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Acoustically Excited Heated Jets

III—Mean Flow Data

J. Lepicovsky, K. K. Ahuja, W. H. Brown,
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FOREWORD

This report was prepared by Lockheed Aeronautical Systems Company - Georgia Division, Marietta, Georgia for NASA-Lewis Research Center, Cleveland, Ohio under Contract NAS3-23708, entitled "Experimental Investigation of the Effects of Acoustic Excitation on Hot Jet Mixing." The work was performed under a two phase effort.

Mr. James R. Stone was the Project Manager for NASA-Lewis Center for the Phase I effort. Lockheed's Program Manager was Dr. H. K. Tanna. Dr. Ed Rice was the Project Manager for NASA-Lewis Center for the Phase II effort. Lockheed's Program Manager was Dr. K. K. Ahuja.

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1.0 INTRODUCTION

This report is Part 3 of a three-part report on the excitability of heated jets under the influence of acoustic excitation. The effects of upstream internal acoustic excitation on jet mixing were described in detail in Part I. Part 2 describes the effects of external excitation on flow mixing. Part 3 contains detailed quantitative results from the measurements of mean Mach number and temperature and consists of radial profiles and centerline distributions measured at selected jet operating conditions for internally excited and unexcited jets. The mean flow data are presented in both graphical and tabulated forms. For the sake of completeness, this part contains temperature probe calibration curves also.

2.0 FLOWFIELD MEASUREMENTS

The objective of these experiments was to obtain a general mean flow survey of the acoustically excited heated jets. The measurements consisted of the flow total pressure and total temperature measurements along the jet centerline and selected jet radial locations. The data in this section are presented as measured. The corresponding corrected temperature data and computed velocities are presented in a tabular form in Section 3.

2.1 TEST CONDITIONS

The flow parameters were measured at twelve equally-spaced axial stations from the nozzle exit plane to X/D = 12. The radial profiles were measured at five axial stations X/D = 1, 3, 5, 7, and 9, with a reasonably fine space resolution in the radial direction. The mean flow experiments were conducted only for those jet operating conditions, where strong effects of upstream acoustic excitation in terms of the changes in the mean velocities were found during the optimization experiment.

It should be emphasized here that the data presented are raw, experimental data uncorrected for thermocouple recovery. Before using these data for velocity or other computations, therefore, the measured temperatures have to be corrected using temperature probe correction curves, which are presented in Section 2.3. However, as already mentioned above, the corrected data are readily available in Section 3.

The velocity and temperature distributions and profiles were measured at jet operating conditions corresponding to Test Points 1 through 6, and 8 in the Test Matrix presented in Table 2.1. The results for both excited and unexcited jets are presented for Test Points 1 through 3, and 6; while for Test Points 4, 5, and 8, only the experimental results for the unexcited jet are shown.

A limited number of flowfield measurements was carried out at the excitation level of L_e = 150 dB and excitation Strouhal number of St_j = 0.4 at Test Points 4, 5 and 8. These measurements were taken for the sake of completeness, even though no effects of the upstream acoustic excitation were observed during the optimization experiments at these jet operating conditions. In all these cases (Test Points 4, 5, and 8), the

measurements have yielded either the identical velocity and temperature values as for the unexcited cases, or the difference between these sets of measurements were random and always within the experimental error band.

Velocity and temperature distributions and profiles are plotted in dimensionless coordinate systems. For velocity measurements, the Mach number ratio M_p/M_j (for definition see below) is plotted versus the dimensionless axial or radial station, and in the cases of temperature measurements, the temperature ratio $(T_p-T_o)/(T_t-T_o)$ is plotted against dimensionless axial or radial station.

The Mach number ratio M_p/M_j is defined as

$$M_p/M_j = \sqrt{\frac{(p_p/p_o)^{(\gamma-1)/\gamma} - 1}{(p_t/p_o)^{(\gamma-1)/\gamma} - 1}}$$

where M_p is the local flow Mach number,

M_j is the jet exit Mach number,

p_p is the measured local flow total pressure,

p_t is the plenum total pressure

p_o is the ambient, barometer pressure, and

γ is the specific heat ratio.

The temperature ratio is defined by expression

$$(T_p-T_o)/(T_t-T_o)$$

where T_p is the measured, uncorrected local flow total temperature,

T_t is the plenum total temperature,

and T_o is the ambient temperature.

2.2 CENTERLINE DISTRIBUTIONS AND RADIAL PROFILES

The velocity centerline distributions are show in Figures 2.1 through 2.11, and the temperature centerline distributions are shown in Figures 2.12 through 2.20. The particular ambient conditions of each of the experiments are given in Table 2.2.

The radial velocity and temperature profiles were measured at five axial stations at X/D = 1, 3, 5, 7, and 9. The velocity radial profiles are shown in Figures 2.21 through 2.31, and the temperature radial profiles are shown in Figures 2.32 through 2.40. The particular ambient conditions of each of the tests are summarized in Table 2.3.

2.3 TEMPERATURE PROBE CALIBRATION

For temperature measurements involving the immersion of a temperature probe in heated free jets, corrections to the temperature, indicated by the probe, are necessary for accurate quantification. The reason for these corrections is that the probe junction attains thermal equilibrium at a temperature other than that of the undisturbed free jet. The equilibrium temperature results from a balance between heat transferred to and from the probe. Convective heat transfer between gas and probe is balanced against radiative heat transfer between the probe and surroundings and simultaneously against conductive heat transfer between the probe stem and its support. The heat transfer between the probe and its support is particularly severe for a probe immersed in heated free jet of small diameter with the temperature probe supported in the unheated surroundings. At low Mach numbers and high jet temperatures, the temperature indicated by the probe is particularly influenced more by probe stem heat conduction and radiation than by convective heat transfer. In this case, the temperature indicated by the probe will differ significantly from the jet total temperature. Without going into further details, the dynamic calibration of the temperature probe is clearly needed and the dynamic correction ratio has to be applied to all measured temperatures to correct the temperature readings.

TEST POINT	TOTAL TEMPERATURE T_t K (°F)	PRESSURE RATIO ξ	JET MACH NUMBER M_J	REYNOLDS NUMBER Re_J (MILLION)	VELOCITY RATIO U_J/a_o
1	294 (70)	1.50	0.78	1.0	0.74
2	367 (200)	1.50	0.78	0.8	0.83
3	489 (420)	1.50	0.78	0.5	0.95
4	672 (750)	1.50	0.78	0.4	1.12
5	811 (1000)	1.50	0.78	0.3	1.23
6	489 (420)	1.17	0.48	0.3	0.60
7	489 (420)	2.43	1.20	1.0	1.36
8	672 (750)	1.88	0.99	0.5	1.38

Table 2.1 Test matrix of jet operating conditions.

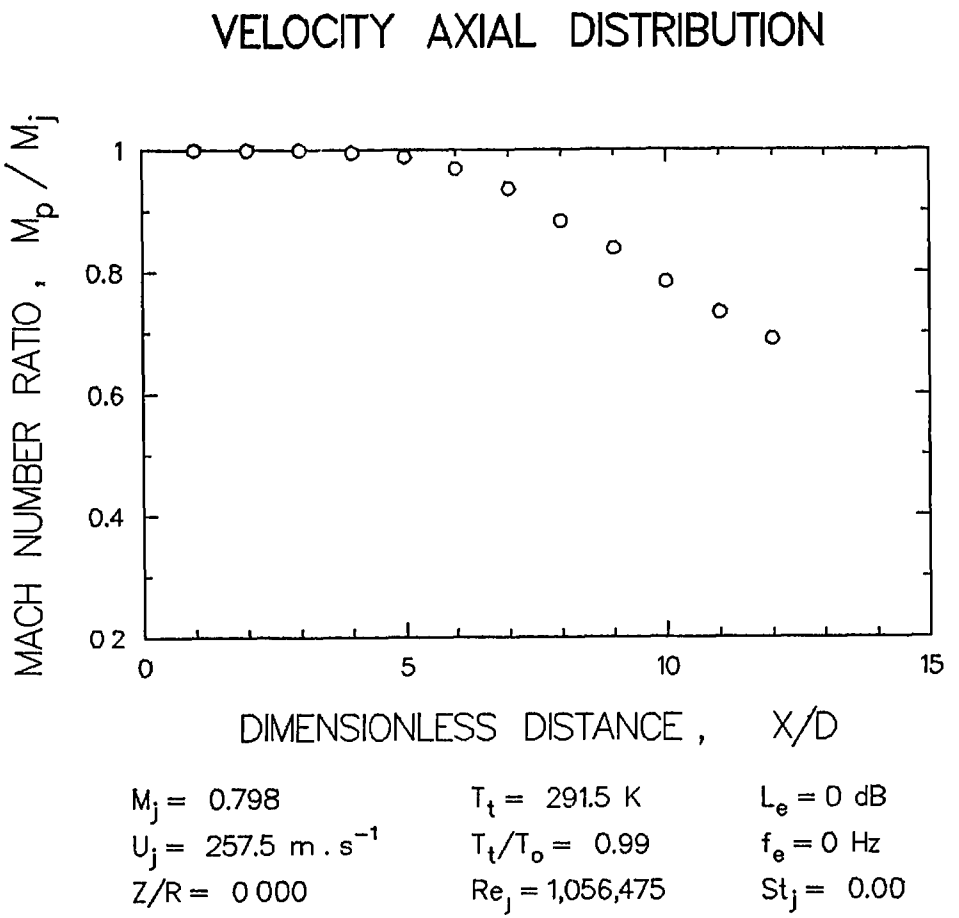

Figure 2.1 Unexcited unheated jet centerline velocity decay. Test Point 1.

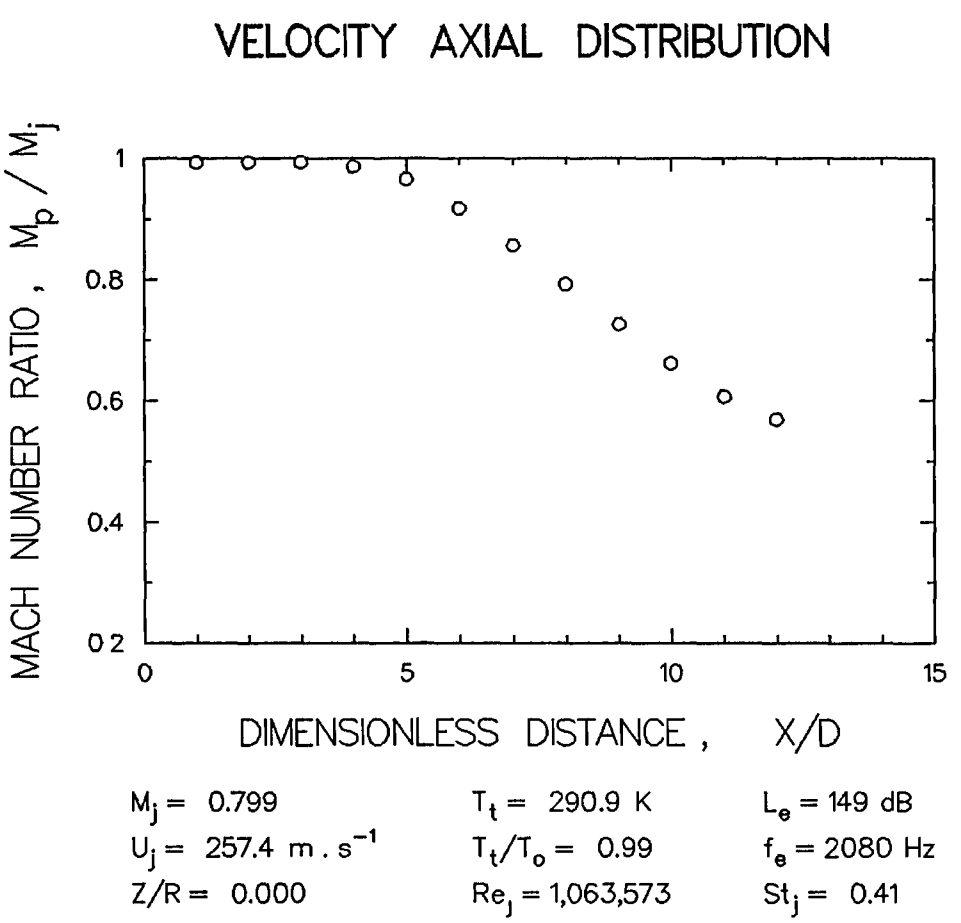

Figure 2.2 Tone excited unheated jet centerline velocity decay. Test Point 1.

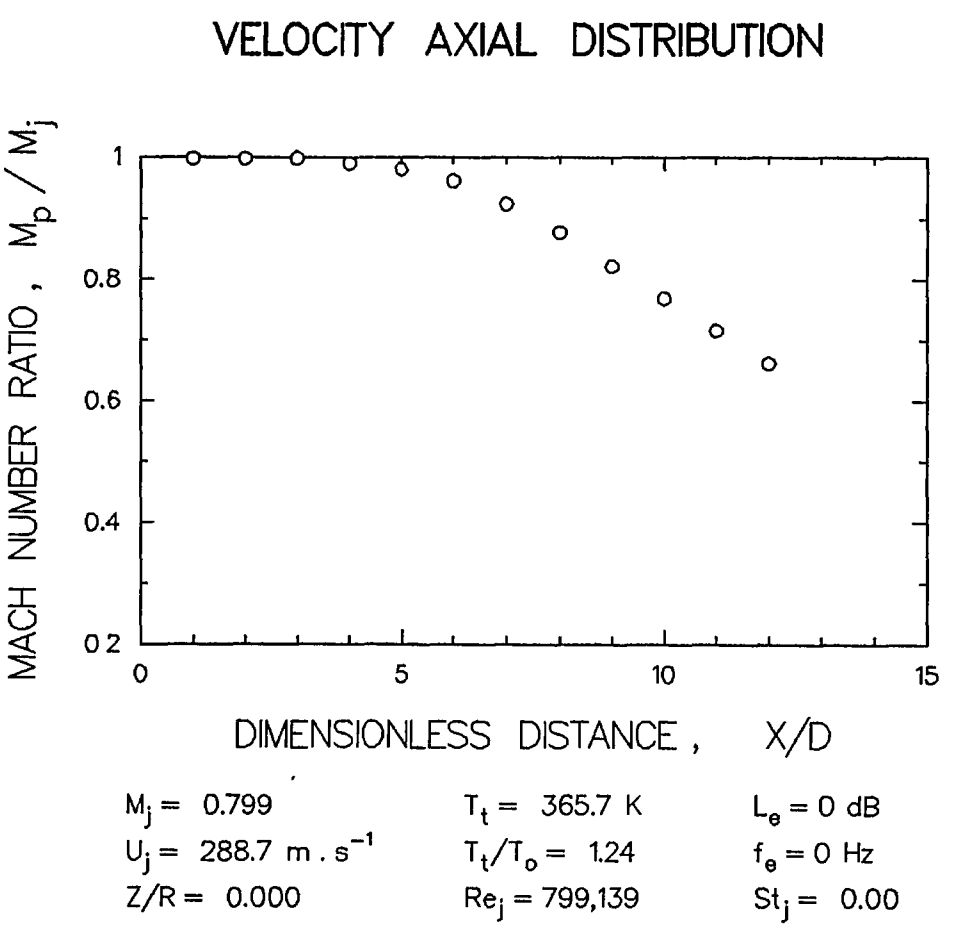

Figure 2.3 Unexcited heated jet centerline velocity decay. Test Point 2.

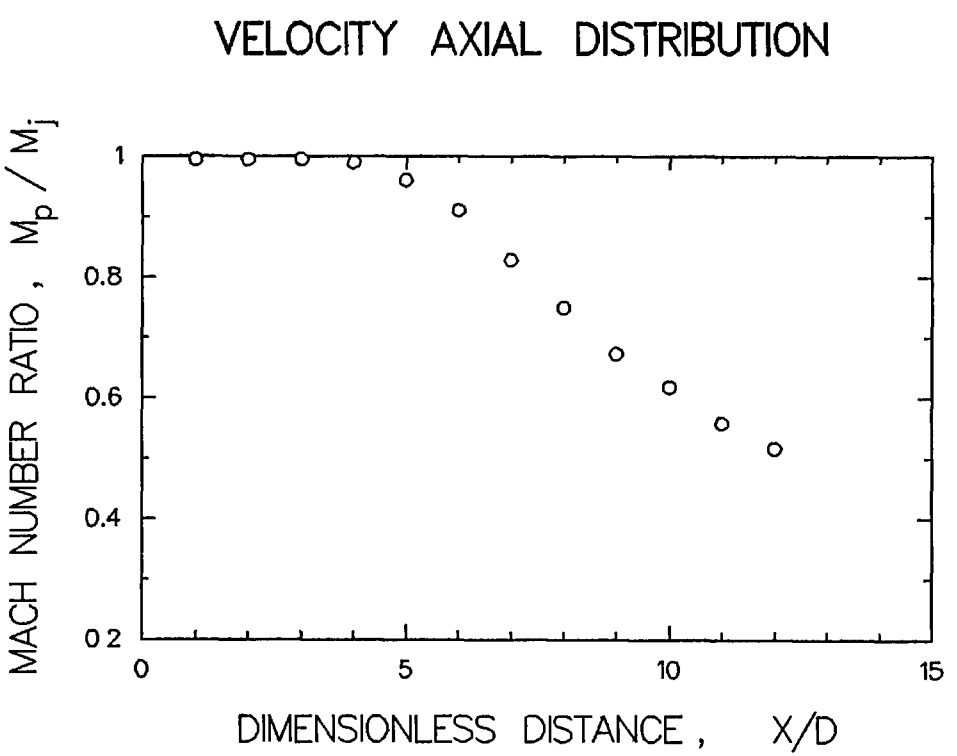

Figure 2.4 Tone excited heated jet centerline velocity decay. Test Point 2.

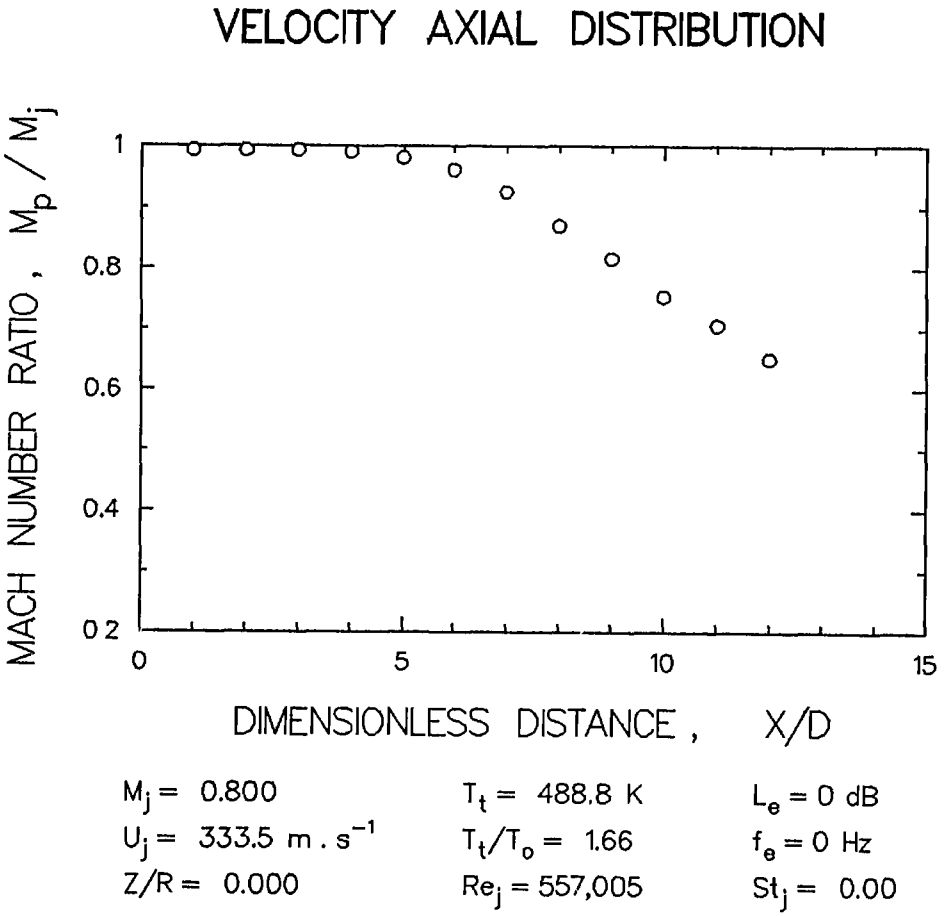

Figure 2.5 Unexcited heated jet centerline velocity decay. Test Point 3.

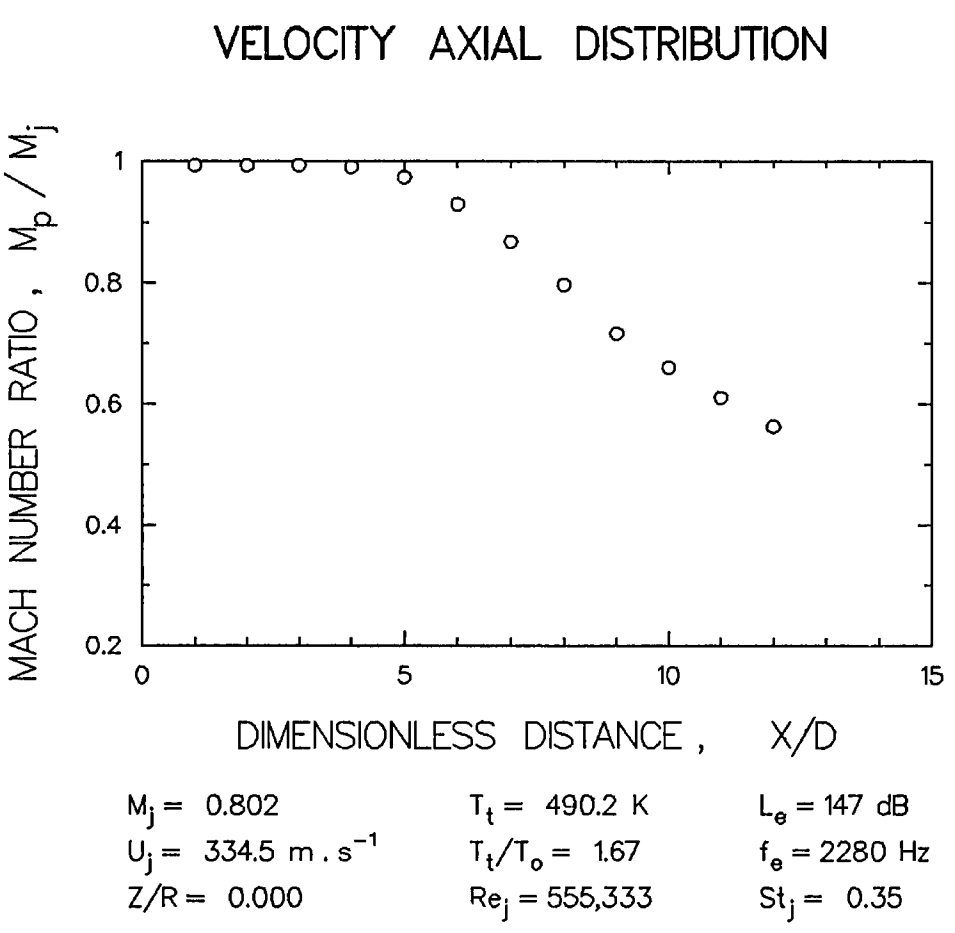

Figure 2.6 Tone excited heated jet centerline velocity decay. Test Point 3.

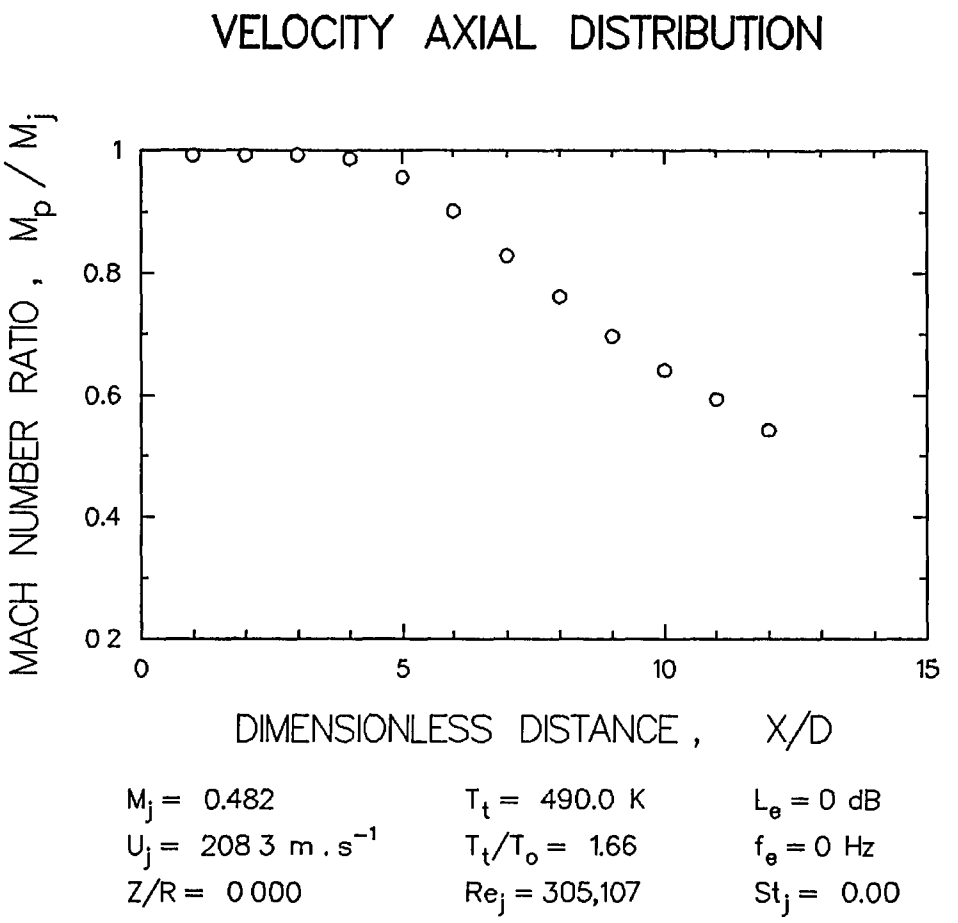

Figure 2.7 Unexcited heated jet centerline velocity decay. Test Point 6.

