05001
Issued February 2005

Prediction of combustor noise from gas turbine engines

Endorsed by
The Royal Aeronautical Society

ESDU DATA ITEMS

Data Items provide validated information in engineering design and analysis for use by, or under the supervision of, professionally qualified engineers. The data are founded on an evaluation of all the relevant information, both published and unpublished, and are invariably supported by original work of ESDU staff engineers or consultants. The whole process is subject to independent review for which crucial support is provided by industrial companies, government research laboratories, universities and others from around the world through the participation of some of their leading experts on ESDU Technical Committees. This process ensures that the results of much valuable work (theoretical, experimental and operational), which may not be widely available or in a readily usable form, can be communicated concisely and accurately to the engineering community.

We are constantly striving to develop new work and review data already issued. Any comments arising out of your use of our data, or any suggestions for new topics or information that might lead to improvements, will help us to provide a better service.

THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Aircraft Noise Committee. This Committee first met in 1971 and now has the following membership:

Chairman
Mr R. Pinker — QinetiQ, Farnborough

Members
Mr S. Arrowsmith — Civil Aviation Authority, Aircraft Environmental Section, Gatwick
Mr W.D. Bryce — Bryce Research (Member Emeritus)
Dr M.J. Fisher — Institute of Sound and Vibration Research, Southampton
Mr R.A. Golub* — NASA, Langley Research Center, USA
Mr P.J. Hopkins — Rolls-Royce plc, Derby
M. P. Lempereur — Airbus France, Toulouse, France
Mr D. Patience — BAE SYSTEMS, Farnborough
Mr W.J. Readman* — European Aviation Safety Agency (EASA), Germany
Mr D.C. Riordan — Bombardier Aerospace Short Brothers plc, Northern Ireland

* Corresponding Member

The person with overall responsibility for the work in this subject area is Dr. C.B. Chinoy, Head of the Aircraft Noise and Structural Dynamics Group.

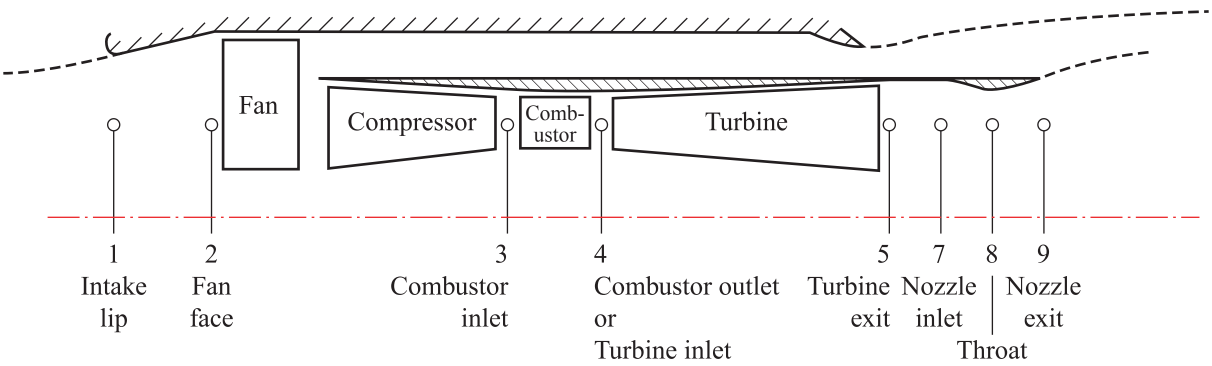
PREDICTION OF COMBUSTOR NOISE FROM GAS TURBINE ENGINES

1. NOTATION

c_0	ambient speed of sound	m/s
$D(\theta_i)$	directivity function	dB
f	frequency	Hz
M	flight Mach number	
$OAPWL$	overall sound power level, re W_{ref}	dB
PWL	one-third octave band sound power level, re W_{ref}	dB
P_3	total pressure at combustor inlet (Sketch 1.1, station 3)	Pa*
p_{ref}	reference sound pressure (= 20×10^{-6} Pa)	Pa
p_0	ambient air pressure	Pa*
r, θ, ϕ	spherical coordinates (see Appendix A)	
$S(f)$	one-third octave spectral function	dB
SPL	one-third octave band sound pressure level, re p_{ref}	dB
T_0	ambient air temperature	K
T_3	total temperature at combustor inlet (Sketch 1.1, station 3)	K
T_4	total temperature at combustor exit or turbine inlet (Sketch 1.1, station 4)	K
T_5	total temperature at turbine exit (Sketch 1.1, station 5)	K
W	mass flow through engine core	kg/s
W_{ref}	reference power (= 10^{-12} W)	W
ΔT_{ref}	$T_4 - T_5$, the total temperature drop across the complete turbine system, at maximum take-off condition	K
θ_i	nominal engine angle (= $180 - \theta_j$) (see Sketch 3.3)	degrees

θ_j	angle between engine exhaust axis and direction of sound propagation	degrees
ρ_0	ambient air density	kg/m^3
ψ	angle between aeroplane flight path and engine axis	degrees

* It should be noted that P_3 and p_0 are entered into the computer program in kPa for convenience.



Sketch 1.1 Idealized engine station designation

2. INTRODUCTION

This Item allows the user to estimate the noise levels in one-third octave bands resulting from the combustion process within a gas turbine engine. The engine may be either static or flying. This noise, referred to as combustor noise, generally comprises two components: direct and indirect noise. The direct noise is the noise of combustion itself propagating out of the engine through the exhaust nozzle. The indirect component, also referred to as entropy noise, is believed to be generated when the hot turbulent products of combustion pass through pressure gradients downstream of the combustor *e.g.* in the turbine stages.

