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Aircraft Performance Program Part 6: Examples of application Programs APP02 and APP03



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THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Performance Committee. This Committee first met in 1946 and at the time of first issue of this Item had the following membership:

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AIRCRAFT PERFORMANCE PROGRAM PART 6: EXAMPLES OF APPLICATION PROGRAMS APP02 AND APP03

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AIRCRAFT PERFORMANCE PROGRAM PART 6: EXAMPLES OF APPLICATION PROGRAMS APP02 and APP03

1. INTRODUCTION

Typical sets of input and output files used with the programs that make up the ESDU Aircraft Performance Program are described in this Data Item. These programs are as follows

- APP02, the Flight Performance Program,
- APP03, the Interpolation Program.

2. FLIGHT PERFORMANCE PROGRAM, APP02

This program contains the '**point performance**' and '**path performance**' routines and the time histories of the aircraft performance parameters. Two of the major lower level routines below these performance calculations are available for use in isolation (Utilities Option). Descriptions of the program and the input requirements are given in ESDU Data Items 00033, 00034 and 00035 (References 8, 9 and 10).

Note : Date and time information is output at the start of the output file. The actual text is replaced by '**date and time of run**'.

A rough estimate is made of the program run time, based on the type of calculation option chosen (*e.g.* SEP, MAXSPEED) and the number of cases. The data input section makes some correction for individual computer speed by calculating a correction factor which is applied to the set of reference times stored in the program. An example output is as follows.

Estimated elapsed run time = 0.19 minutes.

The actual program run time is output at the end of the output file.

Actual elapsed run time = 0.20 minutes.

A set of test cases and example files is provided with the program. Selections from the output of some of these cases are presented in the Appendices. The input files are not reproduced in this document since a copy of the input, with messages added during data input, is part of the output file. The full input data and output files for these and other cases may be inspected in the ...\\ESDUpacs\\APPV##\\EXAMPLES\\APP02 folder to see other applications of the program. The cases are,

Point Performance (Appendix A)

- Cruise at given power setting (SINGLE.IN).
Small single engine aircraft (eventually to be propeller driven), see Section A.1.,
- Ceiling and Specific Excess Power, and use of optimum speeds (SUBSONIC.IN).

The input file contains the following,

- Rate of climb ceiling at 100 ft/min **specific excess power** or ceiling limited by buffet onset lift coefficient.
- Two engine sets giving one engine at each setting: Operating, Windmilling and Idling.
- Ceiling calculated at the lower of the input TMN and CAS.
- END_CASE keyword followed by optional extra text.

After the main data set, the follow-on data sets are as shown here.

(1) **Data Set 2**

- Optimum ceiling at 100 ft/min **rate of climb** or ceiling lift limited by buffet lift coefficient.

(2) **Data Set 3**

- Specific excess power at a given mass.
- One effective engine set with two engines operating (other windmilling engines have zero drag).
- Order of permutation controlled by re-ordering the input: N, CAS, HP, DRAGINDEX.

(3) **Data Set 4**

- Optimum specific excess power.

(4) **Data Set 5**

- Factored optimum specific excess power

- Sustained turn and maximum speed (COMBAT.IN).

Supersonic twin engine aircraft, see Section A.2.

- Cruise and loiter at given speed (TPORT.IN).

The input file contains the following,

- Cruise calculation at TMN, adjusting the power of engine set 1.
- Five engine sets having a mix of operating and windmilling engines.
- Set of limiting values which are not exceeded.
- The radius of turn (**Radius**) is output as '*****' for a normal load factor of unity.

After the main data set, the follow-on data sets are as shown here.

(1) **Data Set 2**

- Loiter calculation at CAS 10 kt above buffet onset speed and at 1.05 normal load factor.

(2) **Data Set 3**

- Loiter calculation at CAS 10% above minimum drag speed and at 1.05 normal load factor.
- Engine set 1 at fixed power.
- Power of engine set 2 adjusted to achieve correct speed.

- Take-off safety speed using tailplane trim and power-off stall (FLAPS.IN).
Twin engine aircraft with reheat, see Section A.3.

Path Performance (Appendix B)

- Level acceleration (ACCEL.IN).
Subsonic twin engine aircraft, see Section B.1.
- Climb at given speed and power setting (CLIMB.IN).
Supersonic twin engine aircraft, see Section B.2.
- Descent at given flight path angle (DESCENT).
The input file contains the following,
 - Descent at given speed (TMN/EAS) and flight path angle.
 - Single engine with no thrust resolution ('RESOLVE NONE').