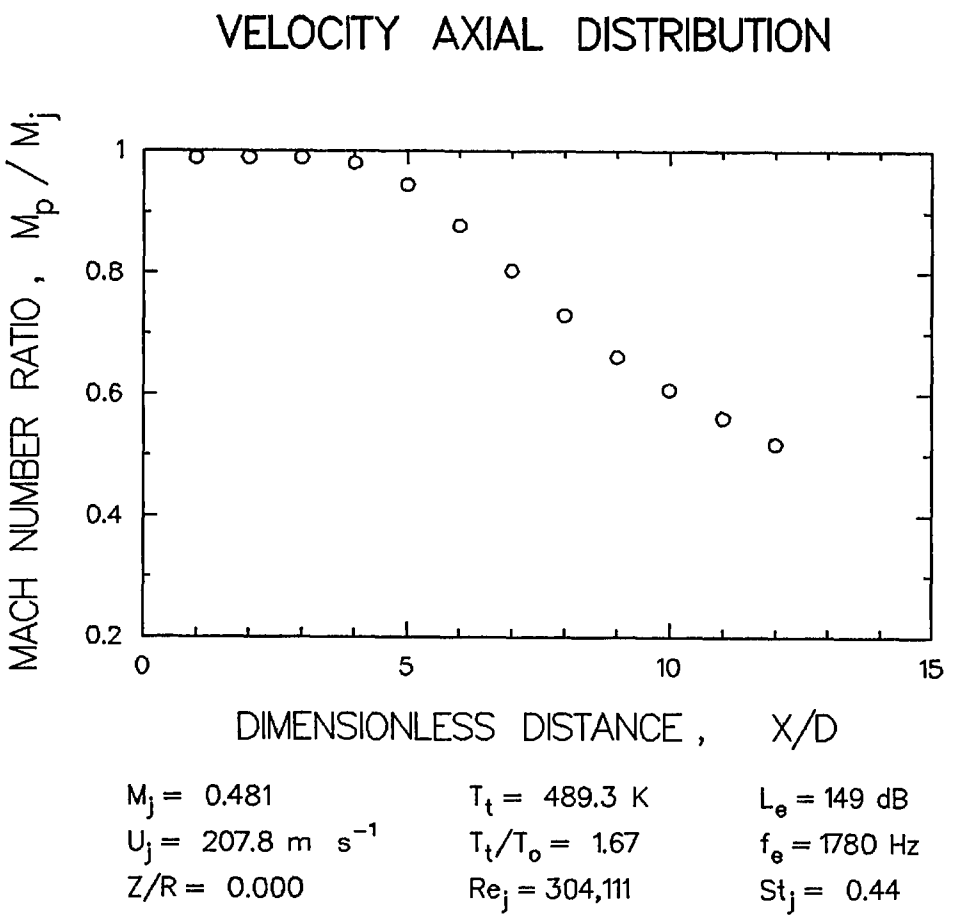

Figure 2.8 Tone excited heated jet centerline velocity profile. Test Point 6.

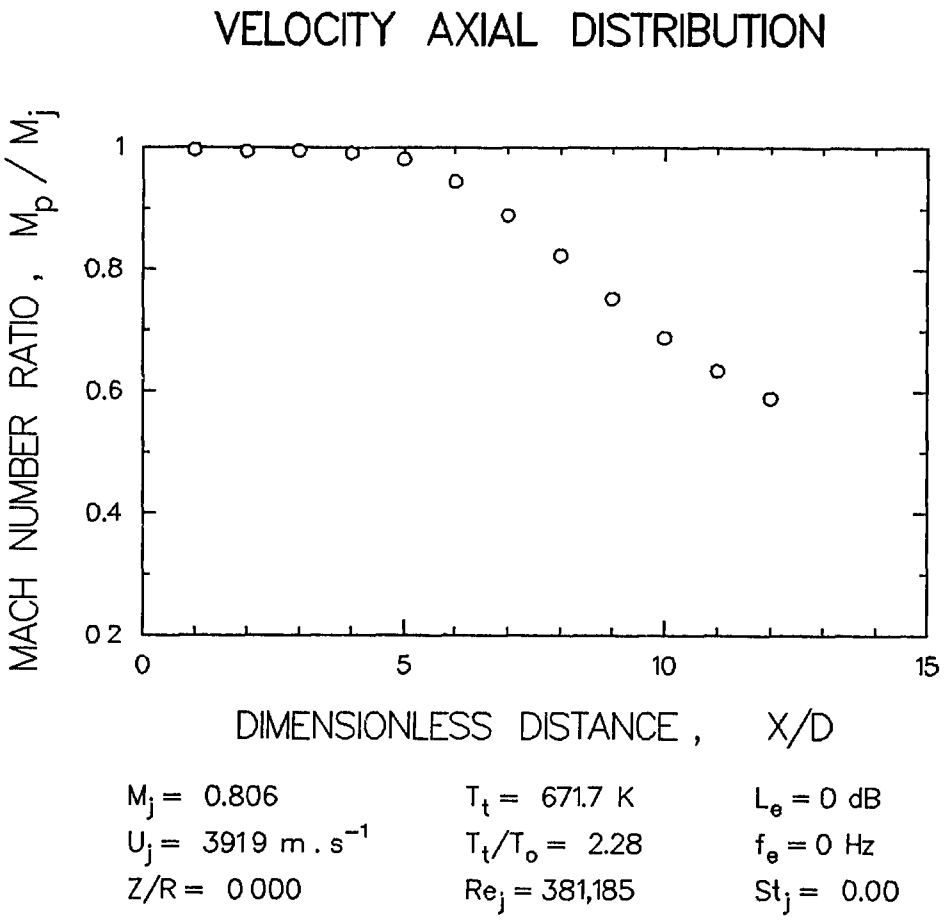

Figure 2.9 Unexcited heated jet centerline velocity decay. Test Point 4.

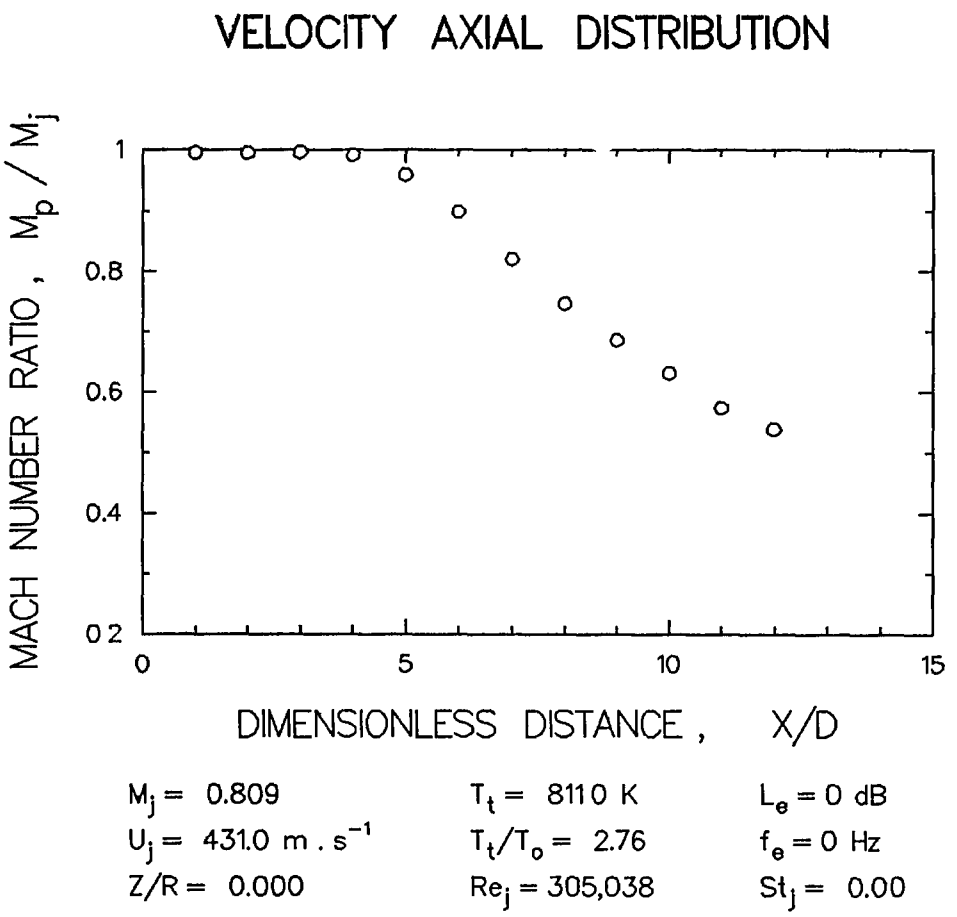

Figure 2.10 Unexcited heated jet centerline velocity decay. Test Point 5.

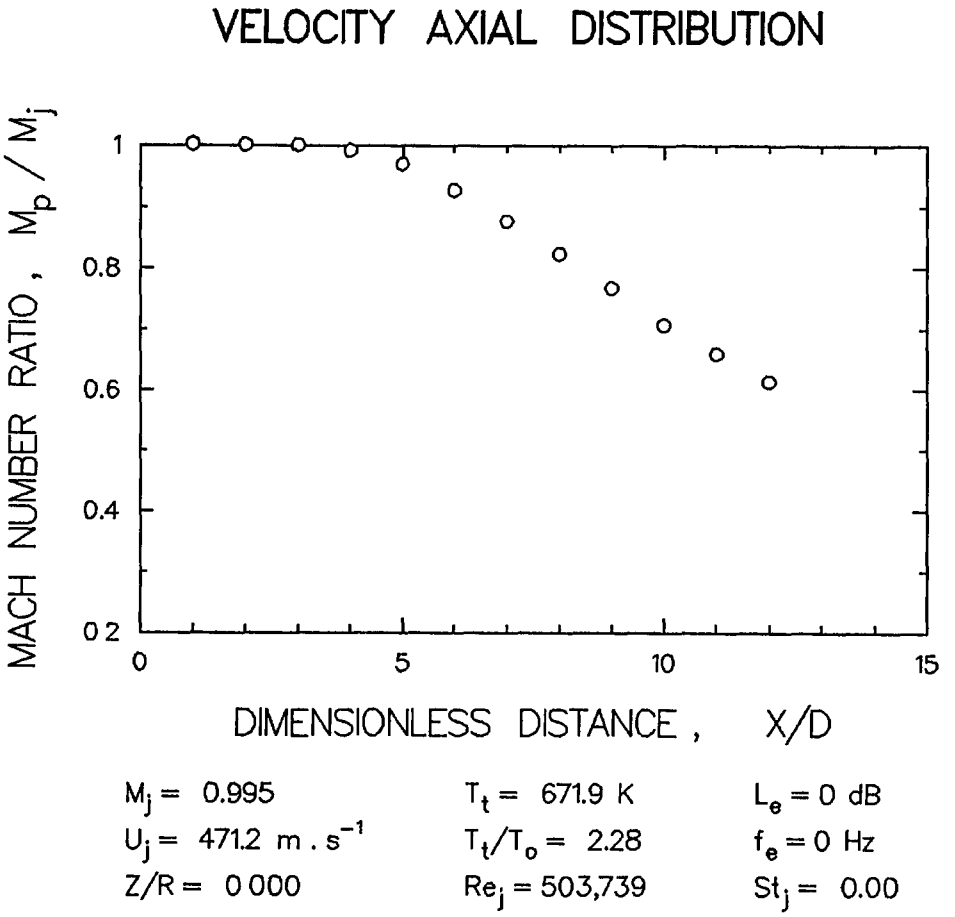

Figure 2.11 Unexcited heated jet centerline velocity decay. Test Point 8.

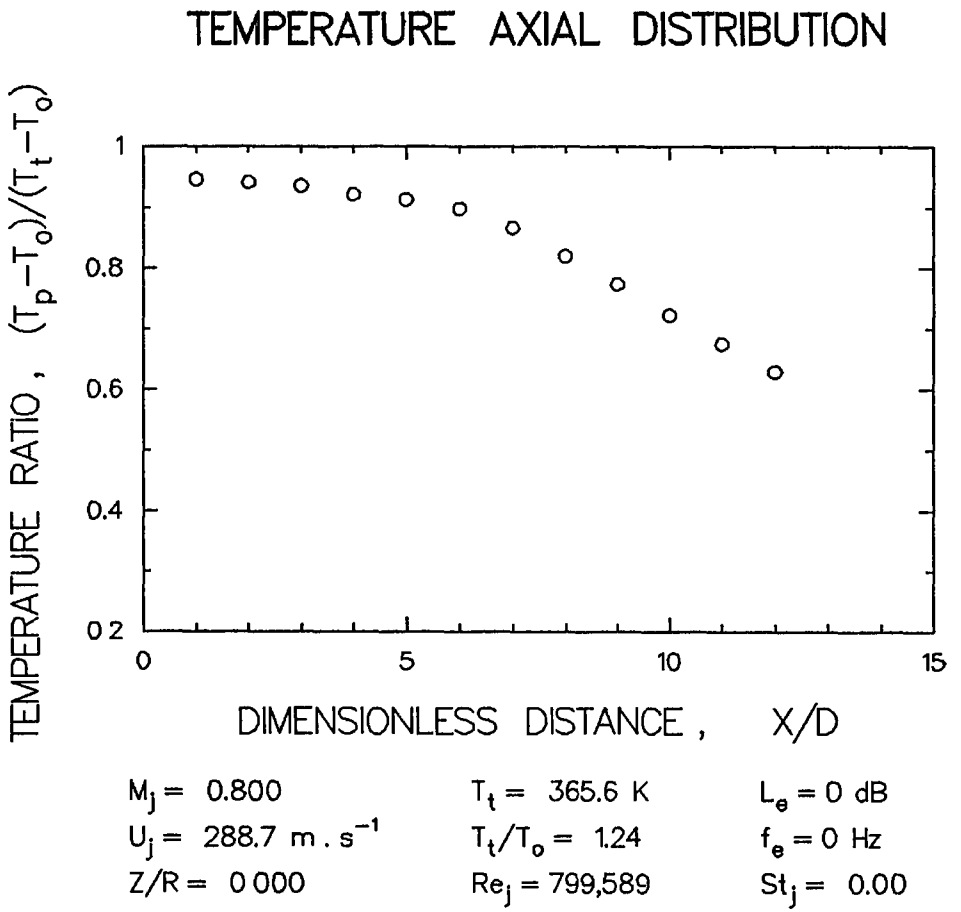

Figure 2.12 Unexcited heated jet centerline temperature decay. Test Point 2.

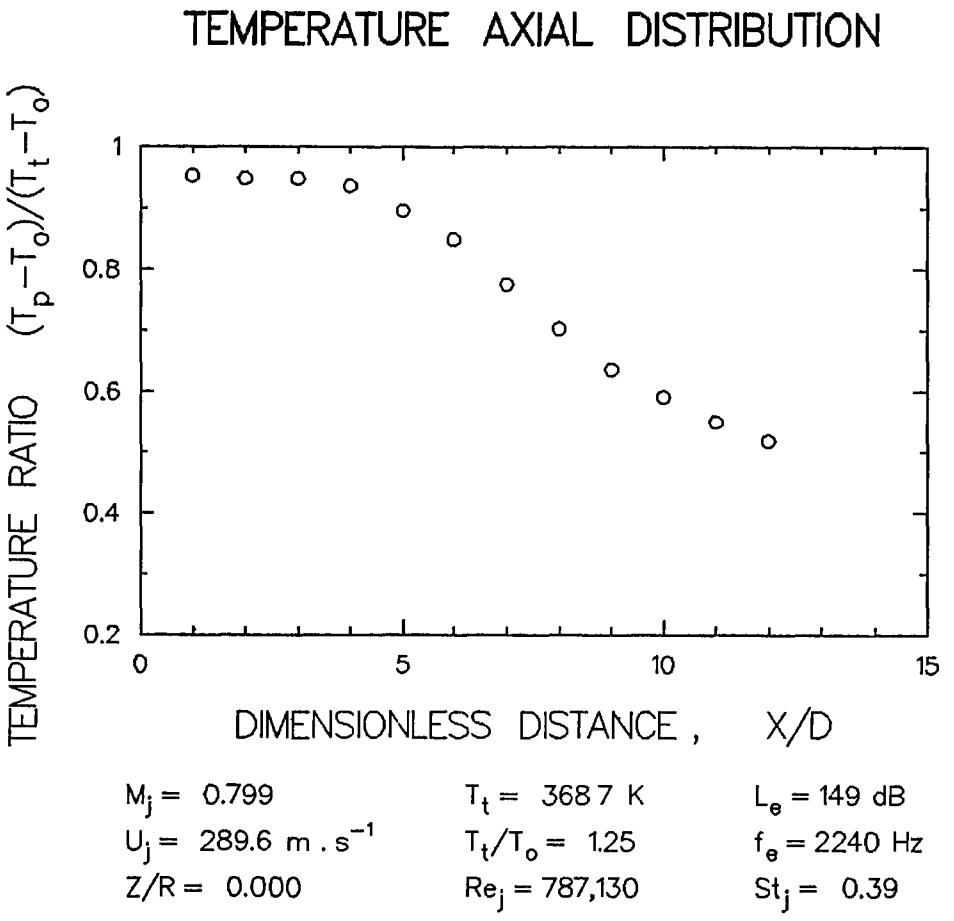

Figure 2.13 Tone excited heated jet centerline temperature decay. Test Point 2.

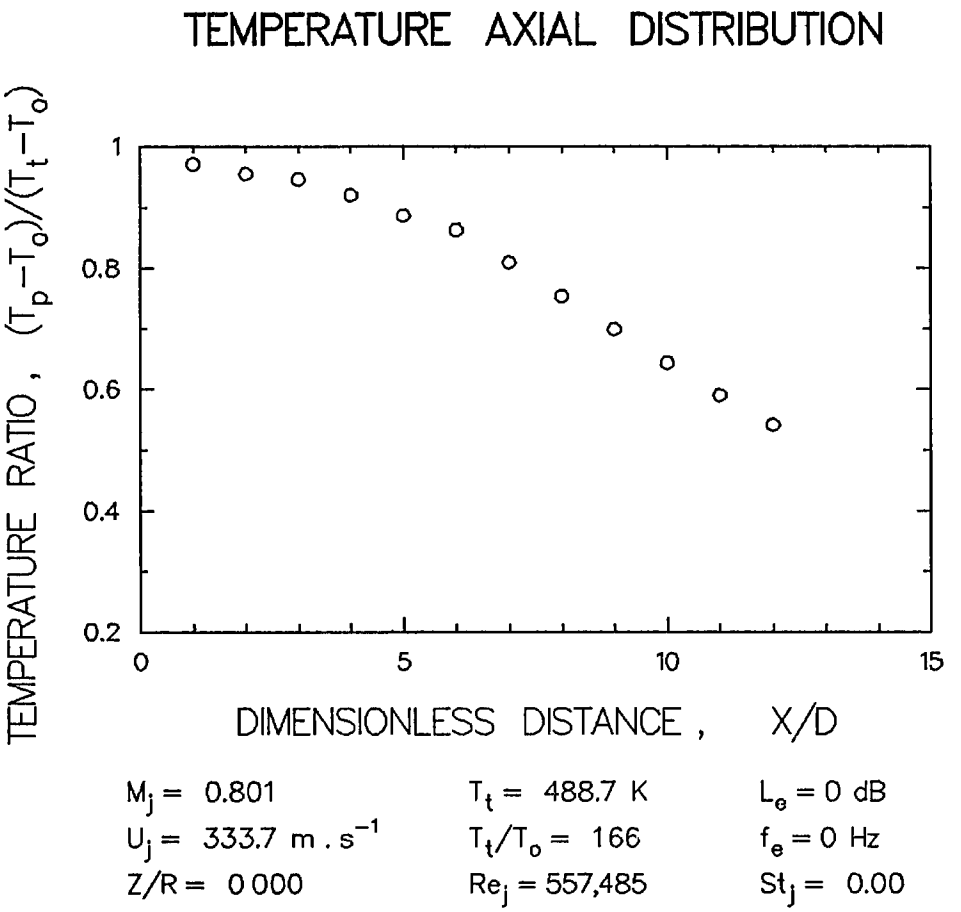

Figure 2.14 Unexcited heated jet centerline temperature decay. Test Point 3.

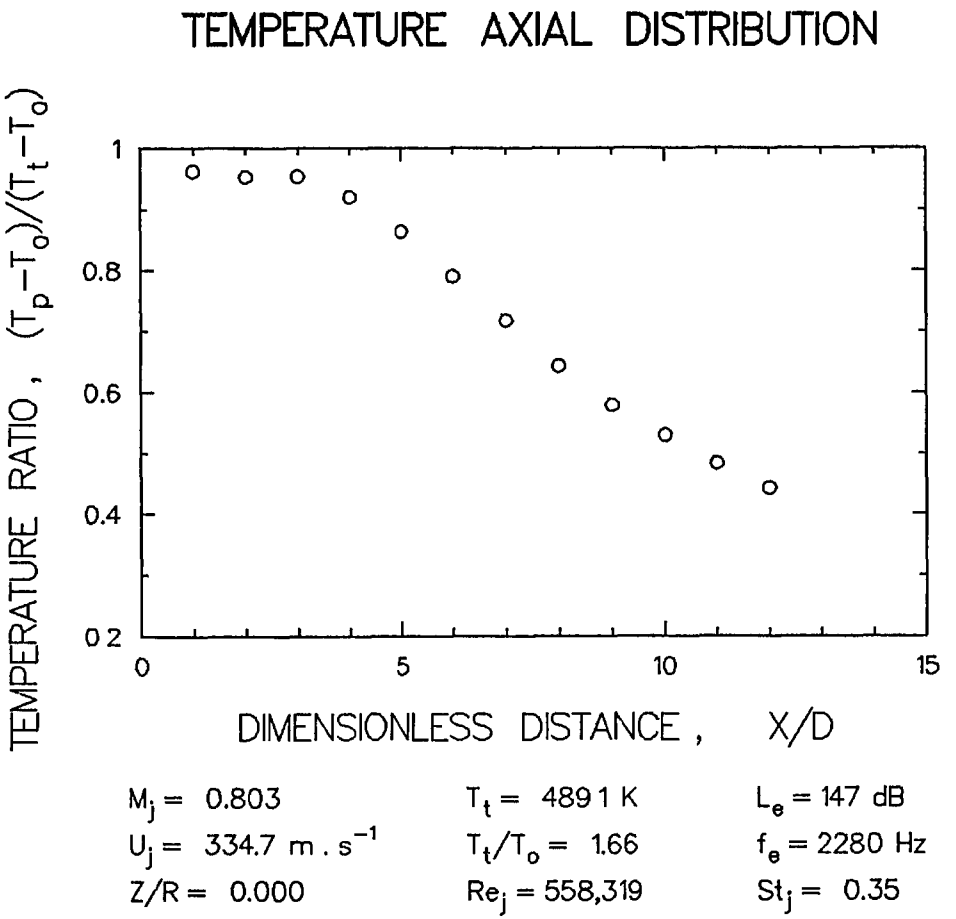

Figure 2.15 Tone excited heated jet centerline temperature decay. Test Point 3.

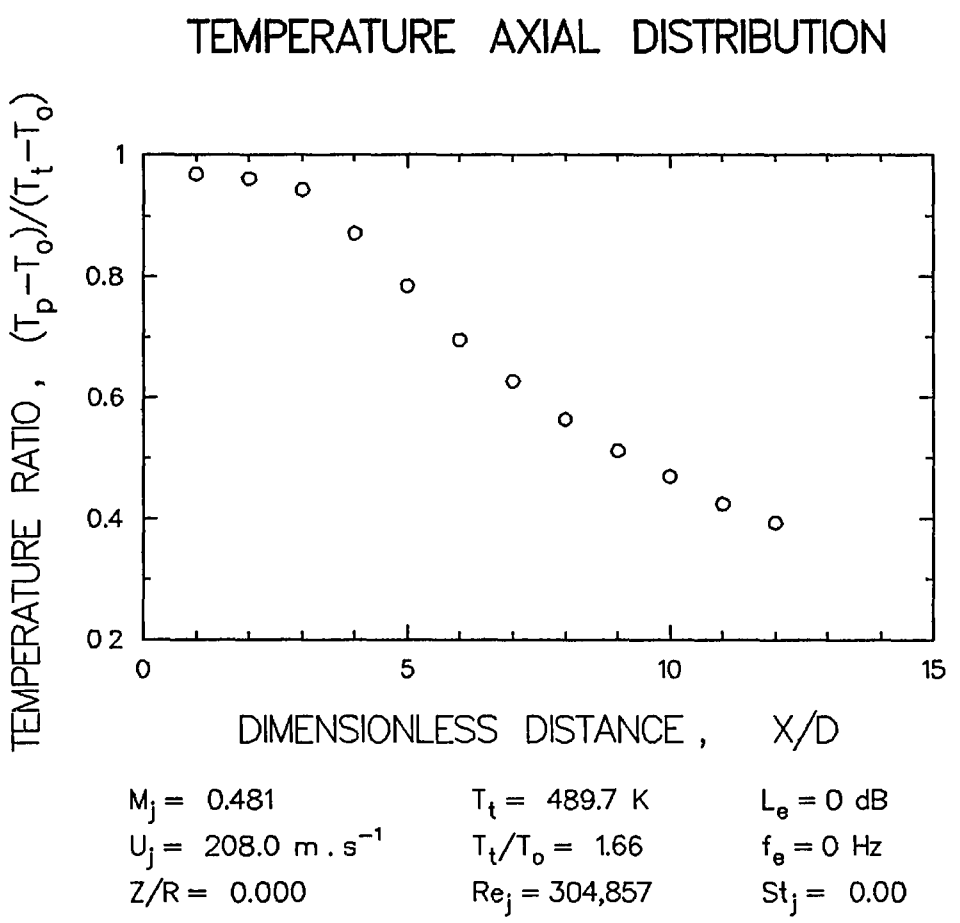

Figure 2.16 Unexcited heated jet centerline temperature decay. Test Point 6.