The prediction program accompanying this Item is based on the semi-empirical SAE method described in Derivation 1.

3. THEORETICAL BACKGROUND

The overall sound power level, $OAPWL$, is first determined from the combustor operating conditions and the total temperature drop across the complete turbine system at the maximum take-off condition using Equation (3.1).

$$OAPWL = 10\log_{10}\left[\frac{W c_0^2}{W_{ref}}\right] + 10\log_{10}\left\{\left(\frac{T_4 - T_3}{T_3}\right)^2\left(\frac{P_3}{p_0}\right)^2\left(\frac{\Delta T_{ref}}{T_0}\right)^{-4}\right\} - 60.5 \ . \qquad (3.1)$$

Tests have shown that combustor noise has a specific spectrum shape that peaks around 400 Hz irrespective of gas turbine type, size or power setting. This shape, shown in Sketch 3.1, is imposed on the overall power level to obtain a power spectrum. The power level spectrum, $PWL(f)$, is given by

$$PWL(f) = OAPWL + S(f) \ . \qquad (3.2)$$

The power level spectrum is converted into a sound pressure level spectrum at an angle θ_i and distance r using Equation (3.3).

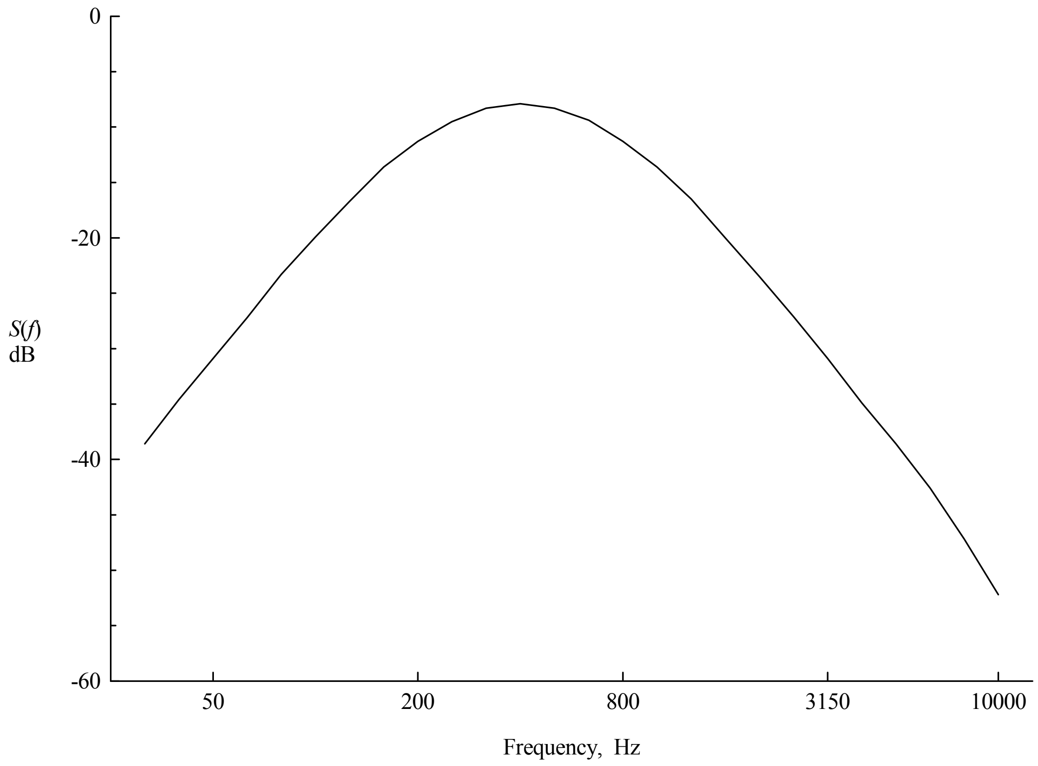
$$SPL(f, \theta_i) = PWL(f) + D(\theta_i) - 20\log r + 10\log_{10}\left(\frac{\rho_0 c_0 W_{ref}}{4\pi p_{ref}^2}\right), \qquad (3.3)$$

where the directivity function, $D(\theta_i)$ is shown in Sketch 3.2.

