SEE E.O.		4-5-76	[illegible]
B (2) SEE E.O.		1-8-76	[illegible]



389

QUANTITY REQD			FIND NO.	PART NO OR IDENTIFYING NO	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
	10	10	2		5	PAD		CRES 302 MIL-S-5059	
	1	1	1	3604381-1		STIFFENER			
	-2	-1	← — PART NUMBER			PARTS LIST			

REQD	NEXT ASSY	USED ON
		MINI BRU
		CCPS2-1
1(-2)	240610-1	240610-1
1(-1)	240610-1	240610-1

HEAT TREATMENT | PROCESS
HARDNESS AND SPEC | NAME AND SPEC

SIGNATURES	DATES
[illegible]	11-4-74
[illegible]	8-24-76
[illegible]	8-22-76
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
DESIGN ACTIVITY APVD B C [illegible]	8-30-76
OTHER ACTIVITY APVD QA [illegible]	9/22/76

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

BEARING, FOIL THRUST

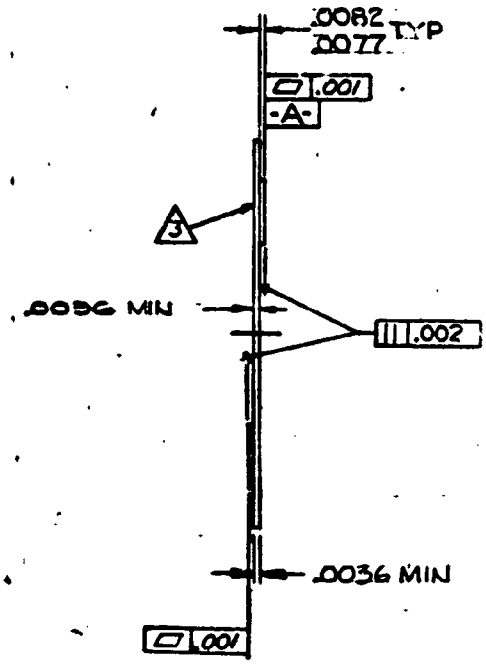
SIZE	CODE IDENT NO	DWG NO
D	99193	3604339

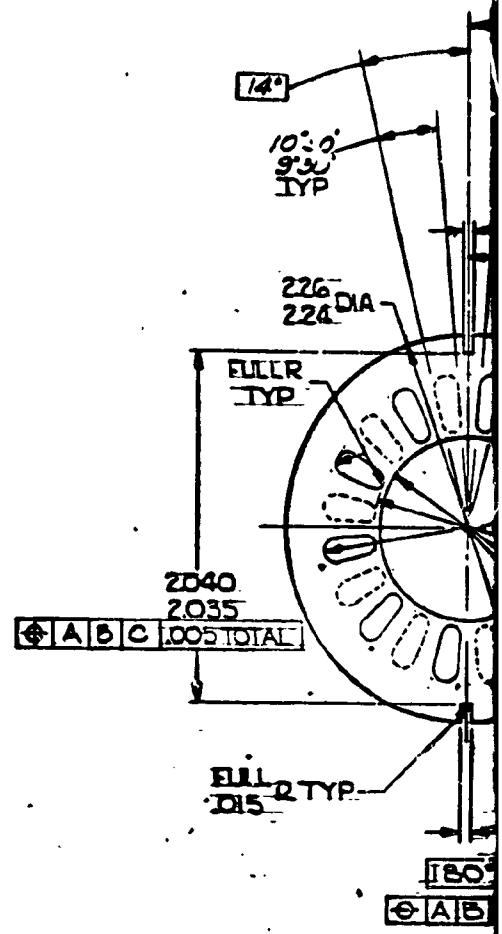
SCALE: FULL | SHEET

3604339

PART NUMBER
3604340-1

FOLDOUT FRAME 2.2





7. IDENTIFICATION & TRACEABILITY REQD. LOT CONTROL TO BE ESTABLISHED WITH MATERIAL. SERIALIZATION TO BE ESTABLISHED WITH COMPLETION OF PART

6. MATERIAL TO BE CRES 302 PRECISION SHEET STOCK .020 THK. (± 5% THICKNESS TOLERANCE) IN MINIMUM 1/2 HARD COND.

5. CLEAN PER AIRESEARCH AF5465 AND PACKAGE IN COMPARTMENTED RIGID PLASTIC OR CARDBOARD CONTAINER.

4. SEE TL3604340-1 REV. N/C FOR FLAT PATTERN DATA WHEN PHOTO-ETCH FABRICATION PROCESS IS USED

3. PART NO., LOT NO. & SERIAL NO. PER AIRESEARCH MC5014 CLASS II A

2. SHALL CONFORM TO AIRESEARCH:

SC6001 MACHINED FEATURES

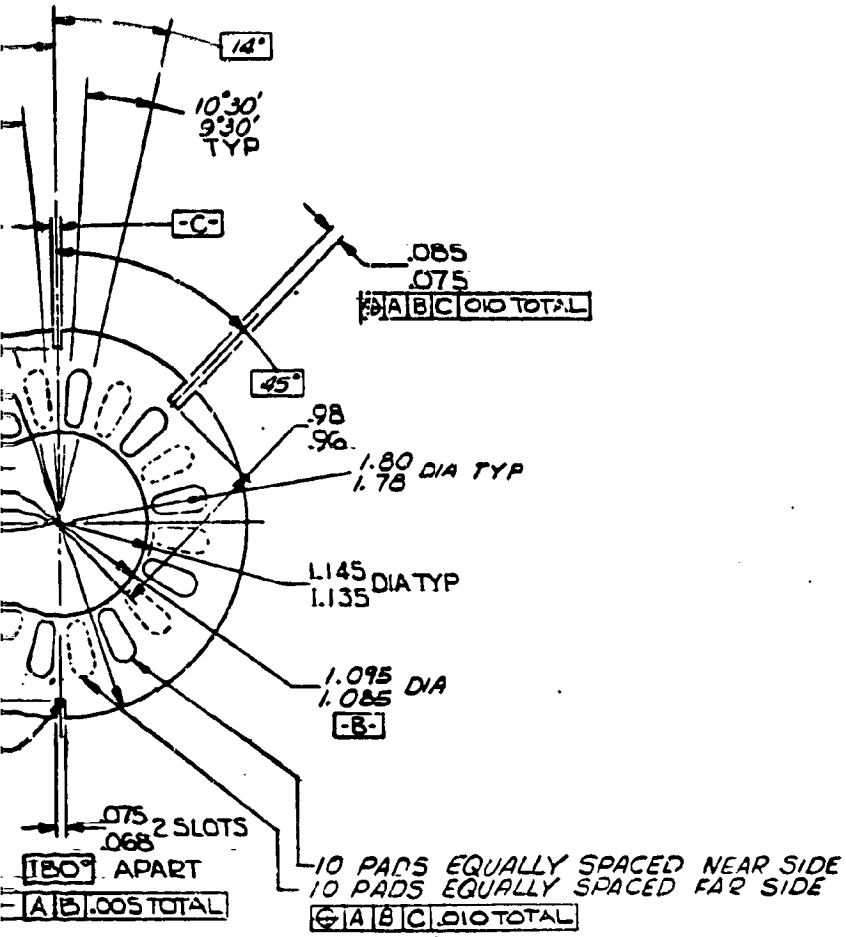
SC6002 SHEET METAL PARTS.

1. 63 ALL OVER.

CRITICAL ITEM

ZONE LTR	REVISIONS DESCRIPTION	DATE	APPROVED
A8	A (1) SEE EO.		

FOLDOUT FRAME 3



SEE NOMENCLATURE BLOCK (UPPER LEFT CORNER) FOR PART NUMBER.

391

QUANTITY REQD	FIND NO	PART NO OR IDENTIFYING NO	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
						CRES 302 MIL-S-5059	

← PART NUMBER — PARTS LIST

		MINI BRU CCP32-1
2(-1)	240610-1	240610-1
REQD	NEXT ASSY	USED ON
HEAT TREATMENT		PROCESS
NOTED		

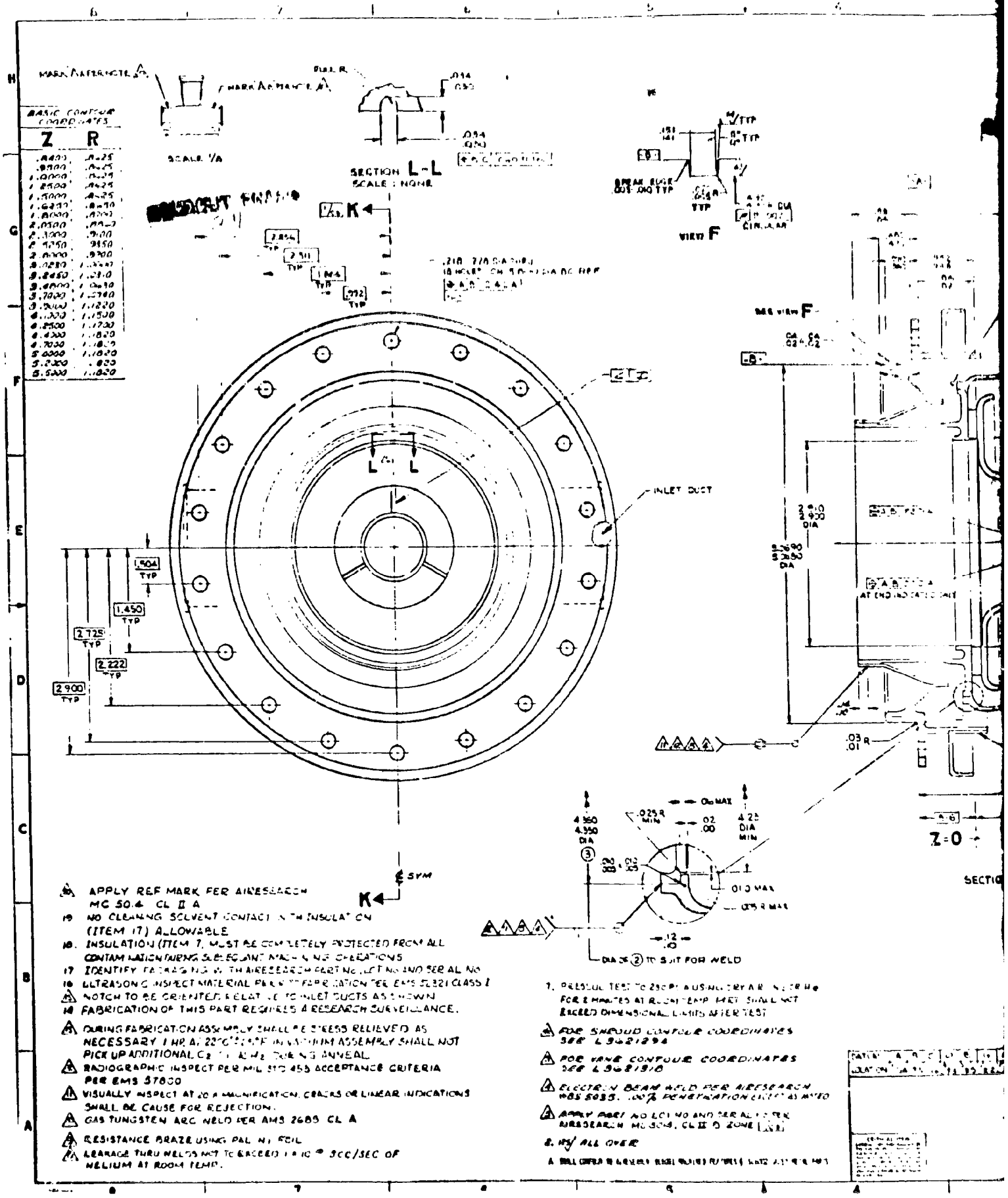
SIGNATURES / DATES: 7-6-76; 8-26-76; 9-27-76; 9-27-76; 8-30-76; 9/28/76

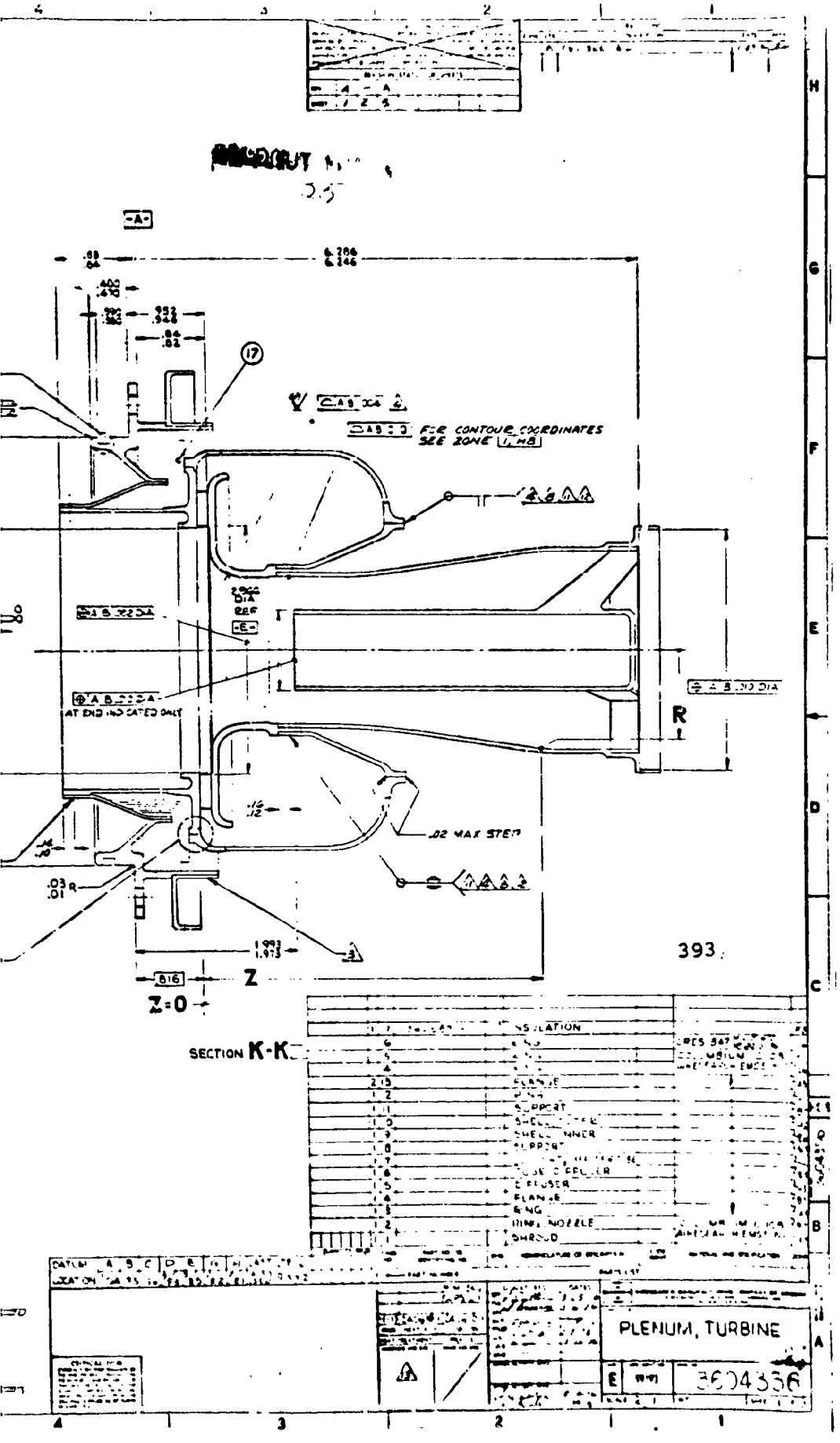
AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