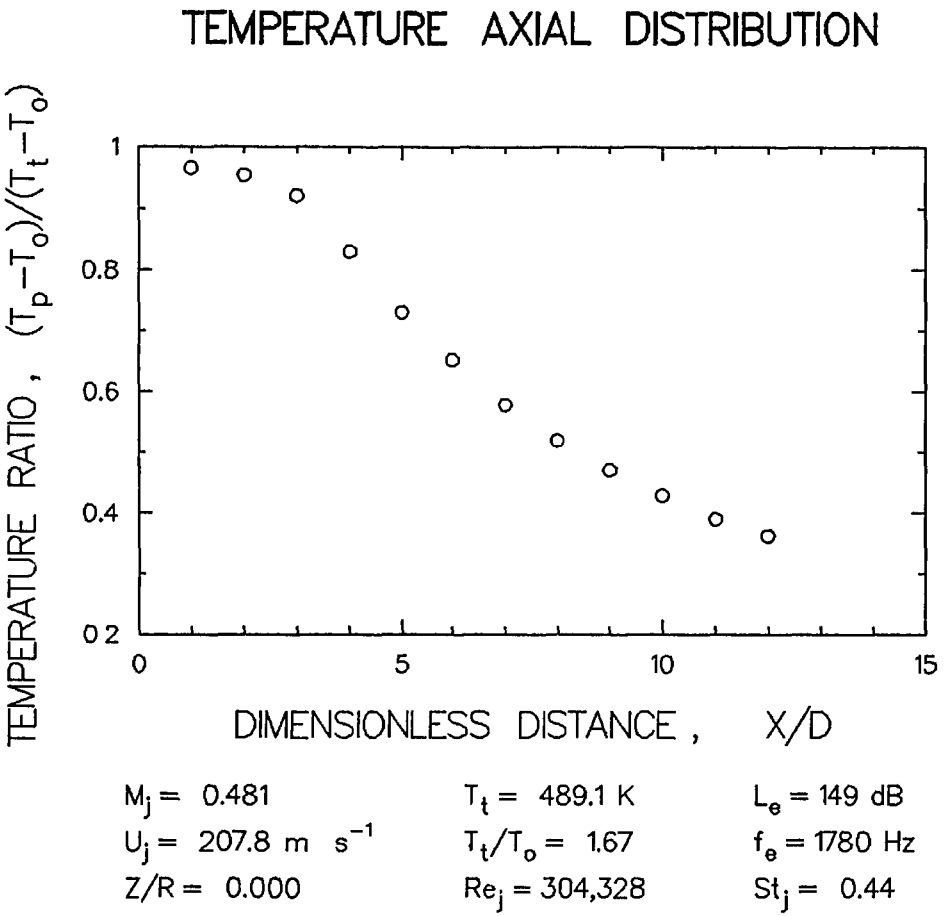

Figure 2.17 Tone excited heated jet centerline temperature decay. Test Point 6.

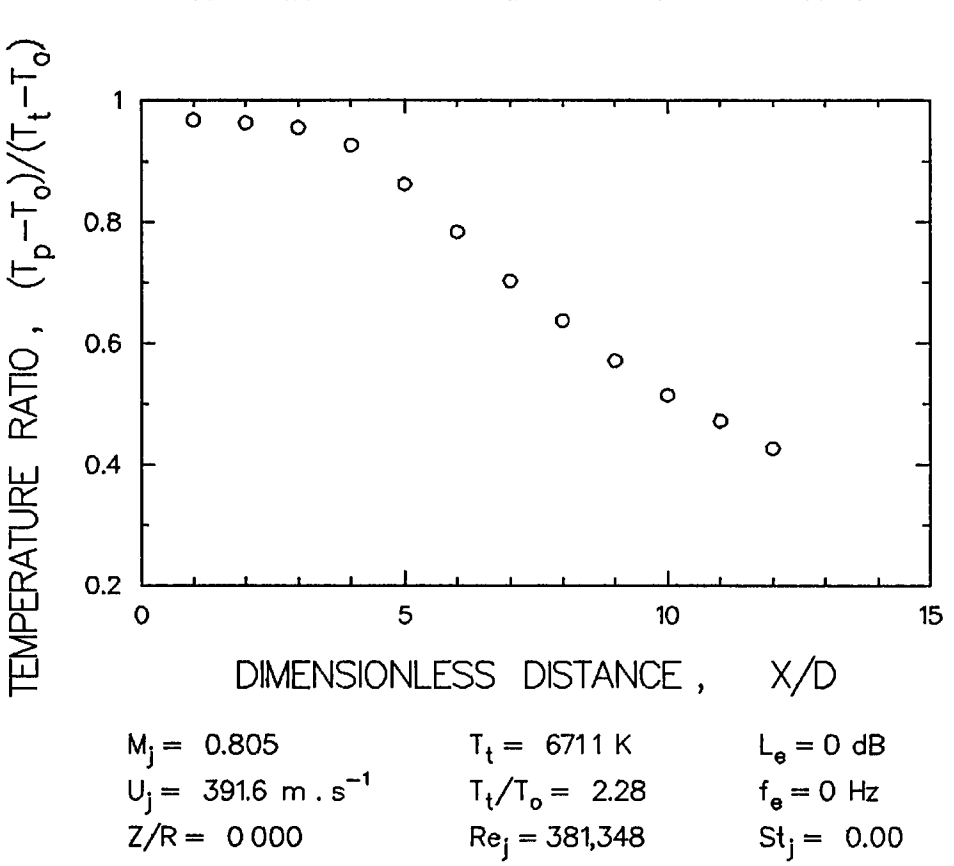

Figure 2.18 Unexcited heated jet centerline temperature decay. Test Point 4.

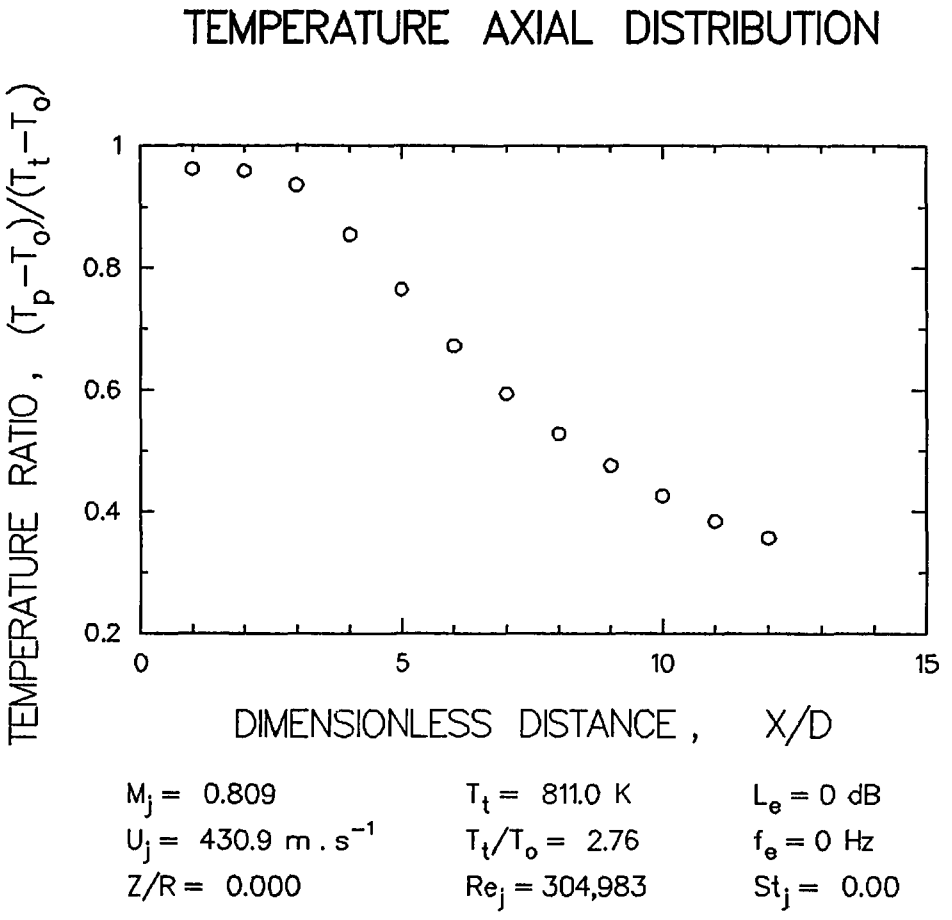

Figure 2.19 Unexcited heated jet centerline temperature decay. Test Point 5.

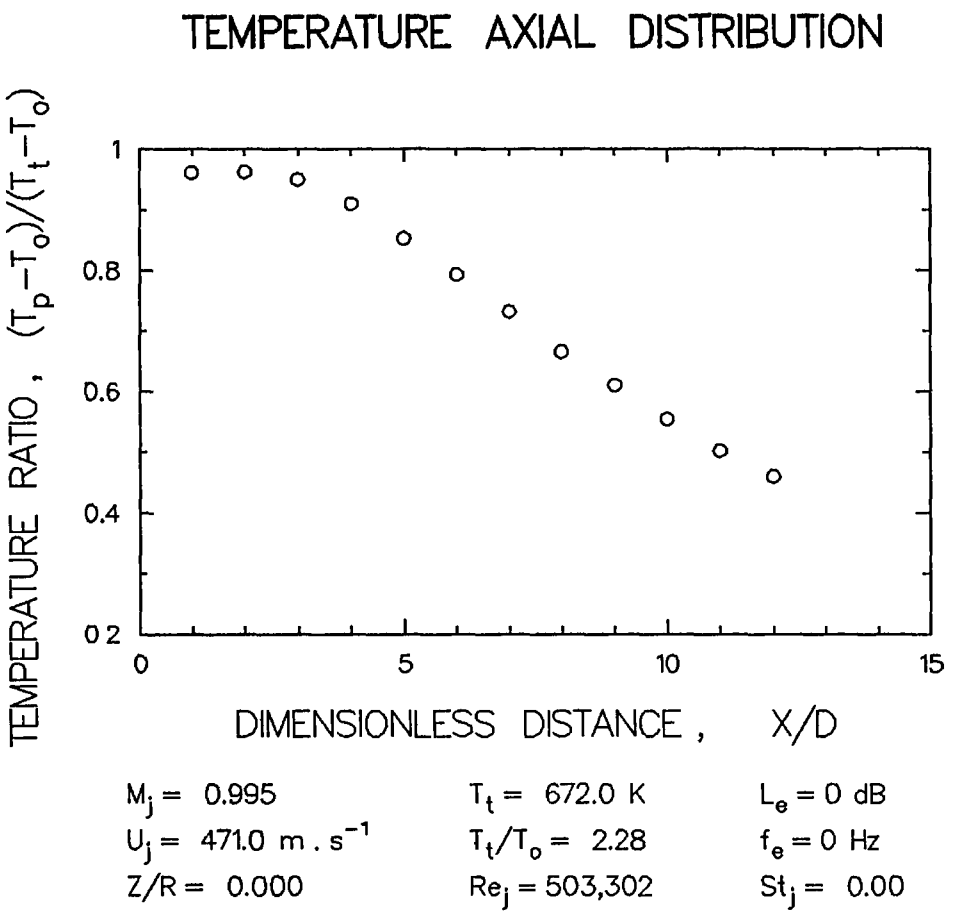

Figure 2.20 Unexcited heated jet centerline temperature decay. Test Point 8.

Figure	p_o (kPa)	T_o (K)
2.1	98.339	294.3
2.2	98.615	294.8
2.3, 2.12	99.305	294.3
2.4 2.13	98.960	294.8
2.5, 2.14	99.236	294.3
2.6, 2.15	99.098	294.3
2.7, 2.16	99.167	294.3
2.8, 2.17	98.891	292.6
2.9, 2.18	99.098	294.3
2.10, 2.19	98.822	293.7
2.11, 2.20	99.098	294.3

Table 2.2 Ambient conditions.

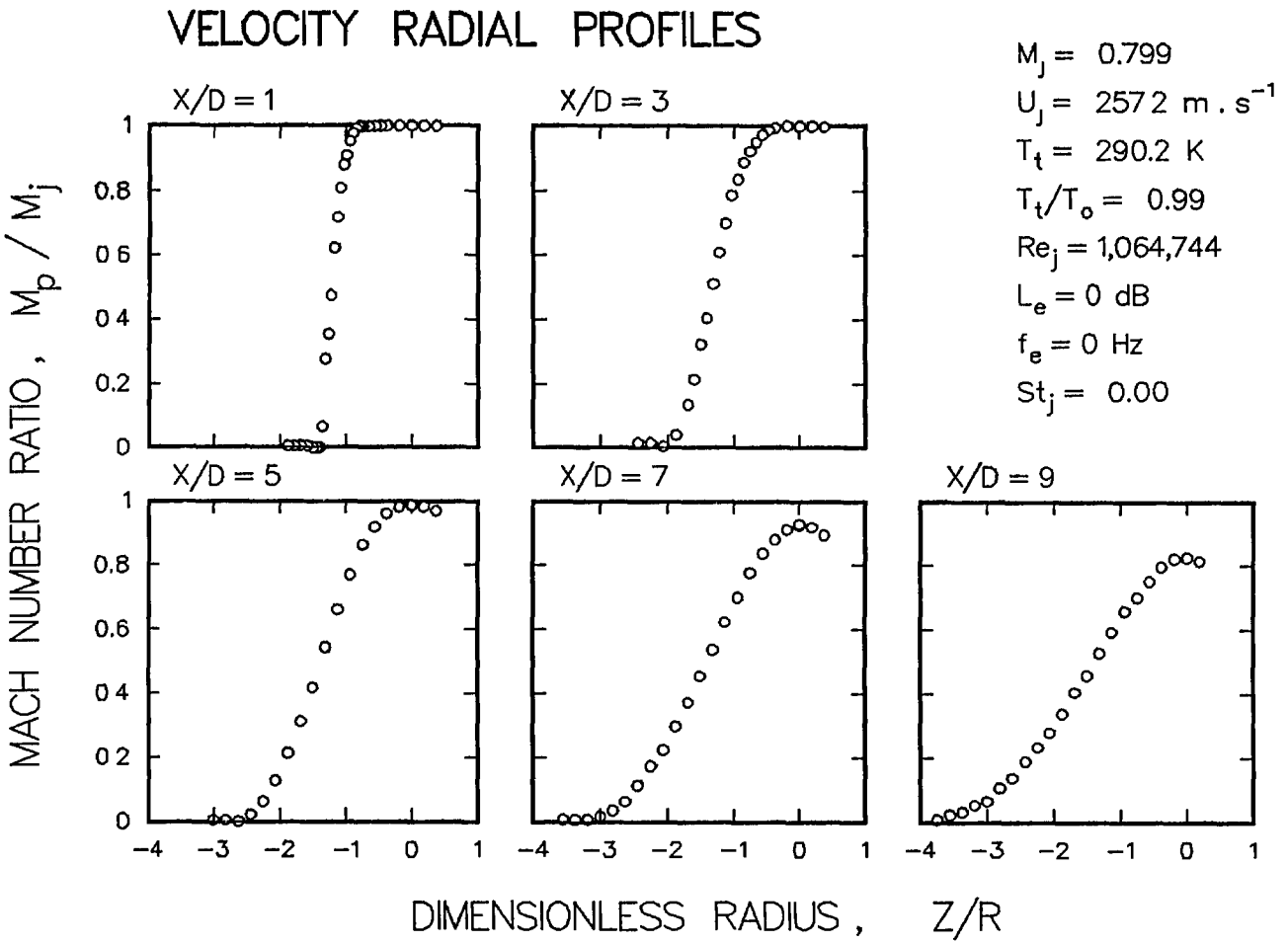

Figure 2.21 Unexcited unheated jet radial velocity profiles. Test Point 1.

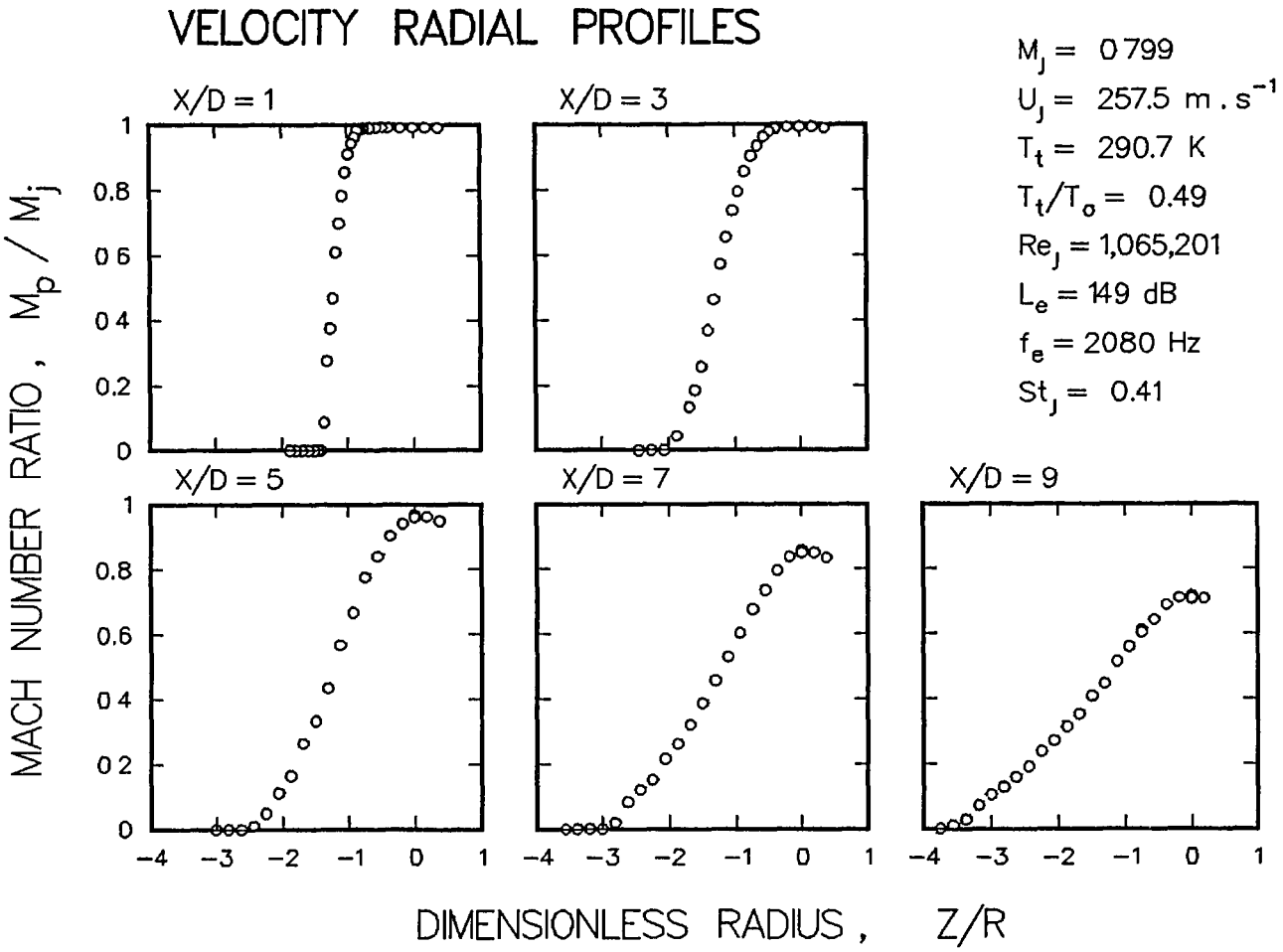

Figure 2.22 Tone excited unheated jet radial velocity profiles. Test Point 1.

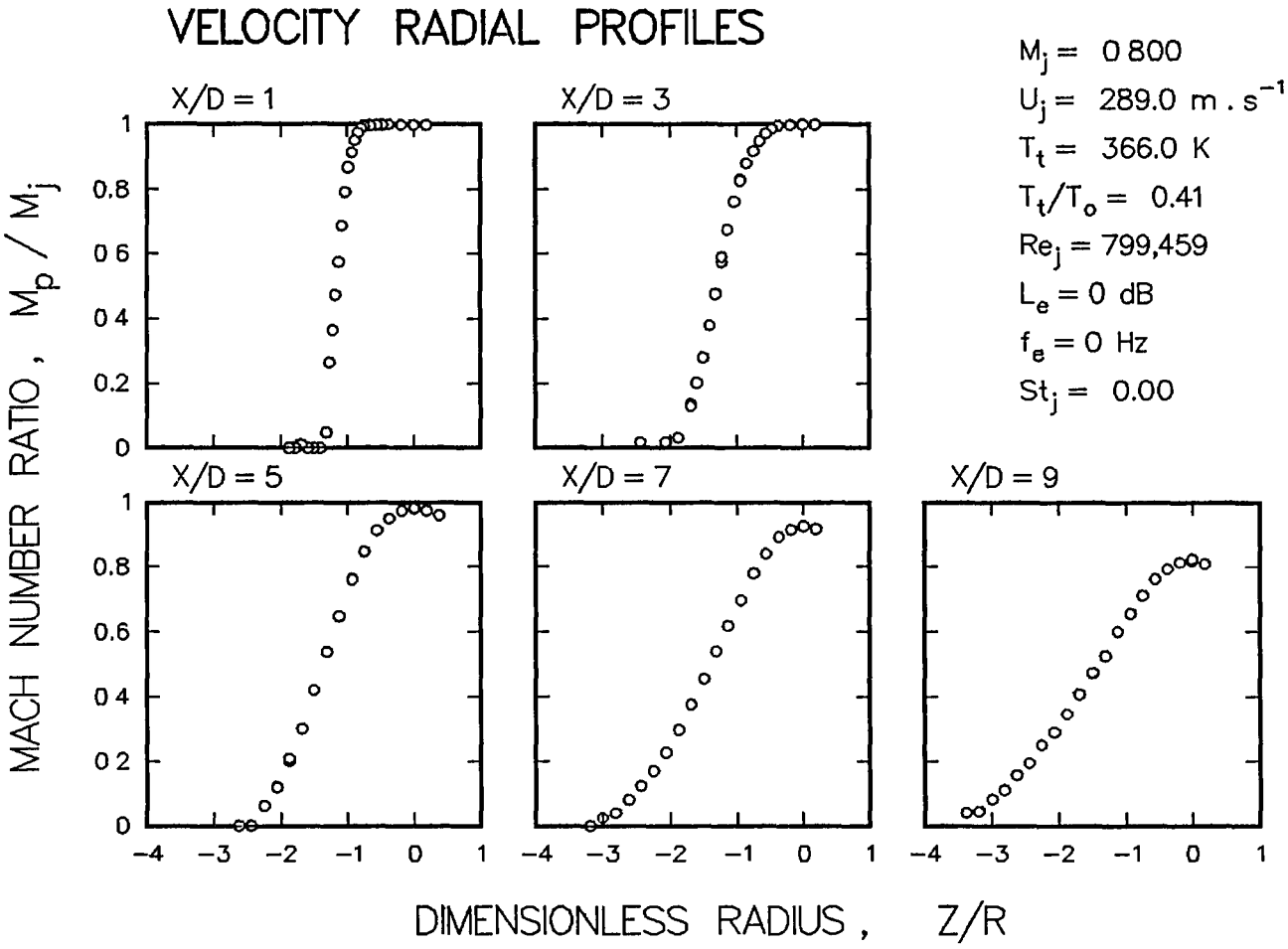

Figure 2.23 Unexcited heated jet radial velocity profiles. Test Point 2.

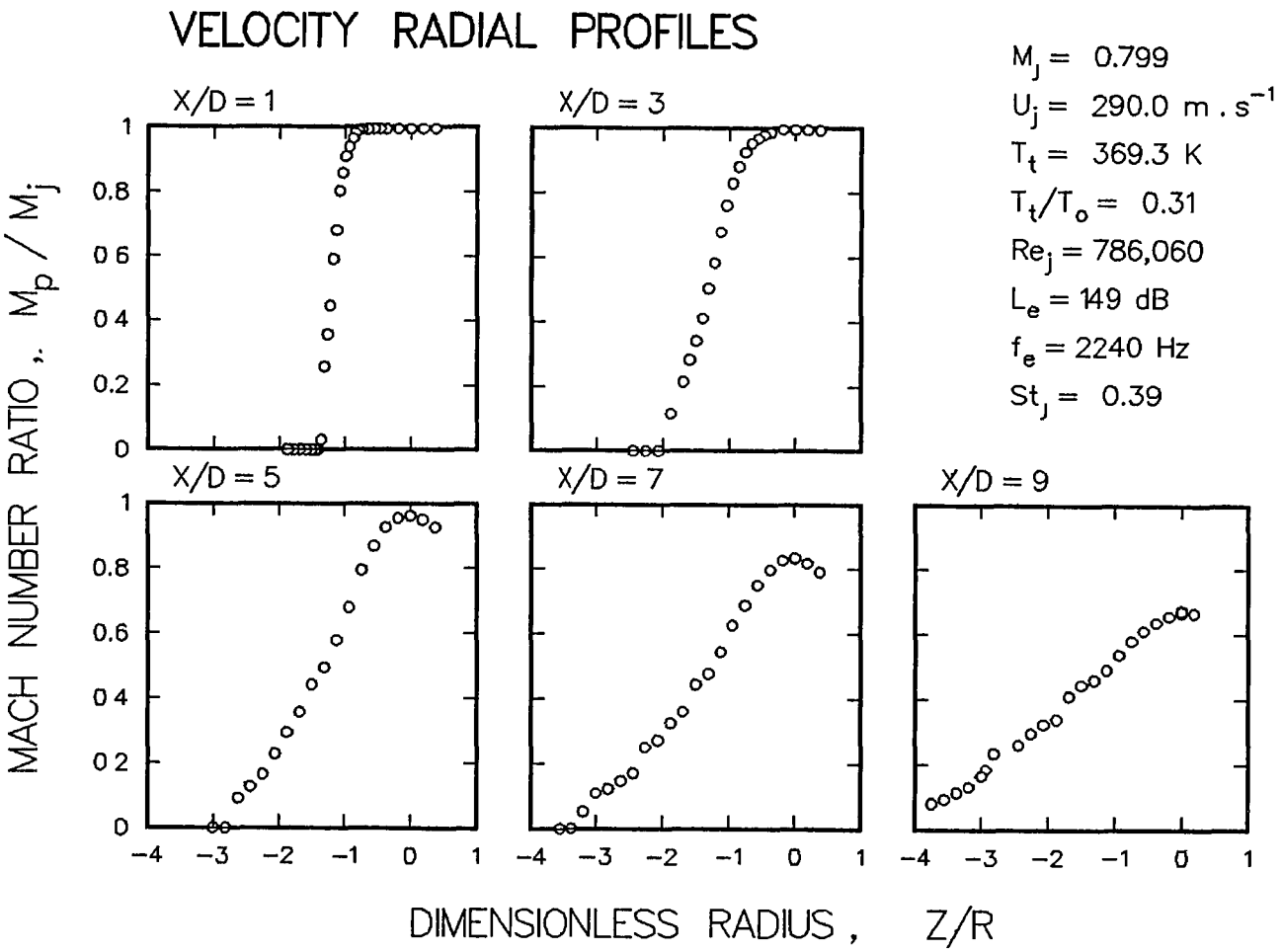

Figure 2.24 Tone excited heated jet radial velocity profiles.
Test Point 2.