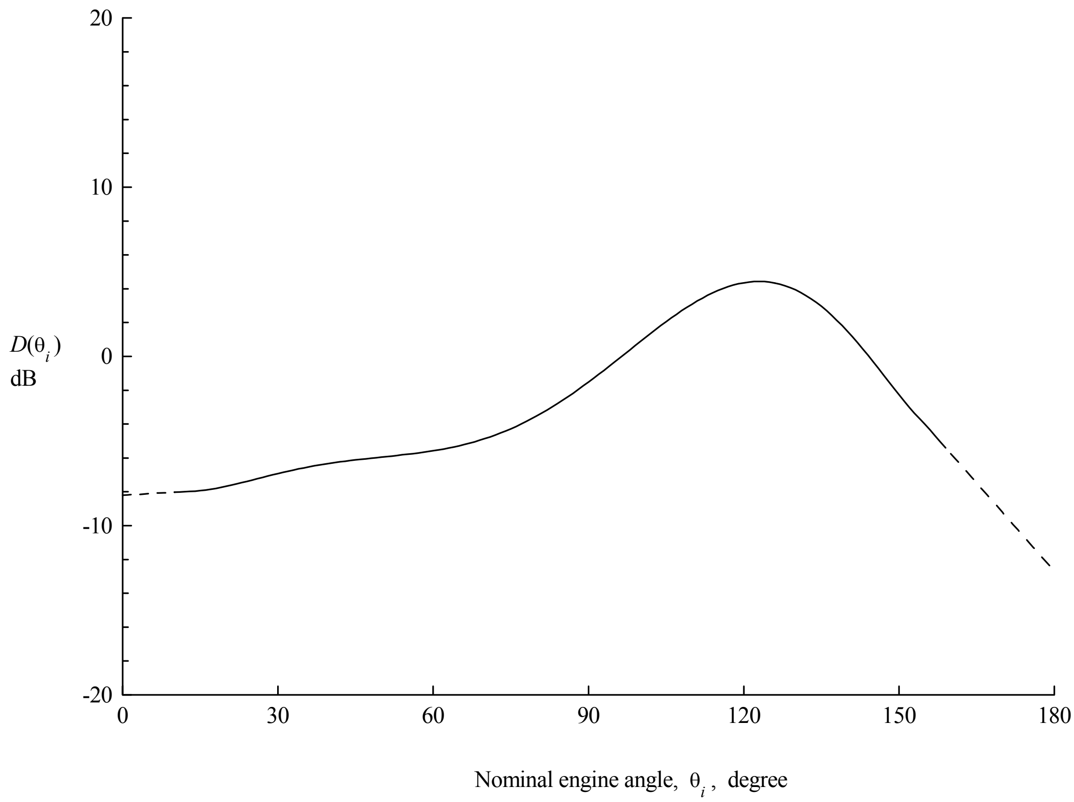
In the computer program, multi-ordered polynomials are used to replicate the curves in Deriviation 1. These replicated curves are shown in Sketches 3.1 and 3.2. Any differences are negligible.

At Standard sea level conditions, *i.e.* $\rho_0 = 1.225 \text{ kg/m}^3$ and $c_0 = 340.294 \text{ m/s}$, the last term in Equation (3.3) is –10.8 dB.

In Sketch 3.2 the dashed lines indicate that linear extrapolation is applied outside the range of 10 to 160 degrees.



Sketch 3.1 Spectral function



Sketch 3.2 Directivity function

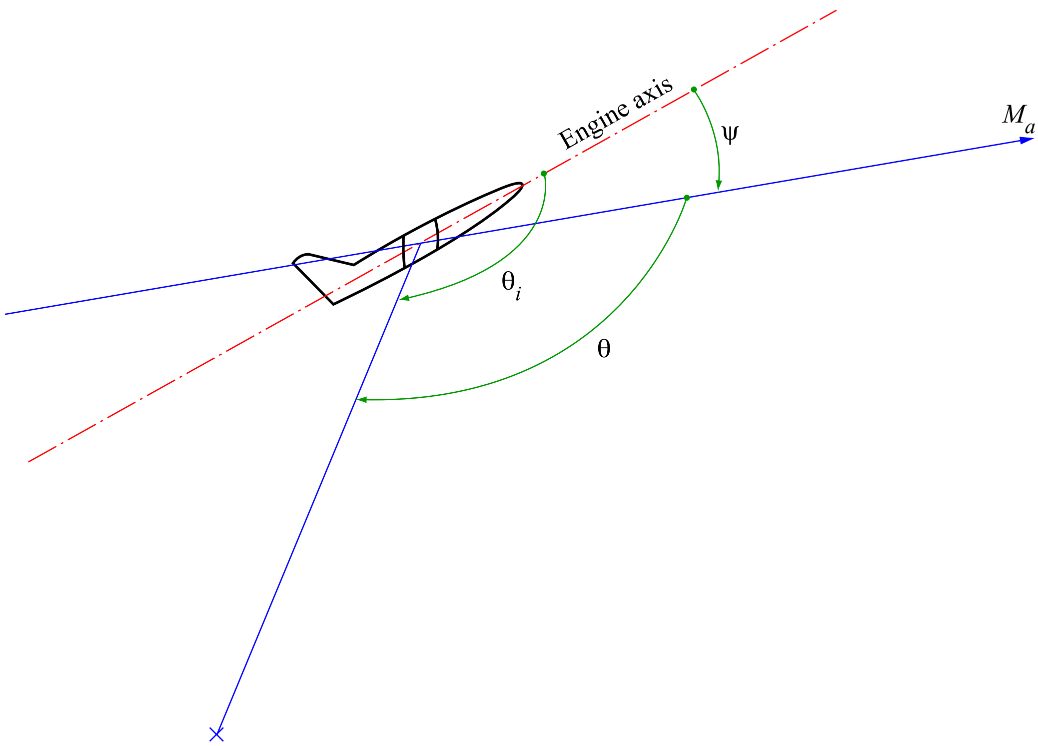
3.1 Flight Effects

Flight has an effect on source sound pressure levels. Static sound pressure levels are affected by a fourth power 'Doppler' amplification factor. The sound pressure level from a source moving at a Mach number of M may be obtained from the static sound pressure level using the equation below.

$$SPL_{flight} = SPL_{static} - 40\log_{10}(1 - M_a\cos\theta), \tag{3.4}$$

where $\theta = \theta_i - \psi$, and ψ is the angle between the flight path and the engine axis.