After the main data set, the follow-on data set is as shown here.

(1) Data Set 2

- Descent at given power setting and rate of descent.
- The lower of the speeds at the initial height are used as the initial values.
- Cruise for a given distance and loiter for a given time (CRUISE.IN).
Four engine large transport with a fifth powerplant (*e.g.* an auxiliary power unit), see Section B.3.
- Succession of trajectories to form a continuous flight profile (PROFILE.IN).
The input file contains the following.
 - (a) A series of manoeuvres with the data for the next manoeuvre taking the final weight, speed and height at the end of the previous data set.
 - (b) Pressure error corrections using static and total pressure coefficients based on true values of dynamic pressure ('PECTYPE PT-PS:True, DCP_STATIC and DCP_TOTAL').
 - (c) Additional output of heights, speeds and trimming surface data ('AEROUNIT +HT').
 - (d) Series of manoeuvres.
 - Acceleration flaps down.) Trimmed using fixed
 - Acceleration flaps up.) Tail with elevator
 - Climb at given speed (IAS/IMN) and power.)
 - Cruise at 38000 ft and 0.85 IMN using 3000 lb fuel.) Trimmed using
 - Descend to 5000 ft with speed-brake.)
 - Combat for 30 s turning at 10 deg/s.) All-moving tail.
 - Decelerate to 250 KIAS.)
 - Cruise at 5000 ft, 250 KIAS using 3200 lb fuel.) Trimmed using fixed
 - Descend at 5deg in a turn of 1.05 normal load factor.) Tail with elevator

Utilities Options (Appendix C)

- Atmosphere properties (ATMOS.IN), see Section C.1.
- Speed conversion (SPEED.IN).

3. INTERPOLATION PROGRAM, APP03

APP03 is a free-standing program allowing interpolation (including inverse interpolation which finds the value of one of the table variables that gives a required result from the table when all the other variables are known) on tables used by the performance program. The use of the program is described in ESDU Data Item 00034 (Reference 9) and an example is given in Appendix [D](#).

4. REFERENCES

For the list of References see ESDU Data Item 00031 (Reference 6).

APPENDIX A – POINT PERFORMANCE

Edited versions of some of the sample output files are presented for point performance test cases. The input files, the complete output files and further examples of the use of the program can be found by inspecting the test case files provided with the program (see ESDU Data Item 00032 (Reference 7)).

A.1 CRUISE AT GIVEN POWER SETTING

A.1.1 Input File (SINGLE.IN)

This example shows the use of minimum data input.

- Minimum data input allows the program to insert the default values for those items that are not input. Because so many default values will be used the warning messages associated with these defaults are suppressed by using the input 'Default Off'.
- This point performance option (CRUISE2) finds the speed for the given power setting; that is, it calculates the maximum speed for the given conditions. See also the path performance cruise cases in Section B.3.
- The thrust resolution keyword is set to stop the thrust components being resolved ('RESOLVE NONE'). Therefore the engine setting angle and splay angle are not required and are set to zero. (Note: The default setting for RESOLVE is 'ALL'.)
- Net thrust ('XNMAIN1 tab (xn_case1) lb') is used for this simple data set.
- The order in which the variables in the permutation ('HP' and 'WEIGHT') are specified in the data will control the order in which the permutation is expanded.
- The additional input data line, 'EAS 100 m/s' (commented out to keep to the minimum data input), could be used to control the type of output speed (EAS) and the units used for the output (m/s).

A.1.2 Running the Program

For instructions on running this test case refer to ESDU Data Item 00032, Section 5 (Reference 7)

A.1.3 Output Results File (SINGLE.OUT)

The output file contains a copy of the input file (SINGLE.IN) with messages generated during data input. This is followed by the performance calculation results. For a full description of the input data see ESDU Data Items 00034 and 00035 (References 9 and 10), for the output data see ESDU Data Item 00035 (Reference 10) and for a description of the warning and error messages see ESDU Data Item 00037 (Reference 12).

The radius of turn in the cruise ('Radius') is output as '*****' because at a normal load factor of unity the value is infinite.