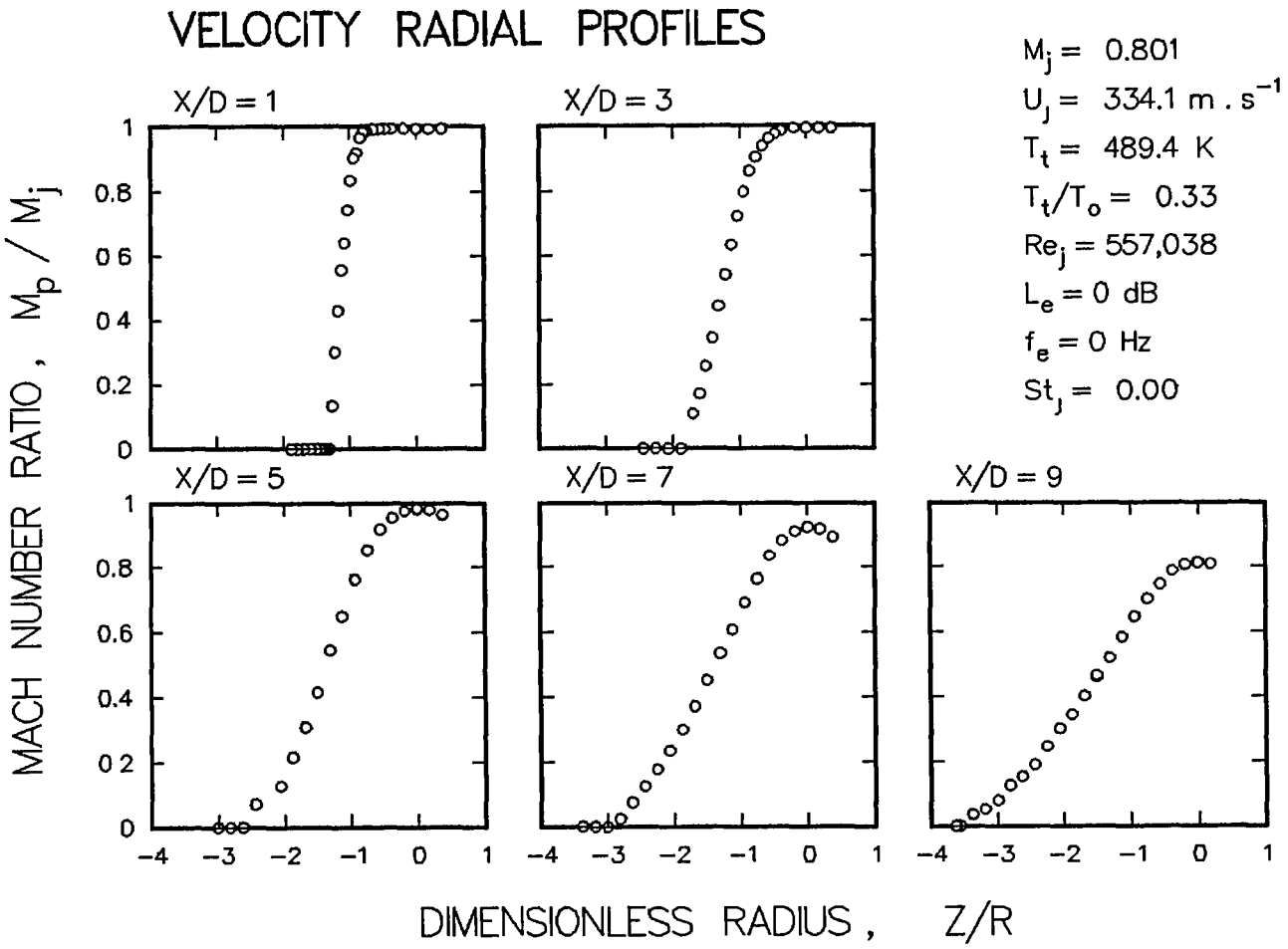

Figure 2.25 Unexcited heated jet radial velocity profiles. Test Point 3.

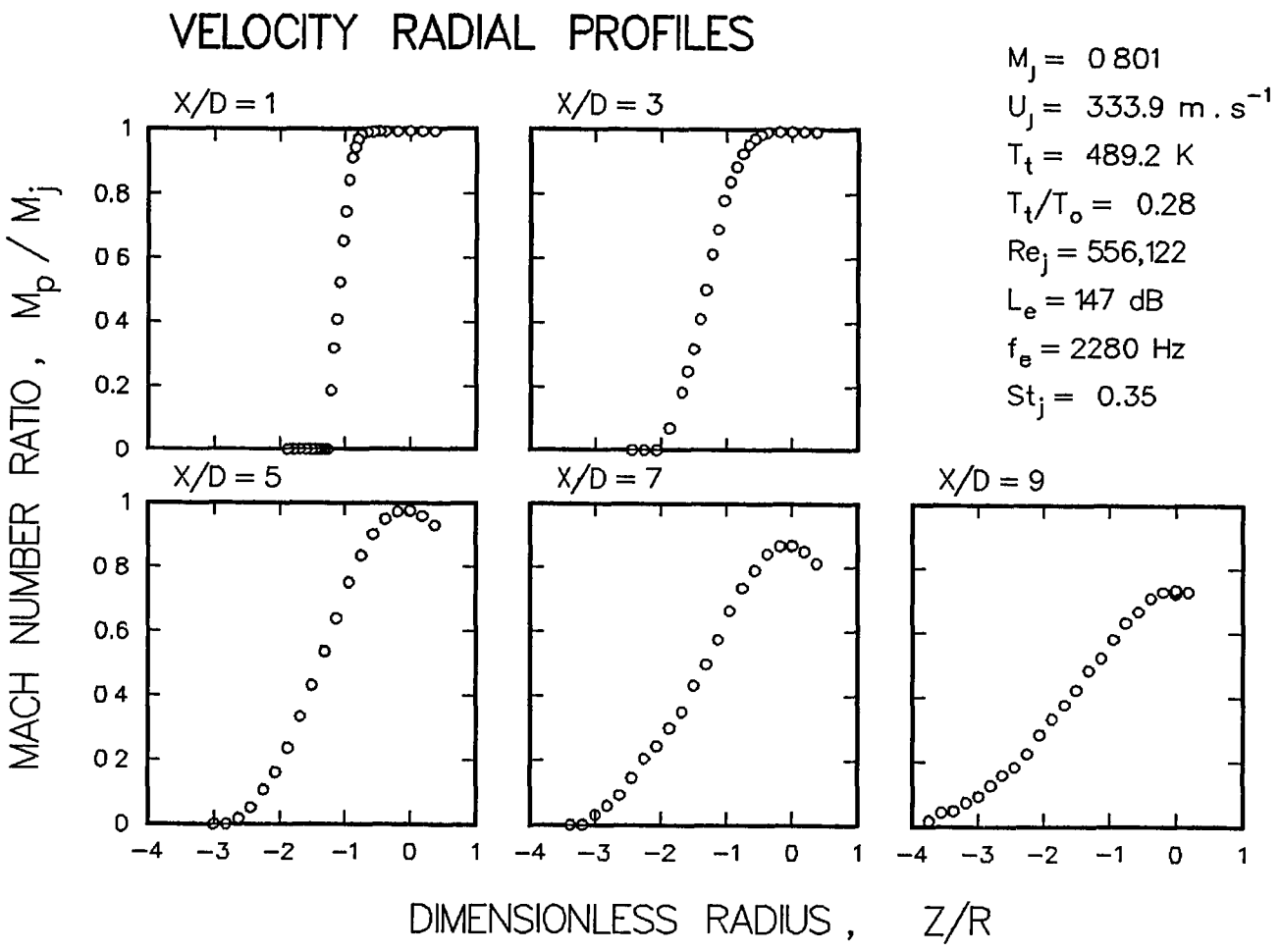

Figure 2.26 Tone excited heated jet radial velocity profiles. Test Point 3.

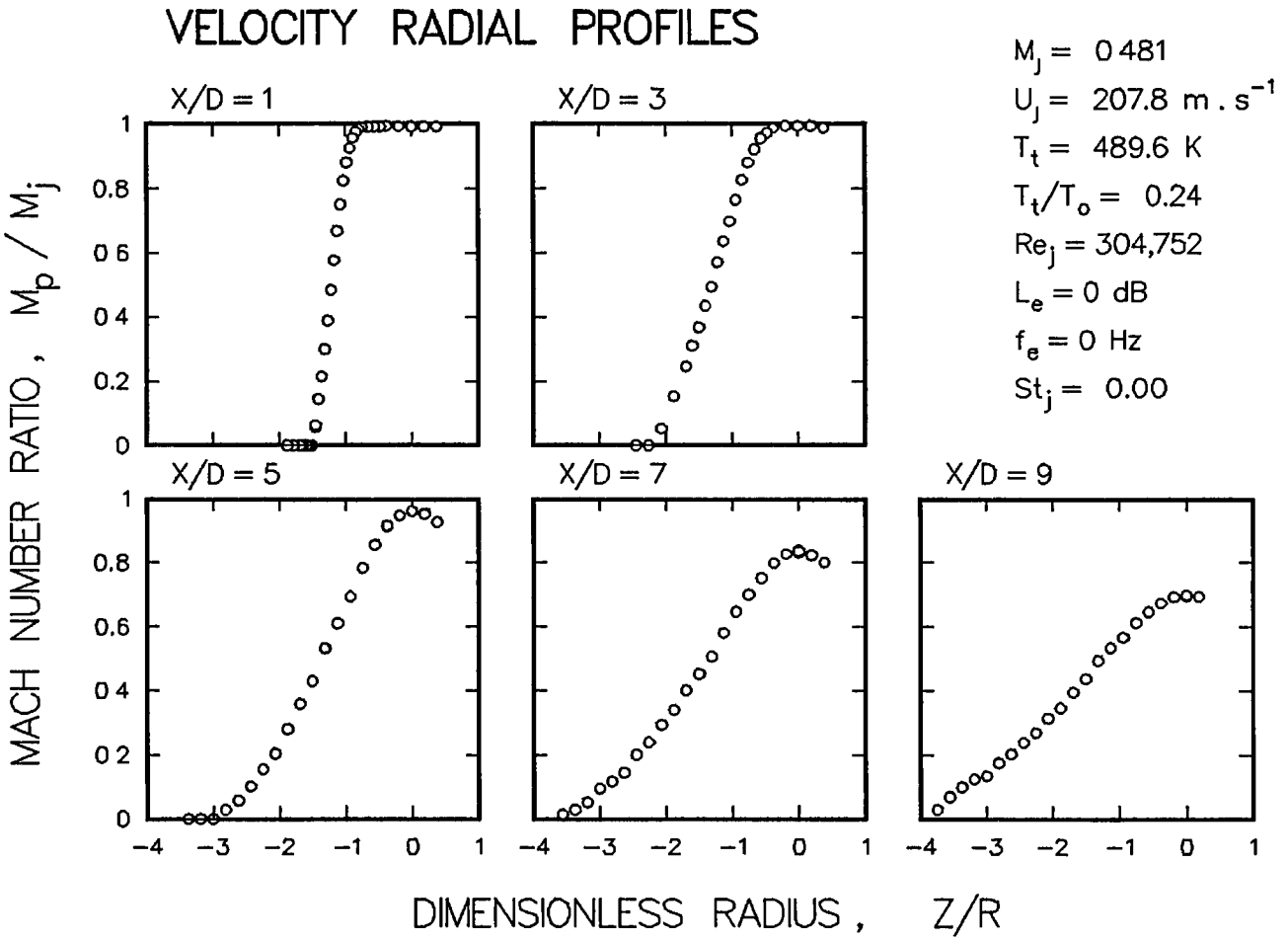

Figure 2.27 Unexcited heated jet radial velocity profiles.
Test Point 6.

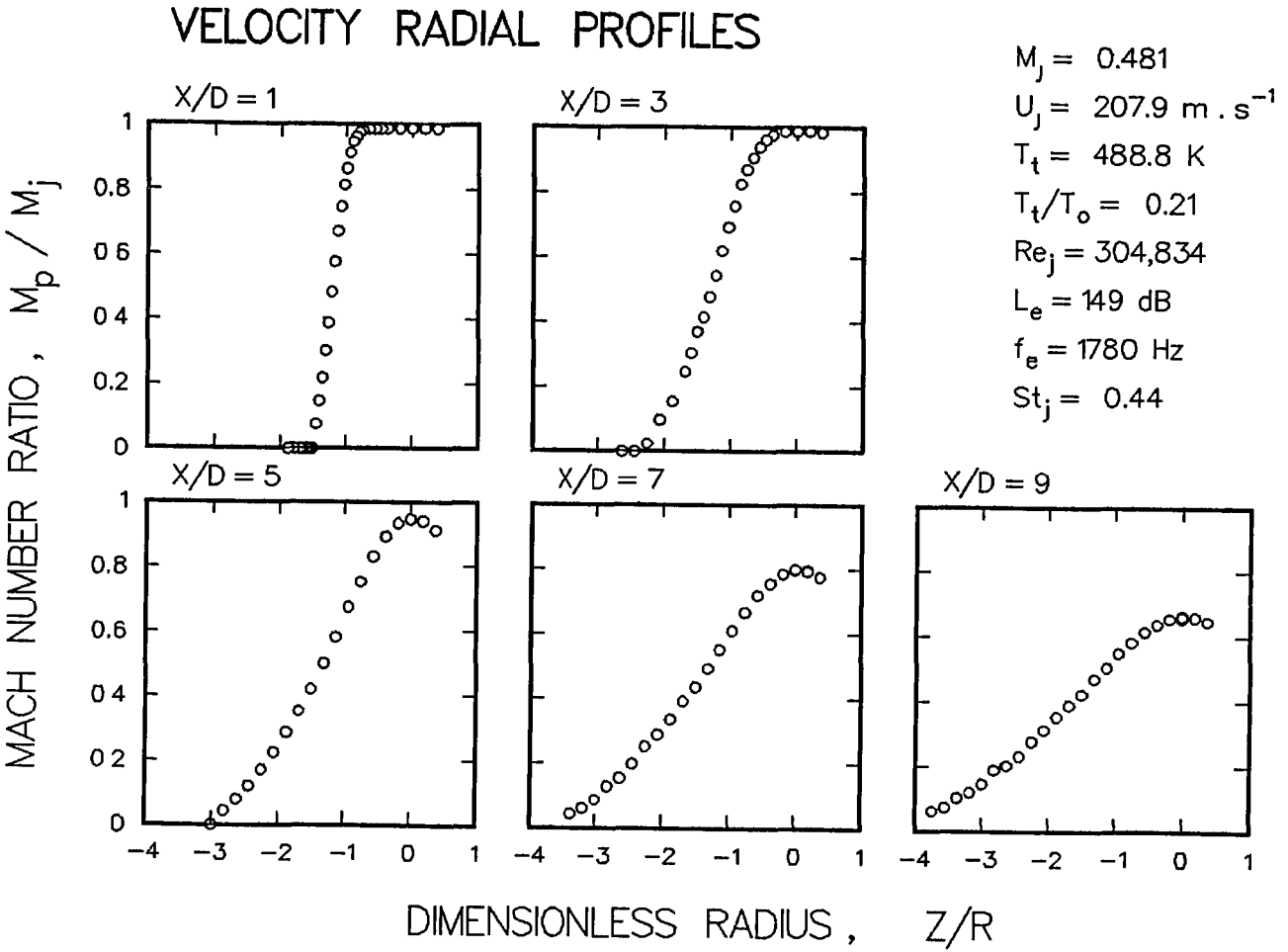

Figure 2.28 Tone excited heated jet radial velocity profiles.
Test Point 6.

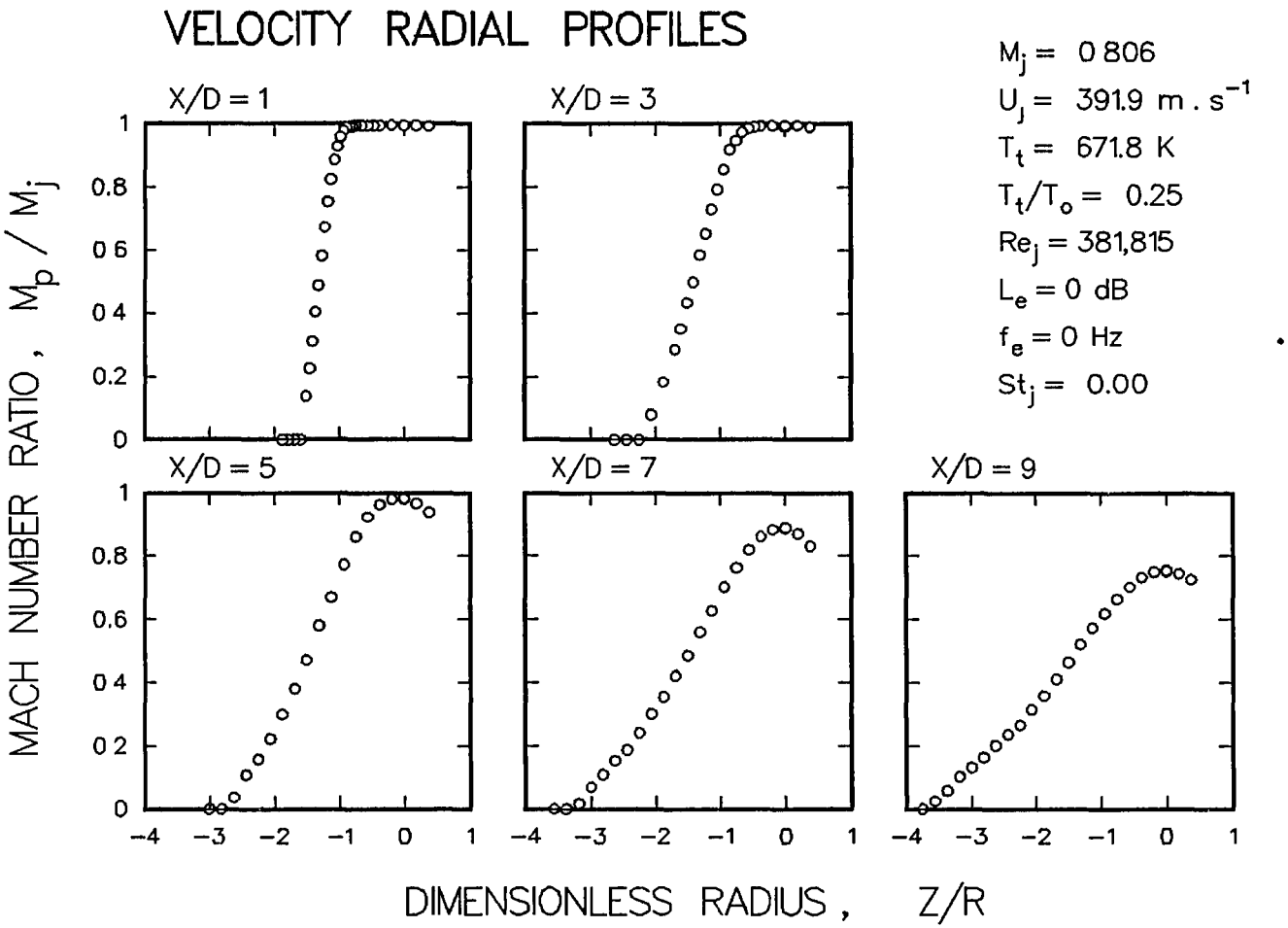

Figure 2.29 Unexcited heated jet radial velocity profiles. Test Point 4.

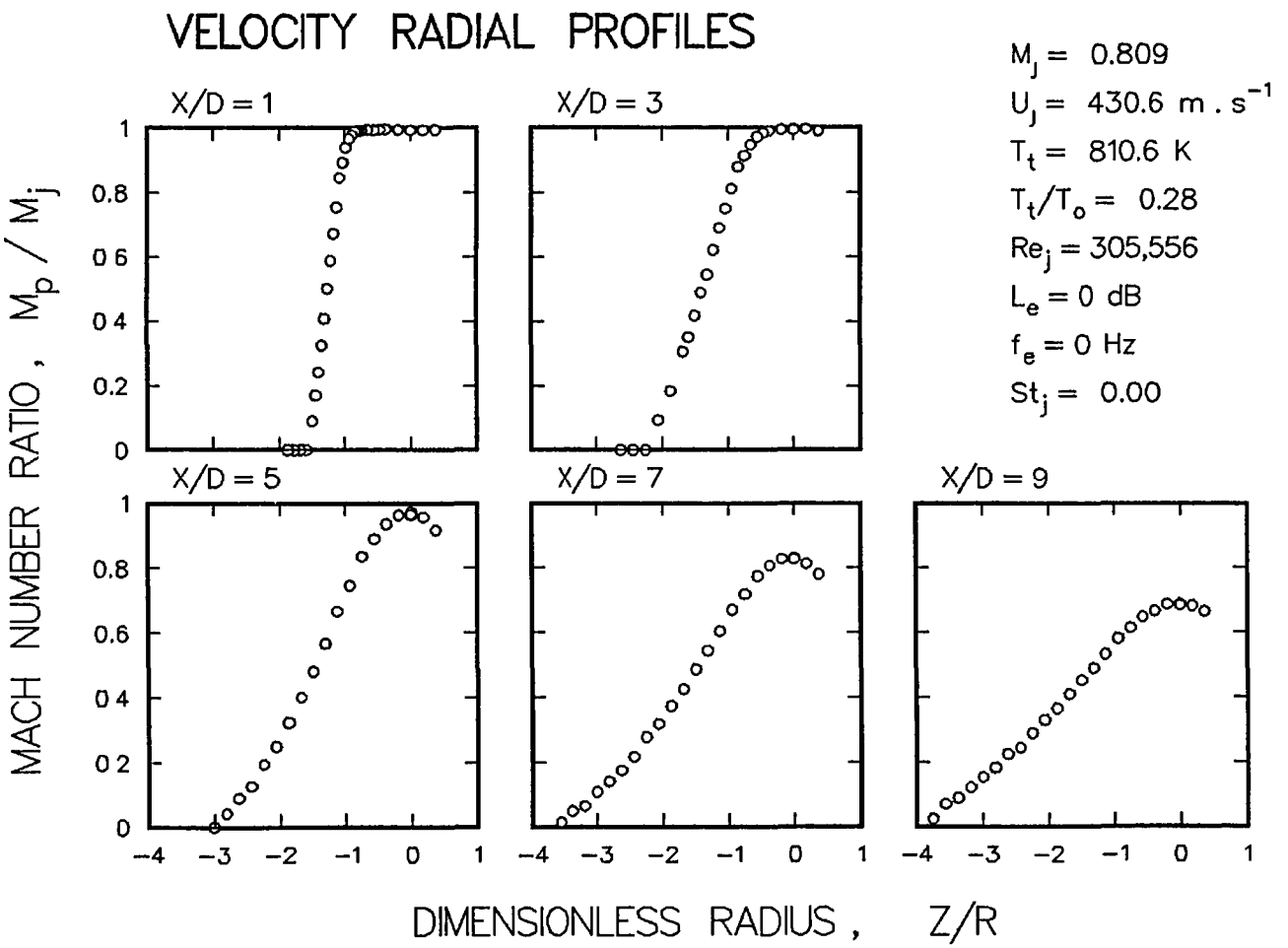

Figure 2.30 Unexcited heated jet radial velocity profiles. Test Point 5.

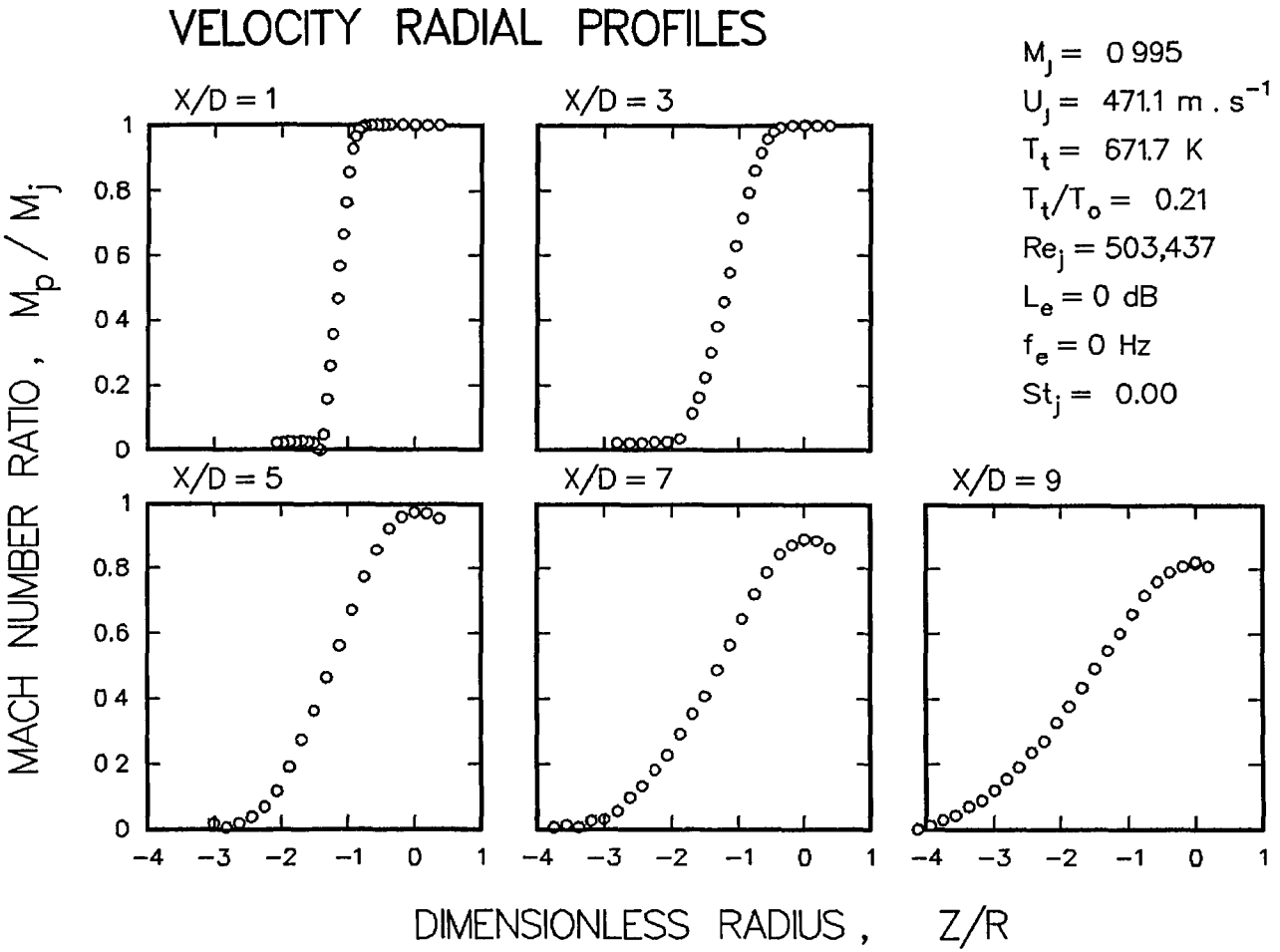

Figure 2.31 Unexcited heated jet radial velocity profiles. Test Point 8.