The normal Doppler frequency shift for relative motion between source and observes is also included in the program.



Sketch 3.3 Source-receiver geometry

4. ACCURACY AND APPLICATION

An accuracy of prediction within +5 dB to –3 dB is quoted by SAE based on data from turbojet, tubofan and turboshaft engines from five manufacturers.

The basic method assumes a peak in the power spectrum at 400 Hz. If, however, the method is being used with data where it is known that the peak is slightly above or below 400 Hz, the user may include an appropriate adjustment so that the symmetrical shape of the power spectrum is retained but centred on the known peak value. An adjustment greater that one-third of an octave on either side of 400 Hz is not expected. The frequency range of prediction of 31.5 Hz to 10 kHz is then shifted appropriately .

The basic method as described in Section 3 provides sound pressure levels as a function of θ_i, the angle to the engine axis. Unless the engine axis is parallel to the flight path, this angle is different from θ, is the angle used to specify the location of the aeroplane (see Appendix A) by the user. The program requires the user to enter the value of the angle ψ, the angle between the flight path and the engine axis.

The equivalent θ_i for the specified θ is calculated automatically using the relationship

$$\theta_i = \theta + \psi . \tag{4.1}$$

For a static engine, $\psi = 0$. The prediction is carried out for θ in the nominal range of 0 to 180 degrees.

5. COMPUTER PROGRAMS

There are two computer programs associated with this Item, programs A0501 and B0501.

Program A0501 permits the user to estimate combustor noise in one-third octave bands. This program requires the user to enter the name of the file containing the input data. The structure of this input file is shown in Table 5.1. Program B0501 facilitates the generation of input files.

Both source code and executable versions of these programs are provided. Typically, the program to estimate combustor noise can be run by either typing in the program name, A0501V10, or by clicking on the icon associated with the executable version of the program. The user is then prompted to enter the name of the input file.

Every reasonable effort has been made to ensure that the program performs the intended calculations satisfactorily. However, in common with other providers of software no representation as to the suitability or fitness of the program for any particular purpose is made and no liability for any loss occasioned by any persons as a direct or indirect result of the use of the program whether arising from negligence or otherwise can be accepted. In no event shall ESDU or any individuals associated with the development of the program be liable for damages, including loss of profit or consequential loss arising out of or in connection with the program. However, if you have any difficulty in using this program please contact ESDU International and we shall do all we can to assist you to overcome the problem.

5.1 Input Data and Output

The structure of the input file is shown in Table 5.1. An example is given in Section 7.

TABLE 5.1

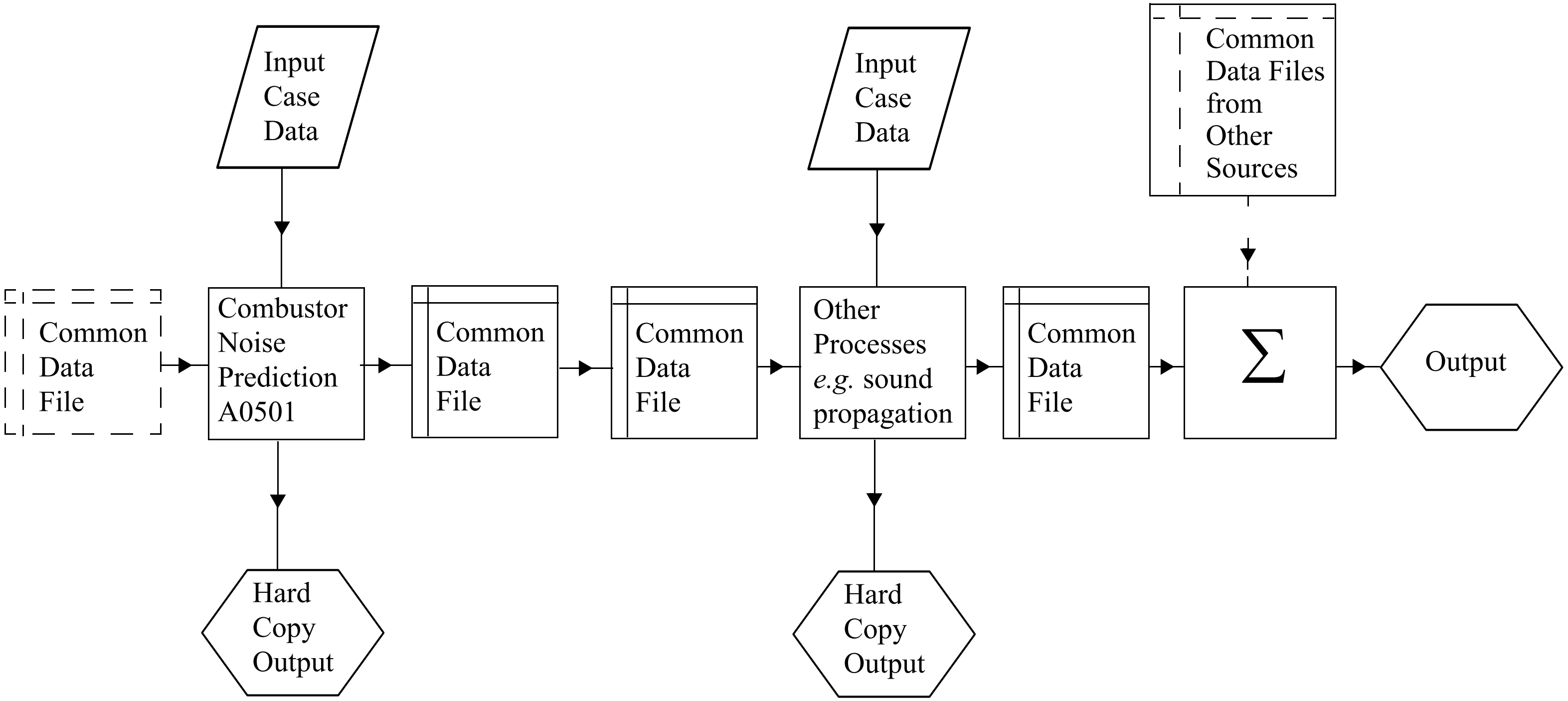
First line of run title (maximum of 75 characters)
Second line of run title (maximum of 75 characters)
Third line of run title (maximum of 75 characters)
Output file name (maximum of 8 characters)
Common data input file name (enter 'NONE' if there is none) (maximum of 8 characters)
Common data output file name (enter 'NONE' if there is none) (maximum of 8 characters)
Enter mass flow through engine core, kg/s, W
Enter total pressure at combustor inlet, kPa, P_3
Enter total temperature at combustor inlet, K, T_3
Enter total temperature at combustor exit/turbine inlet, K, T_4
Enter total temperature drop across turbine system, K, ΔT_{ref}
Enter angle between flight path and engine axis, deg, ψ
If the spectrum peak is at 315 Hz Enter –1 400 Hz Enter 0 500 Hz Enter 1
If a common data input file name has been specified above, input is complete. Otherwise, enter the following parameters
Enter ambient air temperature, K, T_0
Enter ambient air pressure, kPa, p_0
Enter flight Mach number, M
Enter r, θ for 1st location
Enter r, θ for 2nd location . . . .
Enter r, θ for last location