The output file contains the following

```
-----
ESDU International Plc

PROGRAM APP02 (Salford FTN95 Compiler)

ESDUpac Number:   APPV23
ESDUpac Title:Aircraft Performance Program

Data Item Numbers: 00031 to 00039
Data Item Title:   Aircraft Performance Program - Parts 1 to 9

ESDUpac Version:   2.3
(See Data Item No. 00035 (Part 5) for full input/output specification and interpretation)
=====

Input data on date and time of run
*****
! Test case for single engined light aircraft
! Temporary test case with factored engine data
! Uses minimum data input to allow the default values to be used
DEFAULT Warning Messages OFF          !Suppress default warning messages
TABLEDIR ..\..\TABLES
CALCTYPE Cruise2
OUTPUT Aerounit
RESOLVE None
XNMAIN1 tab(xn_case1) lb
FEMAIN1 tab(fe_case1) lb/hr
PRIMARY1 40
SWING 160 sqft
CLOWING 0.2
A1WING 5.4 /rad
CDMIN 0.035
CLCRIT 0.7
KWING 0.058
DELKWING 0.12
HP 0 (4000) 16000 ft          !Order of perm variables: range of
WEIGHT 2000 2500 lb          !height (hp) at each Weight
! Optional extra input data.
! EAS 100 m/s
! The speed type (EAS) and units (m/s) are used to control the output and
! will override the units defined by OUTPUT AEROUNIT. The value (100) is
! ignored for this calculation type, CRUISE2.
```

The following default data values have been set:-

```

NENG1      = 1          , NOPT1      = 1          , ENGANG1    = 0.0    deg
SPLAY      = 0.0 deg
ATMOSTYPE   = ISA        , DELTAT     = 0.0    C  , LATITUDE   = 45.5425N
TRIMTYPE    = TRIMMED    ,
ALW-ALB     = 0.0 deg    , TMN        = MAX
N           = 1.0        , GAMMA      = 0.0    deg
  
```

Data format read with no syntax errors or warnings.

Total number of performance cases generated by this data set is 10
 Estimated elapsed run time = 0.01 minutes.

Output Data using file SINGLE.IN on **date and time of run**
 =====

Table file directory ...\\...\\TABLES
 2 different table(s) used :-

- 1 XN_CASE1 ~ ECP , EAS , HP
 ! Single engine test case net thrust
- 2 FE_CASE1 ~ ECP , EAS , HP
 ! Single engine test case Fuel Flow

Element 376 was the last one used in array TABDAT, size 10000

CRUISE (Speed at known power setting) (TMN)using ISA Atmosphere,
 and Trimmed aerodynamic data input
 1 Engine set(s) in use (no thrust resolved).

Case	DelISA (C)	Hp (ft)	TMN Radius (m)	CAS (kt)	Weight (lb)	N	ECP1
	Gamma (deg)	T.Rate (deg/s)	SumD/q (sqm)	FF (kg/min)	SAR (nm/kg)	ISAR (kg/nm)	DELXN (lb)
	CL	Alpha (deg)		Drag (lb)	XNX (lb)	Fe (lb/hr)	
1	+0.0	0	0.253	167.4	2000	1.000	40.00
	0.0	0.000	*****	3.4094	0.8181	1.2223	0 at TMN
	0.132	-0.7	0.000	546	546	451	
2	+0.0	4000	0.246	151.5	2000	1.000	40.00
	0.0	0.000	*****	2.7420	0.9760	1.0246	0 at TMN
	0.161	-0.4	0.000	453	453	363	

Note: Case 3, HP 8000ft, WEIGHT 2000 lb
 Case 4, HP 2000ft, WEIGHT 2000 lb omitted

5 +0.0 16000 0.147 71.6 2000 1.000 40.00
 E2224: No cruise speed for this power setting
 CD error = -0.003905. TMN = 0.14688

Note: Case 6, HP 0ft, WEIGHT 2500 lb
 Case 7, HP 4000ft, WEIGHT 2500 lb
 Case 8, HP 8000ft, WEIGHT 2500 lb omitted

9	+0.0	12000	0.187	99.0	2500	1.000	40.00
	0.0	0.000	*****	1.5867	1.2473	0.8018	0 at TMN
	0.472	2.9	0.000	254	254	210	