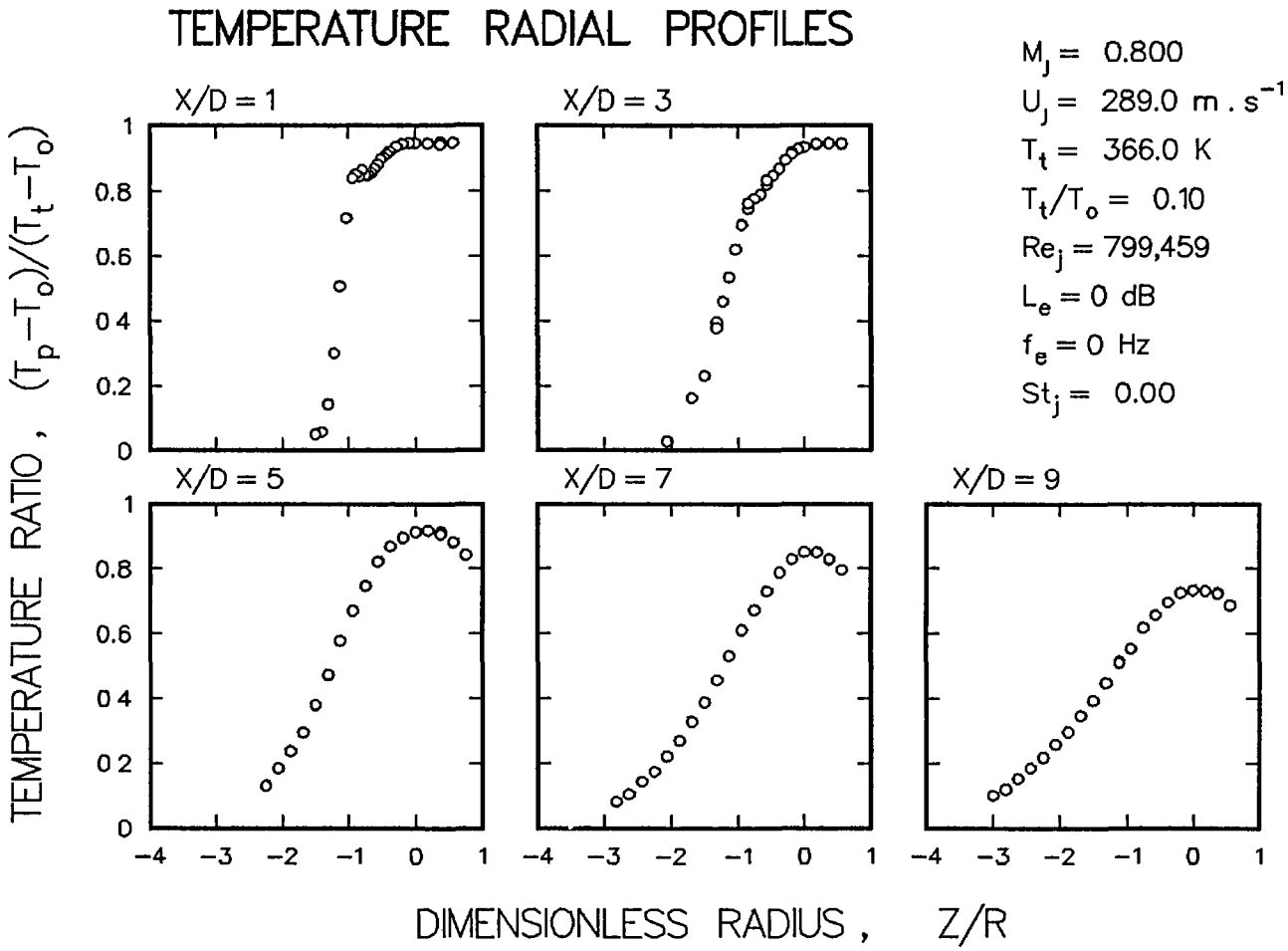

Figure 2.32 Unexcited heated jet radial velocity profiles.
Test Point 2.

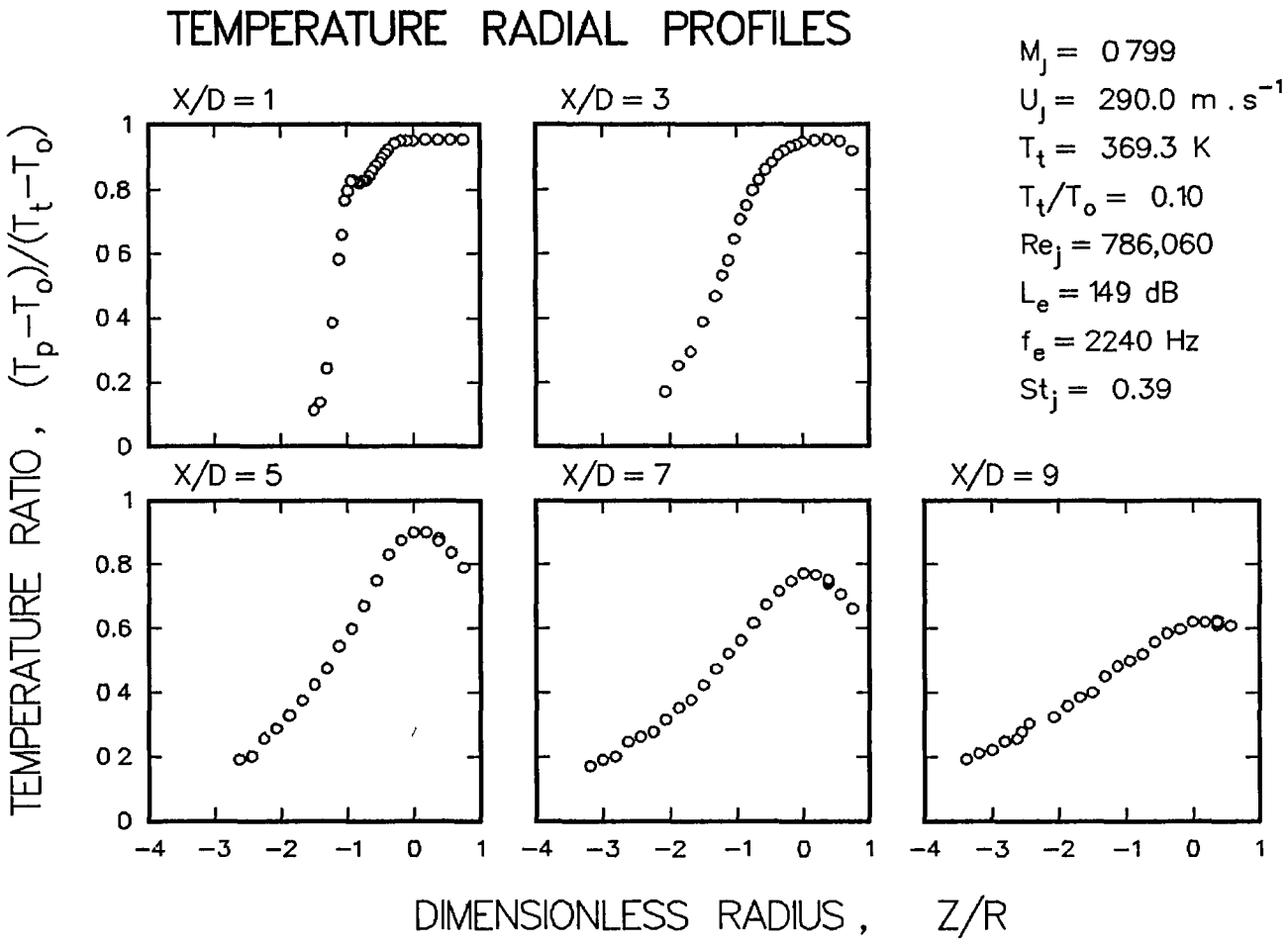

Figure 2.33 Tone excited heated jet radial temperature profiles. Test Point 2.

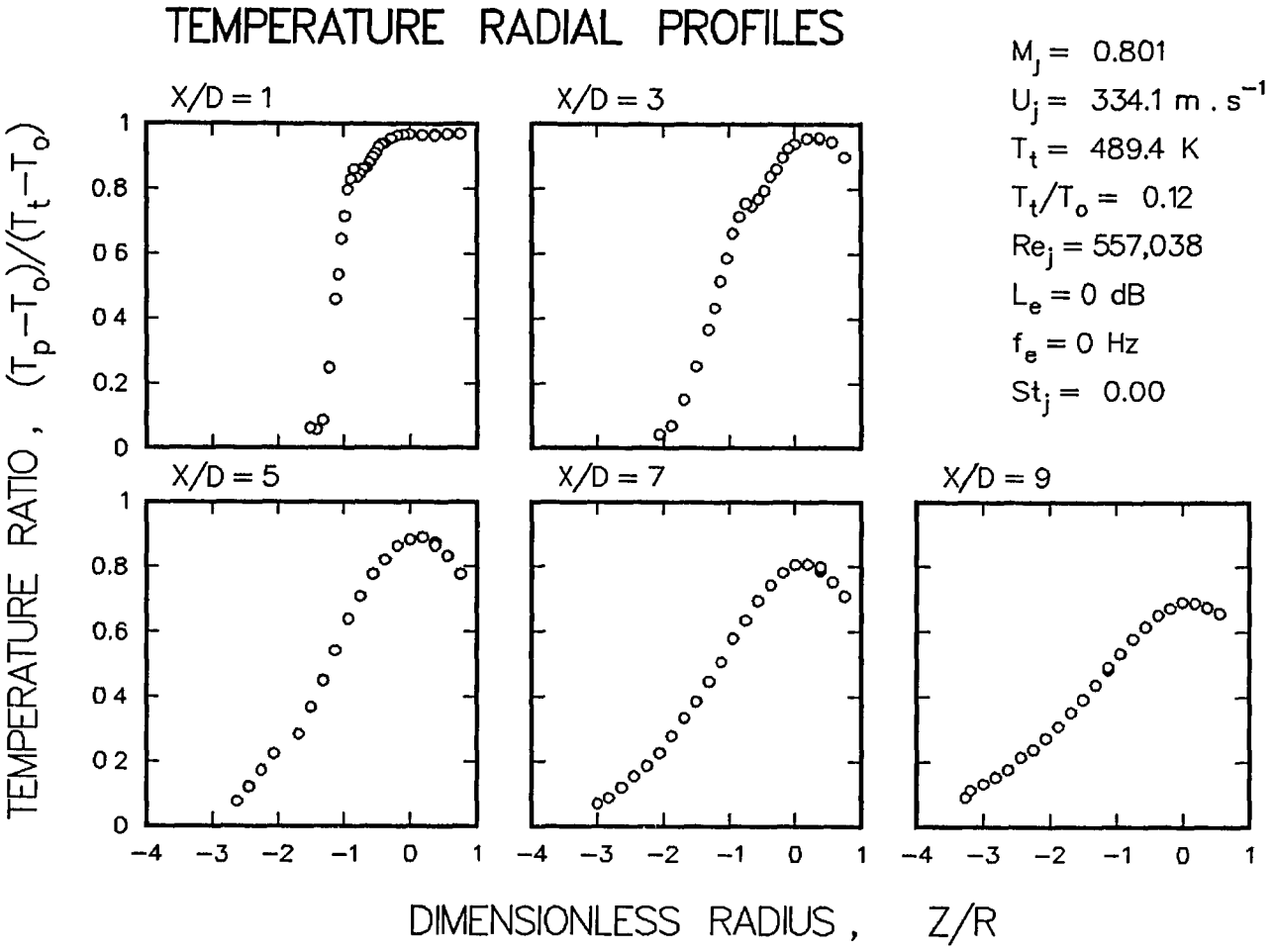

Figure 2.34 Unexcited heated jet radial temperature profiles. Test Point 3.

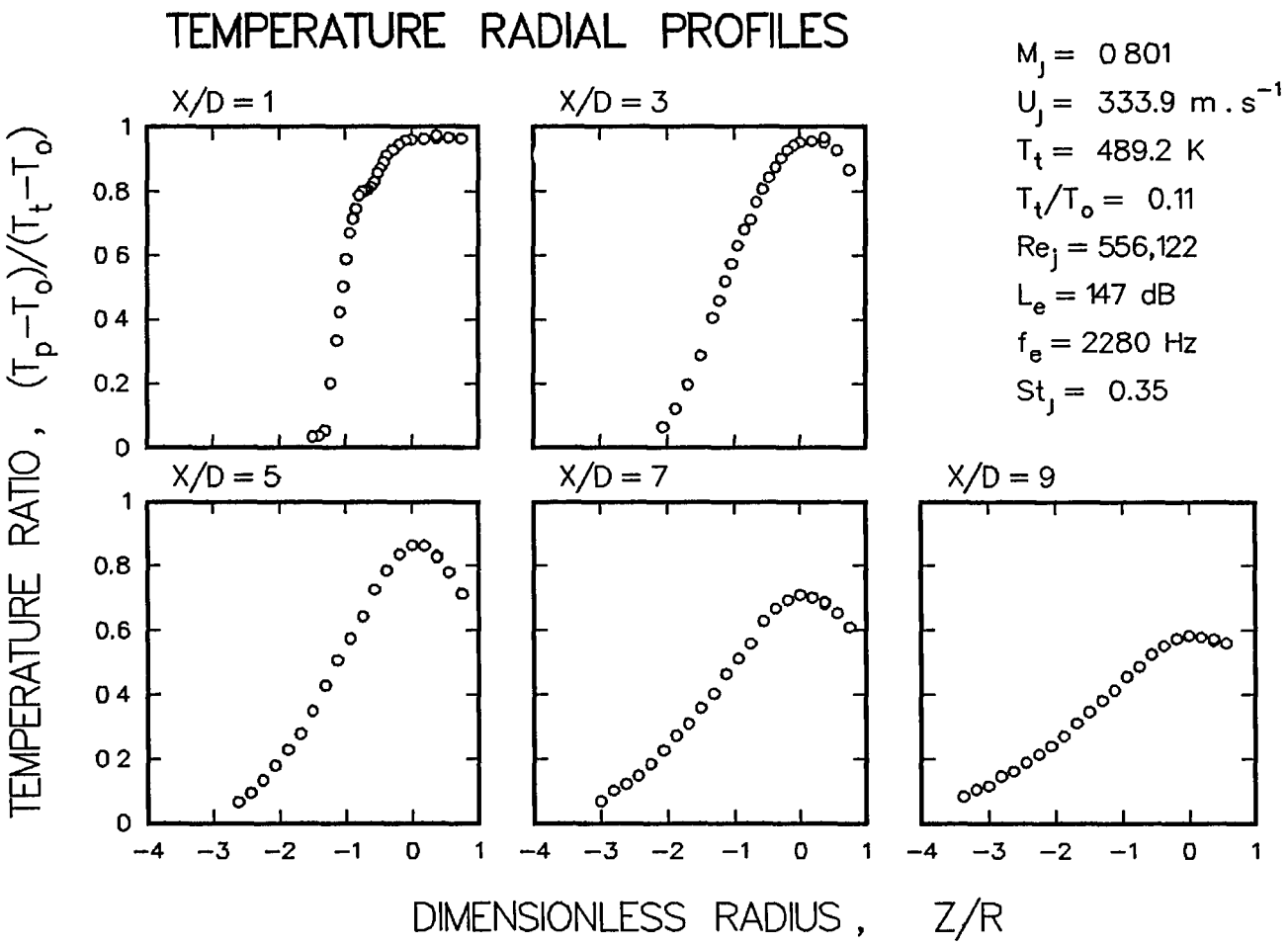

Figure 2.35 Tone excited heated jet radial temperature profiles. Test Point 3.

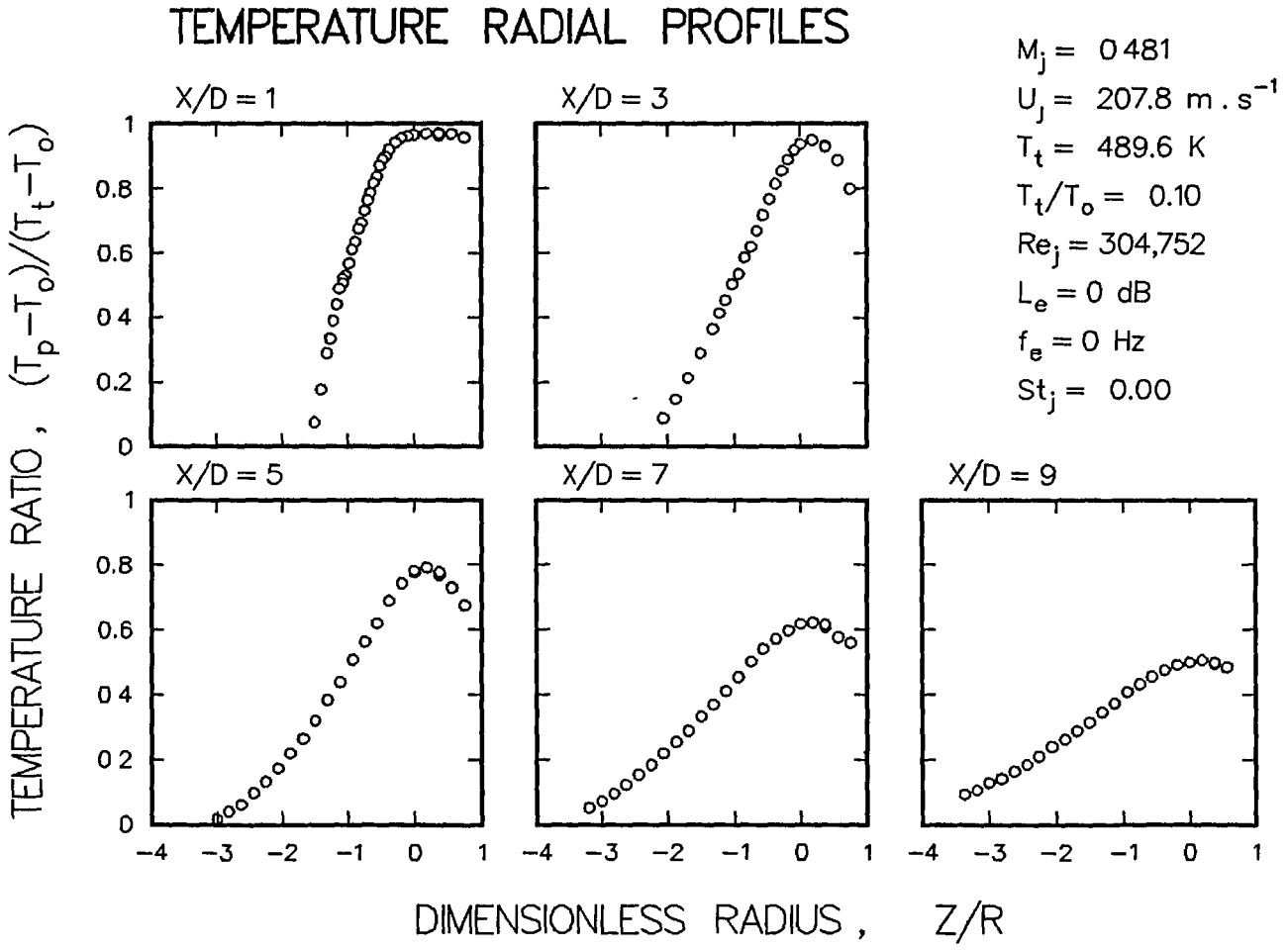

Figure 2.36 Unexcited heated jet radial temperature profiles. Test Point 6.

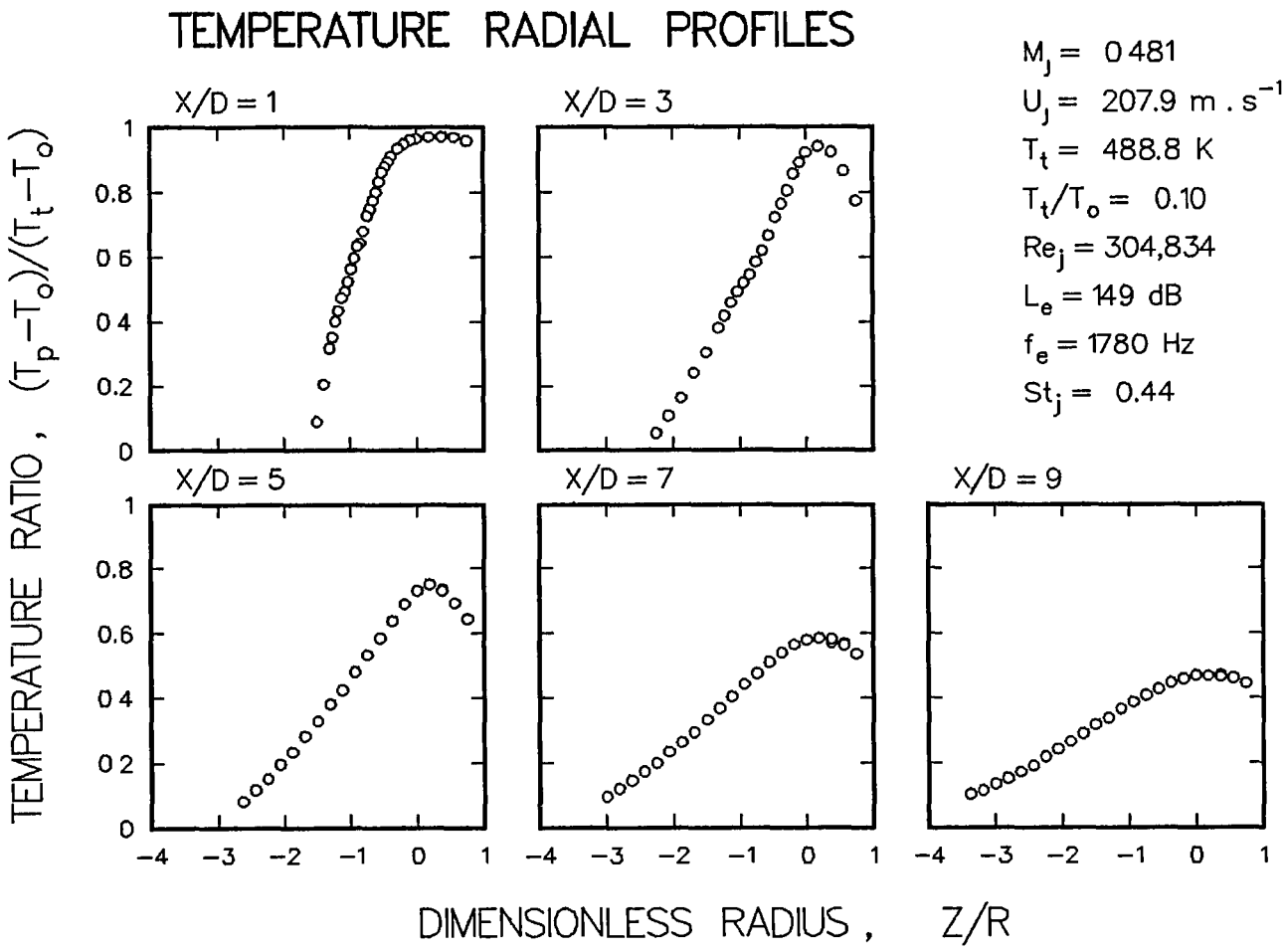

Figure 2.37 Tone Excited heated jet radial temperature profiles. Test Point 6.

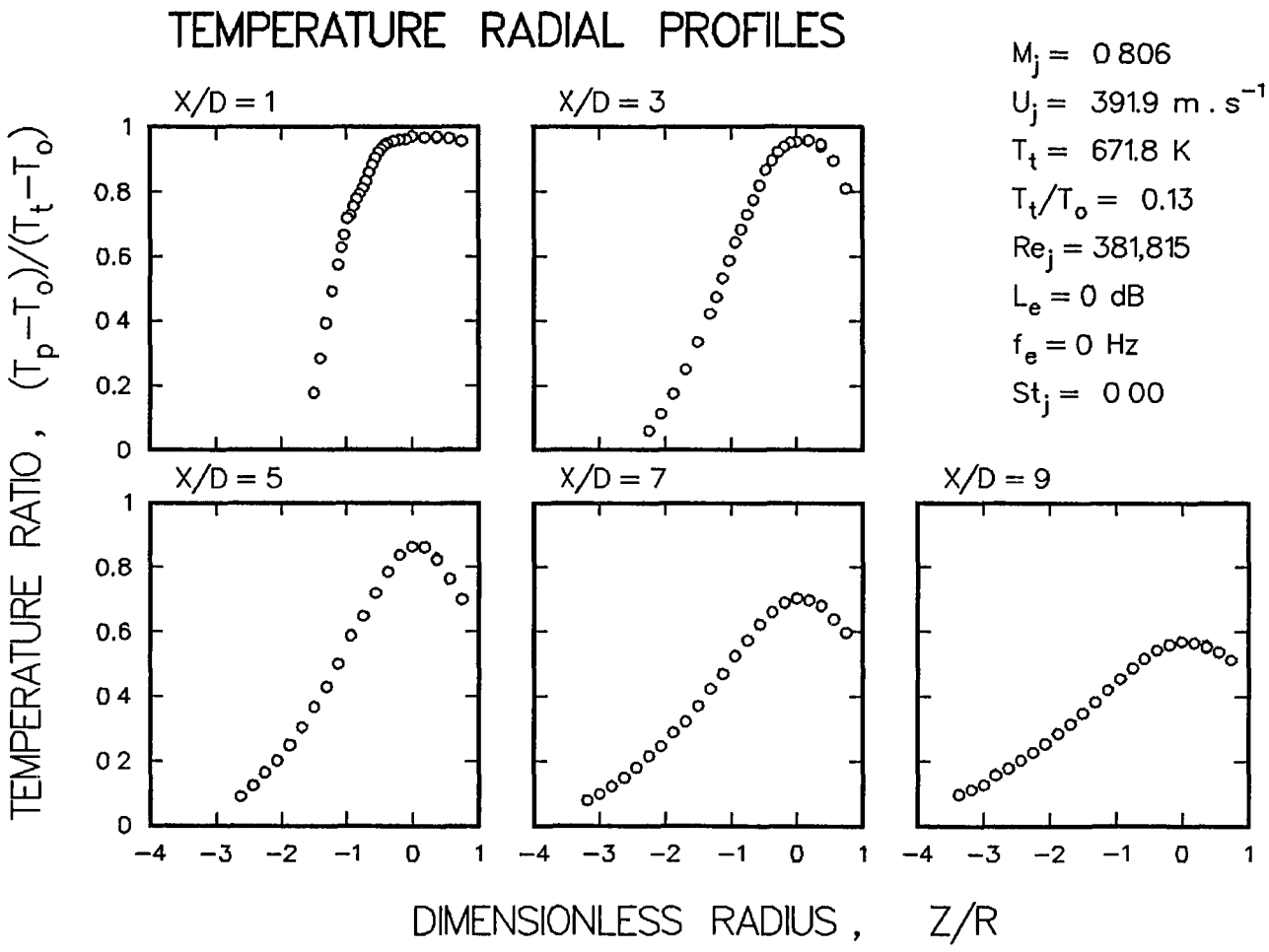

Figure 2.38 Unexcited heated jet radial temperature profiles. Test Point 4.