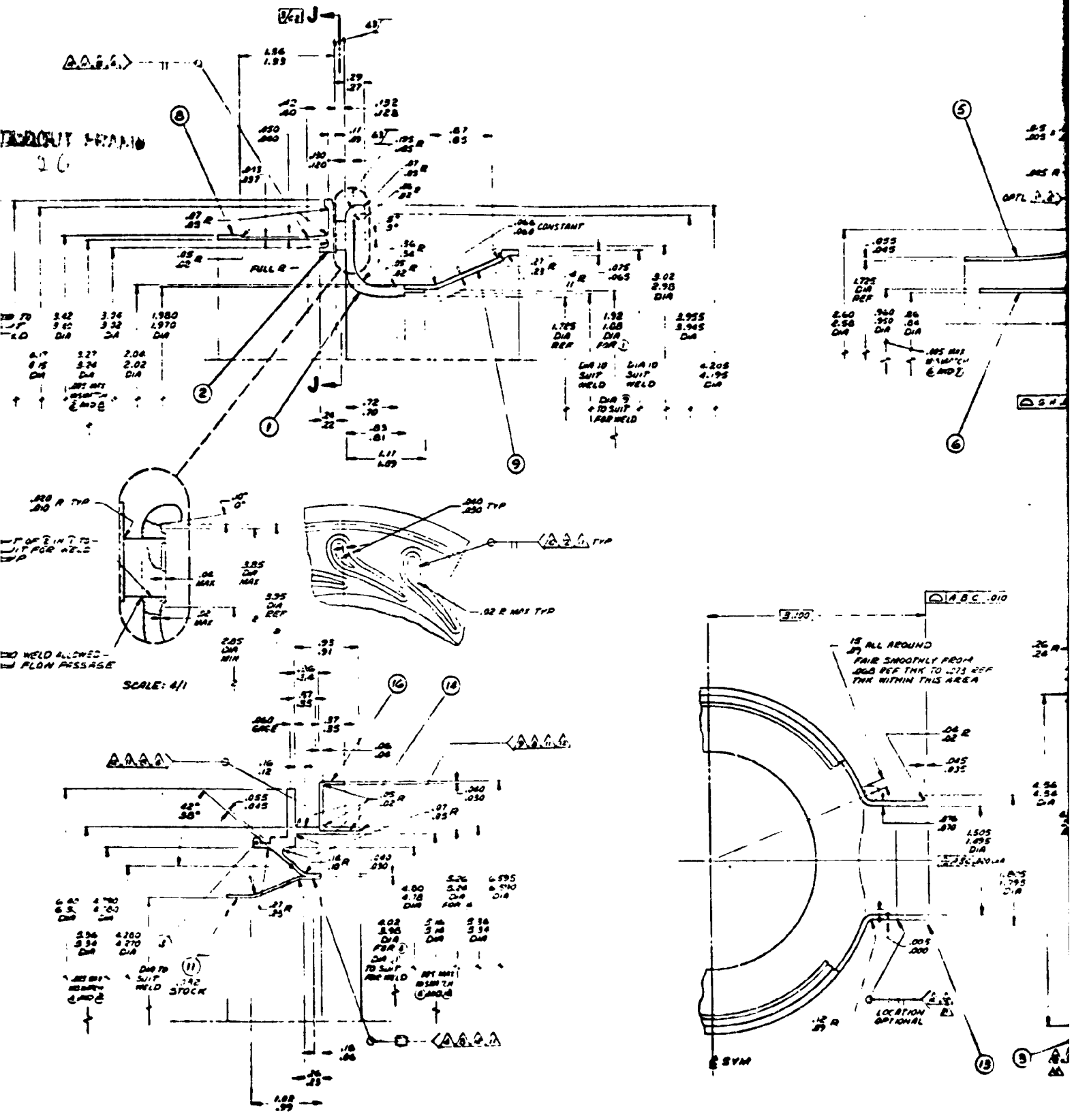
DWG TITLE: SPRING, FOIL THRUST BEARING

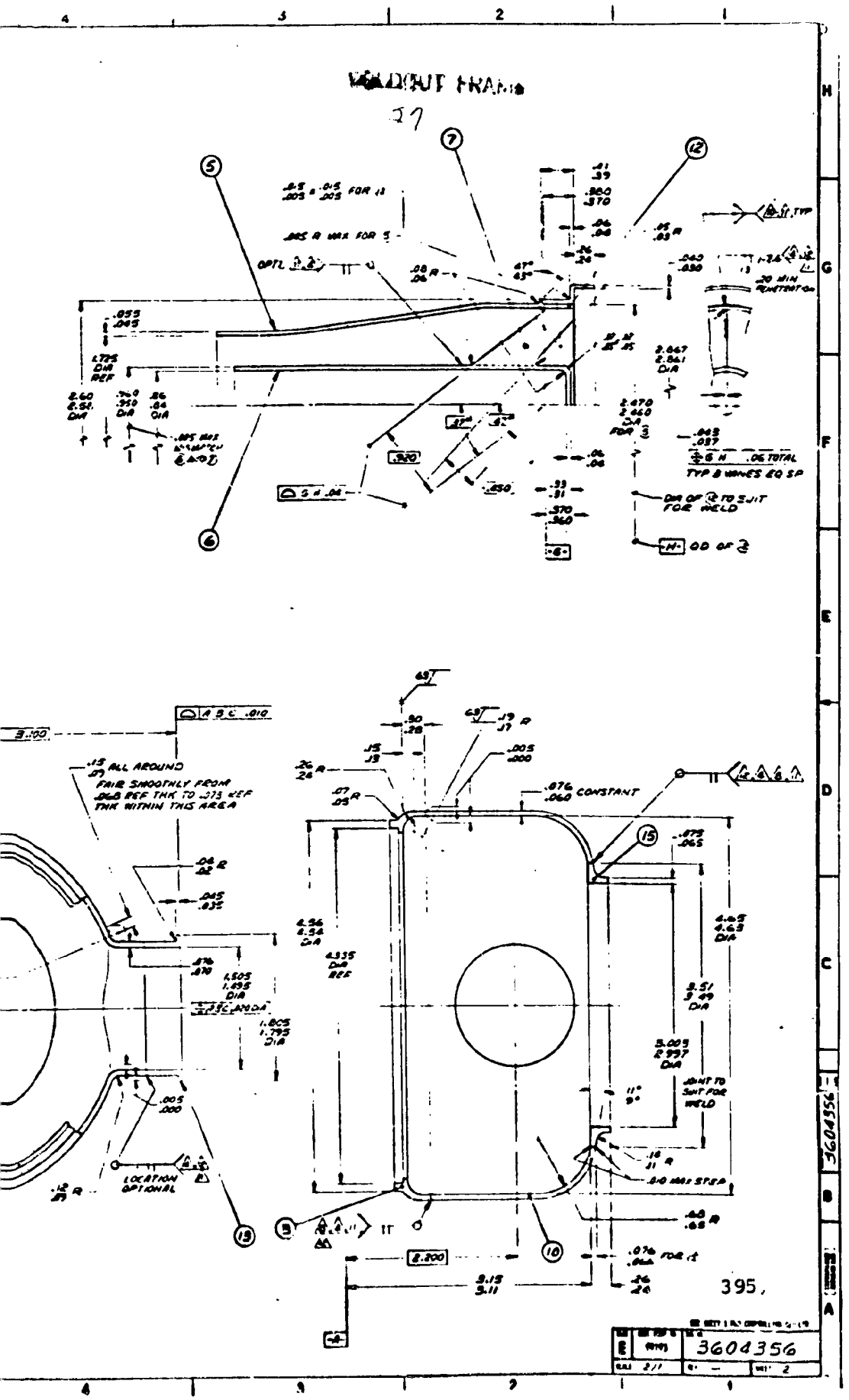
SIZE	CODE IDENT NO	DWG NO
D	99193	3604340
SCALE 2/1	WT	SHEET — OF —

3604340


BASIC CONTOUR COORDINATES
Z R
SCALE 1/4
SECTION L-L
SCALE : NONE
VIEW F
INLET DUCT
SYM
Z=0
SECTION
APPLY REF MARK PER AIRESEARCH MC 50.4 CL II A
NO CLEANING SOLVENT CONTACT WITH INSULATION (ITEM 17) ALLOWABLE
INSULATION (ITEM 7) MUST BE COMPLETELY PROTECTED FROM ALL CONTAMINATION DURING SUBSEQUENT MACHINING OPERATIONS
IDENTIFY PER DRAWING WITH AIRESEARCH PART NO LOT NO AND SERIAL NO
ULTRASONIC INSPECT MATERIAL PER MIL STD 414 PER EMS 5321 CLASS I
NOTCH TO BE ORIENTED RELATIVE TO INLET DUCTS AS SHOWN
FABRICATION OF THIS PART REQUIRES A RESEARCH SURVEILLANCE.
DURING FABRICATION ASSEMBLY SHALL BE STRESS RELIEVED AS NECESSARY 1 HR @ 22°C ± 2.5°F IN VACUUM ASSEMBLY SHALL NOT PICK UP ADDITIONAL C2 OR H2 DURING ANNEAL
RADIOGRAPHIC INSPECT PER MIL STD 453 ACCEPTANCE CRITERIA PER EMS 37800
VISUALLY INSPECT AT 20 X MAGNIFICATION. CRACKS OR LINEAR INDICATIONS SHALL BE CAUSE FOR REJECTION.
GAS TUNGSTEN ARC WELD PER AMS 2685 CL A
RESISTANCE BRAZE USING PALNI FOIL
LEAKAGE THRU WELDS NOT TO EXCEED 1 X 10 -9 SCC/SEC OF HELIUM AT ROOM TEMP.
PRESSURE TEST TO 250 PSI AUSING DRY AIR OR N2 OR He FOR 5 MINUTES AT ROOM TEMP. PART SHALL NOT EXCEED DIMENSIONAL LIMITS AFTER TEST
FOR SHROUD CONTOUR COORDINATES SEE L 9621294
FOR VANE CONTOUR COORDINATES SEE L 9621910
ELECTRON BEAM WELD PER AIRESEARCH MBS 5035. 100% PENETRATION UNLESS NOTED
APPLY PART NO LOT NO AND SERIAL NO PER AIRESEARCH MC 50.4, CL II D ZONE
8. MS ALL OVER


FOR CONTOUR COORDINATES SEE ZONE
.02 MAX STEP
R
Z
Z=0
SECTION K-K
393
PLENUM, TURBINE
3604336

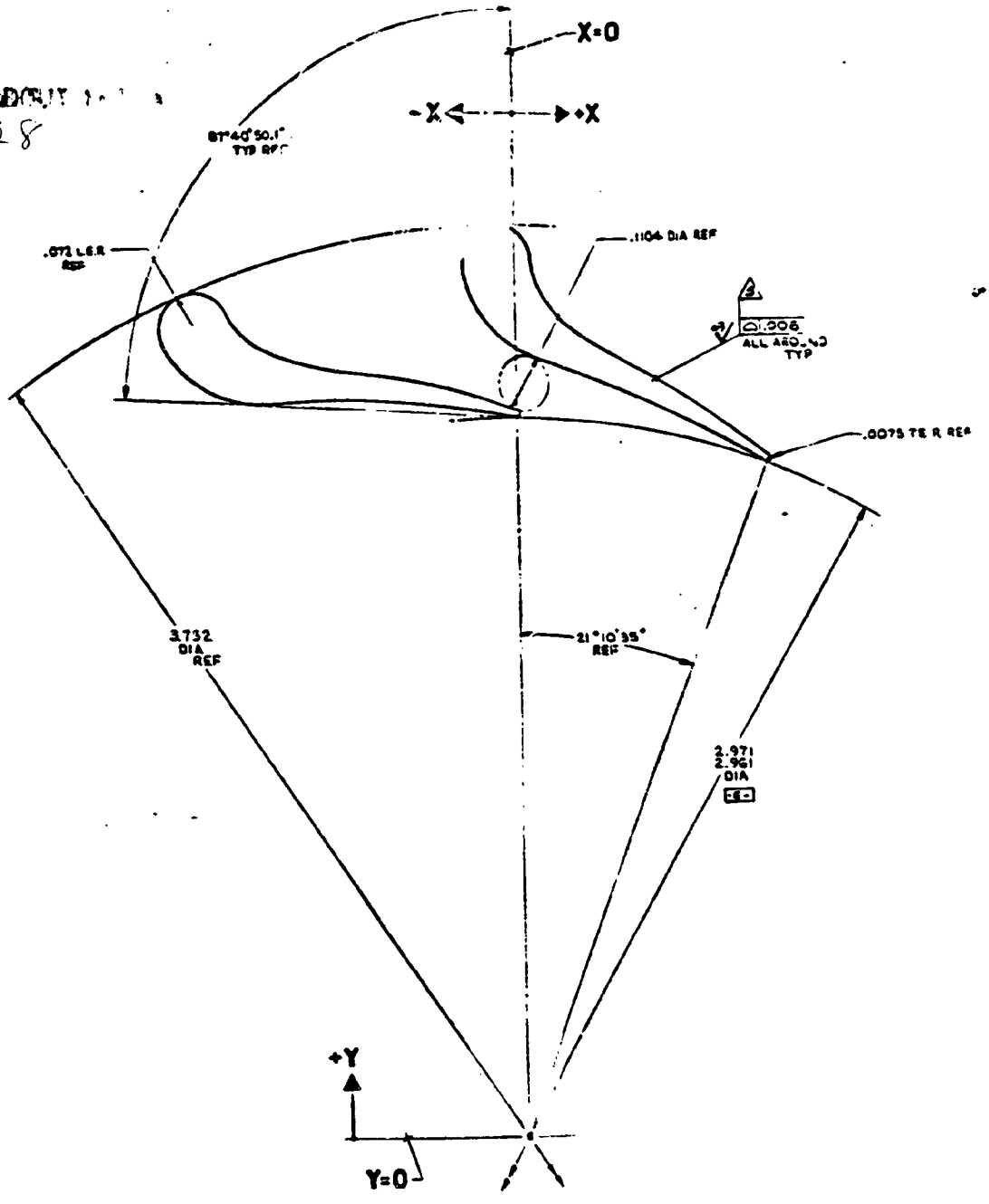

FULL R
CONSTANT
WELD ALLOWED
FLOW PASSAGE
SCALE: 4/1
STOCK
ALL AROUND
FAIR SMOOTHLY FROM
THK WITHIN THIS AREA
LOCATION OPTIONAL



FOLDOUT FRAME
27
.20 MIN PENETRATION
TYP 8 VANES EQ SP
DIA OF ⊗ TO SUIT FOR WELD
OD OF ⊗
ALL AROUND
FAIR SMOOTHLY FROM .068 REF THK TO .075 REF THK WITHIN THIS AREA
.076 .060 CONSTANT
JOINT TO SUIT FOR WELD
.010 MAX STEP
LOCATION OPTIONAL
3604356

395,

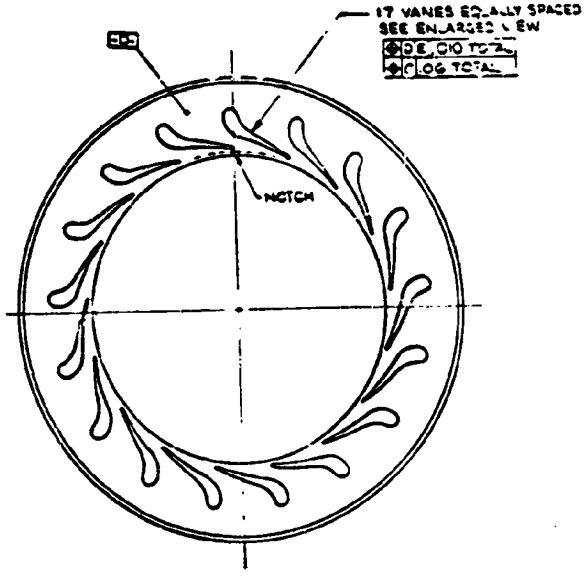
28



ENLARGED VIEW
SCALE 10/1

FOLDOUT FRAME

27

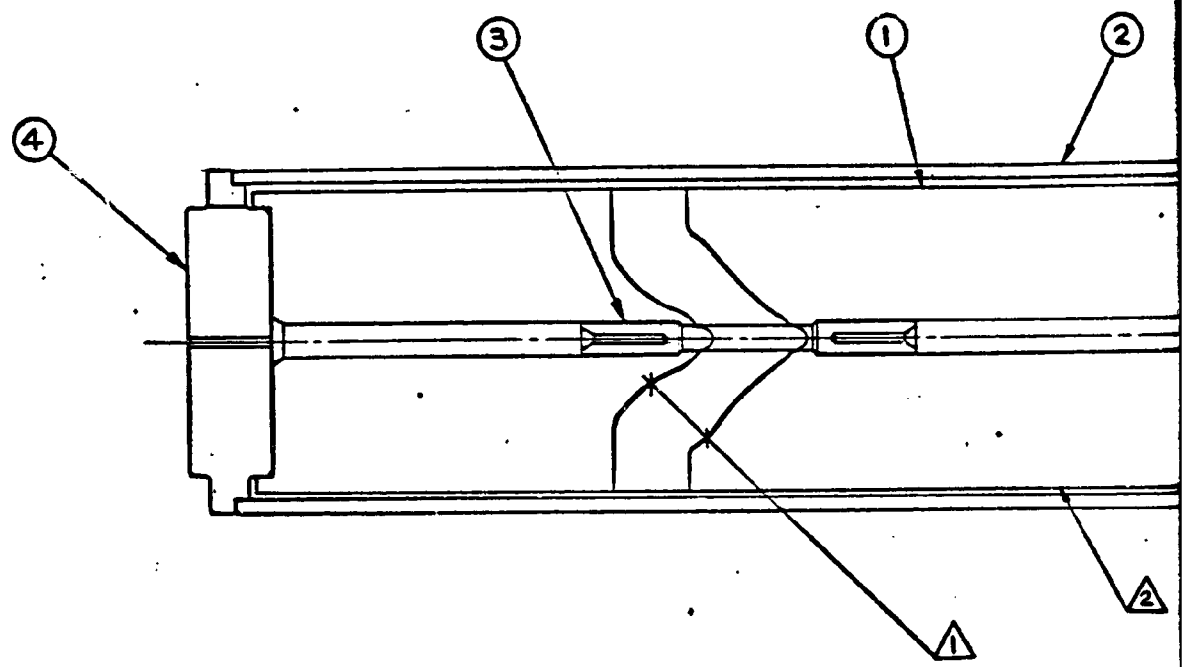


SECTION J-J 2.47

3604356

FOLDOUT FRAME

30



6. IDENTIFY PACKAGING WITH AIRESEARCH PART NUMBER, LOT NUMBER, SERIAL NUMBER AND ACCEPTANCE STAMP.

5. RADIOGRAPHIC INSPECT BRAZE PER MIL-STD-453. RADIOGRAPHIC SENSITIVITY AND ACCEPTANCE CRITERIA DEFINED IN BRAZE AND PROCESS SPECIFICATION (REF NOTE 1).