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```

10      +0.0  16000      0.164      80.1      2500      1.000      40.00
E2224: No cruise speed for this power setting
      CD error = -0.016017. TMN      =      0.16431

```

Actual elapsed run time = 0.00 minutes.
 10 Cases 2 Failed Cases

A.2 SUSTAINED TURN AND MAXIMUM SPEED

A.2.1 Input File (COMBAT.IN)

This input file shows a more extensive data consisting of three data sets.

- A main data set (ending with 'END_CASE') and two further data sets applying changes to this main data set.
- The non-standard Mean Tropical atmosphere (TROPMEAN) (see ESDU Data Items 00033 to 00035 (References 8 to 10)). This uses the non-standard atmosphere built-in to the program. The atmosphere text line for the non-standard atmosphere is added to the output file ('Atmos. :').
- The use of a combination (the line 'Hp @0 11000 m' plus the line 'Gamma @1(2)3 deg') so that in the first data set,

Gamma = 1 deg is used for Hp = 0 m
 and Gamma = 3 deg is used for Hp = 11000 m.

This combination is expanded first, before the permutation using CAS and DELTAT.

- Tables XG_RH1_M.TAB, XDT_RH1M.TAB and FE_RH1_M.TAB which show the use of 'M-points' in areas outside the engine and aircraft flight envelopes (e.g. high speed at sea level and low speed at high altitude).
- The input file also shows the use of units applied to tables where these units are not the same as the units stored with the tables. The data on the stored table (e.g. XG_RH1_M.TAB) are in Imperial units, the input line (e.g. 'Xgmain1 tab (xg_rh1_M) N') ensures that the output values are in Newtons.
- Tables for XGMAIN1 and FEMAIN1 are factored to represent a 'minimum' engine.
- Table CLBUFF is reduced by 0.1 CL to show the use of the table increment facility, although this change has no effect on the associated results.
- The excess thrust required to maintain the required constant speed type (e.g. TMN, CAS) when the flight path angle is not zero is output as DelXN (see case 11). This item is not relevant to a lift or angle of attack limited condition and it is then output as '---'.

After the main data set, the follow-on data sets are as shown here.

- **Data Set 2.** The use of the Special Speed (MAX) to find the sustained turn performance at 10 kt CAS below the maximum level speed ('CAS MAX-10 kt').
- The combination is reduced to a single item ('Hp @0 11000 m') which will be taken as the first variable in the permutation.
 - The limiting lift coefficient ('LIMITCL BUFFET') and the latitude ('LATITUDE 45 deg') are added to the data so that the default values do not have to be set. LIMITCL is required for the calculation of the lift limited turn boundary.
- **Data Set 3.** Calculation of maximum level speed with the Special Speed (MAX) being used to define the type of speed (CAS) and the units (kt) required for this output. (Note: a normal speed input (e.g. 'CAS 100 kt') could also have been used. The value (100) would have been ignored.)

A.2.2 Running the Program

This test case with multiple data sets is run from the Microsoft® Windows Command Prompt using a batch file based on the one provided with the program (e.g. APPV##.BAT).

The batch file assumes that the input file extension is *.IN. Enter the following command at the Microsoft® Windows Command Prompt,

```
C:> APPV## COMBAT
```

or C:> C:\ESDU\ESDUpacs\APPV##\EXEs\APP02V##.EXE COMBAT

A.2.3 Output Results File (COMBAT.OUT)

The output file contains a copy of the input file (COMBAT.IN) with messages generated during data input. This is followed by the performance calculation results. For a full description of the input data see ESDU Data Items 00034 and 00035 (References 9 and 10), for the output data see ESDU Data Item 00035 (Reference 10) and for a description of the warning and error messages see ESDU Data Item 00037 (Reference 12).

The output file contains the following.

ESDU International Plc

PROGRAM APP02 (Salford FTN95 Compiler)

ESDUpac Number: APPV23

ESDUpac Title:Aircraft Performance Program

Data Item Numbers: 00031 to 00039

Data Item Title: Aircraft Performance Program - Parts 1 to 9

ESDUpac Version: 2.3
(See Data Item No. 00035 (Part 5) for full input/output specification and interpretation)
=====

Input data on **date and time of run**
=====