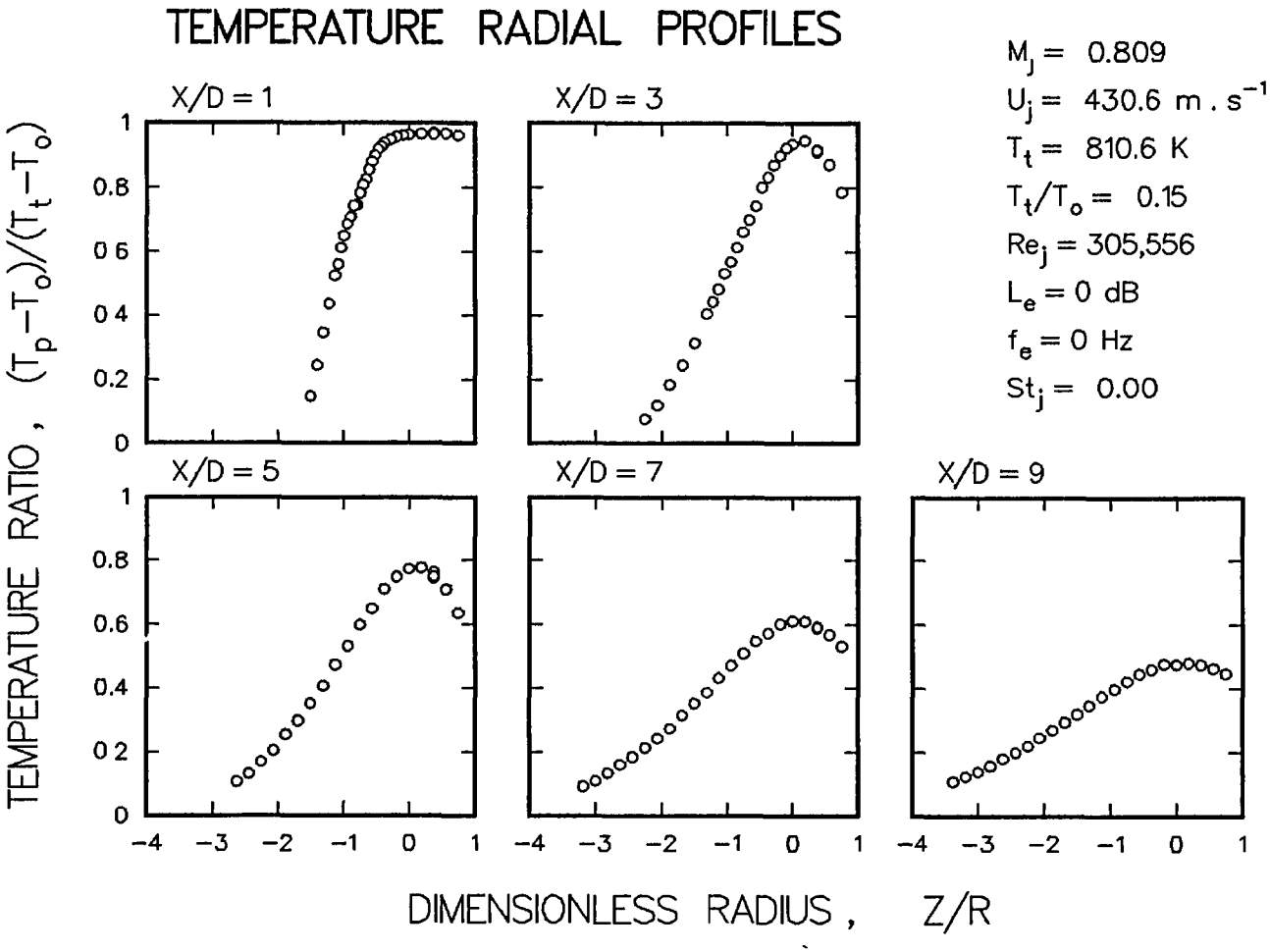

Figure 2.39 Unexcited heated jet radial temperature profiles. Test Point 5.

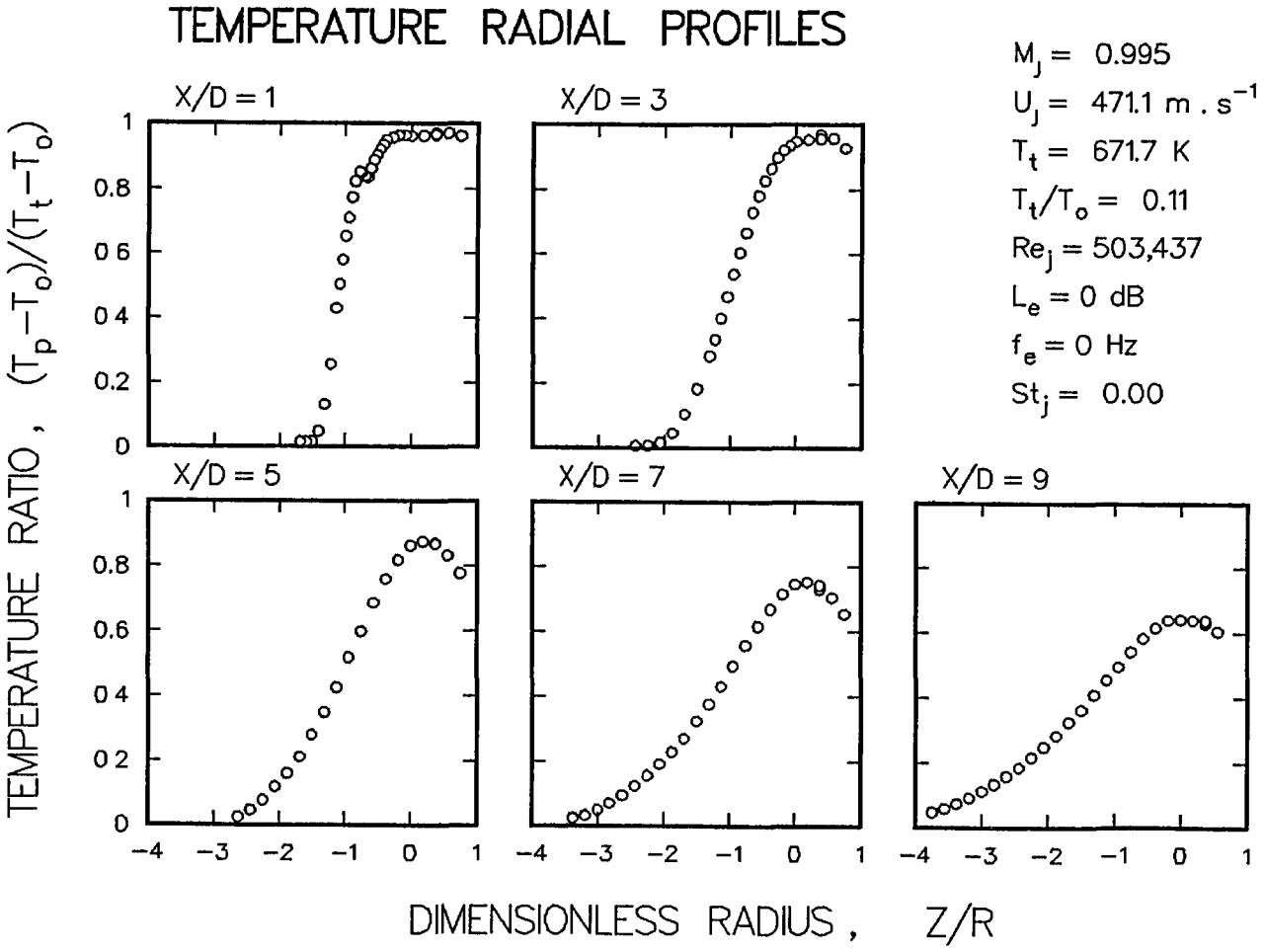

Figure 2.40 Unexcited heated jet radial temperature profiles. Test Point 8.

Figure	p_o (kPa)	T_o (K)
2.21	98.408	294.8
2.22	98.615	294.3
2.23 2.32	99.443	293.7
2.24 2.33	98.960	294.3
2.25 2.34	99.236	292.0
2.26 2.35	99.098	293.7
2.27 2.36	99.167	294.3
2.28 2.37	98.891	292.0
2.29 2.38	99.374	294.3
2.30 2.39	99.098	294.3
2.31 2.40	98.822	294.3

Table 2.3 Ambient conditions.

The probe dynamic corrective curves, for five different jet total temperatures T_t = 287 K, 367 K, 490 K, 672 K, and 802 K, are shown in Figures 2.41 through 2.45. The correction curve at the total temperature of T_t = 367 K could not be completed at low Mach numbers. The reason for this was that the flame in the burner in the test facility becomes unstable at moderate flow temperatures and low air mass flows. Thus the values of the dynamic correction ratio for these flow and temperature conditions have to be interpolated from correction curves measured at the other flow and temperature conditions.

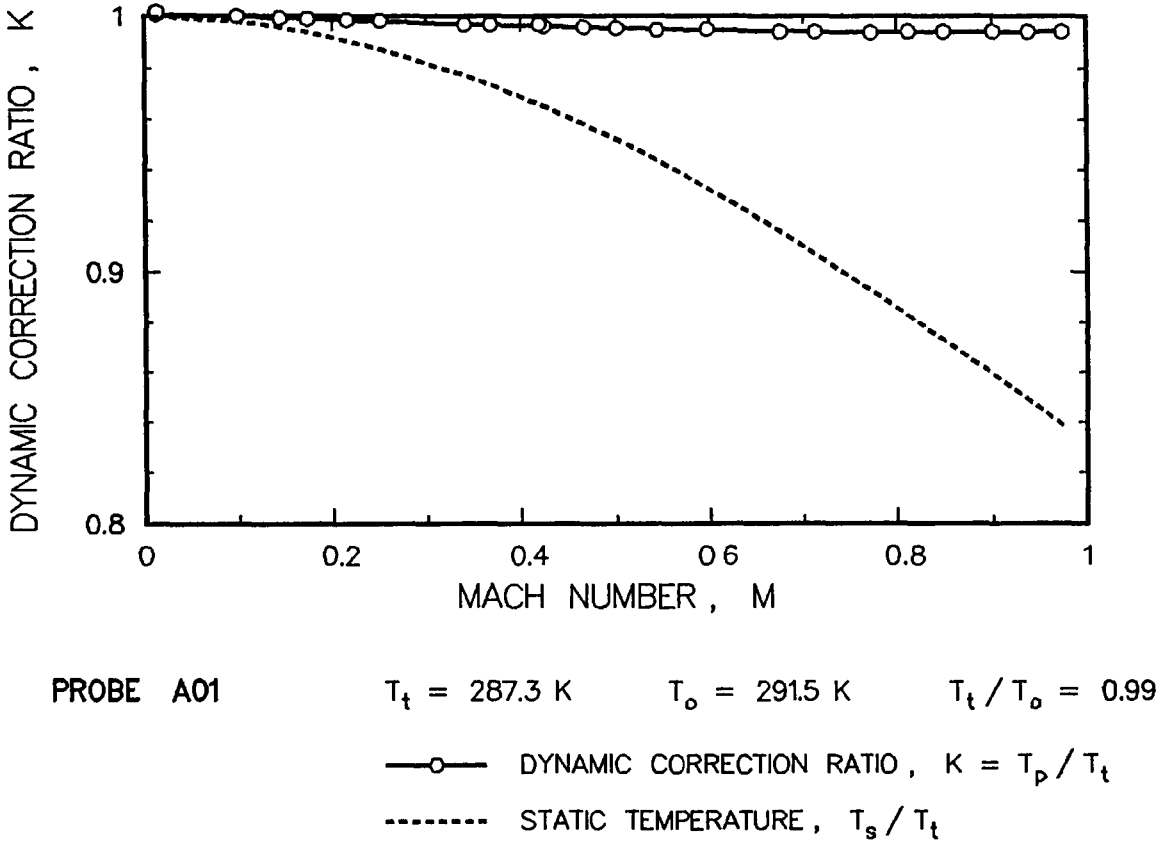

Figure 2.41 Temperature probe dynamic calibration curve.

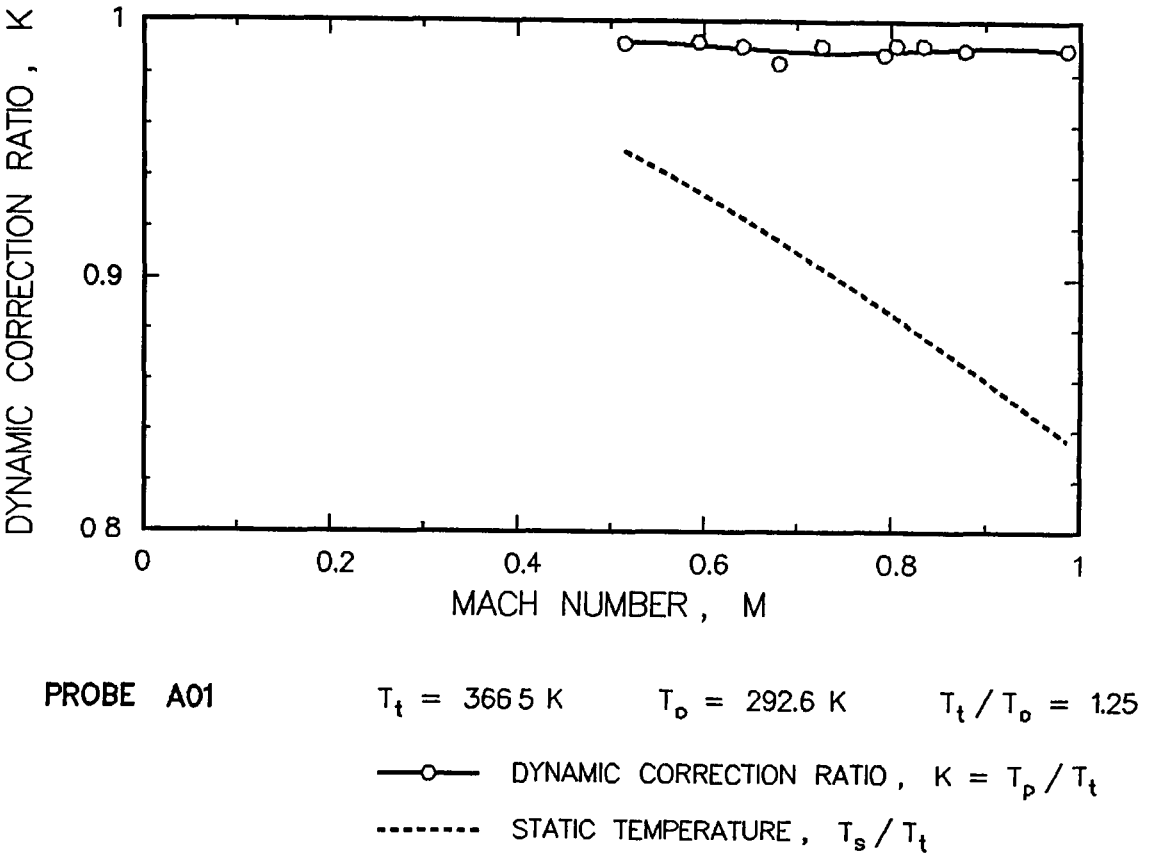

Figure 2.42 Temperature probe dynamic calibration curve.

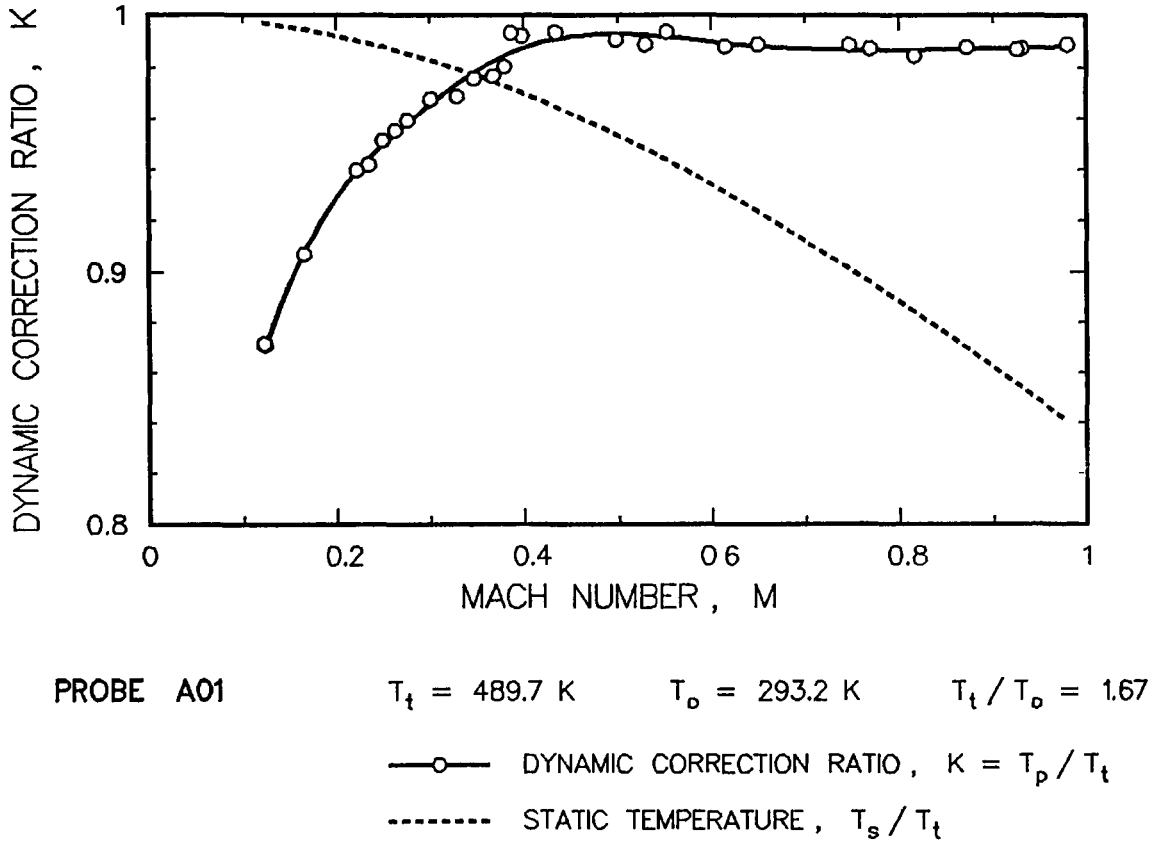

Figure 2.43 Temperature probe dynamic calibration curve.

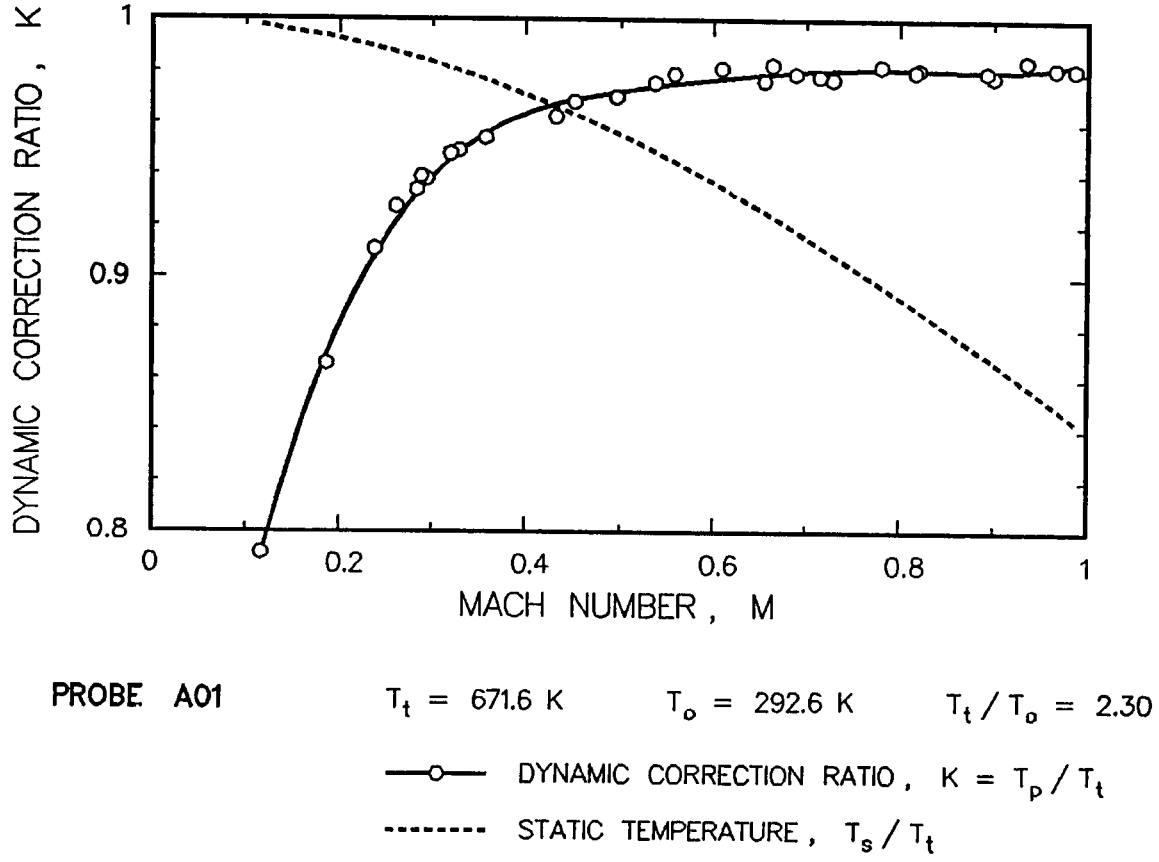

Figure 2.44 Temperature probe dynamic calibration curve.

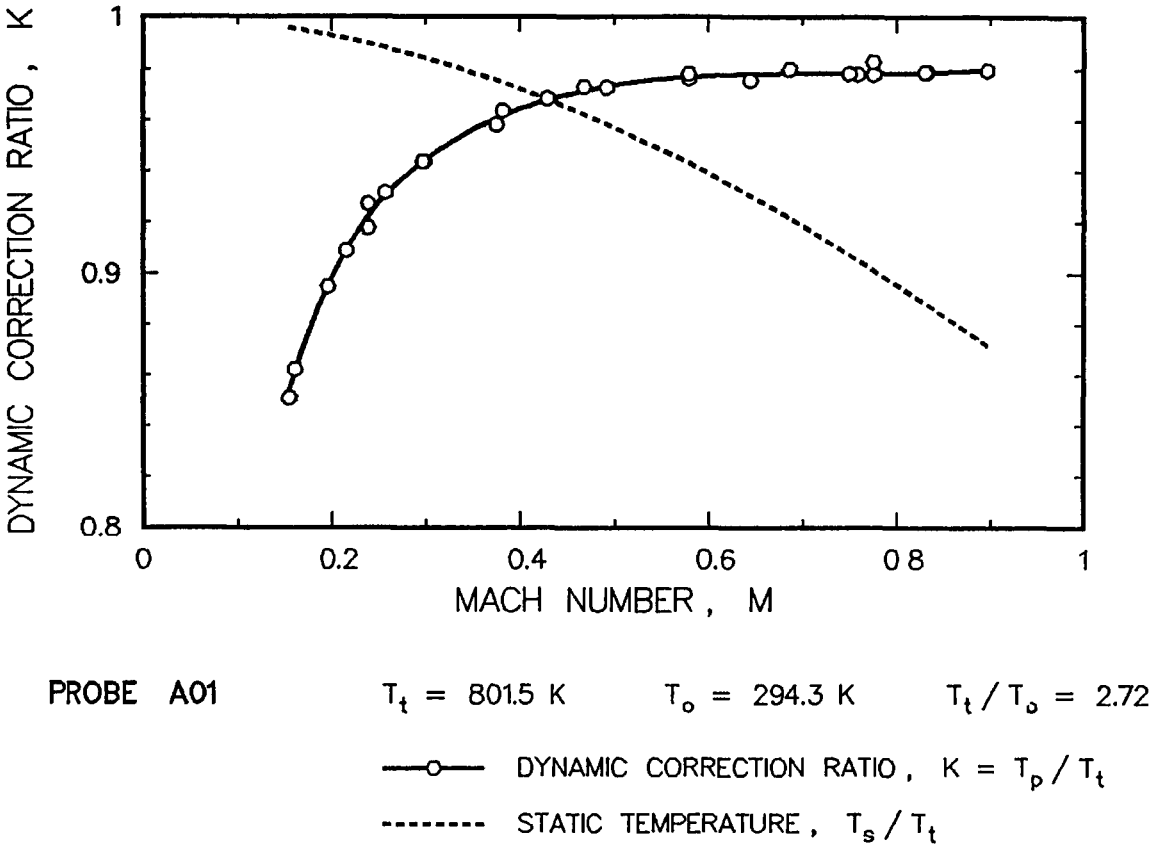

Figure 2.45 Temperature probe dynamic calibration curve.

3.0 TABULATED FLOW DATA

This section presents tabulated flow data duly corrected for the thermocouple recovery. The temperature corrections were made using the probe dynamic correction curves presented in Section 2.3. The correction procedure started with computation of local Mach number values using the measured total, probe, and ambient pressures, as mentioned in Section 2.1. Then, for a given plenum total temperature T_t and computed local Mach number, a value of a temperature probe correction ratio K was found using probe dynamic calibration curves, presented in Section 2.3. Finally, using the ratio K, a corrected local total temperature T_t was computed. The corrected local total temperatures and flow local Mach number data were used to compute flow local velocities and flow local static temperatures, also presented in this appendix.

Tone excitation and jet operating conditions are presented at the head of each table. A summary of results presented is given in Table 3.1.