4. CLEAN PER AIRESEARCH AF5465.

3. IDENTIFICATION AND TRACEABILITY REQUIRED. LOT CONTROL TO BE ESTABLISHED WITH RAW MATERIAL AND USE SERIALIZATION PREVIOUSLY ESTABLISHED ON FIND NO. 1.

2. MARK PART NUMBER, LOT NUMBER AND SERIAL NUMBER PER AIRESEARCH MC5014, CLASS IIB.

1. AFTER ALIGNING INDEX MARKS, BRAZE AND PROCESS PER AIRESEARCH EMS 52468.

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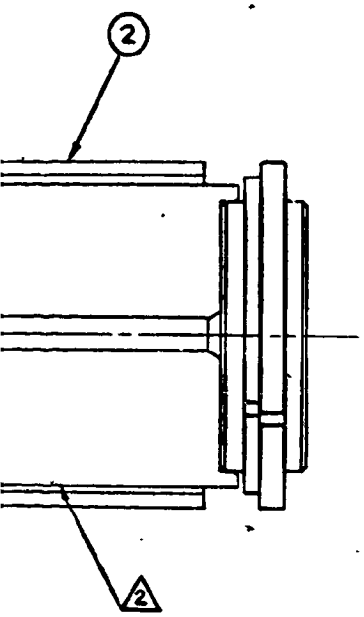
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A (3)	SEE E.O.	11-9-76	[illegible]

FOLDOUT FRAME

31



399

QUANTITY REQD	FIND NO.	PART NO OR IDENTIFYING NO.	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE
2	4	3604375-1		END PLATE INSULATOR			
2	3	3604374-1		PLUG, THERMOCOUPLE			
1	2	3604373-1		SLEEVE			
1	1	3604370-1		POLE & SEPARATOR ASSY			

-1 ← PART NUMBER

PARTS LIST

REQD	NEXT ASSY	USED ON
		MINI BRU
		CCPS2-1
1(-1)	3604336-1	240610-1

HEAT TREATMENT	PROCESS
HARDNESS AND SPEC	NAME AND SPEC

SIGNATURES	DATES
DFT E. WING	8-21-74
CHK [illegible]	1-16-74
MFG	
MATL	
PRESS	
AERO	
APVD [illegible]	9-17-74
APVD [illegible]	9-17-74
DESIGN ACTIVITY APVD [illegible]	1-16-74
OTHER ACTIVITY APVD QA [illegible]	11/9/76