```

PROGRAM  APP02
INFILE    COMBAT.IN
OUTFILE   COMBAT.OUT
TABLEDIR  ..\..\TABLES
OUTPUT    AEROUNIT
TITLE1    Combat Aircraft
ENGTEXT1  Maximum Reheat. Tables show the use of M-points.
TRIMTYPE  Trimmed
CALCTYPE  Sustain+
ATMOSTYPE TROPMEAN                      !Non-standard atmosphere
CAS       400  620  kt
WEIGHT    45000  lb
HP        @0  11000  m                  !Combination of HP and GAMMA
GAMMA     @1(2)3  deg                  !to give 1 deg at SL, 3 deg at 11000 m
DELTAT    -20  0  15  C                ! Relative to Mean Tropical
! Maximum reheat on both engines
RESOLVE   Jet
NENG1     2
NOPT1     2
ENGANG1   6.75  deg
SPLAY1    0.917  deg
XGMAIN1   tab (xg_rh1_M)*0.98 N        ! Units input not the same as the tables
XDMAIN1   tab (xdt_rh1M) N            ! These units will control the output units
FEMAIN1   tab (fe_rh1_M)*1.01 kg/hr    ! XG and FE factored to 'minimum' engine
PRIMARY1  100
!Aero
SWING     530  sqft
ALW-ALB   1  deg
RL        15  ft
CLWING    tab(cl)
CDWING     tab(cd)
D/Q1      tab (missile) sqm
!Basic
FLAP      0
GEAR      UP
VARIABLE1 1                          ! For reheat lit base drag in CD.TAB
!Limits
VDIVETMN  2.4
VDIVECAS  800  kt
CLBUFF    tab(clbuff2)
ALBUFF    tab(alpbuff2)  deg
END_CASE

```

W0102: The limiting CL type, LIMITCL, has not been defined.
The default setting, Buffet , will be used.

W0133: Nominal LATITUDE of 45.5425 deg (North) will be used.

The following default data values have been set:-
LATITUDE = 45.5425N, LIMITCL = Buffet

Data Set Number 2

```

TITLE2    Sustained Turn at Maximum Speed minus 10 knots.
CAS       MAX-10  kt
GAMMA     0  deg                          ! Change back to zero, no combination

```

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```
CLBUFF  tab(clbuff2)-0.1          ! Buffet onset CL reduced by 0.1
LIMITCL BUFFET
LATITUDE 45 deg
END_CASE
```

```
W0152: For special speed MAX      the LONGACCN is required.
      It has been set to 0.0 (m/s)/s
```

```
      The following default data values have been set:-
      LONGACCN = 0.0 (m/s)/s
```

```
Data Set Number 3
*****
```

```
CANCEL  Title2
CALCTYPE MaxSpeed
CAS      Max kt
END_DATA
```

```
W0142: For calculation type MAXSPEED the LONGACCN may be specified.
      It has been set to the default value of 0.0 (m/s)/s
```

```
      The following default data values have been set:-
      LONGACCN = 0.0 (m/s)/s
```

```
      4 Warnings found in the data.
```

```
Total number of performance cases generated by this data set is    24
Estimated elapsed run time =    0.01 minutes.
```

```
=====
Output Data using file COMBAT.IN on date and time of run
*****
```

```
Table file directory ..\..\TABLES\
8 different table(s) used :-
```

- 1 XG_RH1_M ~ TMN , HP , DELISA
! Combat aircraft production engine maximum gross thrust using M-points
- 2 XDT_RH1M ~ TMN , HP , DELISA
! Combat aircraft engine maximum ram drag + intake spillage
drag using M-points
- 3 FE_RH1_M ~ TMN , HP , DELISA
! Combat aircraft production engine maximum fuel flow using M-points
- 4 CL ~ ALPHA , TMN
! Combat aircraft trimmed CL
- 5 CD ~ CLTRIM , TMN , VARIABLE1
! Combat aircraft trimmed CD.
- 6 MISSILE ~ TMN
! Combat aircraft. Drag of underfuselage missiles
- 7 CLBUFF2 ~ TMN
! Combat aircraft. Buffet onset CL extrapolated to M = 0
- 8 ALPBUFF2 ~ TMN
! Combat aircraft. Buffet onset incidence to give same CL as CLBUFF2.TAB

```
Element 2632 was the last one used in array TABDAT, size 10000
```

```
SUSTAINED TURN RATE (Thrust and Lift) using TROPMEAN Atmosphere,
and Trimmed aerodynamic data input
```

```
Title1 : Combat Aircraft
```

```
Atmos. : Mean Tropical Atmosphere. DEF STAN 00-970, Vol. 1, Leaf. 101/2, Table 2.
```

```
Engine1: Maximum Reheat. Tables show the use of M-points.
```

```
      1 Engine set(s) in use (jet gross thrust resolved).
```

This page Amendmenst C and D

Buffet Onset lift is limiting condition.

