

MAINBRN Program

Example Screens

Version 1.1

December 8, 2003

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Main Burner (MAINBNR) Program – Example Screens

MAINBNR - Design of Annular Main Burner

File Help Plot Units

1) DATA ENTRY | 2) AIR PARTITIONING | 3) DIFFUSER | 4) PRIMARY ZONE | 5) SECONDARY ZONE | 6) DILUTION ZONE

Station 3.1
HPC exit / MB diffuser entrance

Total pressure, psia	585.11
Total temperature, °R	1660.0
Air mass flow, lbm/s	104.24
Mach number	0.29780
Mean radius **, in.	9.0000
Outer radius, in.	9.2472
Inner radius, in.	8.7528
Height, in.	0.49444
Static pressure, psia	550.19
Velocity, ft/s	589.53
Area, ft²	0.19417

* fixed by design of HPC outlet

Station 3.2
MB diffuser exit / MB entrance

Total pressure, psia	579.26
Total temperature, °R	1660.0
Fuel mass flow, lbm/s	2.7017
Mach number **	8.21000E-02
Mean radius **, in.	5.9260
Outer radius **, in.	7.2363
Inner radius **, in.	4.6157
Height, in.	2.6205
Static pressure, psia	576.54
Velocity, ft/s	163.85
Area, ft²	0.67760

** principal design variables

Station 4
MB exit / HPT entrance (choked)

Total pressure, psia	555.86
Total temperature, °R	3138.8
Mean radius **, in.	7.0000
Mach number	1.0000
Equivalence ratio	0.37832
Outer radius, in.	7.2364
Inner radius, in.	6.7636
Height, in.	0.47289
Static pressure, psia	303.35
Velocity, ft/s	2467.7
Area, ft²	0.14444

* fixed by design of HPT inlet

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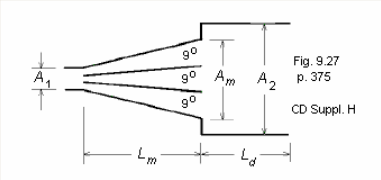
DESIGN INPUTS

Estimated B.L. thickness at diffuser entry Bt :
(see Eq. (9.68): $0.01 < Bt < 0.12$)

Number of subdivided 9 deg streams:
(see Fig. 9.27)

Type of diffuser (see Secs. 9.1.5.1 and 9.2.3.1):
 Flat-wall Flat-wall+Dump Dump

Optimal or Selected area A_m at flat-wall exit?
 Area ratio at flat-wall exit A_m/A_1 :



PERFORMANCE

Diffuser efficiency η_{dD}	0.8696
Pressure recovery coefficient CP	0.7973
Total pressure ratio PID	0.9928
Total pressure loss (Pt3.2-Pt3.1), psi	4.210
NEW total pressure Pt3.2, psia	580.9

DIMENSIONS

Area ratio $AR = A_2/A_1$	3.490
Height at flat-wall exit H_m , in.	1.502
Length of flat-wall section L_m , in.	1.590
Length of tailpipe L_d , in.	1.119
Total diffuser length L_{diff} , in.	2.709

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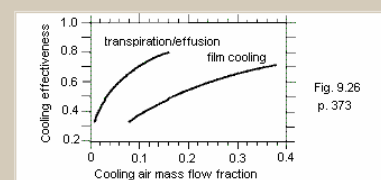
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DESIGN INPUTS

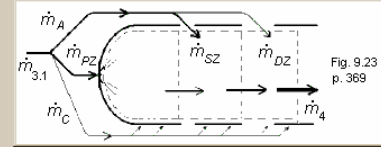
Wall cooling method: Film Transpiration/effusion

Gas temperature: T_g in Eq. (9.91), °R	3849
PZ combustion efficiency: ϵ_{psPZ} in Eq. (9.92)	0.7000
PZ equivalence ratio: ϕ in Eqs. (9.92-93)	0.8000
Max. material temperature: T_m in Eq. (9.94), °R	2110



RESULTS

Cooling effectiveness: Eqs. (9.94) - (9.96)	0.7944	
Primary air flow: m_{PZ}	lbm/s	fraction
Cooling air flow: m_c	16.113	0.15457
Secondary air flow: m_{SZ}	21.126	0.20267
Dilution air flow: m_{DZ}	17.707	0.16986
Total air flow: $m_{3.1}$	104.24	1.0000



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LINER and FUEL NOZZLES

Single- or double-annular array?