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX ARIZONA

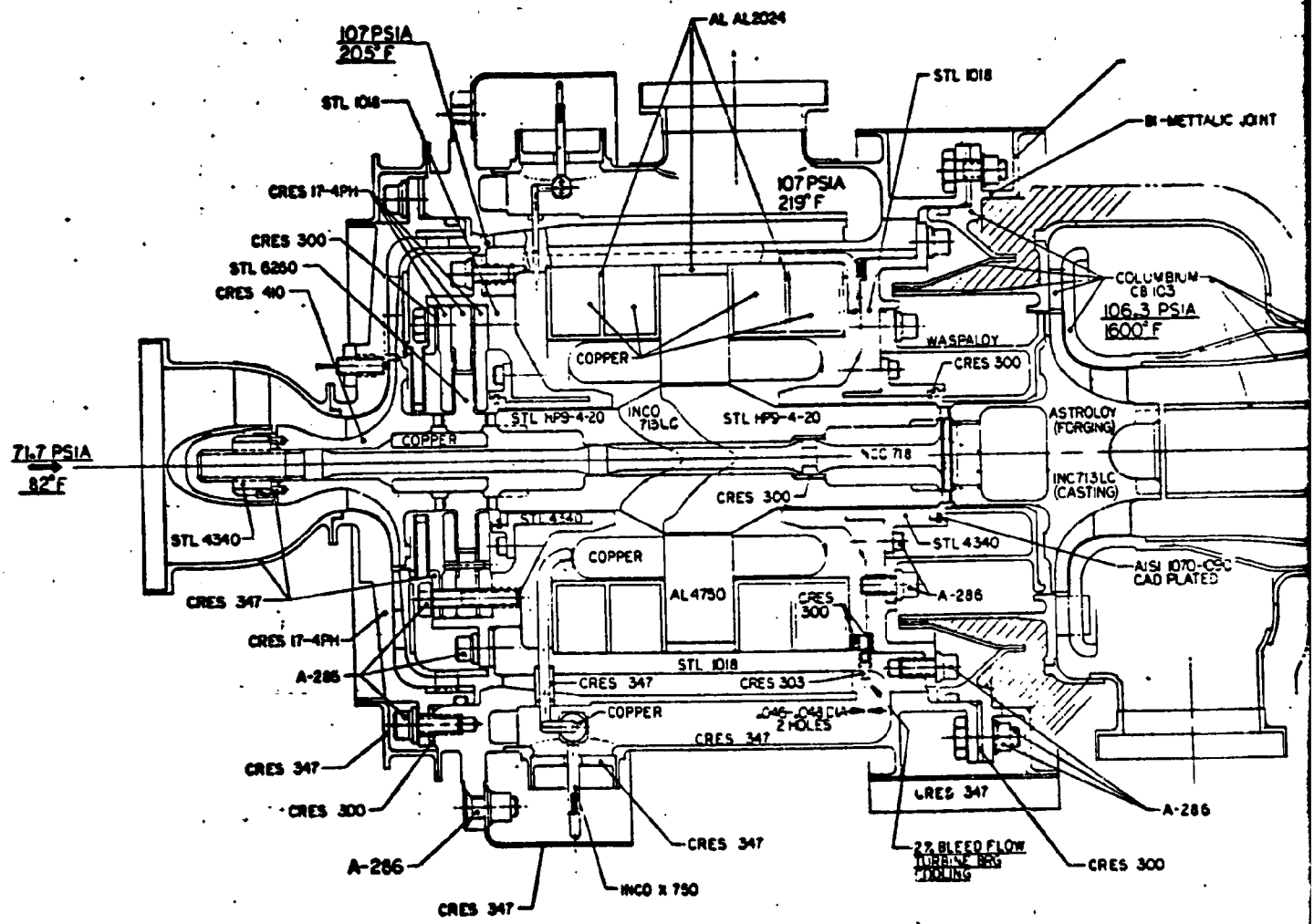
DWG TITLE
POLE AND SEPARATOR ASSEMBLY, BRAZED-ALTERNATOR ROTOR

SIZE	CODE IDENT NO	DWG NO
D	99193	3604369

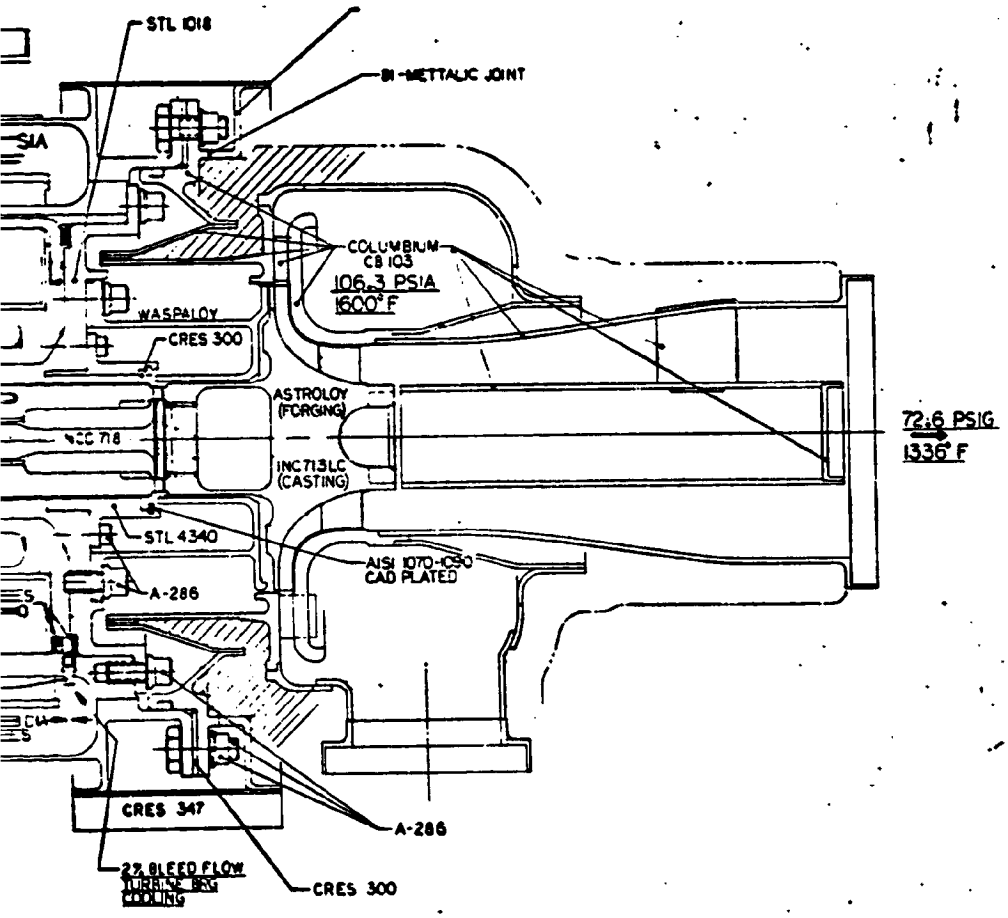
SCALE 2/1 | WT | SHEET —OF—

3604369 A

MICROFILMED REDUCED SIZE

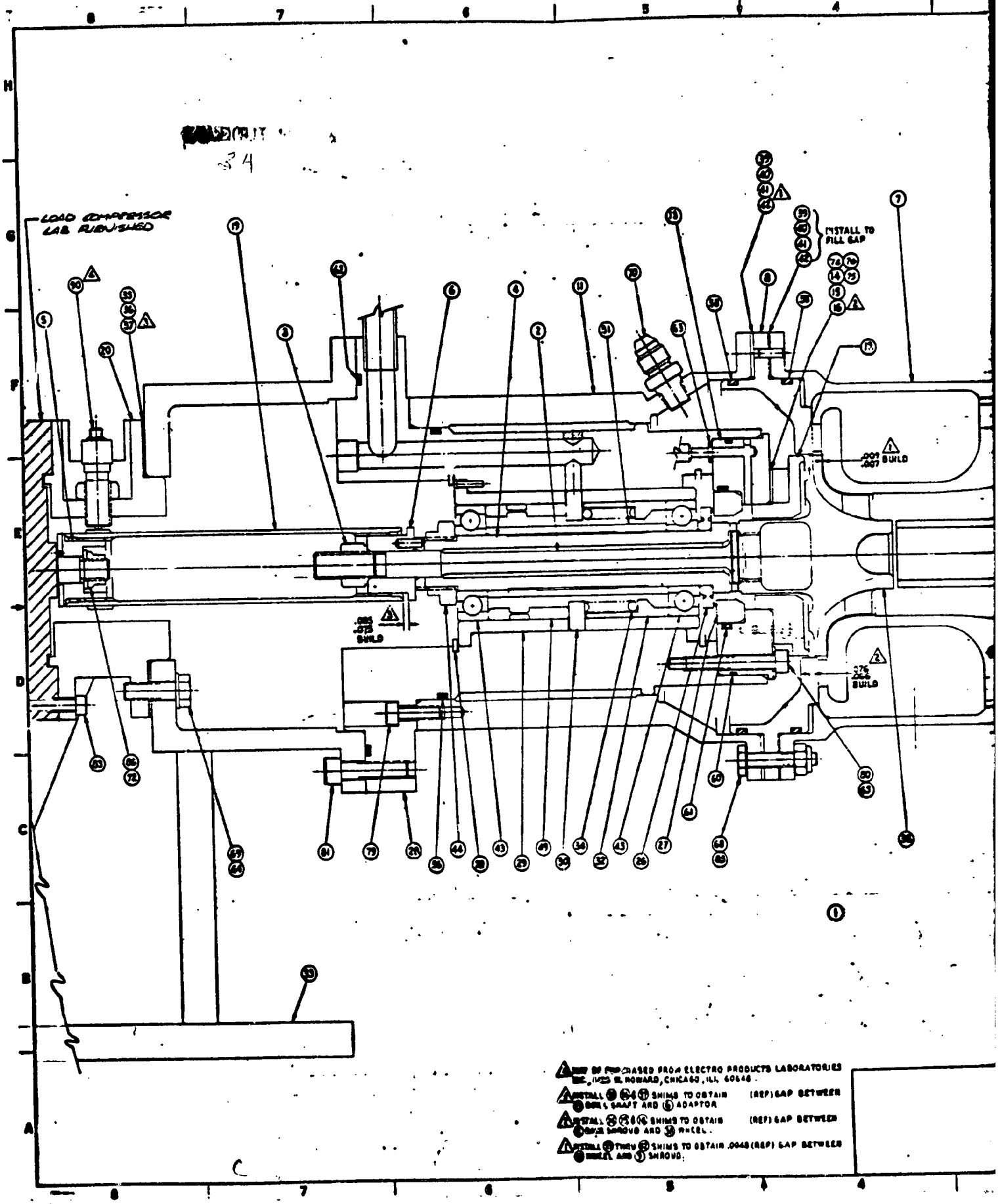


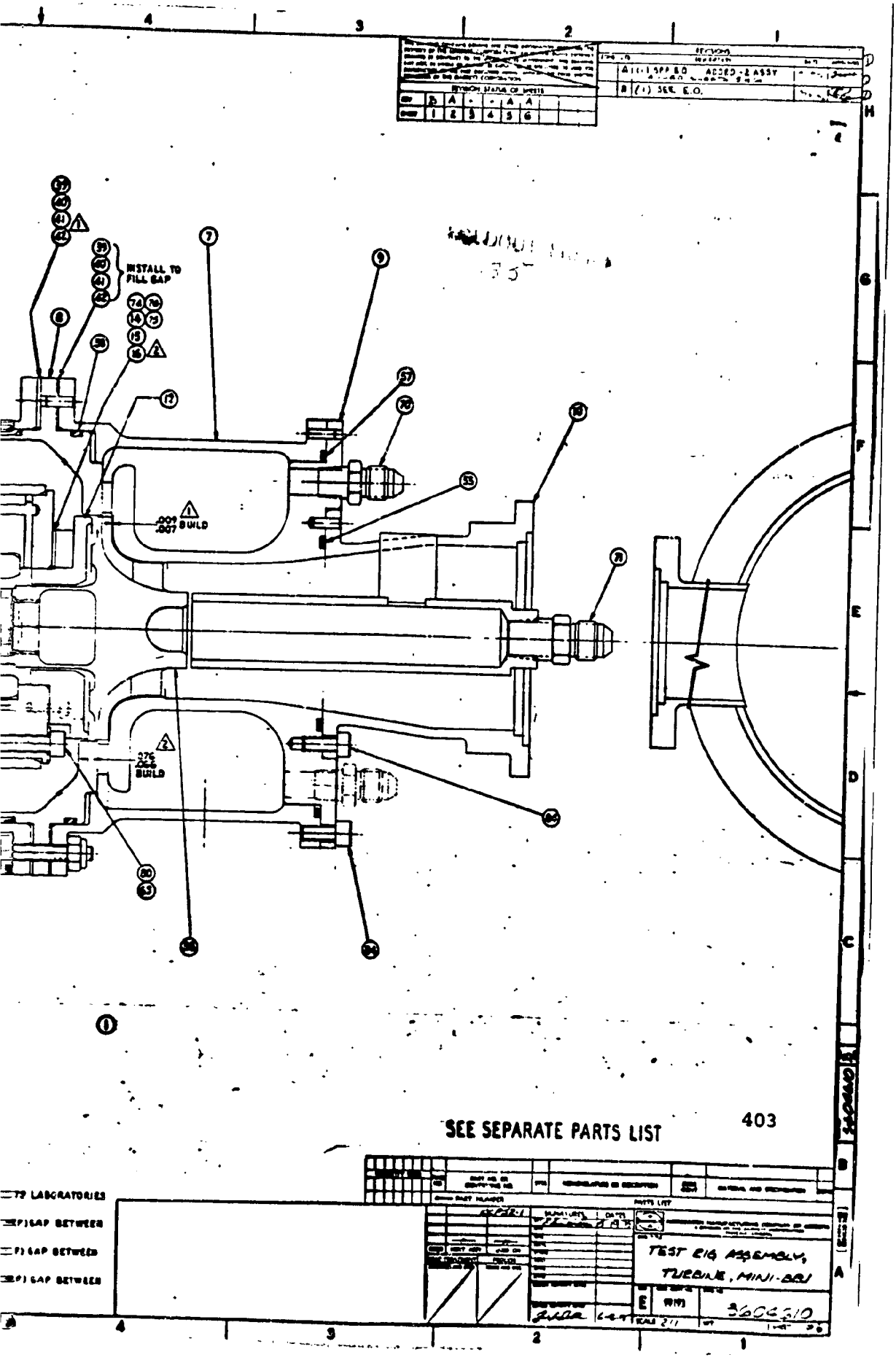
TEMP & PRESS VALUES FOR 2 KW NET OUTPUT



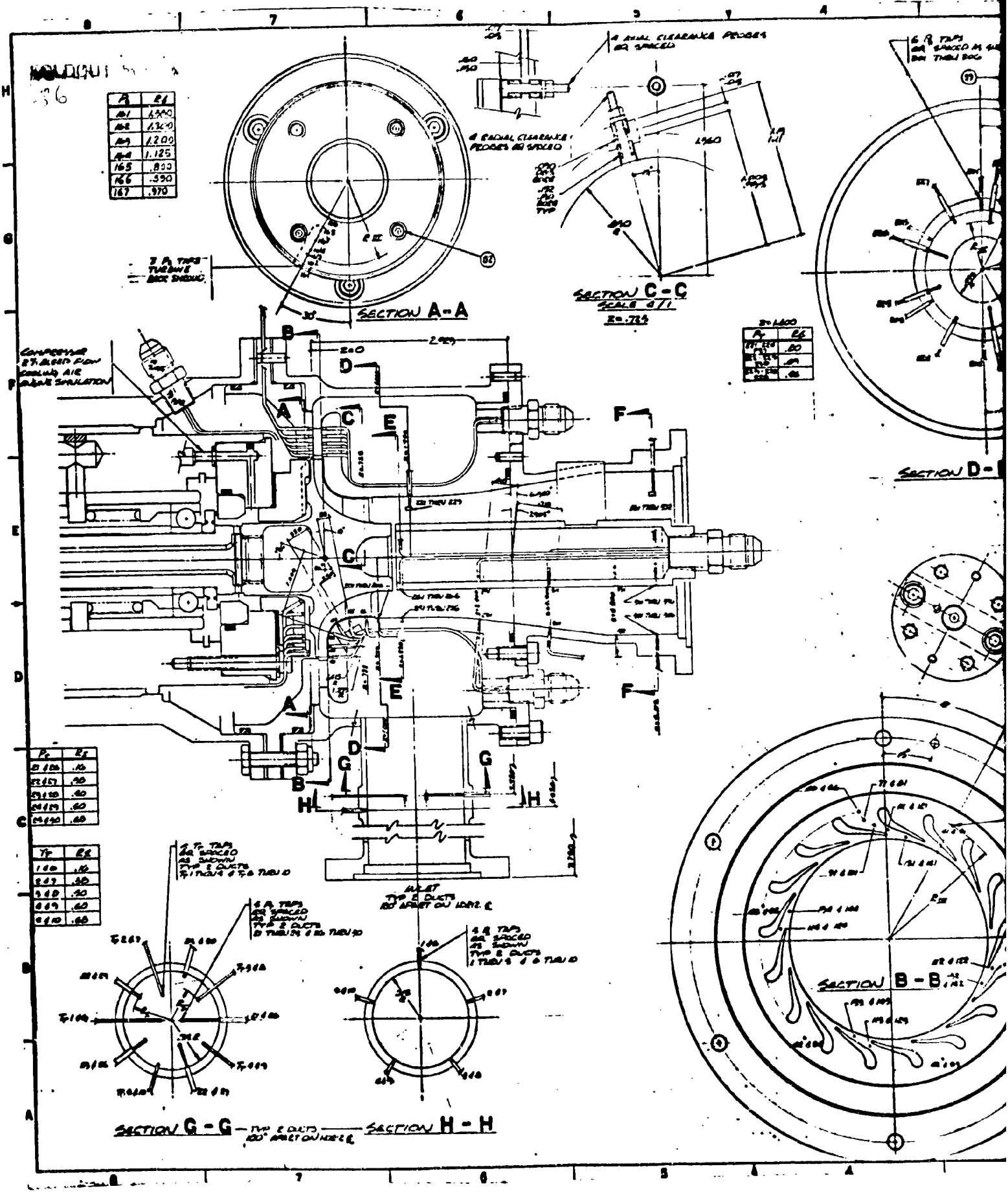
MINI BRAYTON
ROTATING UNIT
MATERIALS

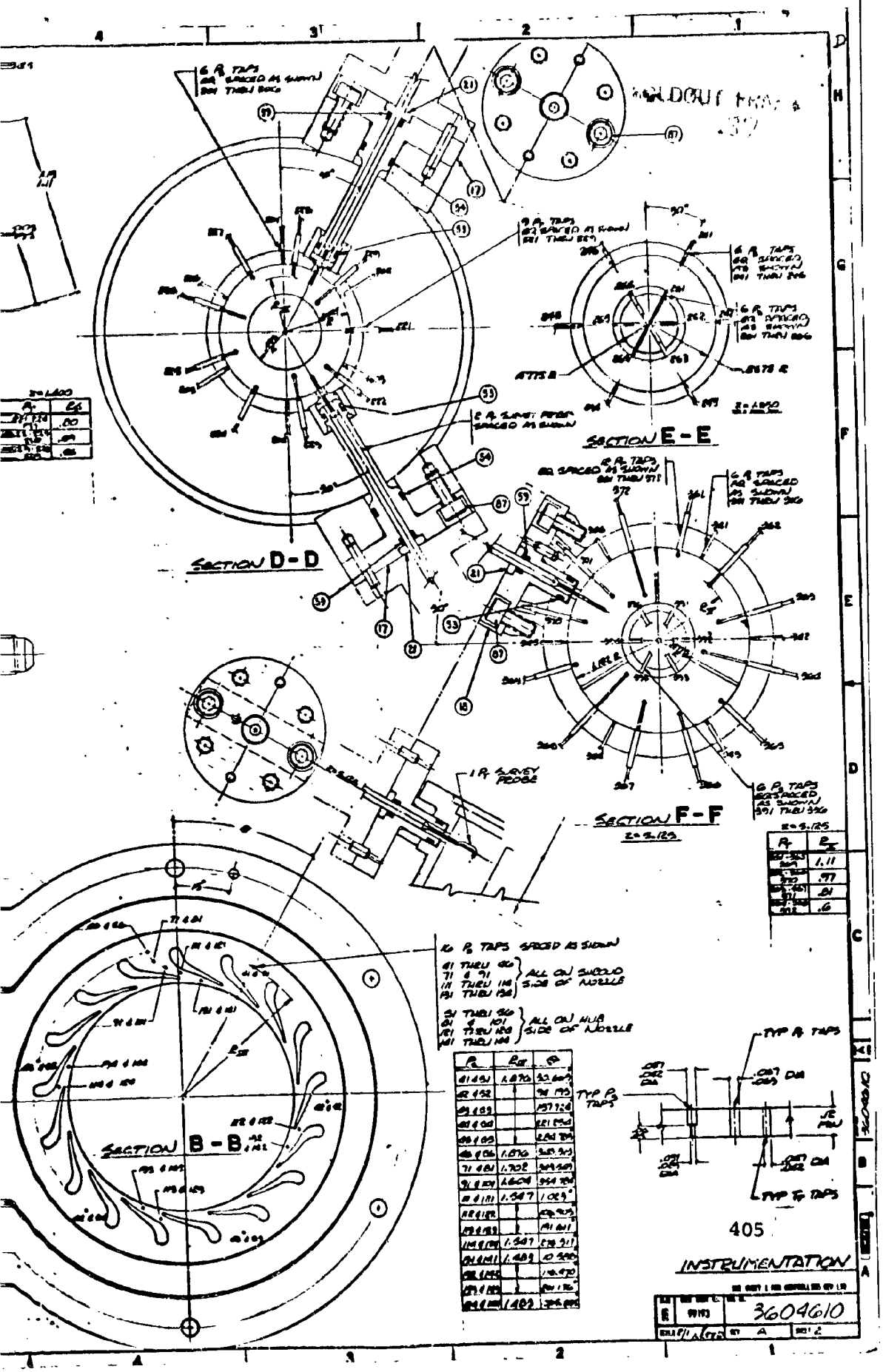
E 3604385

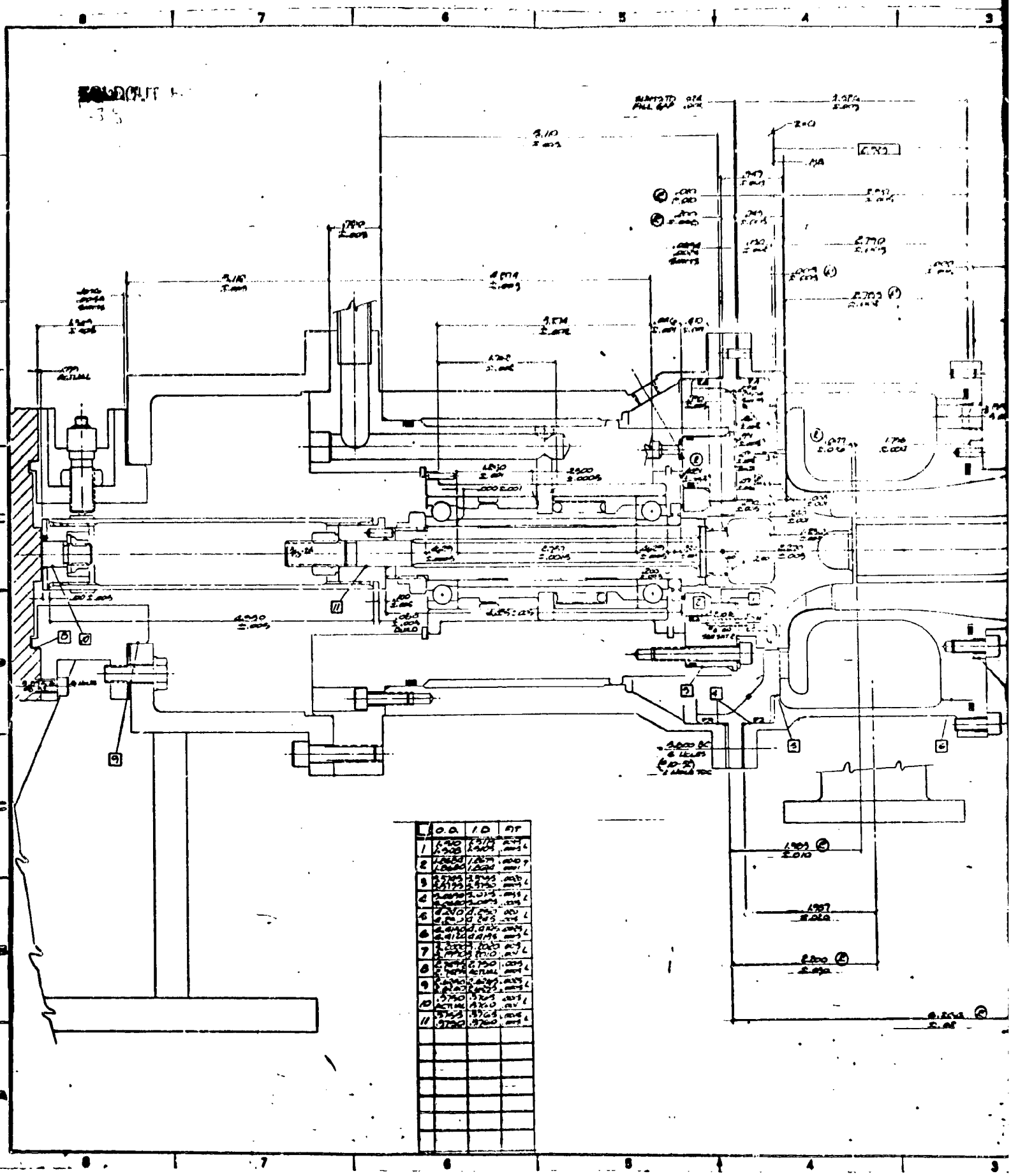

LOAD COMPRESSOR LAB FURNISHED
INSTALL TO FILL GAP
.009 .007 BUILD
.085 .075 BUILD
.076 .066 BUILD
SHIMS TO OBTAIN (REF) GAP BETWEEN
SHAFT AND ADAPTOR
SHIMS TO OBTAIN (REF) GAP BETWEEN
SHROUD AND WHEEL.
SHIMS TO OBTAIN .0048 (REF) GAP BETWEEN
SHROUD.



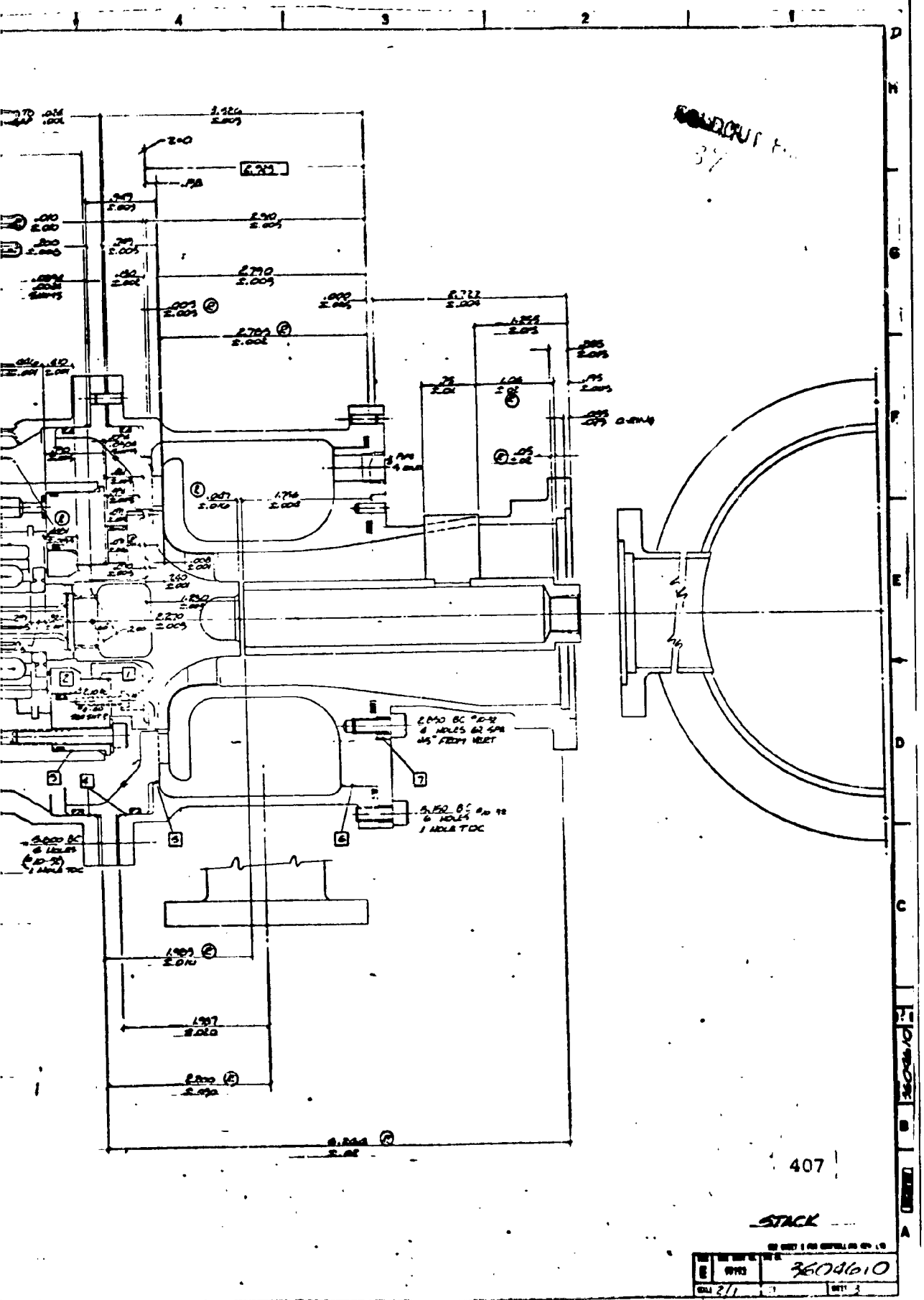
INSTALL TO FILL GAP
.009 .007 BUILD
.076 .066 BUILD
SEE SEPARATE PARTS LIST
TEST RIG ASSEMBLY, TURBINE, MINI-BBJ
3604310