Table number	Excitation Srouhal number	Jet exit Mach number	Reservoir total temperature	Test point number
3.2	0	0.80	290 K	1
3.3	0.41	0.80	291 K	1
3.4	0	0.80	366 K	2
3.5	0.39	0.80	369 K	2
3.6	0	0.80	489 K	3
3.7	0.35	0.80	489 K	3
3.8	0	0.48	490 K	6
3.9	0.44	0.48	489 K	6
3.10	0	0.81	672 K	4
3.11	0	0.81	810 K	5
3.12	0	1.00	672 K	8

Table 3.1 Summary of tabulated results.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 290 K
Tt/To = 0.99
Rej = 1.06 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.359	0.05	-1.219	292	284	127
-1.312	0.22	-1.125	292	274	190
-1.265	0.28	-1.078	292	270	213
-1.219	0.38	-1.031	294	267	230
-1.172	0.50	-0.984	295	267	239
-1.125	0.57	-0.937	295	265	248
-1.078	0.65	-0.890	295	263	255
-1.031	0.70	-0.844	294	261	256
-0.984	0.73	-0.797	292	259	257
-0.937	0.76	-0.750	291	258	257
-0.891	0.78	-0.703	290	257	257
-0.844	0.79	-0.656	289	257	257
-0.797	0.79	-0.609	289	256	257
-0.750	0.80	-0.562	290	257	258
-0.656	0.80	-0.516	290	257	258
-0.562	0.80	-0.469	289	256	257
-0.468	0.80	-0.422	289	256	257
-0.375	0.80	-0.375	289	256	256
-0.188	0.80	-0.281	289	256	256
0.000	0.80	-0.187	289	256	256
		-0.093	289	256	257
		0.000	289	256	257

Table 3.2 Unexcited unheated jet. Test Point 1.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 290 K
Tt/To = 0.99
Rej = 1.06 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.687	0.11	-1.500	292	289	88
-1.594	0.17	-1.312	292	282	137
-1.500	0.26	-1.219	292	279	163
-1.406	0.32	-1.125	292	275	186
-1.312	0.41	-1.031	293	271	208
-1.219	0.49	-0.937	294	270	220
-1.125	0.56	-0.844	294	267	233
-1.031	0.63	-0.750	295	266	241
-0.937	0.67	-0.656	294	264	247
-0.844	0.71	-0.562	294	262	252
-0.750	0.74	-0.469	293	260	255
-0.656	0.76	-0.375	292	259	257
-0.562	0.78	-0.281	291	258	257
-0.468	0.79	-0.187	290	257	257
-0.375	0.79	-0.093	290	257	257
-0.188	0.80	0.000	289	257	256
0.000	0.80				

Table 3.2 (continued) Unexcited unheated jet. Test Point 1.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 290 K
Tt/To = 0.99
Rej = 1.07 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.062	0.10	-1.687	292	288	84
-1.875	0.17	-1.500	291	285	113
-1.687	0.25	-1.312	291	281	146
-1.500	0.33	-1.125	292	276	177
-1.312	0.43	-0.937	293	272	204
-1.125	0.53	-0.750	294	268	227
-0.937	0.62	-0.562	294	265	240
-0.750	0.69	-0.375	293	262	250
-0.562	0.74	-0.187	292	260	254
-0.375	0.77	0.000	291	259	255
-0.188	0.79				
0.000	0.79				

Table 3.2 (continued) Unexcited unheated jet. Test Point 1.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.80
Uj = 258 m/s
Tt = 290 K
Tt/To = 0.98
Rej = 1.07 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.05	-1.875	293	290	81
-2.437	0.09	-1.687	293	287	101
-2.250	0.14	-1.500	292	285	123
-2.062	0.18	-1.312	293	282	145
-1.875	0.24	-1.125	293	279	167
-1.687	0.30	-0.937	294	276	187
-1.500	0.36	-0.750	295	273	207
-1.312	0.43	-0.562	295	271	222
-1.125	0.50	-0.375	296	269	232
-0.937	0.56	-0.187	295	267	239
-0.750	0.62	0.000	295	266	243
-0.562	0.67				
-0.375	0.71				
-0.188	0.73				
0.000	0.74				

Table 3.2 (continued) Unexcited unheated jet. Test Point 1.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 290 K
Tt/To = 0.98
Rej = 1.06 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.000	0.05	-2.250	294	292	64
-2.813	0.08	-2.062	293	290	76
-2.625	0.11	-1.875	293	289	92
-2.437	0.15	-1.687	293	287	110
-2.250	0.19	-1.500	293	285	124
-2.062	0.22	-1.312	293	283	142
-1.875	0.27	-1.125	293	280	160
-1.687	0.32	-0.937	294	278	176
-1.500	0.37	-0.750	294	277	187
-1.312	0.42	-0.562	295	275	199
-1.125	0.48	-0.375	295	273	211
-0.937	0.53	-0.187	296	272	218
-0.750	0.56	0.000	296	273	218
-0.562	0.60				
-0.375	0.64				
-0.188	0.66				
0.000	0.66				

Table 3.2 (concluded) Unexcited unheated jet. Test Point 1.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 291 K
Tt/To = 0.99
Rej = 1.07 x 1,000,000

Acoustic excitation parameters :

Stj = 0.41
fe = 2080 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.359	0.07	-1.219	291	283	126
-1.312	0.22	-1.125	293	276	187
-1.265	0.30	-1.078	295	273	208
-1.219	0.37	-1.031	296	271	226
-1.172	0.49	-0.984	297	269	239
-1.125	0.56	-0.937	297	267	247
-1.078	0.63	-0.890	297	265	251
-1.031	0.68	-0.844	296	263	255
-0.984	0.73	-0.797	294	261	255
-0.937	0.75	-0.750	293	260	256
-0.891	0.77	-0.703	292	259	255
-0.844	0.78	-0.656	291	258	255
-0.797	0.79	-0.609	290	258	255
-0.750	0.79	-0.562	290	258	256
-0.656	0.79	-0.516	290	258	256
-0.562	0.79	-0.469	290	258	256
-0.468	0.79	-0.422	290	258	256
-0.375	0.79	-0.375	290	258	256
-0.188	0.79	-0.281	291	258	255
0.000	0.79	-0.187	291	258	255
		-0.093	291	258	256
		0.000	291	258	256

Table 3.3 Tone excited unheated jet. Test Point 1.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.80
Uj = 257 m/s
Tt = 291 K
Tt/To = 0.99
Rej = 1.06 x 1,000,000

Acoustic excitation parameters :

Stj = 0.41
fe = 2080 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.687	0.11	-1.500	292	289	70
-1.594	0.15	-1.312	292	285	125
-1.500	0.20	-1.219	294	282	154
-1.406	0.29	-1.125	295	280	176
-1.312	0.37	-1.031	298	278	197
-1.219	0.46	-0.937	299	276	212
-1.125	0.52	-0.844	299	274	227
-1.031	0.59	-0.750	299	271	238
-0.937	0.64	-0.656	298	268	245
-0.844	0.68	-0.562	297	265	252
-0.750	0.72	-0.469	295	263	255
-0.656	0.75	-0.375	294	261	256
-0.562	0.77	-0.281	293	260	256
-0.468	0.78	-0.187	292	259	257
-0.375	0.79	-0.093	291	259	256
-0.188	0.79	0.000	291	258	256
0.000	0.79				

Table 3.3 (continued) Tone excited unheated jet. Test Point 1.

Axial distance :	X/D = 5

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.80	Stj = 0.41
Uj = 257 m/s	fe = 2080 Hz
Tt = 291 K	Le = 149 dB
Tt/To = 0.99	
Rej = 1.07 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.062	0.09	-1.687	293	291	72
-1.875	0.13	-1.500	293	289	91
-1.687	0.21	-1.312	293	287	118
-1.500	0.27	-1.125	295	283	153
-1.312	0.35	-0.937	297	281	179
-1.125	0.45	-0.750	298	277	207
-0.937	0.53	-0.562	299	274	223
-0.750	0.62	-0.375	299	270	238
-0.562	0.67	-0.187	298	268	246
-0.375	0.72	0.000	296	265	251
-0.188	0.75				
0.000	0.77				

Table 3.3 (continued) Tone excited unheated jet. Test Point 1.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.80
Uj = 258 m/s
Tt = 291 K
Tt/To = 0.99
Rej = 1.07 x 1,000,000

Acoustic excitation parameters :

Stj = 0.41
fe = 2080 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.07	-1.875	296	294	72
-2.437	0.10	-1.687	296	292	88
-2.250	0.12	-1.500	296	290	106
-2.062	0.17	-1.312	296	289	124
-1.875	0.21	-1.125	297	286	144
-1.687	0.26	-0.937	297	284	163
-1.500	0.31	-0.750	298	282	182
-1.312	0.37	-0.562	299	279	197
-1.125	0.42	-0.375	299	277	212
-0.937	0.48	-0.187	300	275	222
-0.750	0.54	0.000	300	274	226
-0.562	0.59				
-0.375	0.63				
-0.188	0.67				
0.000	0.68				

Table 3.3 (continued) Tone excited unheated jet. Test Point 1.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.80
Uj = 258 m/s
Tt = 291 K
Tt/To = 0.99
Rej = 1.07 x 1,000,000

Acoustic excitation parameters :

Stj = 0.41
fe = 2080 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.06	-2.250	295	293	65
-3.000	0.08	-2.062	295	292	74
-2.813	0.10	-1.875	295	291	86
-2.625	0.13	-1.687	295	290	96
-2.437	0.15	-1.500	295	289	111
-2.250	0.19	-1.312	295	288	121
-2.062	0.22	-1.125	296	286	140
-1.875	0.25	-0.937	296	285	152
-1.687	0.28	-0.750	297	283	164
-1.500	0.33	-0.562	297	282	174
-1.312	0.36	-0.375	298	281	185
-1.125	0.41	-0.187	299	280	191
-0.937	0.45	0.000	299	281	191
-0.750	0.49				
-0.562	0.52				
-0.375	0.55				
-0.188	0.57				
0.000	0.57				

Table 3.3 (concluded) Tone excited unheated jet. Test Point 1.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 289 m/s
Tt = 366 K
Tt/To = 1.24
Rej = 0.80 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.265	0.21	-1.219	318	313	103
-1.219	0.29	-1.125	332	319	164
-1.172	0.38	-1.031	348	322	228
-1.125	0.46	-0.937	357	323	263
-1.078	0.55	-0.890	358	321	273
-1.031	0.63	-0.844	358	319	279
-0.984	0.69	-0.797	359	319	284
-0.937	0.73	-0.750	358	318	284
-0.891	0.76	-0.703	358	318	284
-0.844	0.78	-0.656	359	318	285
-0.797	0.79	-0.609	359	319	285
-0.750	0.79	-0.562	360	320	285
-0.656	0.80	-0.516	362	321	286
-0.562	0.79	-0.469	362	322	286
-0.468	0.80	-0.422	363	322	287
-0.375	0.80	-0.375	363	322	288
-0.188	0.80	-0.281	365	323	288
0.000	0.80	-0.187	365	324	288
		-0.093	365	324	288
		0.000	365	324	288

Table 3.4 Unexcited heated jet. Test Point 2.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.80
Uj = 289 m/s
Tt = 365 K
Tt/To = 1.24
Rej = 0.80 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.688	0.10	-1.500	313	310	79
-1.687	0.11	-1.313	323	314	135
-1.594	0.16	-1.312	324	315	135
-1.500	0.22	-1.219	329	315	166
-1.406	0.30	-1.125	334	316	193
-1.312	0.38	-1.031	340	316	218
-1.219	0.47	-0.937	346	318	237
-1.125	0.54	-0.844	350	319	252
-1.031	0.61	-0.750	353	319	262
-0.937	0.66	-0.656	354	317	271
-0.844	0.70	-0.562	356	318	278
-0.750	0.73	-0.469	358	318	283
-0.656	0.76	-0.375	359	319	285
-0.562	0.78	-0.281	361	320	286
-0.468	0.79	-0.187	362	321	287
-0.375	0.80	-0.093	363	322	288
-0.188	0.80	0.000	364	323	288
0.000	0.80				

Table 3.4 (continued) Unexcited heated jet. Test Point 2.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.80
Uj = 289 m/s
Tt = 366 K
Tt/To = 1.24
Rej = 0.80 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.250	0.05	-1.687	318	314	85
-2.062	0.10	-1.500	324	316	120
-1.875	0.16	-1.312	330	318	154
-1.687	0.24	-1.125	337	320	185
-1.500	0.34	-0.937	344	321	219
-1.312	0.43	-0.750	351	321	244
-1.125	0.52	-0.562	356	321	263
-0.937	0.61	-0.375	360	322	274
-0.750	0.68	-0.187	362	323	281
-0.562	0.73	0.000	363	323	283
-0.375	0.76				
-0.188	0.78				
0.000	0.79				

Table 3.4 (continued) Unexcited heated jet. Test Point 2.

Axial distance :	X/D = 7

Jet mean flow parameters :

Mj = 0.80
Uj = 289 m/s
Tt = 366 K
Tt/To = 1.25
Rej = 0.80 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.06	-1.875	316	312	84
-2.437	0.10	-1.687	320	314	106
-2.250	0.14	-1.500	324	315	130
-2.062	0.18	-1.312	329	317	154
-1.875	0.24	-1.125	334	318	177
-1.687	0.30	-0.937	340	320	200
-1.500	0.36	-0.750	345	320	223
-1.312	0.43	-0.562	350	321	242
-1.125	0.49	-0.375	354	321	258
-0.937	0.56	-0.187	357	322	264
-0.750	0.62	0.000	358	323	267
-0.562	0.67				
-0.375	0.72				
-0.188	0.73				
0.000	0.74				

Table 3.4 (continued) Unexcited heated jet. Test Point 2.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.80
Uj = 289 m/s
Tt = 367 K
Tt/To = 1.25
Rej = 0.80 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.000	0.07	-2.437	310	309	55
-2.812	0.09	-2.250	312	310	71
-2.625	0.13	-2.062	315	312	82
-2.437	0.16	-1.875	318	313	99
-2.250	0.20	-1.687	321	315	116
-2.062	0.23	-1.500	324	315	134
-1.875	0.28	-1.312	329	317	150
-1.687	0.33	-1.125	333	318	171
-1.500	0.38	-0.937	336	319	188
-1.312	0.42	-0.750	341	321	204
-1.125	0.48	-0.562	345	321	219
-0.937	0.52	-0.375	348	322	228
-0.750	0.57	-0.187	351	323	235
-0.562	0.61	0.000	351	323	237
-0.375	0.63				
-0.188	0.65				
0.000	0.66				

Table 3.4 (concluded) Unexcited heated jet. Test Point 2.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 290 m/s
Tt = 369 K
Tt/To = 1.25
Rej = 0.79 x 1,000,000

Acoustic excitation parameters :

Stj = 0.39
fe = 2240 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.312	0.20	-1.219	325	317	127
-1.265	0.28	-1.125	340	321	196
-1.219	0.36	-1.078	346	320	230
-1.172	0.47	-1.031	355	324	248
-1.125	0.54	-0.984	357	323	262
-1.078	0.64	-0.937	359	323	271
-1.031	0.69	-0.890	360	322	276
-0.984	0.73	-0.844	359	320	282
-0.937	0.75	-0.797	359	319	284
-0.876	0.77	-0.750	360	319	285
-0.844	0.79	-0.703	360	319	285
-0.797	0.79	-0.656	360	320	285
-0.750	0.79	-0.609	362	321	286
-0.656	0.80	-0.562	363	322	286
-0.562	0.80	-0.501	364	323	287
-0.468	0.80	-0.469	365	324	287
-0.375	0.80	-0.422	366	325	288
-0.188	0.80	-0.375	367	326	288
0.000	0.80	-0.281	368	327	289
		-0.187	369	327	289
		-0.093	369	328	289
		0.000	369	328	289

Table 3.5 Tone excited heated jet. Test Point 2.

Axial distance :	X/D = 3

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.80	Stj = 0.39
Uj = 290 m/s	fe = 2240 Hz
Tt = 370 K	Le = 149 dB
Tt/To = 1.26	
Rej = 0.78 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.875	0.09	-1.687	321	319	61
-1.687	0.17	-1.500	327	322	98
-1.594	0.23	-1.312	331	321	144
-1.500	0.27	-1.219	336	322	168
-1.406	0.33	-1.125	340	321	195
-1.312	0.40	-1.031	345	321	219
-1.219	0.47	-0.937	350	322	239
-1.125	0.54	-0.844	354	322	254
-1.031	0.61	-0.750	358	322	266
-0.937	0.66	-0.656	360	323	275
-0.844	0.70	-0.562	363	324	279
-0.750	0.74	-0.469	364	325	283
-0.656	0.76	-0.375	366	325	285
-0.562	0.77	-0.281	367	326	287
-0.468	0.78	-0.187	368	327	288
-0.375	0.79	-0.093	369	327	288
-0.188	0.80	0.000	369	328	288
0.000	0.79				

Table 3.5 (continued) Tone excited heated jet. Test Point 2.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.80
Uj = 290 m/s
Tt = 369 K
Tt/To = 1.25
Rej = 0.79 x 1,000,000

Acoustic excitation parameters :

Stj = 0.39
fe = 2240 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.07	-1.875	322	318	84
-2.437	0.10	-1.687	325	320	102
-2.250	0.13	-1.500	328	320	126
-2.062	0.18	-1.312	331	321	142
-1.875	0.23	-1.125	336	323	166
-1.687	0.28	-0.937	341	322	195
-1.500	0.35	-0.750	347	321	227
-1.312	0.39	-0.562	353	322	249
-1.125	0.46	-0.375	359	324	267
-0.937	0.54	-0.187	363	325	276
-0.750	0.63	0.000	364	326	278
-0.562	0.69				
-0.375	0.74				
-0.188	0.76				
0.000	0.77				

Table 3.5 (continued) Tone excited heated jet. Test Point 2.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.80
Uj = 290 m/s
Tt = 370 K
Tt/To = 1.26
Rej = 0.78 x 1,000,000

Acoustic excitation parameters :

Stj = 0.39
fe = 2240 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.000	0.09	-2.250	319	316	71
-2.812	0.10	-2.062	321	318	78
-2.625	0.12	-1.875	324	319	93
-2.437	0.14	-1.687	325	320	103
-2.250	0.20	-1.500	328	320	127
-2.062	0.22	-1.312	332	322	137
-1.875	0.26	-1.125	335	323	157
-1.687	0.29	-0.937	338	322	180
-1.500	0.35	-0.750	343	323	198
-1.312	0.38	-0.562	347	324	216
-1.125	0.44	-0.375	351	324	230
-0.937	0.50	-0.187	353	325	239
-0.750	0.55	0.000	355	326	241
-0.562	0.60				
-0.375	0.64				
-0.188	0.66				
0.000	0.67				

Table 3.5 (continued) Tone excited heated jet. Test Point 2.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.80
Uj = 290 m/s
Tt = 369 K
Tt/To = 1.25
Rej = 0.79 x 1,000,000

Acoustic excitation parameters :

Stj = 0.39
fe = 2240 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.750	0.06	-2.625	317	314	70
-3.562	0.07	-2.555	318	316	72
-3.375	0.09	-2.437	321	318	74
-3.187	0.11	-2.062	321	317	92
-3.000	0.13	-1.875	324	319	97
-2.930	0.15	-1.687	325	319	117
-2.812	0.19	-1.500	326	318	127
-2.437	0.21	-1.312	330	321	132
-2.250	0.24	-1.125	332	322	142
-2.062	0.26	-0.937	333	321	154
-1.875	0.27	-0.750	335	321	167
-1.687	0.33	-0.562	338	322	176
-1.500	0.36	-0.375	340	323	184
-1.312	0.37	-0.187	341	323	189
-1.125	0.39	0.000	343	324	193
-0.937	0.43				
-0.750	0.46				
-0.562	0.49				
-0.375	0.51				
-0.188	0.53				
0.000	0.54				

Table 3.5 (concluded) Tone excited heated jet. Test Point 2.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.265	0.11	-1.125	386	372	171
-1.219	0.24	-1.078	401	381	200
-1.172	0.34	-1.031	424	396	237
-1.125	0.44	-0.984	439	403	268
-1.078	0.51	-0.937	455	412	293
-1.031	0.59	-0.890	461	416	300
-0.984	0.67	-0.844	466	417	315
-0.937	0.72	-0.797	462	411	319
-0.891	0.74	-0.750	464	412	322
-0.844	0.77	-0.703	467	415	324
-0.797	0.79	-0.656	468	416	325
-0.750	0.79	-0.609	472	419	325
-0.656	0.80	-0.562	475	422	326
-0.562	0.79	-0.516	477	424	327
-0.468	0.79	-0.469	481	427	328
-0.375	0.80	-0.422	483	428	330
-0.188	0.80	-0.375	483	429	331
0.000	0.80	-0.281	487	432	331
		-0.187	490	435	332
		-0.093	490	435	332
		0.000	489	434	332

Table 3.6 Unexcited heated jet. Test Point 3.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.687	0.09	-1.500	351	348	77
-1.594	0.14	-1.312	369	360	135
-1.500	0.20	-1.219	381	368	166
-1.406	0.28	-1.125	398	378	198
-1.312	0.35	-1.031	413	387	228
-1.219	0.43	-0.937	429	396	255
-1.125	0.51	-0.844	440	401	277
-1.031	0.58	-0.750	447	405	292
-0.937	0.64	-0.656	445	399	301
-0.844	0.69	-0.562	449	401	309
-0.750	0.73	-0.469	455	405	315
-0.656	0.75	-0.375	463	412	321
-0.562	0.77	-0.281	468	416	324
-0.468	0.78	-0.187	476	422	327
-0.375	0.79	-0.093	482	427	329
-0.188	0.80	0.000	483	429	330
0.000	0.80				

Table 3.6 (continued) Unexcited heated jet. Test Point 3.

Axial distance :	X/D = 5

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.437	0.06	-1.687	355	351	93
-2.062	0.10	-1.500	370	362	127
-1.875	0.17	-1.312	383	369	167
-1.687	0.25	-1.125	402	381	203
-1.500	0.33	-0.937	423	394	243
-1.312	0.43	-0.750	437	399	274
-1.125	0.52	-0.562	449	405	297
-0.937	0.61	-0.375	458	411	310
-0.750	0.69	-0.187	468	417	320
-0.562	0.74	0.000	473	421	323
-0.375	0.76				
-0.188	0.78				
0.000	0.79				

Table 3.6 (continued) Unexcited heated jet. Test Point 3.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 490 K
Tt/To = 1.66
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.06	-1.875	355	351	89
-2.437	0.10	-1.687	365	359	112
-2.250	0.14	-1.500	374	364	138
-2.062	0.19	-1.312	385	371	165
-1.875	0.24	-1.125	397	379	189
-1.687	0.30	-0.937	411	388	218
-1.500	0.36	-0.750	423	394	242
-1.312	0.43	-0.562	436	400	267
-1.125	0.49	-0.375	444	404	284
-0.937	0.55	-0.187	451	408	294
-0.750	0.61	0.000	456	411	300
-0.562	0.67				
-0.375	0.71				
-0.188	0.73				
0.000	0.74				

Table 3.6 (continued) Unexcited heated jet. Test Point 3.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 490 K
Tt/To = 1.68
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.000	0.06	-2.437	343	341	56
-2.812	0.10	-2.250	346	343	72
-2.625	0.12	-2.062	352	348	89
-2.437	0.15	-1.875	359	353	103
-2.250	0.19	-1.687	366	359	121
-2.062	0.24	-1.500	373	363	141
-1.875	0.27	-1.312	382	369	159
-1.687	0.32	-1.125	391	375	181
-1.500	0.37	-0.937	400	380	202
-1.312	0.41	-0.750	410	386	220
-1.125	0.47	-0.562	418	390	236
-0.937	0.52	-0.375	426	394	250
-0.750	0.56	-0.187	430	397	257
-0.562	0.60	0.000	433	399	260
-0.375	0.63				
-0.188	0.64				
0.000	0.65				

Table 3.6 (concluded) Unexcited heated jet. Test Point 3.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Stj = 0.35
fe = 2280 Hz
Le = 147 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.219	0.15	-1.125	363	356	123
-1.172	0.25	-1.078	379	366	161
-1.125	0.33	-1.031	394	373	203
-1.078	0.42	-0.984	412	384	234
-1.031	0.52	-0.937	429	393	267
-0.984	0.60	-0.890	439	397	290
-0.937	0.67	-0.844	445	400	302
-0.891	0.73	-0.797	452	404	311
-0.844	0.75	-0.750	454	404	316
-0.797	0.77	-0.703	455	404	317
-0.750	0.79	-0.656	456	405	318
-0.656	0.79	-0.609	458	407	319
-0.562	0.79	-0.562	462	410	321
-0.468	0.79	-0.516	467	415	323
-0.375	0.79	-0.469	470	417	325
-0.188	0.79	-0.422	474	421	326
0.000	0.79	-0.375	478	425	328
		-0.281	482	428	329
		-0.187	485	431	330
		-0.093	487	433	331
		0.000	488	433	331

Table 3.7 Tone excited heated jet. Test Point 3.

Axial distance :	X/D = 3

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.80	Stj = 0.35
Uj = 334 m/s	fe = 2280 Hz
Tt = 490 K	Le = 147 dB
Tt/To = 1.66	
Rej = 0.56 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.875	0.06	-1.500	355	351	95
-1.687	0.15	-1.312	376	364	154
-1.594	0.20	-1.219	385	368	189
-1.500	0.25	-1.125	398	375	214
-1.406	0.33	-1.031	409	379	244
-1.312	0.40	-0.937	420	385	265
-1.219	0.49	-0.844	431	392	281
-1.125	0.55	-0.750	438	395	294
-1.031	0.63	-0.656	449	402	306
-0.937	0.67	-0.562	457	407	314
-0.844	0.71	-0.469	465	413	321
-0.750	0.74	-0.375	473	420	325
-0.656	0.76	-0.281	479	425	327
-0.562	0.78	-0.187	483	429	329
-0.468	0.79	-0.093	486	432	330
-0.375	0.79	0.000	489	434	331
-0.188	0.80				
0.000	0.79				

Table 3.7 (continued) Tone excited heated jet. Test Point 3.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.80
Uj = 334 m/s
Tt = 489 K
Tt/To = 1.67
Rej = 0.56 x 1,000,000

Acoustic excitation parameters :

Stj = 0.35
fe = 2280 Hz
Le = 147 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.250	0.08	-1.687	353	348	99
-2.062	0.13	-1.500	365	357	130
-1.875	0.19	-1.312	380	366	163
-1.687	0.26	-1.125	395	376	198
-1.500	0.34	-0.937	409	382	235
-1.312	0.43	-0.750	423	389	264
-1.125	0.51	-0.562	441	399	288
-0.937	0.60	-0.375	453	407	306
-0.750	0.67	-0.187	464	414	316
-0.562	0.72	0.000	470	419	319
-0.375	0.76				
-0.188	0.78				
0.000	0.78				

Table 3.7 (continued) Tone excited heated jet. Test Point 3.