Case	DELT (C)	Hp (m)	TMN	CAS (kt)	Weight (lb)	N	ECP1
	DI	Flap	SpdBrk	U/C	Var1	Var2	Var3
	Gamma (deg)	T.Rate (deg/s)	Radius (m)	DELXN (N)			
	CL	Alpha (deg)	SumD/q (sqm)	Drag (N)	XNX (N)	Fe (kg/hr)	
1	-20.0	0	0.605	400.0	45000	3.334	100.00
	#	0.00	#	UP	1.00	#	#
	1.0	8.8	1334	---	Lift Limit		
	0.474	9.3	0.049	72182	168562	42204	
2	-20.0	11000	1.146	400.0	45000	1.442	100.00
	#	0.00	#	UP	1.00	#	#
	3.0	1.7	10953	5862	Sustained Turn at CAS		
	0.256	6.4	0.099	59350	75688	18928	
3	-20.0	0	0.937	620.0	45000	6.916	100.00
	#	0.00	#	UP	1.00	#	#
	1.0	12.2	1489	---	Alpha Limit		
	0.430	6.9	0.057	170196	178046	46844	

Note: Case 4, HP 11000 m, GAMMA 5 deg, CAS 620 kt, DELTAT -20 C
Case 5, HP 0 m, GAMMA 1 deg, CAS 400 kt, DELTAT 0 C
Case 6, HP 11000 m, GAMMA 5 deg, CAS 400 kt, DELTAT 0 C
Case 7, HP 0 m, GAMMA 1 deg, CAS 620 kt, DELTAT 0 C
Case 8, HP 11000 m, GAMMA 5 deg, CAS 620 kt, DELTAT 0 C
Case 9, HP 0 m, GAMMA 1 deg, CAS 400 kt, DELTAT +15 C
Case 10, HP 11000 m, GAMMA 5 deg, CAS 400 kt, DELTAT +15 C, omitted.

11	+15.0	0	0.937	620.0	45000	5.143	100.00
	#	0.00	#	UP	1.00	#	#
	1.0	8.5	2270	1364	Sustained Turn at CAS		
	0.321	5.3	0.057	122573	127430	43146	
12	+15.0	11000	1.743	620.0	45000	*****	100.00
	#	0.00	#	UP	1.00	#	#

E2212: Can't sustain level flight at this condition
With N=1 in SUSTAIN+ , CD error = -.0207543

Data Set Number 2

Table file directory ..\..\TABLES\

Note: Same list of tables as first data set. List omitted.

SUSTAINED TURN RATE (Thrust and Lift) using TROPMEAN Atmosphere,
and Trimmed aerodynamic data input

Title1 : Combat Aircraft

Title2 : Sustained Turn at Maximum Speed minus 10 knots.

Atmos. : Mean Tropical Atmosphere. DEF STAN 00-970, Vol. 1, Leaf. 101/2, Table 2.

Engine1: Maximum Reheat. Tables show the use of M-points.

1 Engine set(s) in use (jet gross thrust resolved).

Buffet Onset lift is limiting condition.

Performance at Maximum Level Speed . CAS *1.00 -10.00 kt
with Maximum speed margin defined by LONGACCN

Case	DELT (C)	Hp (m)	TMN	CAS (kt)	Weight (lb)	N	ECP1
	DI	Flap	SpdBrk	U/C	Var1	Var2	Var3

This page Amendments C and D

	Gamma (deg) CL	T.Rate (deg/s) Alpha (deg)	Radius (m) SumD/q (sqm)	DELXN (N) Drag (N)	XNX (N)	Fe (kg/hr)	
13	-20.0	0	1.056	698.6	45000	2.272	100.00
	#	0.00	#	UP	1.00	#	#
	0.0	3.2	6345	0	Sustained Turn at CAS		
	0.104	3.3	0.097	167564	167564	45526	
14	-20.0	11000	1.914	675.5	45000	1.338	100.00
	#	0.00	#	UP	1.00	#	#
	0.0	0.9	35884	0	Sustained Turn at CAS		
	0.078	3.6	0.074	108748	108748	36796	