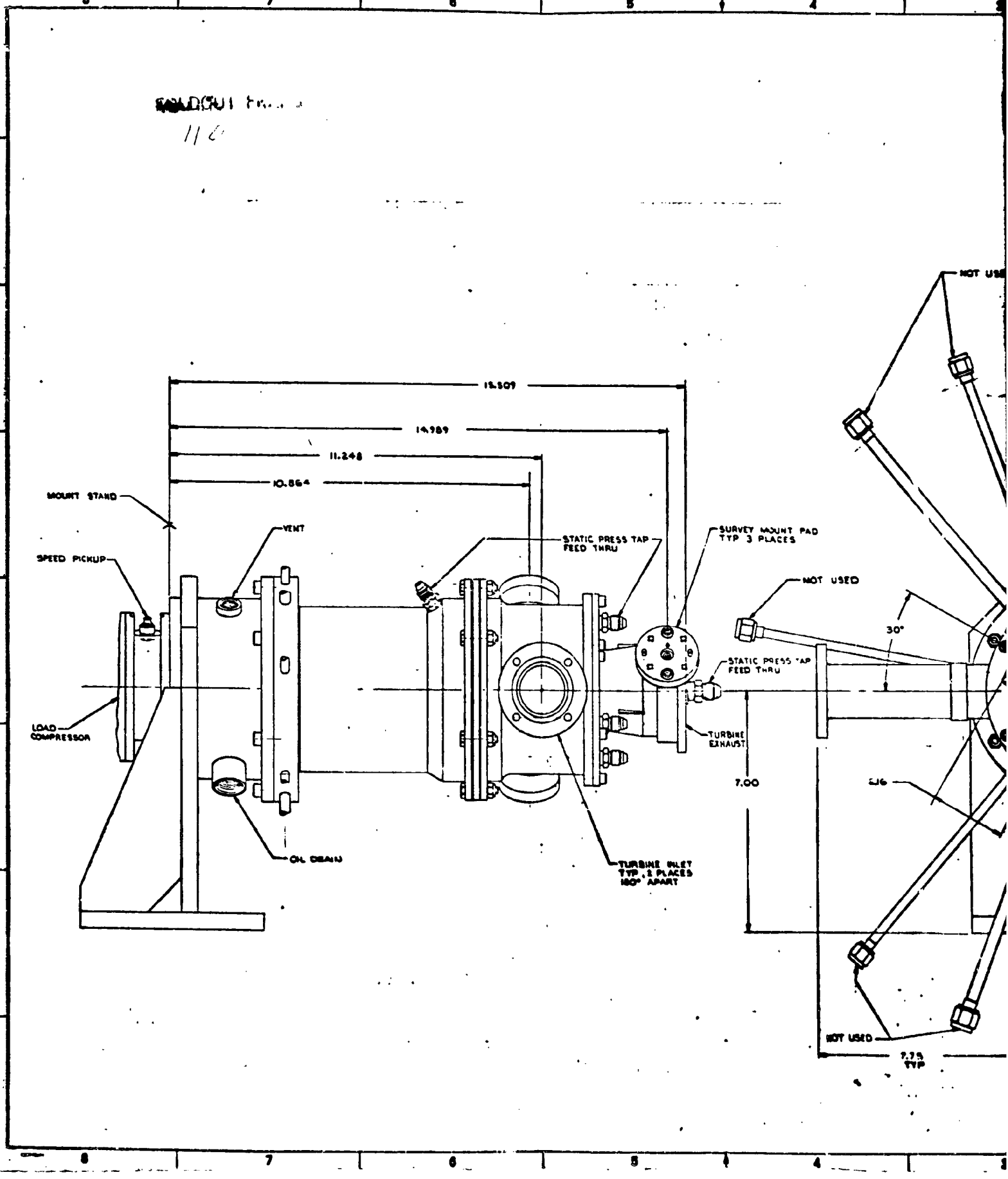

SECTION A-A
SECTION C-C
SCALE 4/1
SECTION D-D
SECTION B-B
SECTION G-G
SECTION H-H
COMPRESSOR
4 AXIAL CLEARANCE PROBES
4 RADIAL CLEARANCE PROBES


SECTION D-D
SECTION E-E
SECTION F-F
SECTION B-B
INSTRUMENTATION
3604610
405

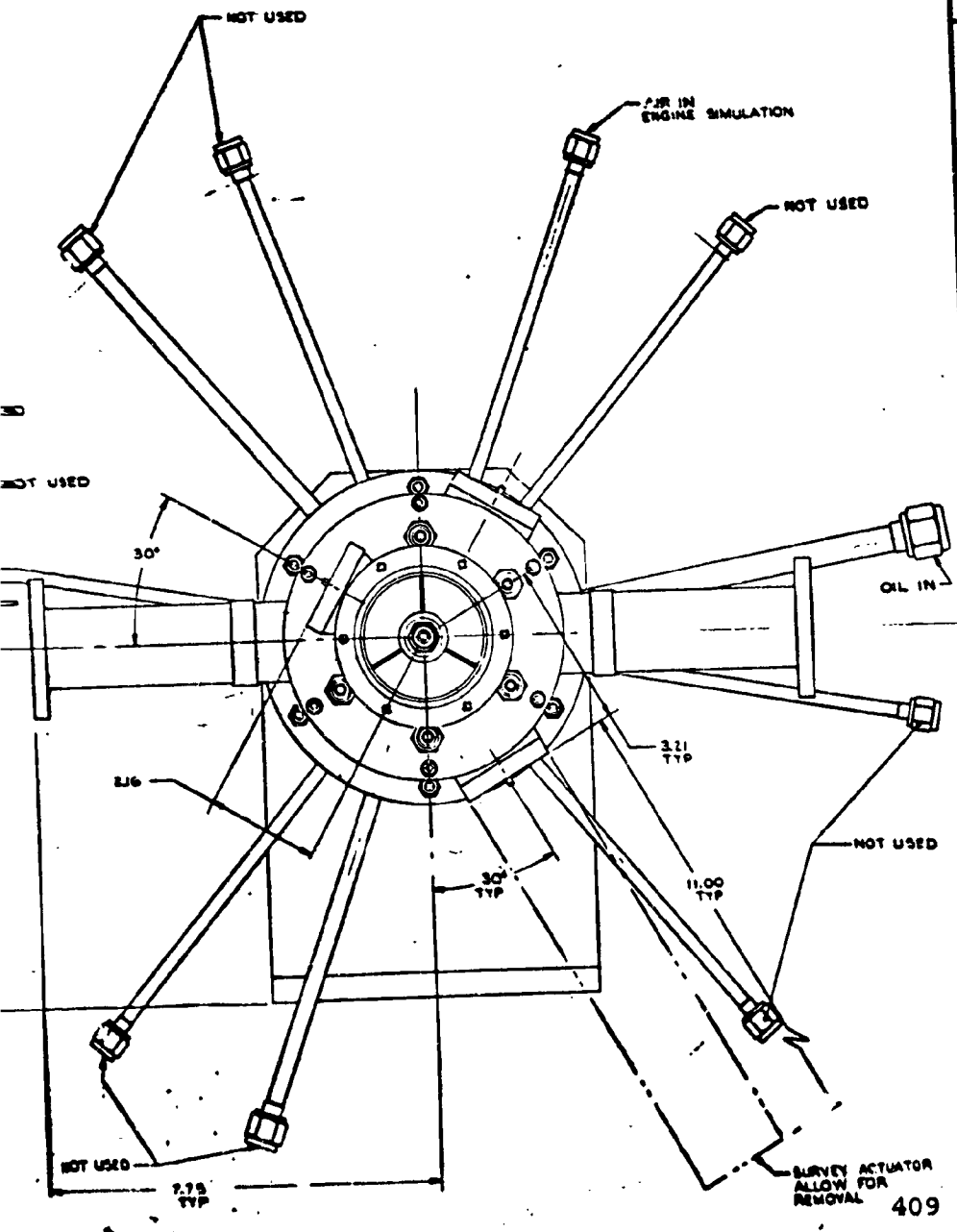


	O.D.	I.D.	RT
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]


STACK
36041610


15.509
14.989
11.248
10.864
MOUNT STAND
VENT
SPEED PICKUP
STATIC PRESS TAP FEED THRU
SURVEY MOUNT PAD TYP 3 PLACES
NOT USED
30°
STATIC PRESS TAP FEED THRU
LOAD COMPRESSOR
TURBINE EXHAUST
7.00
OIL DRAIN
TURBINE INLET TYP, 2 PLACES 180° APART
NOT USED
7.75 TYP