Optimal area ratio AL/Ar (alfa-opt in Eq. (9.109))

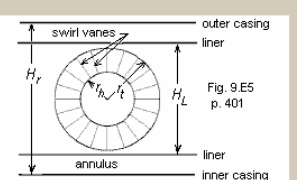
Number of swirler assemblies (Nnoz in Eq. (9.105))

AIR SWIRLER

Swirler blade angle, deg (see Eq. (9.46))

Air flow per swirler (see Eq. (9.111)) lbm/s

Max flow per swirler, lbm/s (when $t = HL/2$)

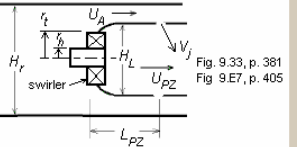


PERFORMANCE

Swirl number S' (see Eq. (9.48))	0.7867
Assigned total pressure loss coefficient	8.589
Minimum required total pressure loss coefficient	3.378
Annulus entry U_A , ft/s	241.4
Mixing jets V_j , ft/s	480.2

DIMENSIONS (inches)

Swirler hub radius r_h	0.5000
Swirler tip radius r_t	0.9544
Liner height HL (see Figs. 9.30, 32)	1.958
PZ length, LPZ	1.502



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SECONDARY ZONE

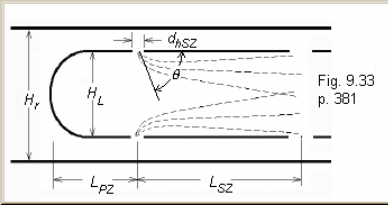
Sharp- or round-edged holes? Plain Plunged
(see Eq. (9.33))

Secondary jet inclination angle theta, deg 53.81
(see Fig. 9.15 and Eq. (9.115))

Number of secondary holes NhSZ 327
(see Eq. (9.113))

Diameter of secondary holes dhSZ, inches 0.2081
(see Eq. (9.114))

Length of secondary zone LSZ, inches 3.916
(see Eq. (9.116))



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DILUTION ZONE

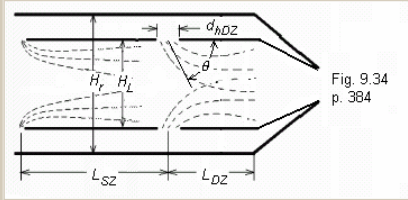
Sharp- or round-edged holes? Plain Plunged
(see Eq. (9.33))

Dilution jet inclination angle theta, deg 76.75
(see Fig. 9.15 and Eq. (9.115))

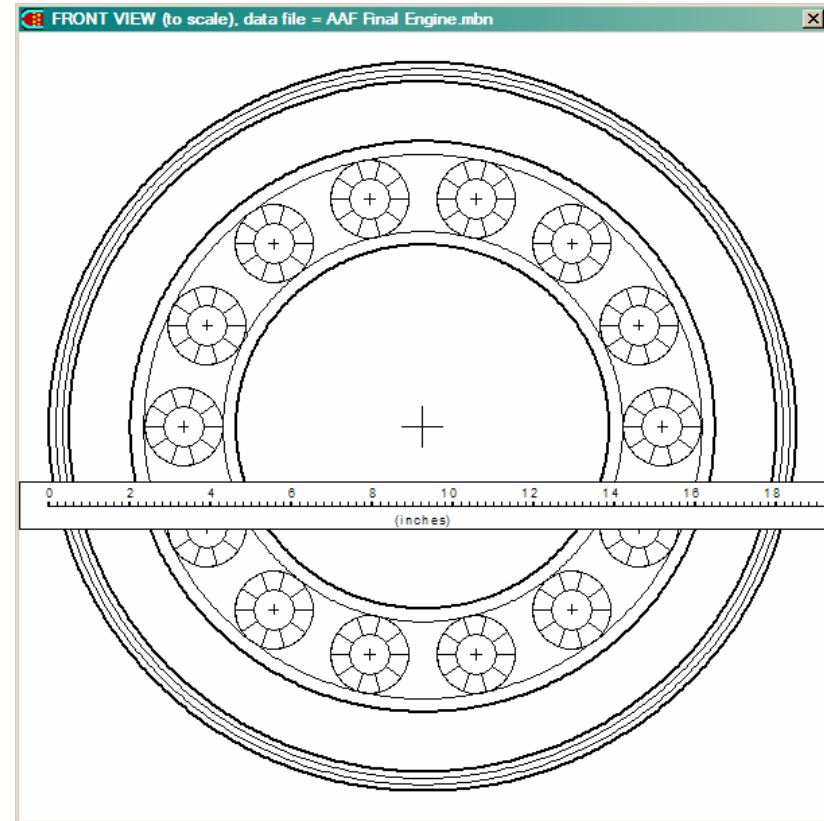
Number of dilution holes NhDZ 95
(see Eq. (9.113))

Diameter of dilution holes dhDZ, inches 0.3127
(see Eq. (9.114))

Length of dilution zone LDZ, inches 2.937
(see p. 384)



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