Output data are written to a file named by the user in the input file. Three lines of descriptive text can be entered in the input file to title the run written to the output file.

In order to facilitate data transfer between programs in the ESDU Aircraft Noise Series, a standardized format for a common data file has been formulated. This format is shown in Appendix A.

Common data files which are named by the user are read automatically and written by the program being used. For example, when running the program the user can name the common data file to which the output is written. This file can then be read by another ESDU program.

The data can, if desired, be processed further. Additionally, sound pressure levels contained in other common data files can be combined. The whole process is illustrated in Sketch 5.1.


Input Case Data
Input Case Data
Common Data Files from Other Sources
Common Data File
Combustor Noise Prediction A0501
Common Data File
Common Data File
Other Processes e.g. sound propagation
Common Data File
Σ
Output
Hard Copy Output
Hard Copy Output

Sketch 5.1

6. DERIVATION AND REFERENCES

6.1 Derivation

The Derivation lists sources that assisted in the preparation of this item.

1.	–	Gas turbine jet exhaust noise prediction. Society of Automotive Engineers, ARP 876, 1978, Revision D, 1994.
2.	–	Unpublished data, QinetiQ, Farnborough, 2004.

6.2 References

The References are selected sources of information supplementary to that given in this Item.

3.	–	Gas turbine engine performance station identification and nomenclature. Society of Automotive Engineers, ARP 755A, 1974.
4.	KAZIN, S.B. MATTA, R.K. EMMERLINE, J.J.	Core engine noise control program – extension of prediction methods, Vol. III, Supplement 1. FAA Report No. FAA-RD-74-125, 1976.
5.	MATTA R.K. SANDUSKY, G.T. DOYLE, V.L.	GE core engine noise investigation program – low emission engines. FAA Report No. FAA-RD-77-4, 1977.

7. Example

Estimate the combustor noise for a static engine at a constant distance of 1m and at angles between the engine axis and the direction of sound propagation ranging from 10 degrees to 160 degrees in 10 degree steps.

The operating condition for the engine are as follows:

Mass flow through engine core: 40 kg/s

Total pressure at combustor inlet: 3880 kPa

Total temperature at combustor inlet: 916 K

Total temperature at combustor exit/turbine inlet: 1790 K

Total temperature drop across turbine system: 1000 K

The ambient air temperature is 288.15 K and the ambient pressure is 101.325 kPa

Input file

```
Input file         |                    Comments
--------------------------------------------------------------
ESDU Item 05001    |  Run title
Example            |  Run title
Section 7          |  Run title
R01A0501           |  Output file name
NONE               |  Common input data file name
NONE               |  Common output data file name
40                 |  Mass flow through engine core, kg/s
3880               |  Total pressure at combustor inlet, kPa
916                |  Total temperature at combustor inlet, K
1790               |  Total temperature at combustor exit, K
1000               |  Total temperature drop across turbine system, K
0                  |  Angle between engine axis and flight path, deg
0                  |  Spectrum peak at 400 Hz, i.e. no shift
288.15             |  Ambient air temperature, K
101.325            |  Ambient air pressure, kPa
0                  |  Flight Mach number
1.0 10.0           |  r           theta
1.0 20.0           |  "             "
1.0 30.0           |  "             "
1.0 40.0           |  "             "
1.0 50.0           |  "             "
1.0 60.0           |  "             "
1.0 70.0           |  "             "
1.0 80.0           |  "             "
1.0 90.0           |  "             "
1.0 100.0          |  "             "
1.0 110.0          |  "             "
1.0 120.0          |  "             "
1.0 130.0          |  "             "
1.0 140.0          |  "             "
1.0 150.0          |  "             "
1.0 160.0          |  "             "
```