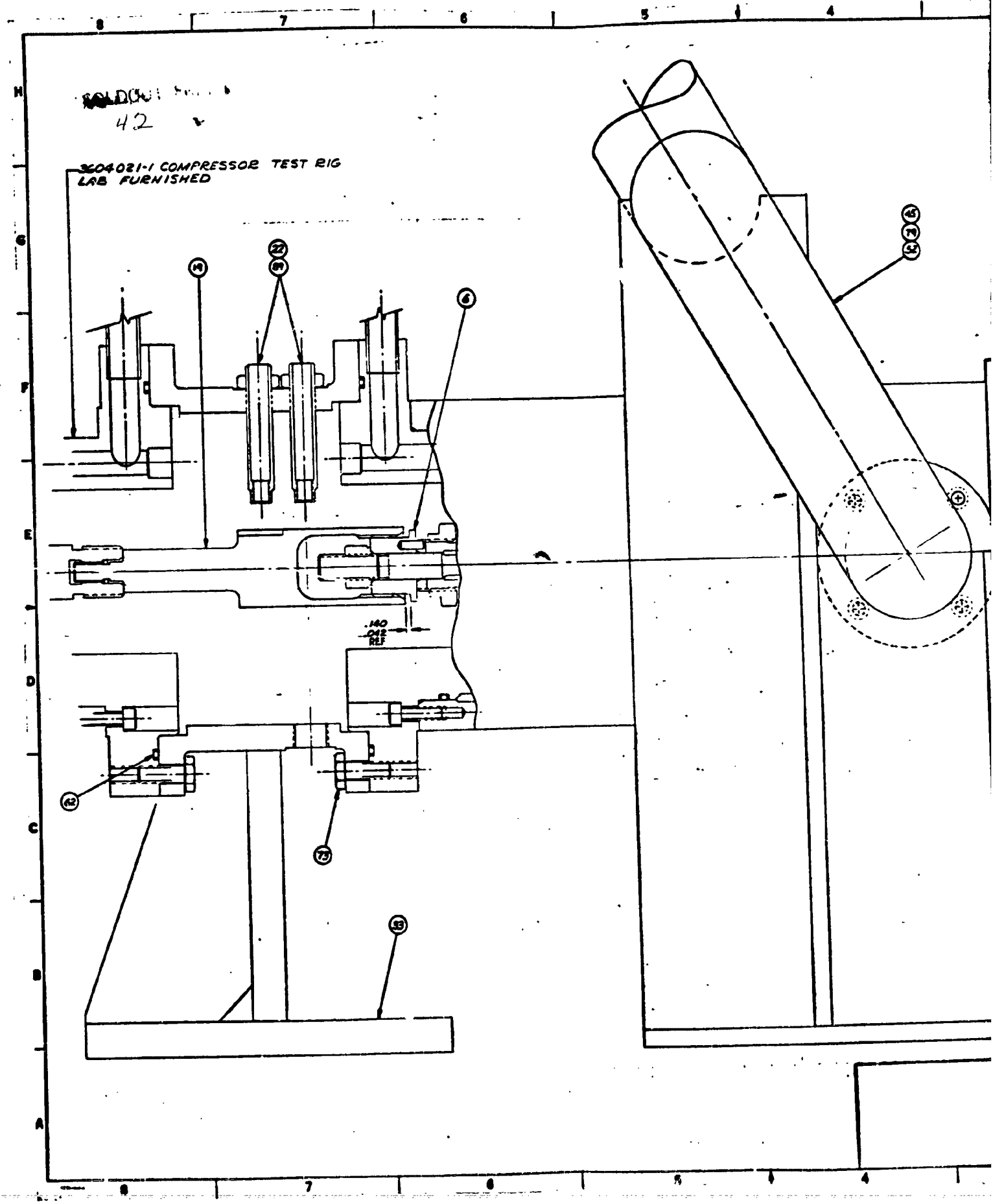
FOLDOUT FRAME 41



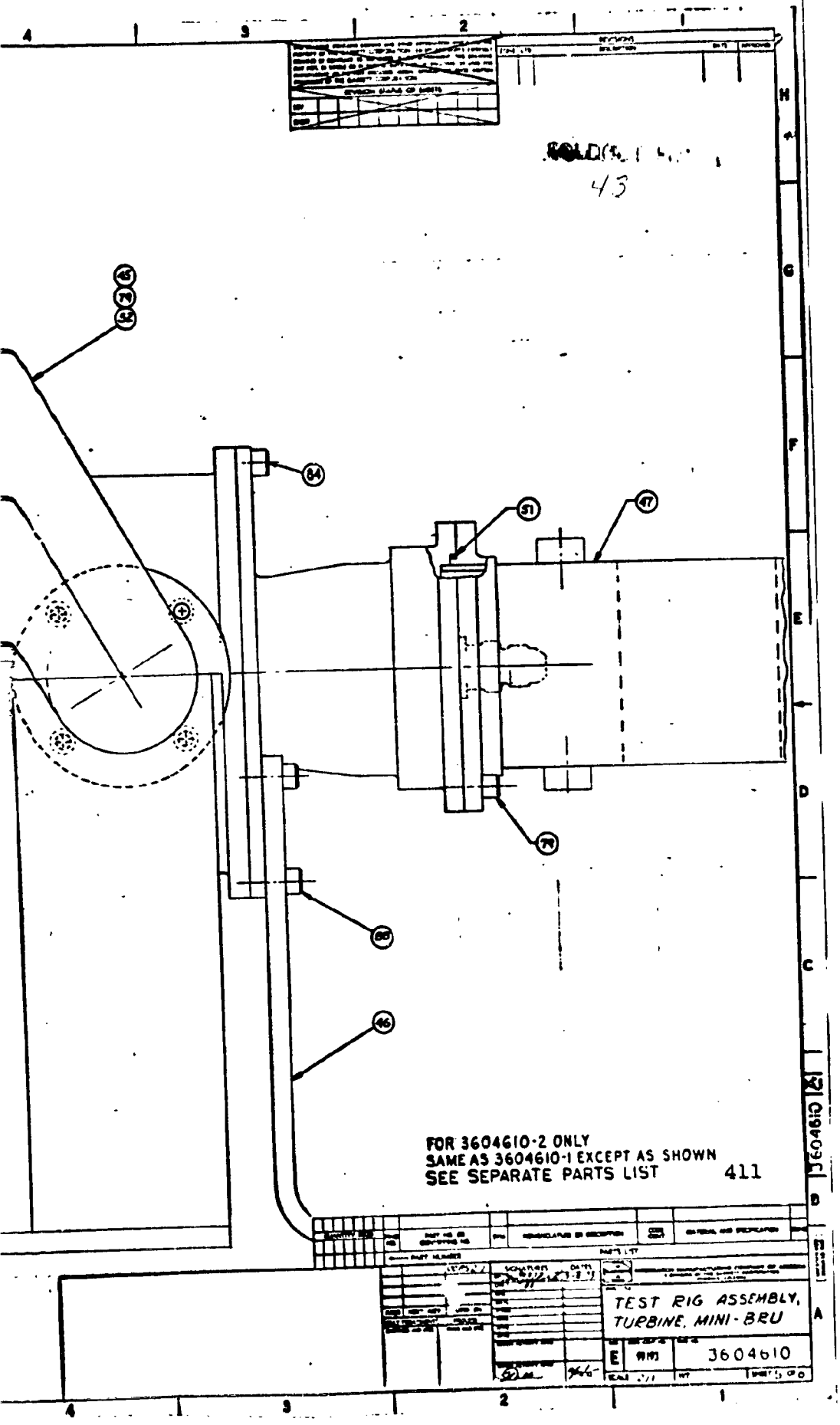
409

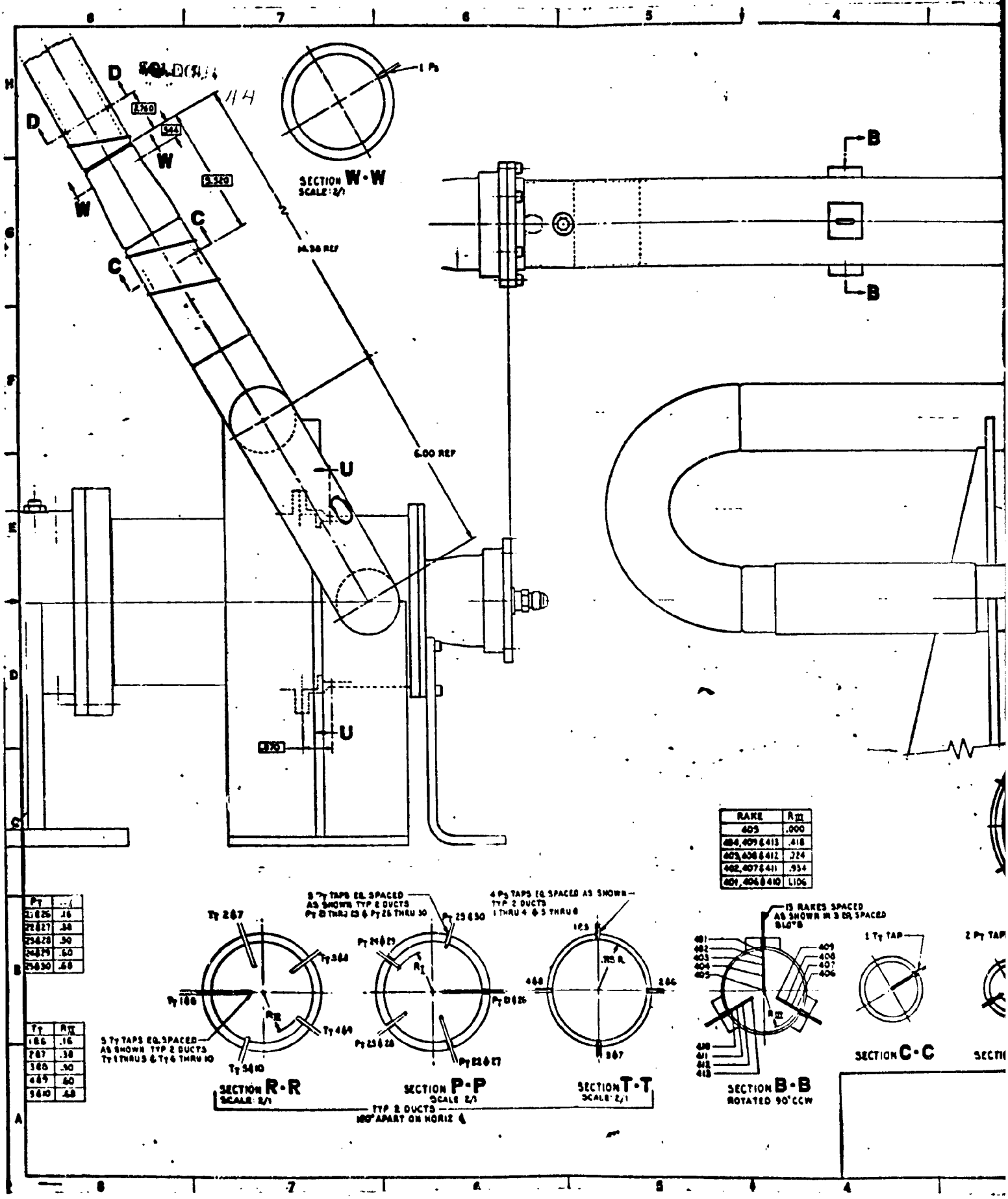
3604610

3604610



42
3604021-1 COMPRESSOR TEST RIG
LAB FURNISHED
.140
.042
REF

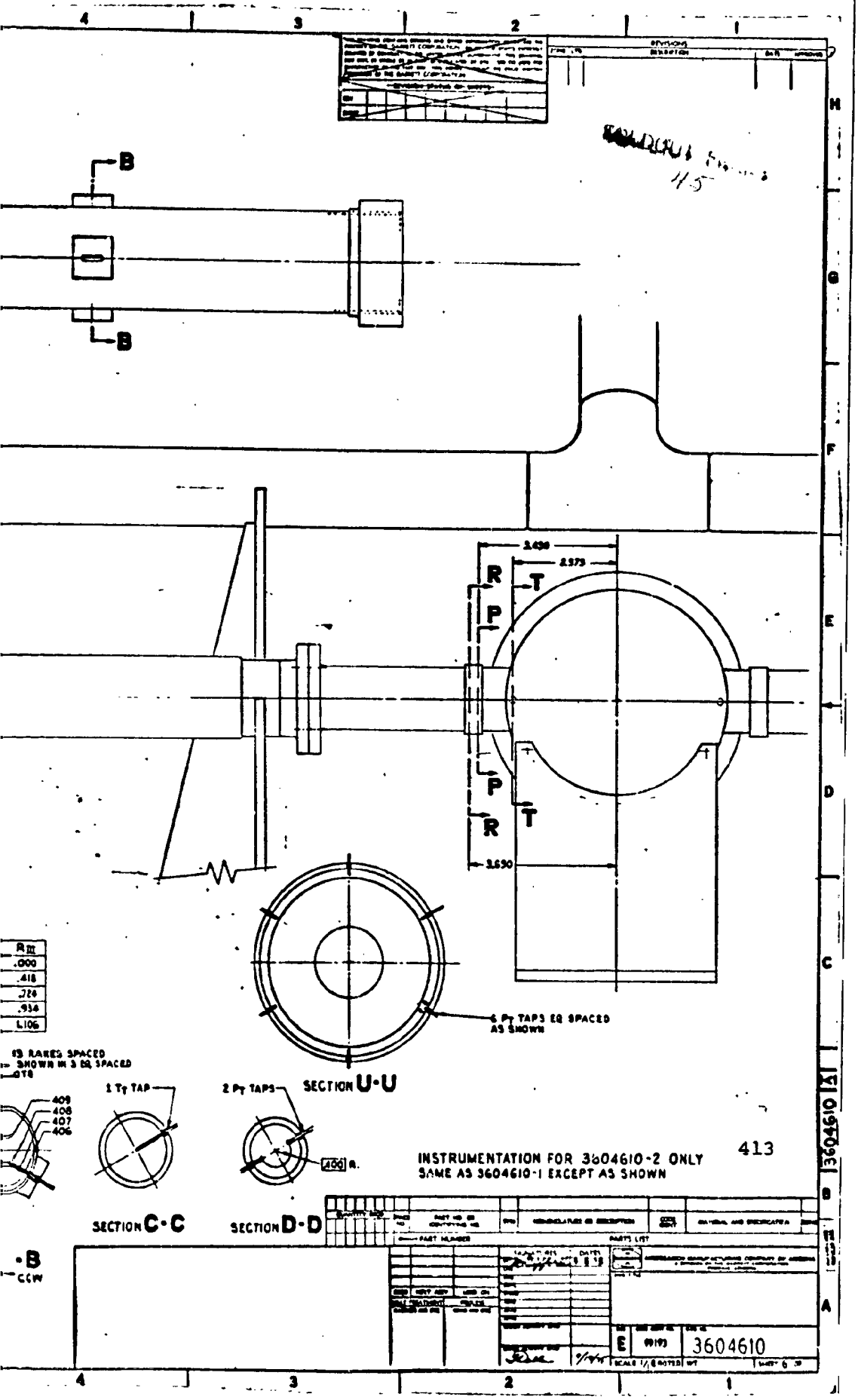

FOR 3604610-2 ONLY
SAME AS 3604610-1 EXCEPT AS SHOWN
SEE SEPARATE PARTS LIST
411
TEST RIG ASSEMBLY,
TURBINE, MINI-BRU
3604610
84
51
47
79
60
46



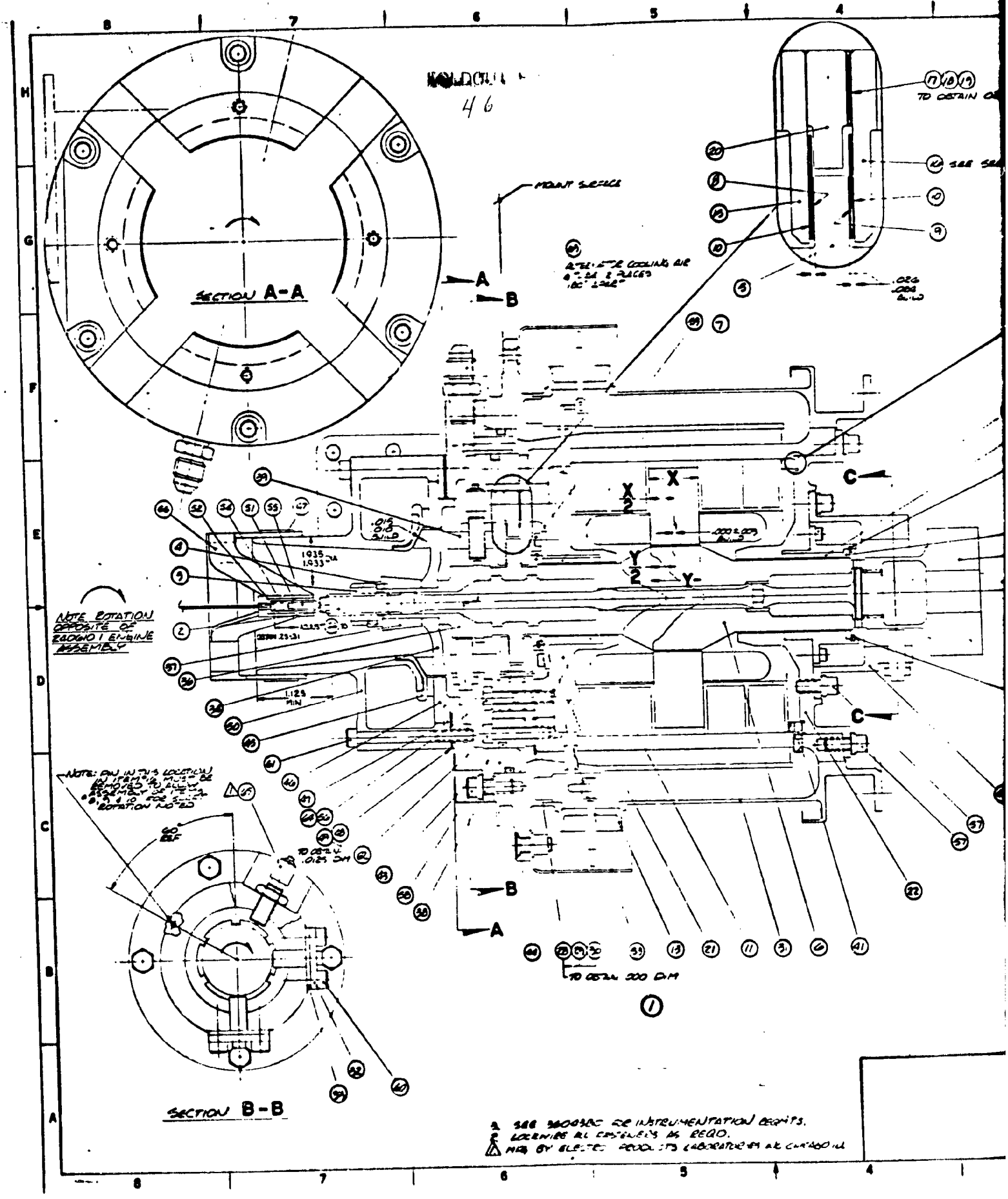
RAKE	R_{III}
405	.000
404, 409 & 413	.418
403, 408 & 412	.724
402, 407 & 411	.934
401, 406 & 410	1.106

Pt	
21 & 26	.16
22 & 27	.38
23 & 28	.50
24 & 29	.60
25 & 30	.68

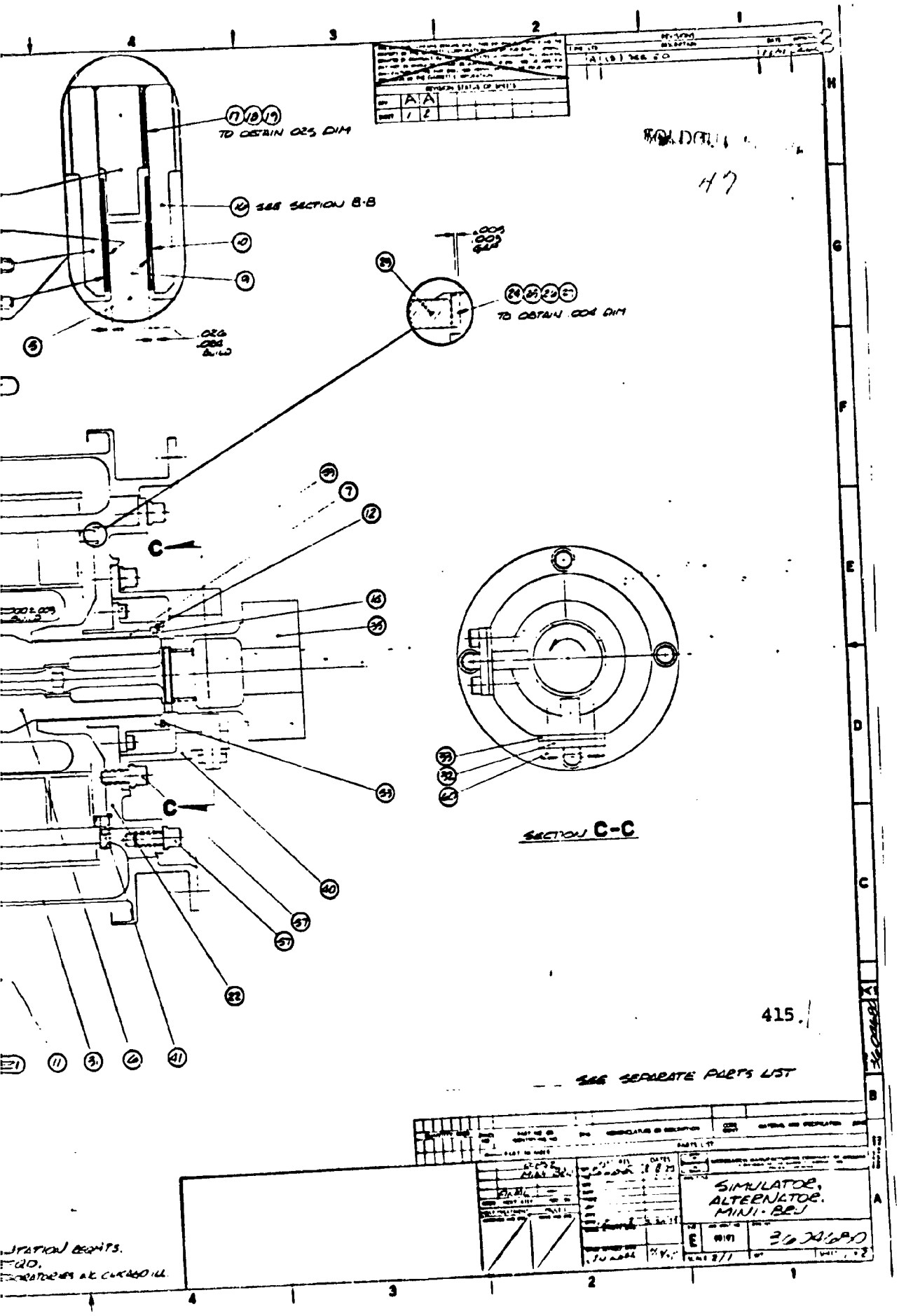
Tt	R_{II}
1 & 6	.16
2 & 7	.38
3 & 8	.50
4 & 9	.60
5 & 10	.68



B
B
R
T
P
P
R
T
3.430
2.573
3.650
6 PT TAPS EQ SPACED AS SHOWN
SECTION U-U
1 TT TAP
2 PT TAPS
SECTION C-C
SECTION D-D
.000
.418
.724
.934
1.106
409
408
407
406
INSTRUMENTATION FOR 3604610-2 ONLY
SAME AS 3604610-1 EXCEPT AS SHOWN
413
3604610
E
3604610



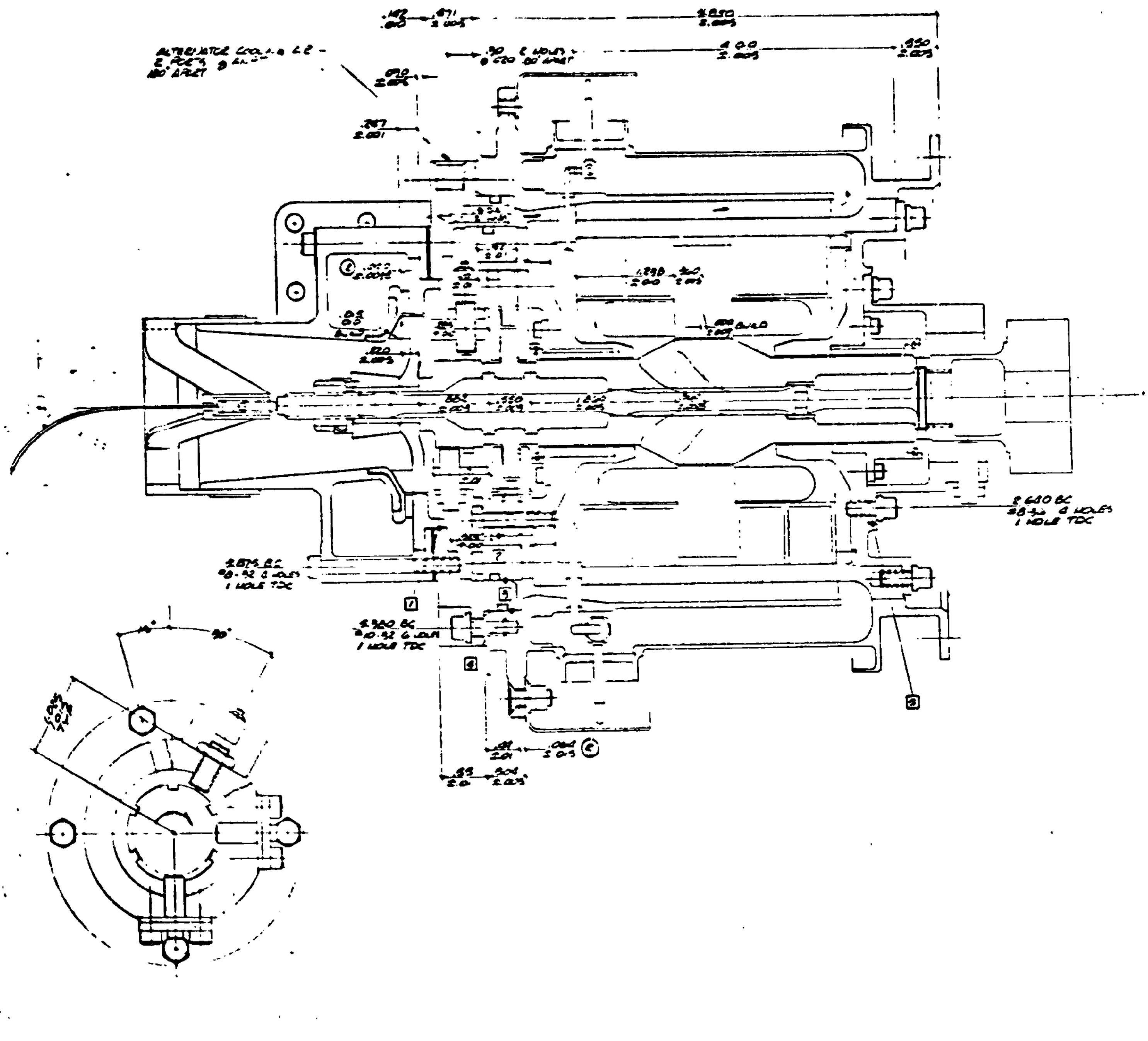
46
SECTION A-A
MOUNT SURFACE
TO OBTAIN
NOTE ROTATION OPPOSITE OF 240610 I ENGINE ASSEMBLY
1.935
1.933
1.125 MIN
TO OBTAIN .000 DIM
SECTION B-B