Axial distance :	X/D = 7

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.80	Stj = 0.35
Uj = 334 m/s	fe = 2280 Hz
Tt = 489 K	Le = 147 dB
Tt/To = 1.67	
Rej = 0.56 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.07	-2.250	336	334	60
-2.437	0.12	-2.062	345	342	72
-2.250	0.16	-1.875	353	349	90
-2.062	0.20	-1.687	359	353	105
-1.875	0.24	-1.500	367	359	131
-1.687	0.28	-1.312	375	364	152
-1.500	0.34	-1.125	386	371	177
-1.312	0.40	-0.937	396	375	206
-1.125	0.46	-0.750	406	380	229
-0.937	0.53	-0.562	420	389	250
-0.750	0.59	-0.375	429	393	268
-0.562	0.63	-0.187	434	396	276
-0.375	0.67	0.000	437	399	277
-0.188	0.69				
0.000	0.69				

Table 3.7 (continued) Tone excited heated jet. Test Point 3.

Axial distance :	X/D = 9

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.80	Stj = 0.35
Uj = 334 m/s	fe = 2280 Hz
Tt = 489 K	Le = 147 dB
Tt/To = 1.66	
Rej = 0.56 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.06	-2.250	342	340	67
-3.000	0.07	-2.062	346	342	84
-2.812	0.10	-1.875	351	346	100
-2.625	0.13	-1.687	359	353	113
-2.437	0.15	-1.500	365	356	128
-2.250	0.18	-1.303	370	360	148
-2.062	0.23	-1.125	377	364	160
-1.875	0.27	-0.937	385	369	178
-1.678	0.30	-0.750	390	371	195
-1.500	0.34	-0.562	399	377	208
-1.312	0.39	-0.375	405	380	222
-1.125	0.42	-0.187	408	383	228
-0.937	0.46	0.000	411	385	228
-0.750	0.50				
-0.562	0.54				
-0.375	0.57				
-0.188	0.58				
0.000	0.58				

Table 3.7 (concluded) Tone excited heated jet. Test Point 3.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 490 K
Tt/To = 1.66
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.406	0.07	-1.219	380	376	90
-1.359	0.10	-1.172	389	383	109
-1.312	0.15	-1.125	396	388	126
-1.265	0.19	-1.078	399	389	142
-1.219	0.23	-1.031	401	389	156
-1.172	0.28	-0.984	408	394	168
-1.125	0.32	-0.937	416	400	178
-1.078	0.36	-0.890	421	404	185
-1.031	0.39	-0.844	429	411	189
-0.984	0.42	-0.797	433	414	192
-0.937	0.44	-0.750	440	421	195
-0.891	0.46	-0.703	446	427	197
-0.844	0.47	-0.656	450	430	198
-0.797	0.47	-0.609	455	435	199
-0.750	0.47	-0.562	462	441	201
-0.656	0.48	-0.516	468	448	202
-0.562	0.48	-0.469	471	450	202
-0.468	0.48	-0.422	475	454	202
-0.375	0.47	-0.375	478	458	203
-0.188	0.48	-0.281	482	461	204
0.000	0.48	-0.187	484	463	204
		-0.093	485	464	205
		0.000	486	465	206

Table 3.8 Unexcited heated jet. Test Point 6.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.875	0.07	-1.500	360	358	67
-1.687	0.12	-1.312	374	370	92
-1.594	0.15	-1.219	383	377	106
-1.500	0.18	-1.125	390	383	120
-1.406	0.21	-1.031	398	389	133
-1.312	0.24	-0.937	403	393	145
-1.219	0.27	-0.844	413	400	159
-1.125	0.31	-0.750	418	404	170
-1.031	0.34	-0.656	427	411	180
-0.937	0.37	-0.562	436	419	187
-0.844	0.40	-0.469	446	428	193
-0.750	0.42	-0.375	455	436	198
-0.656	0.44	-0.281	464	444	200
-0.562	0.46	-0.187	471	451	202
-0.468	0.47	-0.093	477	457	203
-0.375	0.47	0.000	481	460	204
-0.188	0.48				
0.000	0.48				

Table 3.8 (continued) Unexcited heated jet. Test Point 6.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 490 K
Tt/To = 1.66
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.250	0.07	-1.687	356	354	65
-2.062	0.10	-1.500	366	363	79
-1.875	0.13	-1.312	378	373	99
-1.687	0.17	-1.125	387	381	115
-1.500	0.21	-0.937	400	391	132
-1.312	0.26	-0.750	409	397	150
-1.125	0.29	-0.562	419	406	166
-0.937	0.33	-0.375	432	416	179
-0.750	0.38	-0.187	442	425	187
-0.562	0.41	0.000	450	431	191
-0.375	0.44				
-0.188	0.45				
0.000	0.46				

Table 3.8 (continued) Unexcited heated jet. Test Point 6.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 490 K
Tt/To = 1.66
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.812	0.06	-1.687	360	357	73
-2.625	0.07	-1.500	368	365	83
-2.437	0.10	-1.312	375	370	93
-2.250	0.11	-1.125	382	376	108
-2.062	0.14	-0.937	389	382	122
-1.875	0.16	-0.750	398	389	133
-1.687	0.19	-0.562	405	395	143
-1.500	0.22	-0.375	410	398	153
-1.312	0.24	-0.187	415	402	160
-1.125	0.28	0.000	418	405	162
-0.937	0.31				
-0.750	0.34				
-0.562	0.36				
-0.375	0.38				
-0.188	0.40				
0.000	0.40				

Table 3.8 (continued) Unexcited heated jet. Test Point 6.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.48
Uj = 207 m/s
Tt = 489 K
Tt/To = 1.68
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.06	-1.875	353	351	62
-3.000	0.06	-1.687	358	355	71
-2.812	0.08	-1.500	363	359	79
-2.625	0.10	-1.312	368	364	90
-2.437	0.11	-1.125	373	368	98
-2.250	0.13	-0.937	380	375	105
-2.062	0.15	-0.750	385	378	114
-1.875	0.17	-0.562	388	381	121
-1.687	0.19	-0.375	392	384	126
-1.500	0.21	-0.187	394	386	130
-1.312	0.24	0.000	396	388	131
-1.125	0.26				
-0.937	0.27				
-0.750	0.29				
-0.562	0.31				
-0.375	0.32				
-0.188	0.33				
0.000	0.33				

Table 3.8 (concluded) Unexcited heated jet. Test Point 6.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 489 K
Tt/To = 1.67
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Stj = 0.44
fe = 1780 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.406	0.07	-1.219	381	377	90
-1.359	0.10	-1.172	385	380	108
-1.312	0.14	-1.125	391	384	126
-1.265	0.19	-1.078	394	384	141
-1.219	0.23	-1.031	399	387	154
-1.172	0.28	-0.984	406	392	165
-1.125	0.32	-0.937	412	397	175
-1.078	0.36	-0.890	419	403	183
-1.031	0.39	-0.844	421	404	186
-0.984	0.42	-0.797	428	410	190
-0.937	0.44	-0.750	438	419	193
-0.891	0.46	-0.703	442	423	195
-0.844	0.46	-0.656	447	428	196
-0.797	0.47	-0.609	452	433	197
-0.750	0.47	-0.562	459	439	199
-0.656	0.47	-0.516	464	444	200
-0.562	0.47	-0.469	468	448	200
-0.468	0.47	-0.422	471	451	201
-0.375	0.47	-0.375	474	454	202
-0.188	0.47	-0.281	480	459	203
0.000	0.47	-0.187	483	462	203
		-0.093	485	465	204
		0.000	487	466	204

Table 3.9 Tone excited heated jet. Test Point 6.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Stj = 0.44
fe = 1780 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.875	0.07	-1.500	363	361	67
-1.687	0.12	-1.312	377	373	89
-1.594	0.15	-1.219	383	378	102
-1.500	0.18	-1.125	390	383	117
-1.406	0.20	-1.031	395	387	131
-1.312	0.23	-0.937	399	389	144
-1.219	0.26	-0.844	403	391	157
-1.125	0.30	-0.750	411	397	167
-1.031	0.33	-0.656	417	402	175
-0.937	0.36	-0.562	427	410	183
-0.844	0.40	-0.469	437	419	190
-0.750	0.42	-0.375	445	427	194
-0.656	0.44	-0.281	454	435	197
-0.562	0.45	-0.187	465	445	201
-0.468	0.46	-0.093	472	451	202
-0.375	0.47	0.000	477	457	204
-0.188	0.48				
0.000	0.48				

Table 3.9 (continued) Tone excited heated jet. Test Point 6.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 489 K
Tt/To = 1.66
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Stj = 0.44
fe = 1780 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.437	0.06	-1.687	359	357	64
-2.250	0.08	-1.500	367	364	77
-2.062	0.11	-1.312	376	372	93
-1.875	0.14	-1.125	384	378	109
-1.687	0.17	-0.937	393	385	128
-1.500	0.20	-0.750	402	392	144
-1.312	0.24	-0.562	411	399	160
-1.125	0.28	-0.375	421	406	173
-0.937	0.32	-0.187	431	414	183
-0.750	0.36	0.000	439	422	186
-0.562	0.40				
-0.375	0.43				
-0.188	0.45				
0.000	0.45				

Table 3.9 (continued) Tone excited heated jet. Test Point 6.

Axial distance :	X/D = 7

Jet mean flow parameters :

Mj = 0.48
Uj = 208 m/s
Tt = 488 K
Tt/To = 1.67
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Stj = 0.44
fe = 1780 Hz
Le = 149 dB

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.812	0.06	-1.687	359	356	71
-2.625	0.07	-1.500	366	363	79
-2.437	0.09	-1.312	372	368	91
-2.250	0.12	-1.125	379	374	102
-2.062	0.14	-0.937	386	379	114
-1.875	0.16	-0.750	391	383	126
-1.687	0.19	-0.562	396	387	137
-1.500	0.21	-0.375	402	392	143
-1.312	0.24	-0.187	408	397	150
-1.125	0.26	0.000	410	399	153
-0.937	0.29				
-0.750	0.32				
-0.562	0.35				
-0.375	0.36				
-0.188	0.38				
0.000	0.38				

Table 3.9 (continued) Tone excited heated jet. Test Point 6.

Axial distance :	X/D = 9

Jet mean flow parameters :	Acoustic excitation parameters :
Mj = 0.48	Stj = 0.44
Uj = 208 m/s	fe = 1780 Hz
Tt = 489 K	Le = 149 dB
Tt/To = 1.67	
Rej = 0.30 x 1,000,000	

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.06	-1.687	358	355	71
-3.000	0.07	-1.500	363	360	77
-2.812	0.09	-1.312	366	362	86
-2.625	0.10	-1.125	372	367	93
-2.437	0.11	-0.937	376	371	101
-2.250	0.13	-0.750	380	374	108
-2.062	0.15	-0.562	383	377	115
-1.875	0.17	-0.375	386	379	120
-1.687	0.19	-0.187	388	381	123
-1.500	0.20	0.000	390	383	124
-1.312	0.23				
-1.125	0.24				
-0.937	0.26				
-0.750	0.28				
-0.562	0.30				
-0.375	0.31				
-0.188	0.31				
0.000	0.32				

Table 3.9 (concluded) Tone excited heated jet. Test Point 6.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.81
Uj = 392 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.38 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.500	0.11	-1.406	413	408	101
-1.453	0.18	-1.312	447	434	163
-1.406	0.25	-1.219	483	457	231
-1.359	0.32	-1.125	518	476	288
-1.312	0.39	-1.078	539	490	314
-1.265	0.47	-1.031	554	498	332
-1.219	0.54	-0.984	574	513	348
-1.172	0.61	-0.937	579	515	357
-1.125	0.66	-0.890	589	523	362
-1.078	0.71	-0.844	598	531	366
-1.031	0.74	-0.797	605	536	369
-0.984	0.77	-0.750	611	542	371
-0.937	0.79	-0.703	620	549	373
-0.891	0.79	-0.656	630	559	376
-0.844	0.80	-0.609	638	566	378
-0.797	0.80	-0.562	647	573	381
-0.750	0.80	-0.516	653	579	383
-0.656	0.80	-0.469	658	583	384
-0.562	0.80	-0.422	661	586	386
-0.468	0.80	-0.375	664	588	387
-0.375	0.80	-0.281	667	591	387
-0.188	0.80	-0.187	669	593	387
0.000	0.80	-0.093	671	595	388
		0.000	674	598	389

Table 3.10 Unexcited heated jet. Test Point 4.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.81
Uj = 392 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.38 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.062	0.06	-1.687	401	397	91
-1.875	0.15	-1.500	427	417	141
-1.687	0.23	-1.312	457	437	196
-1.594	0.28	-1.219	476	452	223
-1.500	0.35	-1.125	501	468	255
-1.406	0.40	-1.031	523	483	280
-1.312	0.47	-0.937	545	498	306
-1.219	0.52	-0.844	560	504	332
-1.125	0.59	-0.750	579	518	347
-1.031	0.64	-0.656	597	532	360
-0.937	0.69	-0.562	614	545	368
-0.844	0.74	-0.469	632	560	377
-0.750	0.76	-0.375	644	571	380
-0.656	0.78	-0.281	655	581	384
-0.563	0.79	-0.188	659	585	385
-0.468	0.80	-0.093	666	590	387
-0.375	0.80	0.000	668	592	387
-0.188	0.80				
0.000	0.80				

Table 3.10 (continued) unexcited heated jet. Test Point 4.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.81
Uj = 392 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.38 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.437	0.09	-1.875	400	395	95
-2.250	0.12	-1.687	418	410	123
-2.062	0.18	-1.500	438	426	156
-1.875	0.24	-1.312	460	441	195
-1.687	0.30	-1.125	486	460	229
-1.500	0.38	-0.937	522	485	272
-1.312	0.46	-0.750	547	500	308
-1.125	0.53	-0.562	575	518	337
-0.937	0.62	-0.375	600	535	358
-0.750	0.69	-0.187	621	552	369
-0.562	0.74	0.000	631	561	372
-0.375	0.78				
-0.188	0.79				
0.000	0.79				

Table 3.10 (continued) Unexcited heated jet. Test Point 4.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.81
Uj = 392 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.38 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.000	0.06	-2.250	388	386	76
-2.812	0.09	-2.062	397	393	95
-2.625	0.12	-1.875	413	406	114
-2.437	0.15	-1.687	422	413	137
-2.250	0.19	-1.500	439	426	160
-2.062	0.24	-1.312	458	440	188
-1.875	0.28	-1.125	475	452	214
-1.687	0.34	-0.937	497	467	243
-1.500	0.39	-0.750	516	480	268
-1.312	0.45	-0.562	536	493	290
-1.125	0.50	-0.375	551	503	309
-0.937	0.56	-0.187	563	512	320
-0.750	0.61	0.000	570	517	323
-0.562	0.65				
-0.375	0.69				
-0.188	0.71				
0.000	0.71				

Table 3.10 (continued) Unexcited heated jet. Test Point 4.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.81
Uj = 392 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.38 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.08	-2.437	384	381	74
-3.000	0.10	-2.250	393	389	84
-2.812	0.13	-2.062	401	396	100
-2.625	0.16	-1.875	411	405	115
-2.437	0.19	-1.687	421	412	133
-2.250	0.21	-1.500	431	420	152
-2.062	0.25	-1.312	443	428	172
-1.875	0.28	-1.125	456	438	191
-1.687	0.33	-0.937	469	447	209
-1.500	0.37	-0.750	482	456	227
-1.312	0.42	-0.562	494	465	242
-1.125	0.46	-0.375	504	471	255
-0.937	0.49	-0.187	511	476	262
-0.750	0.53	0.000	515	480	264
-0.562	0.56				
-0.375	0.59				
-0.188	0.60				
0.000	0.60				

Table 3.10 (concluded) Unexcited heated jet. Test Point 4.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 0.81
Uj = 431 m/s
Tt = 810 K
Tt/To = 2.75
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.500	0.07	-1.312	485	475	143
-1.453	0.14	-1.219	526	503	212
-1.406	0.19	-1.125	573	534	279
-1.359	0.26	-1.078	593	542	317
-1.312	0.33	-1.031	621	563	340
-1.265	0.40	-0.984	639	573	361
-1.219	0.47	-0.937	658	587	375
-1.172	0.54	-0.890	672	598	383
-1.125	0.61	-0.844	693	614	393
-1.078	0.68	-0.797	692	613	394
-1.031	0.72	-0.750	711	630	400
-0.984	0.76	-0.703	726	643	404
-0.937	0.78	-0.656	734	650	406
-0.891	0.79	-0.609	751	665	411
-0.844	0.80	-0.562	762	675	414
-0.797	0.80	-0.516	774	685	417
-0.750	0.80	-0.469	784	694	420
-0.656	0.80	-0.422	789	698	421
-0.562	0.80	-0.375	795	704	423
-0.468	0.80	-0.281	800	708	424
-0.375	0.81	-0.187	805	712	425
-0.188	0.81	-0.093	808	715	426
0.000	0.80	0.000	810	717	426

Table 3.11 Unexcited heated jet. Test Point 5.

Axial distance :	X/D = 3

Jet mean flow parameters :

Mj = 0.81
Uj = 431 m/s
Tt = 811 K
Tt/To = 2.75
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.062	0.07	-1.687	437	432	102
-1.875	0.15	-1.500	467	457	143
-1.687	0.24	-1.312	510	491	193
-1.594	0.28	-1.219	530	505	224
-1.500	0.33	-1.125	550	518	252
-1.406	0.39	-1.031	579	539	280
-1.312	0.44	-0.937	597	550	304
-1.219	0.50	-0.844	623	566	337
-1.125	0.56	-0.750	647	584	355
-1.031	0.60	-0.656	669	599	372
-0.937	0.65	-0.562	691	615	386
-0.844	0.71	-0.469	722	641	400
-0.750	0.74	-0.375	740	657	405
-0.656	0.76	-0.281	758	672	411
-0.562	0.78	-0.187	774	686	415
-0.468	0.80	-0.093	787	697	419
-0.375	0.80	0.000	795	704	422
-0.188	0.80				
0.000	0.80				

Table 3.11 (continued) Unexcited heated jet. Test Point 5.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 0.81
Uj = 430 m/s
Tt = 811 K
Tt/To = 2.76
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.625	0.07	-2.250	400	398	62
-2.437	0.10	-2.062	416	412	81
-2.250	0.15	-1.875	439	434	107
-2.062	0.20	-1.687	458	449	135
-1.875	0.26	-1.500	483	469	166
-1.687	0.32	-1.312	509	489	200
-1.500	0.38	-1.125	545	516	242
-1.312	0.45	-0.937	577	538	277
-1.125	0.53	-0.750	614	563	316
-0.937	0.60	-0.562	641	581	343
-0.750	0.67	-0.375	673	604	367
-0.562	0.71	-0.187	694	618	385
-0.375	0.75	0.000	708	631	389
-0.188	0.78				
0.000	0.78				

Table 3.11 (continued) Unexcited heated jet. Test Point 5.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.81
Uj = 431 m/s
Tt = 811 K
Tt/To = 2.75
Rej = 0.30 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.187	0.05	-2.437	408	405	69
-3.000	0.09	-2.250	419	415	90
-2.812	0.11	-2.062	433	428	105
-2.625	0.14	-1.875	447	439	124
-2.437	0.17	-1.687	466	455	144
-2.250	0.22	-1.500	482	467	168
-2.062	0.25	-1.312	498	480	190
-1.875	0.30	-1.125	522	499	215
-1.687	0.34	-0.937	545	515	243
-1.500	0.39	-0.750	566	531	265
-1.312	0.44	-0.562	587	545	290
-1.125	0.48	-0.375	601	555	304
-0.937	0.54	-0.187	617	567	315
-0.750	0.58	0.000	622	572	317
-0.562	0.62				
-0.375	0.65				
-0.188	0.67				
0.000	0.67				

Table 3.11 (continued) Unexcited heated jet. Test Point 5.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 0.81
Uj = 431 m/s
Tt = 810 K
Tt/To = 2.75
Rej = 0.31 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.562	0.06	-2.437	414	410	79
-3.375	0.07	-2.250	422	417	94
-3.187	0.10	-2.062	434	428	109
-3.000	0.12	-1.875	446	438	122
-2.812	0.14	-1.687	457	447	138
-2.625	0.18	-1.500	468	456	154
-2.437	0.19	-1.312	479	465	168
-2.250	0.23	-1.125	492	475	185
-2.062	0.26	-0.937	504	483	204
-1.875	0.29	-0.750	517	494	217
-1.687	0.33	-0.562	531	504	232
-1.500	0.36	-0.375	539	511	240
-1.312	0.39	-0.187	547	516	248
-1.125	0.42	0.000	546	515	248
-0.937	0.46				
-0.750	0.49				
-0.562	0.52				
-0.375	0.53				
-0.188	0.55				
0.000	0.55				

Table 3.11 (concluded) Unexcited heated jet. Test Point 5.

Axial distance : X/D = 1

Jet mean flow parameters :

Mj = 1.00
Uj = 471 m/s
Tt = 672 K
Tt/To = 2.30
Rej = 0.50 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.312	0.16	-1.219	393	383	140
-1.265	0.26	-1.125	458	430	233
-1.219	0.36	-1.078	488	448	280
-1.152	0.46	-1.031	518	464	328
-1.125	0.56	-0.984	547	478	371
-1.078	0.66	-0.937	570	487	407
-1.031	0.76	-0.890	595	502	430
-0.984	0.85	-0.844	615	516	444
-0.937	0.92	-0.777	624	521	452
-0.891	0.96	-0.750	625	521	455
-0.844	0.98	-0.703	621	518	453
-0.797	0.99	-0.656	620	517	451
-0.750	1.00	-0.609	630	526	455
-0.656	0.99	-0.562	640	534	458
-0.562	1.00	-0.516	646	539	460
-0.468	0.99	-0.469	650	543	462
-0.375	1.00	-0.422	656	548	464
-0.188	1.00	-0.375	662	552	466
0.000	1.00	-0.281	666	556	468
		-0.187	669	558	469
		-0.093	669	558	469
		0.000	668	557	469

Table 3.12 Unexcited heated jet. Test Point 8.

Axial distance : X/D = 3

Jet mean flow parameters :

Mj = 0.99
Uj = 471 m/s
Tt = 672 K
Tt/To = 2.29
Rej = 0.50 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-1.687	0.11	-1.500	372	368	85
-1.594	0.16	-1.312	406	395	149
-1.500	0.22	-1.219	424	407	182
-1.406	0.30	-1.125	449	424	223
-1.312	0.37	-1.031	475	441	262
-1.219	0.45	-0.937	504	457	304
-1.125	0.54	-0.844	529	470	342
-1.031	0.62	-0.750	554	483	376
-0.937	0.71	-0.656	579	496	406
-0.844	0.79	-0.562	597	505	428
-0.750	0.86	-0.469	616	517	443
-0.656	0.91	-0.375	630	527	453
-0.562	0.95	-0.281	644	538	459
-0.468	0.98	-0.187	653	545	463
-0.375	0.99	-0.093	660	551	465
-0.188	0.99	0.000	666	555	467
0.000	1.00				

Table 3.12 (continued) Unexcited heated jet. Test Point 8.

Axial distance : X/D = 5

Jet mean flow parameters :

Mj = 1.00
Uj = 471 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.50 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.250	0.07	-1.687	382	376	105
-2.062	0.11	-1.500	404	394	142
-1.875	0.19	-1.312	428	411	186
-1.687	0.27	-1.125	458	431	232
-1.500	0.36	-0.937	496	455	284
-1.312	0.46	-0.750	527	472	333
-1.125	0.56	-0.562	563	492	377
-0.937	0.67	-0.375	592	506	413
-0.750	0.77	-0.187	614	520	433
-0.562	0.85	0.000	630	530	445
-0.375	0.92				
-0.188	0.95				
0.000	0.97				

Table 3.12 (continued) Unexcited heated jet. Test Point 8.

Axial distance : X/D = 7

Jet mean flow parameters :

Mj = 0.99
Uj = 471 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.50 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-2.812	0.05	-2.250	363	360	68
-2.625	0.09	-2.062	376	372	86
-2.437	0.13	-1.875	388	382	112
-2.250	0.18	-1.687	402	392	138
-2.062	0.22	-1.500	420	407	163
-1.875	0.29	-1.312	440	420	198
-1.687	0.35	-1.125	461	434	233
-1.500	0.40	-0.937	487	450	271
-1.312	0.48	-0.750	512	464	307
-1.125	0.56	-0.562	534	476	341
-0.937	0.64	-0.375	555	487	369
-0.750	0.71	-0.187	573	498	387
-0.562	0.78	0.000	585	506	397
-0.375	0.84				
-0.188	0.87				
0.000	0.89				

Table 3.12 (continued) Unexcited heated jet. Test Point 8.

Axial distance : X/D = 9

Jet mean flow parameters :

Mj = 1.00
Uj = 471 m/s
Tt = 672 K
Tt/To = 2.28
Rej = 0.50 x 1,000,000

Acoustic excitation parameters :

Unexcited

Radius Z/R	Mach no. M	Radius Z/R	Tot. tem. T (K)	St. tem. Ts (K)	Velocity U (m/s)
-3.375	0.07	-2.625	364	362	72
-3.187	0.09	-2.437	372	368	90
-3.000	0.12	-2.250	384	379	104
-2.812	0.15	-2.062	395	386	128
-2.625	0.19	-1.875	406	395	149
-2.437	0.23	-1.687	420	405	173
-2.250	0.27	-1.500	434	414	199
-2.062	0.32	-1.312	453	427	225
-1.875	0.37	-1.125	471	440	250
-1.687	0.43	-0.937	487	448	278
-1.500	0.49	-0.750	505	459	305
-1.312	0.54	-0.562	523	469	326
-1.125	0.60	-0.375	534	476	341
-0.937	0.66	-0.187	544	481	352
-0.750	0.71	0.000	545	481	358
-0.562	0.75				
-0.375	0.78				
-0.188	0.80				
0.000	0.82				

Table 3.12 (concluded) Unexcited heated jet. Test Point 8.

LIST OF SYMBOLS

D	nozzle exit diameter
f	frequency
K	dynamic correction ratio
L	level
M	Mach number
p	pressure
R	nozzle exit radius
Re	Reynolds number
St	Strouhal number
T	temperature
U	velocity
X	axial coordinate
Z	radial coordinate
γ	specific heat ratio
ξ	pressure ratio

Subscripts

e	excited
j	jet, based on nozzle diameter
p	probe
s	static
t	total
o	ambient

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16 Abstract

This report is part of a three-part report on the excitability of heated jets under the influence of acoustic excitation. The effects of upstream internal acoustic excitation on jet mixing were described in detail in Part I. Part II describes the effects of external excitation on flow mixing. Part III contains detailed quantitative results from the measurements of mean Mach number and temperature and consists of radial profiles and centerline distributions measured at selected jet operating conditions for internally excited and unexcited jets. The mean flow data are presented in both graphical and tabulated forms. For the sake of completeness, this part contains temperature probe calibration curves also.

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