Example output

```
---------------------------------------------------------------------
 ESDU International plc.

 PROGRAM A0501

 ESDUpac Number    :   A0501V10
 ESDUpac Title     :   Combustor noise
 Data Item Number  :   05001
 Data Item Title   :   Prediction of combustor noise from gas turbine engines
 ESDUpac Version   :   1.0. Issued February 2005.

 See Data Item for full input/output specification and interpretation.
 ---------------------------------------------------------------------

 ESDU Item 05001
 Example
 Section 7

 INPUT FILENAME : I01A0501
 OUTPUT FILENAME : R01A0501

 COMMON DATA INPUT FILENAME : NONE
 COMMON DATA OUTPUT FILENAME : NONE

 Input Data
 ==========
 Mass flow :    40.00 kg/s
 Combustor inlet total pressure : 3880.000 kPa
 Combustor inlet total temperature :    916.0 K
 Combustor outlet total temperature :   1790.0 K
 Total temperature drop across turbine at max. take-off condition :   1000.0 K
 Aircraft Mach number : .00
 Ambient temperature :      288.1 K
 Ambient pressure :    101.325 kPa
 Angle between flight path and engine axis :   0.0 degrees
```

1/3 octave band centre frequency (Hz)	SPL (dB) at r / theta	1.0 / 10.0	1.0 / 20.0	1.0 / 30.0	1.0 / 40.0	1.0 / 50.0	1.0 / 60.0
31.5		78.5	78.8	79.5	80.1	80.5	80.9
40.0		82.5	82.7	83.5	84.1	84.5	84.8
50.0		86.1	86.4	87.1	87.8	88.1	88.5
63.0		89.9	90.2	90.9	91.5	91.9	92.3
80.0		93.7	94.0	94.7	95.3	95.7	96.1
100.0		97.1	97.4	98.2	98.8	99.1	99.5
125.0		100.3	100.6	101.4	102.0	102.3	102.7
160.0		103.5	103.7	104.5	105.1	105.5	105.8
200.0		105.8	106.1	106.8	107.4	107.8	108.2
250.0		107.6	107.8	108.6	109.2	109.6	109.9
315.0		108.7	109.0	109.7	110.3	110.7	111.1
400.0		109.1	109.4	110.2	110.8	111.1	111.5
500.0		108.8	109.0	109.8	110.4	110.8	111.1
630.0		107.7	107.9	108.7	109.3	109.7	110.0
800.0		105.8	106.1	106.8	107.4	107.8	108.2
1000.0		103.4	103.7	104.5	105.1	105.4	105.8
1250.0		100.6	100.9	101.6	102.2	102.6	103.0
1600.0		97.0	97.3	98.1	98.7	99.0	99.4
2000.0		93.6	93.8	94.6	95.2	95.6	95.9
2500.0		89.9	90.2	91.0	91.6	91.9	92.3
3150.0		86.1	86.4	87.1	87.8	88.1	88.5
4000.0		82.2	82.4	83.2	83.8	84.2	84.5
5000.0		78.4	78.7	79.5	80.1	80.4	80.8
6300.0		74.4	74.7	75.4	76.0	76.4	76.8
8000.0		69.9	70.1	70.9	71.5	71.9	72.2
10000.0		64.9	65.2	65.9	66.5	66.9	67.3
dBA		111.9	112.2	112.9	113.5	113.9	114.3
OASPL		117.1	117.4	118.1	118.7	119.1	119.5
PNDB		122.7	123.0	123.7	124.3	124.7	125.0

1/3 octave band centre frequency (Hz)	SPL (dB) at r / theta	1.0 / 70.0	1.0 / 80.0	1.0 / 90.0	1.0 / 100.0	1.0 / 110.0	1.0 / 120.0
31.5		81.6	82.9	84.9	87.3	89.5	90.8
40.0		85.6	86.9	88.9	91.3	93.5	94.8
50.0		89.2	90.5	92.5	94.9	97.2	98.4
63.0		93.0	94.3	96.3	98.7	100.9	102.2
80.0		96.8	98.1	100.1	102.5	104.7	106.0
100.0		100.2	101.6	103.6	106.0	108.2	109.4
125.0		103.4	104.8	106.8	109.2	111.4	112.6
160.0		106.6	107.9	109.9	112.3	114.5	115.8
200.0		108.9	110.2	112.2	114.6	116.8	118.1
250.0		110.7	112.0	114.0	116.4	118.6	119.9
315.0		111.8	113.1	115.1	117.5	119.8	121.0
400.0		112.2	113.6	115.6	118.0	120.2	121.4
500.0		111.9	113.2	115.2	117.6	119.8	121.1
630.0		110.8	112.1	114.1	116.5	118.7	120.0
800.0		108.9	110.2	112.2	114.6	116.8	118.1
1000.0		106.5	107.9	109.9	112.3	114.5	115.7
1250.0		103.7	105.0	107.0	109.4	111.6	112.9
1600.0		100.1	101.5	103.5	105.9	108.1	109.3