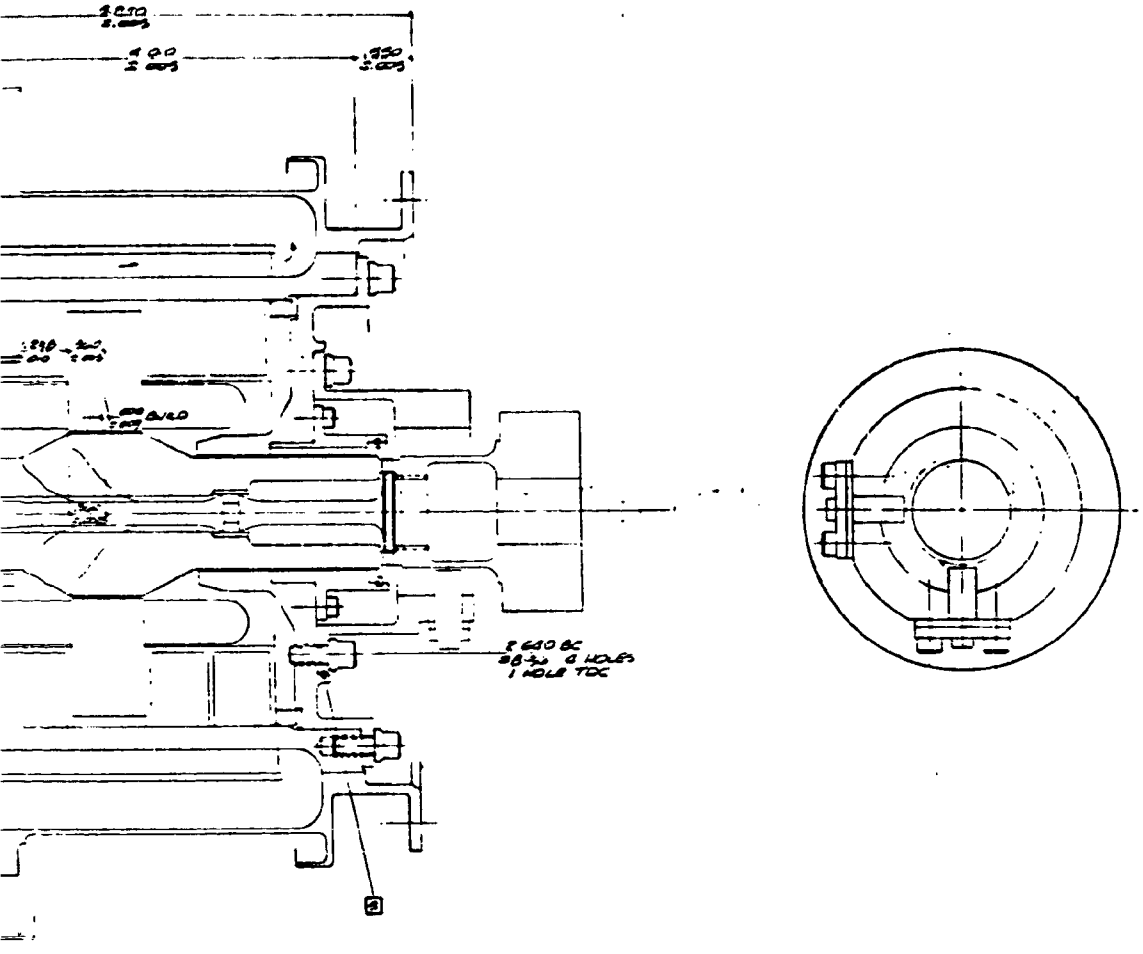

TO OBTAIN .025 DIM
SEE SECTION B-B
TO OBTAIN .004 DIM
SECTION C-C
SEE SEPARATE PARTS LIST
SIMULATOR, ALTERNATOR, MINI-BEJ
415.

FOLDOUT FRAME

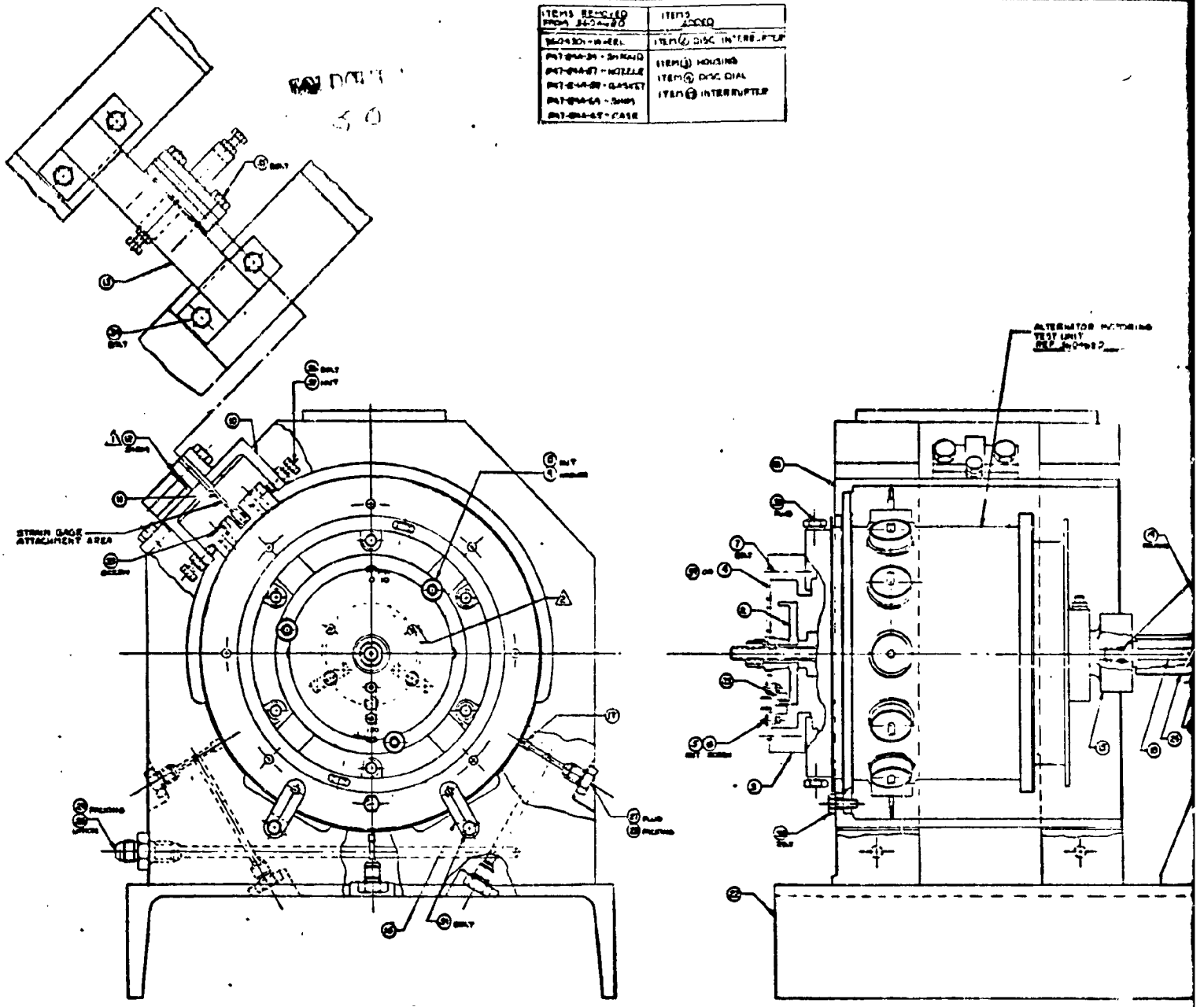
48

ID	OD	FT
3.003 3.001	3.000 2.999	.004 .001 L
3.208 3.200	3.193 3.190	[illegible] L
4.276 4.274	4.270 4.260	[illegible] L
.0015 .9995	4.999 4.997	.0045 .0005 L
.0026 .0005	5.000 4.998	.0045 .0005 L




1 HOLE TOC

ITEMS REMOVED FROM [illegible]	ITEMS ADDED
[illegible] - WHEEL	ITEM (2) DISC INTERRUPTER
[illegible] - SHROUD	ITEM (3) HOUSING
[illegible] - NOZZLE	ITEM (4) DISC DIAL
[illegible] - GASKET	ITEM (5) INTERRUPTER
[illegible] - SHIM	
[illegible] - CASE	

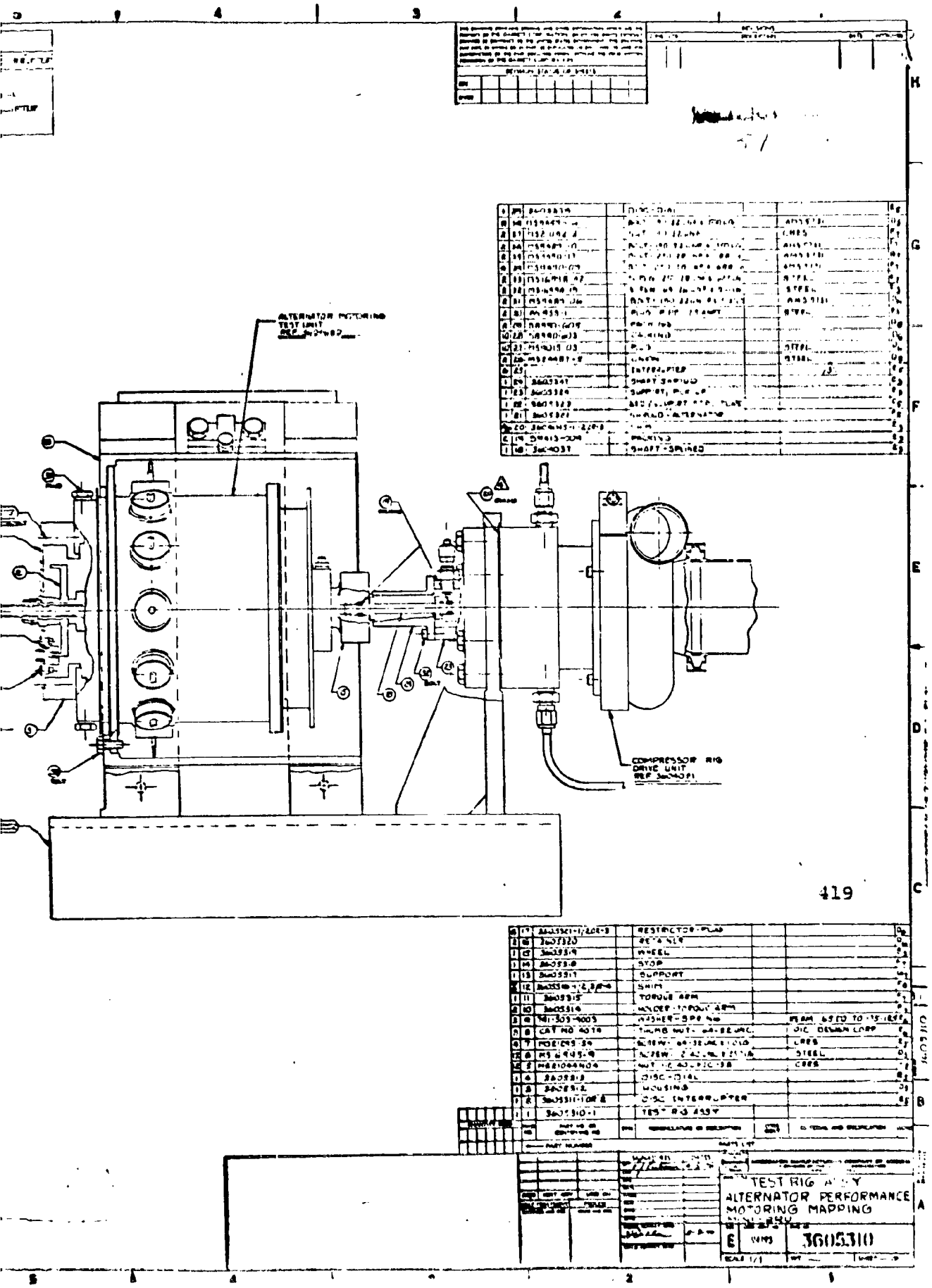


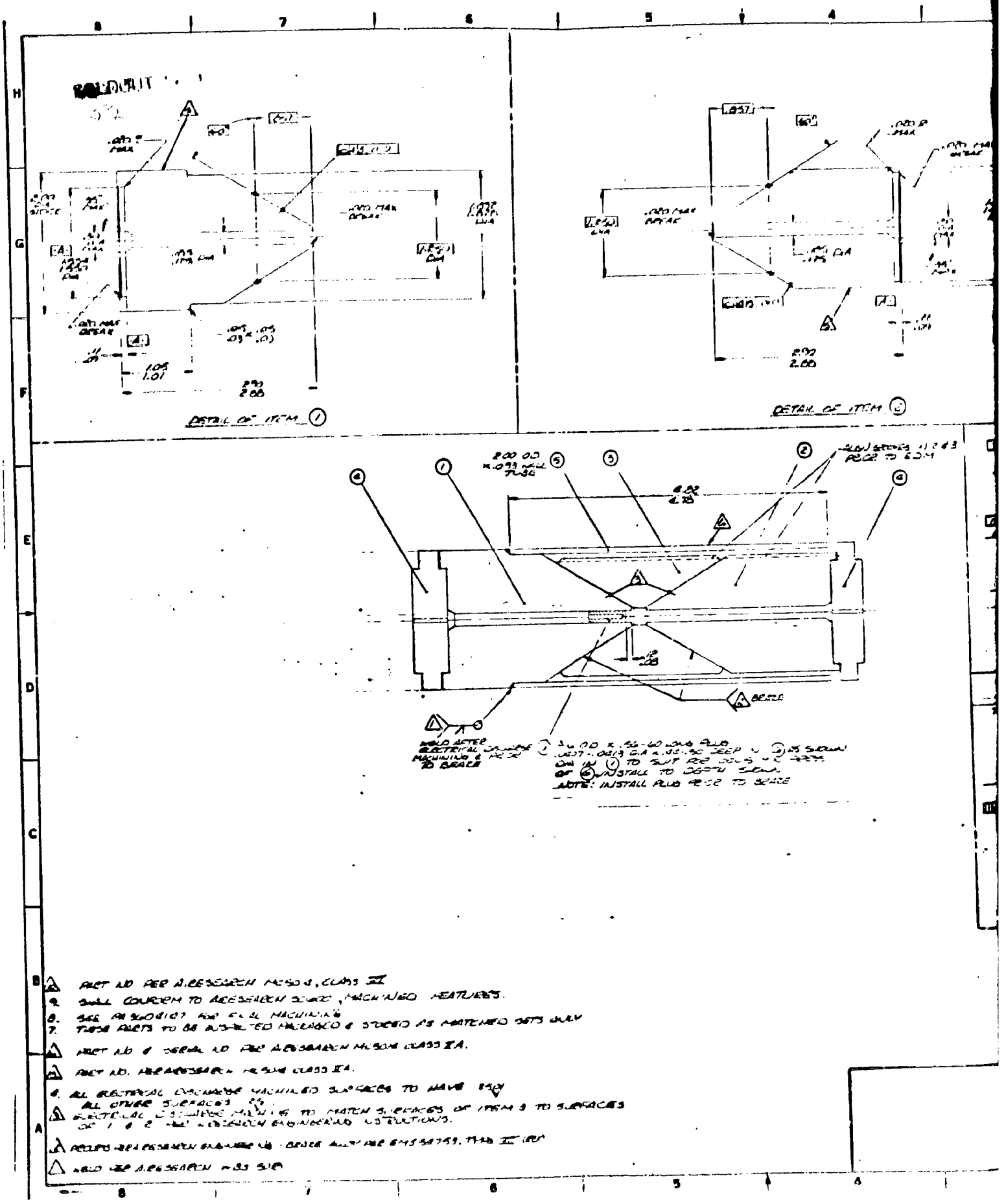
SHIM AS REQ'D PER ENGINEERS INSTRUCTION.