Note: Case 15, HP 0 m, DELTAT 0 C
Case 16, HP 11000 m, DELTAT 0 C, omitted

17	+15.0	0	0.990	654.6	45000	3.045	100.00
	#	0.00	#	UP	1.00	#	#
	0.0	4.6	4440	0	Sustained Turn at CAS		
	0.167	3.3	0.082	126534	126534	43589	
18	+15.0	11000	1.381	491.4	45000	1.065	100.00
	#	0.00	#	UP	1.00	#	#
	0.0	0.5	50942	0	Sustained Turn at CAS		
	0.127	4.1	0.094	65012	65012	19813	

Data Set Number 3

Table file directory ..\..\TABLES\

Note: Same list of tables as first Data set. List omitted.

MAXIMUM LEVEL SPEED using TROPMEAN Atmosphere,
and Trimmed aerodynamic data input

Title1 : Combat Aircraft

Atmos. : Mean Tropical Atmosphere. DEF STAN 00-970, Vol. 1, Leaf. 101/2, Table 2.

Engine1: Maximum Reheat. Tables show the use of M-points.

1 Engine set(s) in use (jet gross thrust resolved).

Buffet Onset lift is limiting condition.

Performance at Maximum Level Speed. CAS *1.00 +0.00 kt
with Maximum speed margin defined by LONGACCN

Case	DelT (C) DI @AXlim ((m/s)/s) CL	Hp (m) Flap SEPlim (m/s)	TMN SpdBrk SumD/q (sqm)	CAS (kt) U/C Drag (N)	Weight (lb) Var1 XNX (N)	N Var2 Fe (kg/hr)	ECP1 Var3
19	-20.0	0	1.071	708.6	45000	1.000	100.00
	#	0.00	#	UP	1.00	#	#
	0.000	0.0					
	0.038	2.4	0.098	165360	165359	45327	
20	-20.0	11000	1.946	685.5	45000	1.000	100.00
	#	0.00	#	UP	1.00	#	#
	0.000	0.0					
	0.053	3.1	0.072	108228	108228	37514	

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Note: Case 21, HP 0 m, DELTAT 0 C
Case 22, HP 11000 m, DELTAT 0 C, omitted

23	+15.0	0	1.005	664.6	45000	1.000	100.00
	#	0.00	#	UP	1.00	#	#
	0.000	0.0					
	0.047	1.9	0.087	126079	126078	43716	
24	+15.0	11000	1.407	501.4	45000	1.000	100.00
	#	0.00	#	UP	1.00	#	#
	0.000	0.0					
	0.114	3.7	0.093	65522	65524	20295	

Actual elapsed run time = 0.03 minutes.
24 Cases 4 Failed Cases

A.3 TAKE-OFF SAFETY SPEED

A.3.1 Input File (FLAPS.IN)

The input file shows the use of the minimum speed calculation to find power-off stalling speed.

- Trimming using all-moving tailplane ('TRIMTYPE TAILMOVE').
- Additional output of trimming surface aerodynamic data and the effect of the trim forces on the overall aircraft lift and drag ('OUTPUT AeroUnit +T'). These values supplement the standard output of tail angle to trim (EtaT).
- Miscellaneous variables are given synonyms which are used as table variables ('VARIABLE7 1.61 =MBC', 'VARIABLE2 0 =Droop'). The synonyms (MBC, Droop) are shown in the tables summary.
- Miscellaneous engine variable ENGVAR11 is redirected to be used as the miscellaneous variable VARIABLE3 ('ENGVAR11 tab(BLC2V7thRH)/Ktas2 =BLC >Variable 3'). The synonym, BLC, is used as a table variable and appears in the tables summary.
- Although the MODTAB factor applied to the miscellaneous engine variable ENGVAR11 has units, the units of this factor are not known to the program. Therefore MODTAB1 is input without units; as a reminder the actual units are shown as a synonym ('MODTAB1 tab(VtasSqr d)# =Ktas2').
- Calculation of take-off safety speed 20% above the power-off stall speed ('CAS Stall_PO*1.20 kt') with two engines at maximum reheat. The power-off stall option ensures that the thrust is included in the pitching moment and trimming balance but not included in the lift equation.

A.3.2 Running the Program

For instructions on running this test case refer to ESDU Data Item 00032, Section 5 (Reference 7).

A.3.3 Output Results File (FLAPS.OUT)

The output file contains a copy of the input file (FLAPS.IN) with messages generated during data input.

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