2000.0	96.6	98.0	100.0	102.4	104.6	105.9
2500.0	93.0	94.4	96.4	98.8	101.0	102.2
3150.0	89.2	90.5	92.5	94.9	97.2	98.4
4000.0	85.2	86.6	88.6	91.0	93.2	94.5
5000.0	81.5	82.9	84.9	87.3	89.5	90.7
6300.0	77.5	78.8	80.8	83.2	85.5	86.7
8000.0	73.0	74.3	76.3	78.7	80.9	82.2
10000.0	68.0	69.3	71.3	73.7	75.9	77.2
dBA	115.0	116.3	118.3	120.7	122.9	124.2
OASPL	120.2	121.5	123.5	125.9	128.1	129.4
PNDB	125.7	127.0	129.0	131.3	133.5	134.8

1/3 octave band centre frequency (Hz)	SPL (dB) at r / theta	1.0 / 130.0	1.0 / 140.0	1.0 / 150.0	1.0 / 160.0
31.5		90.4	87.9	84.2	81.4
40.0		94.3	91.9	88.1	85.4
50.0		98.0	95.6	91.8	89.1
63.0		101.8	99.3	95.6	92.8
80.0		105.6	103.2	99.4	96.7
100.0		109.0	106.6	102.8	100.1
125.0		112.2	109.8	106.0	103.3
160.0		115.3	112.9	109.1	106.4
200.0		117.7	115.2	111.5	108.7
250.0		119.4	117.0	113.2	110.5
315.0		120.6	118.2	114.4	111.7
400.0		121.0	118.6	114.8	112.1
500.0		120.6	118.2	114.5	111.7
630.0		119.5	117.1	113.3	110.6
800.0		117.7	115.2	111.5	108.7
1000.0		115.3	112.9	109.1	106.4
1250.0		112.5	110.1	106.3	103.5
1600.0		108.9	106.5	102.7	100.0
2000.0		105.4	103.0	99.2	96.5
2500.0		101.8	99.4	95.6	92.9
3150.0		98.0	95.6	91.8	89.1
4000.0		94.0	91.6	87.8	85.1
5000.0		90.3	87.9	84.1	81.4
6300.0		86.3	83.9	80.1	77.4
8000.0		81.7	79.3	75.5	72.8
10000.0		76.8	74.3	70.6	67.8
dBA		123.7	121.3	117.6	114.8
OASPL		128.9	126.5	122.7	120.0
PNDB		134.3	132.0	128.3	125.6