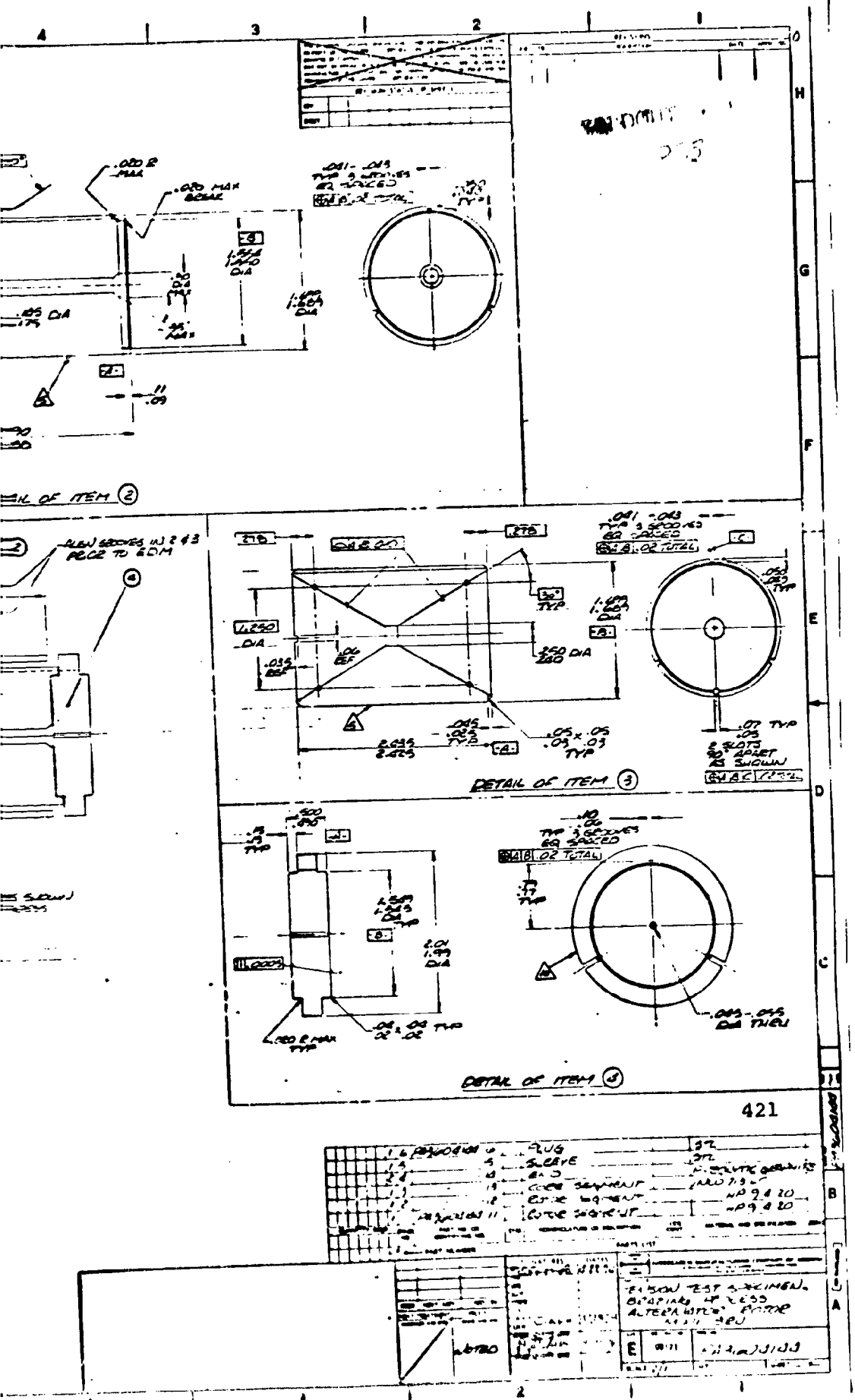
THIS ITEM TO BE PROVIDED BY THE INSTRUMENTATION GROUP.

ITEM (4) IS ROTATED IN RELATION TO ITEM (2) UNTIL TIMING MARKS ARE ALIGNED. ITEM (4) IS THEN SECURED AND THE FACE OF ITEM (3) IS SCRIBED TO INDICATE ZERO POSITION.

SHIM AS REQ'D TO ADJUST ITEM (11).

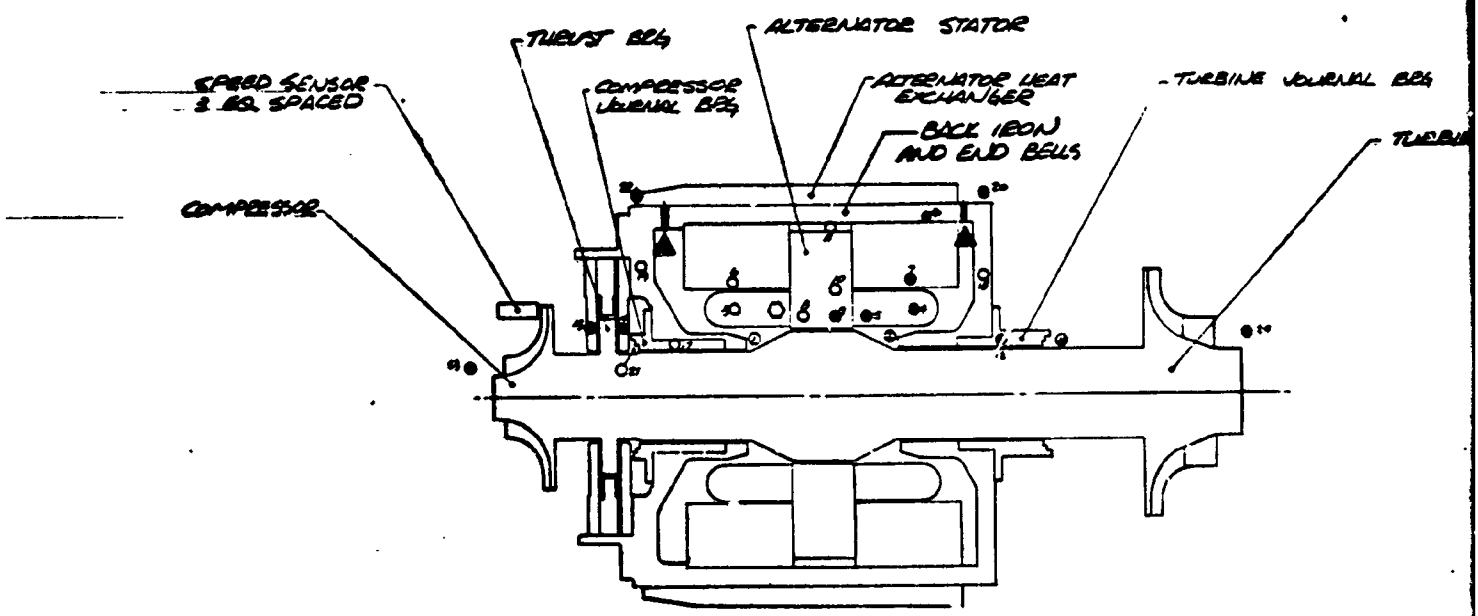

ALTERNATOR MOTORING TEST UNIT
COMPRESSOR RIG DRIVE UNIT
TEST RIG ASSY
ALTERNATOR PERFORMANCE MOTORING MAPPING
3605310


DETAIL OF ITEM 1
DETAIL OF ITEM 6
BRAZE
WELD AFTER ELECTRICAL DISCHARGE MACHINING & PRIOR TO BRAZE
NOTE: INSTALL PLUG PRIOR TO BRAZE
PART NO PER AIRESEARCH MC50 4, CLASS III
SHALL CONFORM TO AIRESEARCH SC600, MACHINED FEATURES.
SEE PA 3604107 FOR FINAL MACHINING
THESE PARTS TO BE INSPECTED PACKAGED & STORED AS MATCHED SETS ONLY
PART NO & SERIAL NO PER AIRESEARCH MC50 4 CLASS IIA.
PART NO. PER AIRESEARCH MC50 4 CLASS IIA.
ALL ELECTRICAL DISCHARGE MACHINED SURFACES TO HAVE
ALL OTHER SURFACES
ELECTRICAL DISCHARGE MACHINING TO MATCH SURFACES OF ITEM 3 TO SURFACES OF 1 & 2 PER AIRESEARCH ENGINEERING INSTRUCTIONS.
WELD PER AIRESEARCH


DETAIL OF ITEM 2
DETAIL OF ITEM 3
DETAIL OF ITEM 4
ALIGN GROOVES IN 2 & 3 PRIOR TO EDM
.020 R MAX
.020 MAX BREAK
.041 - .043 TYP 3 GROOVES EQ SPACED
.02 TOTAL
.250 DIA
.07 TYP
2 SLOTS 90° APART AS SHOWN
.045 - .055 DIA THRU
PLUG
SLEEVE
CORE SEGMENT
ROTOR SEGMENT
ROTOR SEGMENT
TENSION TEST SPECIMEN
BRAZING PROCESS
ALTERNATOR ROTOR
NOTED

FOLDOUT

54



THERMOCOUPLES - S

THERMOUPLES - E

STATIC PRESSU

FLUX COIL

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REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPROVED

FOLDOUT FRAME 55

BRG

TURBINE

ES - SIMULATOR

ES - ENGINE

ESSURE - ENGINE

CAUTION: THIS DRAWING SHOWS PROPOSED CONFIGURATION & DOES NOT NECESSARILY REPRESENT EXACT DESIGN DETAIL OR SCALE

423

QUANTITY REQD	FIND NO.	PART NO OR IDENTIFYING NO	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE

← PART NUMBER

PARTS LIST

REQD	NEXT ASSY	USED ON
HEAT TREATMENT		PROCESS
HARDNESS AND SPEC		NAME AND SPEC

CONTRACT NO

DFT [signature] 10-10-72

CHK

MFG

MATL

STRESS

AERO

APVD

DESIGN ACTIVITY APVD

OTHER ACTIVITY APVD

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

DWG TITLE

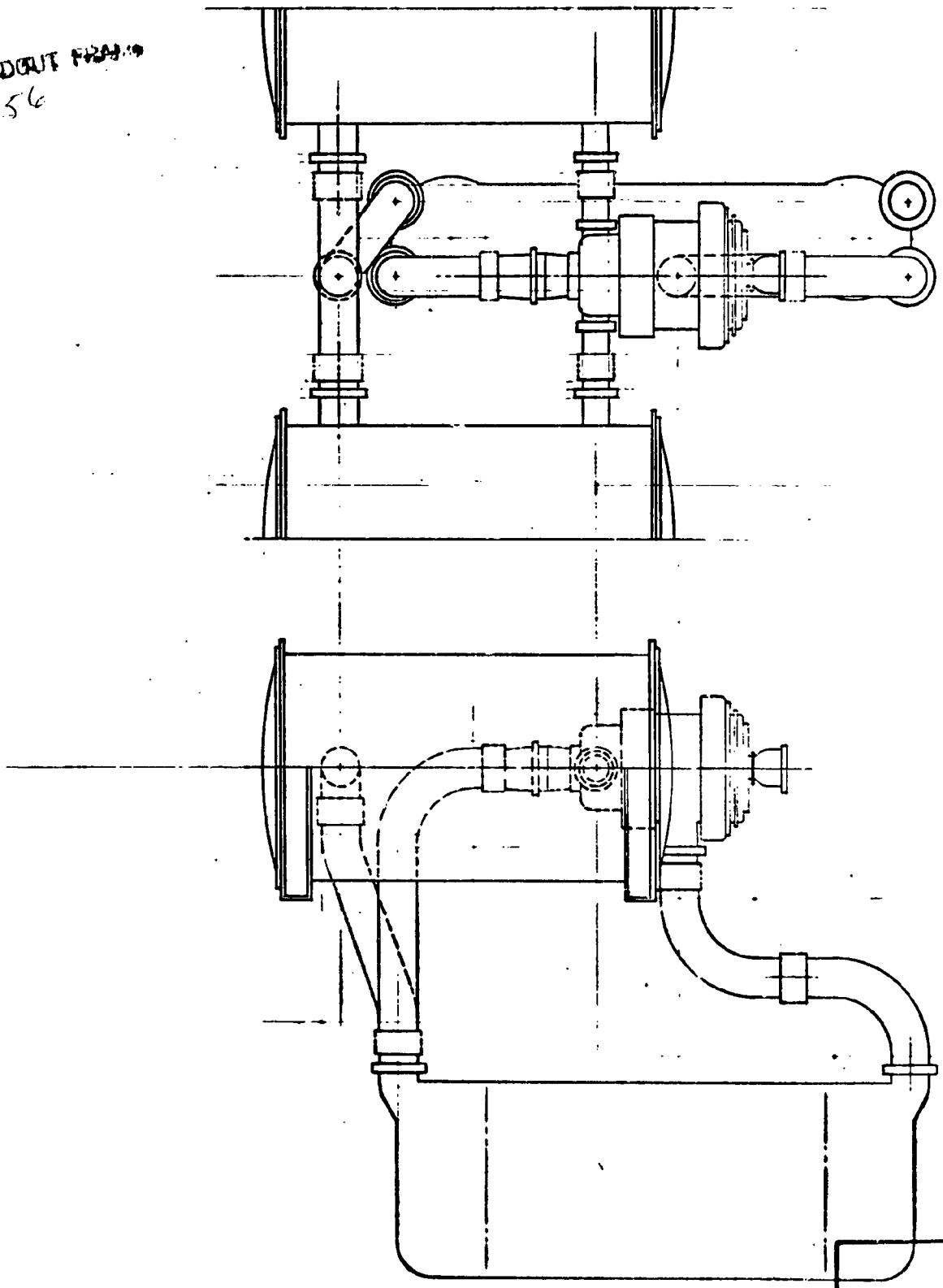
SCHEMATIC
INTERNAL INSTRUMENTATION
CCPS 2-1

SIZE	CODE IDENT NO	DWG NO
D	99193	5KP32488

SCALE 1/1 WT SHEET — OF —

5KP32488

FOLDOUT FRAME
56



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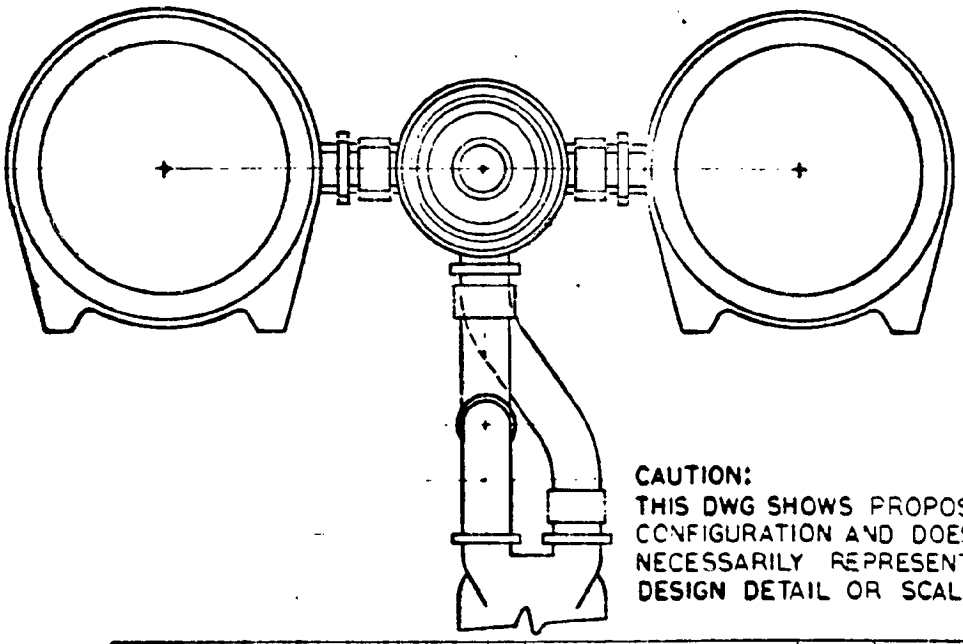
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

FOLDOUT FRAME

57



CAUTION:
THIS DWG SHOWS PROPOSED CONFIGURATION AND DOES NOT NECESSARILY REPRESENT EXACT DESIGN DETAIL OR SCALE

425

QUANTITY REQD	FIND NO	PART NO OR IDENTIFYING NO	SYM	NOMENCLATURE OR DESCRIPTION	CODE IDENT	MATERIAL AND SPECIFICATION	ZONE

← PART NUMBER

PARTS LIST

REQD	NEXT ASSY	USED ON
HEAT TREATMENT		PROCESS
HARDNESS AND SPEC		NAME AND SPEC

CONTRACT NO

DFT
CHK
MFG
MAT
STRESS
KERO
APVD

DESIGN ACTIVITY APVD

OTHER ACTIVITY APVD

AIRESEARCH MANUFACTURING COMPANY OF ARIZONA
A DIVISION OF THE GARRETT CORPORATION
PHOENIX, ARIZONA

DWG TITLE
PROPOSAL
REFERENCE GDS
COMPONENT CONFIG. A

SIZE	CODE IDENT NO	DWG NO
D	99193	SKP32516

SCALE 1:4

SKP32516

MICROFILMED