APPENDIX A ESDU DATA FILE

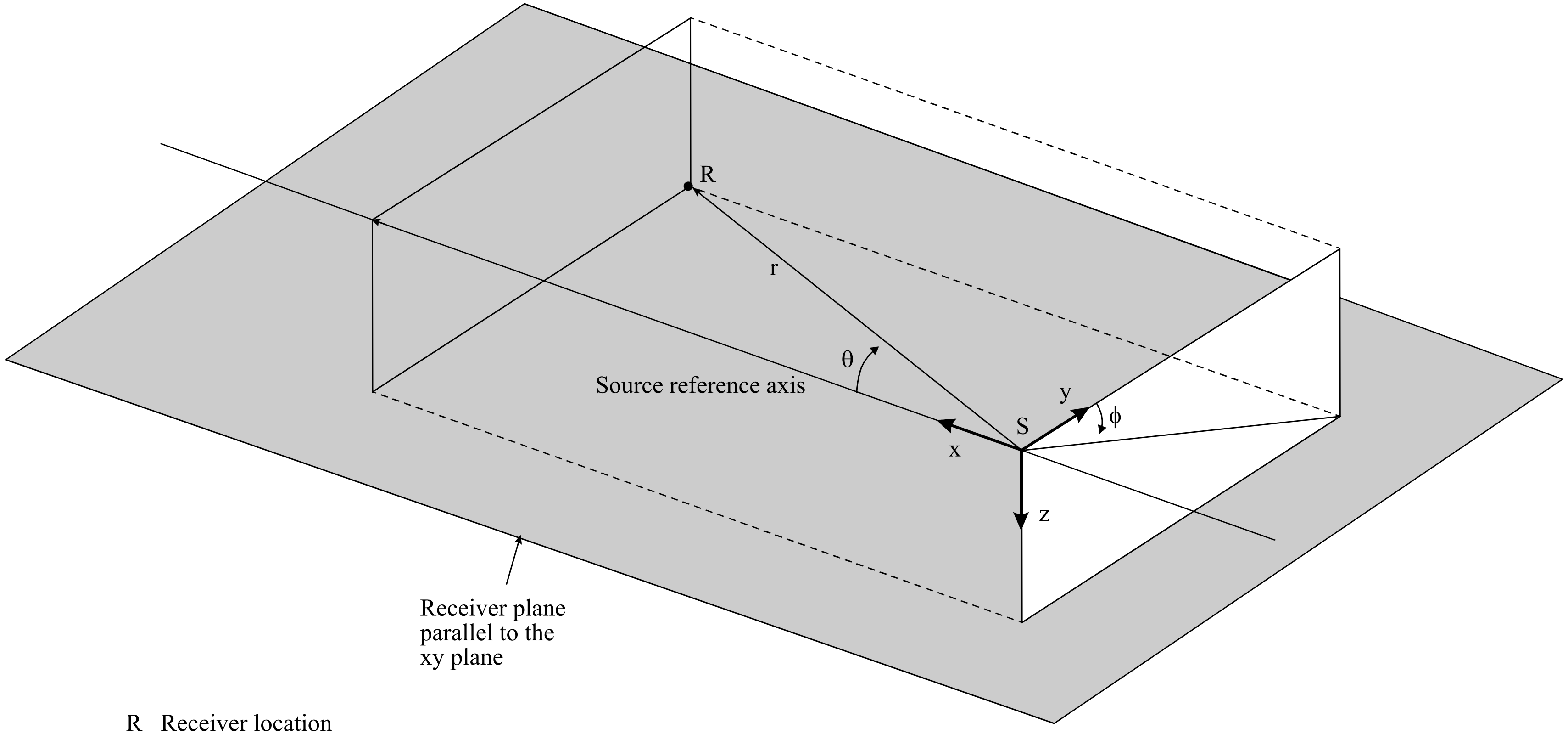
A1. ADDITONAL NOTATION

f	frequency
f_{lower}	lower one-third octave band centre frequency limit
f_{upper}	upper one-third octave band centre frequency limit
M	flight Mach number
p_0	ambient pressure at reception point
r, θ, ϕ *	spherical coordinates (see Sketch A1.1)
T_0	ambient temperature
Δf	frequency shift

Subscripts

m	refers to mth SPL
n	refers to nth receiver location

* The value of the azimuthal angle, ϕ, is set at 90 degrees.



R Receiver location

S Source location

Sketch A1.1

A2. DATA FILE STRUCTURE STANDARD

There is often a requirement for computer programs from the ESDU Aircraft Noise Series to be run successively. For example, the user may wish to run a source noise prediction program for a range of angles and distances, and then run a noise propagation program to estimate the effects of atmospheric absorption and ground reflection on the predicted source noise spectra. In order that relevant data can be transferred from one program to another in a convenient way, the standardisation of a file structure containing these data is necessary. This Appendix describes the standard structure of this data file that will be used throughout the ESDU Aircraft Noise Series.

The structure of the data file is shown in the table at the end of this Appendix. The data file can be readily used for further processing of data, for example, by graphics packages.

The table contains reference data, namely ambient pressure, p_0, ambient temperature, T_0, and flight Mach number, M. Lower and upper limits of a reference frequency range are stored as $10\log f_{lower}$ and $10\log f_{upper}$. Spectral information for n locations (up to a maximum of 100 locations) is stored at consecutive one-third octave band centre frequencies. The data file can also be used to transfer harmonic noise data. An additional parameter, Δf, that quantifies the frequency shift of tones from the one-third octave band centre frequency of the bands in which they fall, at a given location, is also stored. The actual frequency, f, of the mth SPL appearing in the table at the nth location is obtained from the following equation

$$10\log f = 10\log f_{lower} + (m - 1) + \Delta f_n . \tag{A2.1}$$

For one-third octave band spectra, Δf_n is equal to zero.

A3. USING THE DATA FILE

ESDU programs can be run either with or without input from the data file. The user is required to enter the name of the data file to be read and the name of the data file to be written. If the user enters the word 'NONE' in upper or lower case, that particular option will not be exercised.

Structure of Data File

p_0	T_0	M	$10\log f_{lower}$	$10\log f_{upper}$			
r_1	θ_1	ϕ_1	Δf_1	SPL at $(10\log f_{lower} + \Delta f_1)$	SPL at $(10\log f_{lower} + 1 + \Delta f_1)$	. . . .	SPL at $(10\log f_{upper} + \Delta f_1)$
.	.	.	.	.	.	. . . .	.
.	.	.	.	.	.	. . . .	.
.	.	.	.	.	.	. . . .	.
.	.	.	.	.	.	. . . .	.
.	.	.	.	.	.	. . . .	.
r_n	θ_n	ϕ_n	Δf_n	SPL at $(10\log f_{lower} + \Delta f_n)$	SPL at $(10\log f_{lower} + 1 + \Delta f_n)$	. . . .	SPL at $(10\log f_{upper} + \Delta f_n)$

KEEPING UP TO DATE

Whenever Items are revised, subscribers to the service automatically receive the material required to update the appropriate Volumes. If you are in any doubt as to whether or not your ESDU holding is up to date, please contact us.

Please address all technical engineering enquiries and suggestions to:

ESDU International plc	Tel:	020 7490 5151 (from the UK)
		+44 20 7490 5151 (from outside the UK)
	Fax:	020 7490 2701 (from the UK)
		+44 20 7490 2701 (from outside the UK)
	E-Mail:	esdu@esdu.com
	Website:	www.esdu.com

For users in the USA, please address all Customer Service and Support enquiries and suggestions to:

IHS Engineering Products	Tel:	1 800 525 7052 (toll free number)
and	Fax:	1 303 397 2599
Global Engineering Documents	Website:	www.ihs.com
		www.global.ihs.com

05001

Prediction of combustor noise from gas turbine engines
ESDU 05001

ISBN 1 86246 258 5, ISSN 0141-0307-0115

Available as part of the ESDU Series on Aircraft Noise. For information on all ESDU validated engineering data contact ESDU International plc, 27 Corsham Street, London N1 6UA.

This Item provides a means of estimating the noise levels in one-third octave bands resulting from the combustion process within a gas turbine engine which may be either static or flying. The prediction program accompanying this Item is based on the semi-empirical SAE method.

The main input parameters that need to be specified are the mass flow rate through the engine core, the combustor inlet total pressure, the total temperature rise across the combustor and the total temperature fall across the turbine system at the maximum take-off condition.

An additional program to facilitate the generation of input files is included.