



Cycle Counter Operations Specification Document

FOR THE

BK117-C1 AND C2 (EC145) ARRIEL 1E(2) ENGINE

Revision F – July 15th, 2025

- Added a new note to the General Information Pg.9

This document describes in detail the operation of the AKV Arriel 1E(2) Cycle Counter kit P/N BK1172XCC for the BK117-C1 and C2 (EC145).

NOTE: When installing the AKV cycle counter for the first time in an existing airframe, reference EASA AD 2012-0187 for requirements on re-calculating prior recorded Np Cycles.

As a SAFRAN validated cycle counting aid, the cycle counter's primary objective is to accurately monitor and record both the Ng (Gas Producer) and Np (Power Turbine) engine cycles in accordance with SAFRAN Engineering, France "Linear Interpolation" methodology.

Cycle Counter part number and model applicability:

- LRU P/N BK117-008-1 part of kit P/N BK1172XCC for the Arriel 1E(2) engines.

When the **Rev 2b software** is installed, it adds a 3rd data screen to display a resettable flight and engine run time in clock format HH:MM for operation billing purposes. In addition, the reset function now requires pressing and releasing the reset button 3 times in a row. There is no change to the cycle counting methodology.

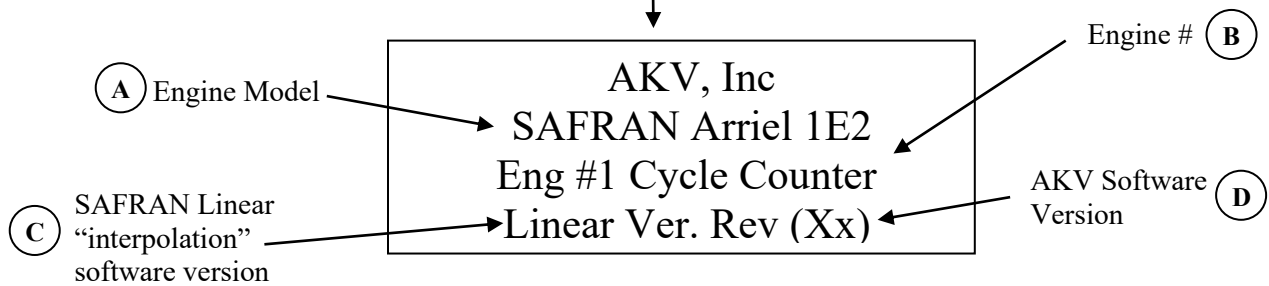
WARNING: Prior to resetting the cycle counter, a "Daily Coherence" check of the accumulated cycles must be completed by the pilot. Ref. the AKV Rotorcraft Flight Manual Supplement (RFMS) Rev D (or later FAA Approved revision) in Section GENERAL: MANUFACTURER'S DATA.

Each **ITEM 1 - 13** below identifies what items are recorded as displayed on the cycle counter screen(s). See Fig 1, page 2 "Screen Layout".

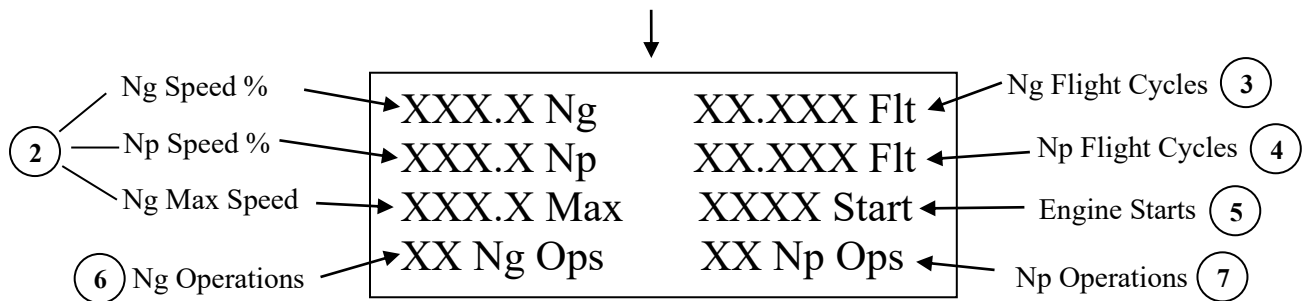
- | | |
|------------------------------------|-------------------------------|
| 1. Power up screen | 8. Ng total |
| 2. Ng, Np speeds and Ng Max | 9. Np total |
| 3. Ng (Gas producer) flight cycles | 10. Flight (Flt) time |
| 4. Np (Free Turbine) flight cycles | 11. Run time |
| 5. Engine starts | 12. (Clock) Flight (Flt) time |
| 6. Ng Operations | 13. (Clock) Run time |
| 7. Np Operations | |



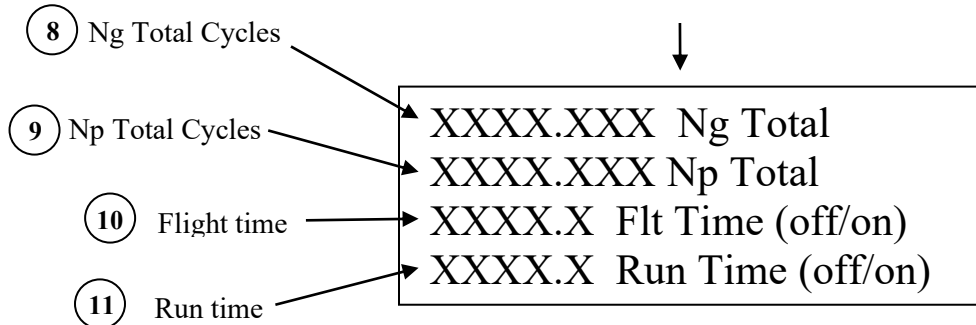
Power Up Screen ①



First Data Screen



Second Data Screen



Third Data Screen

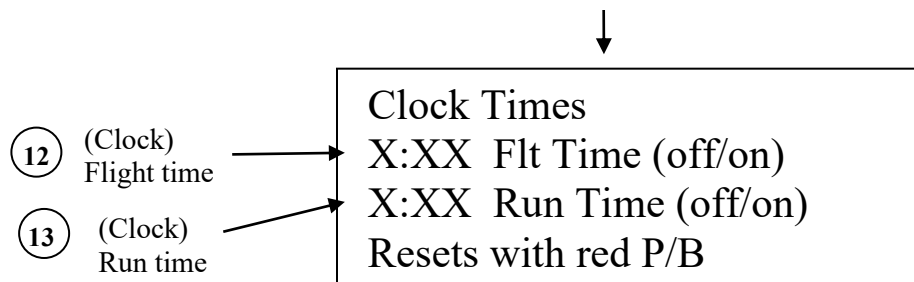


Fig. 1 - Screen Layout



ITEM 1 – “Power up” screen

After the A/C Battery is turned on, the “power up” screen is indicated for 5 seconds at which point it automatically reverts to the first data screen or by pressing the black “screen” button prior to the expiration of the 5 seconds. To view the power up screen again, the battery switch must be cycled.

Engine model (A) indicates “**SAFRAN (Turbomeca) Arriel 1E2**” for the EC145.

Engine #1 or #2 (B). Top display is Engine #1. Bottom display is Engine #2.

Confirmation that the system is based on the (C) *SAFRAN Linear interpolation* software methodology is indicated by “**Linear Ver.**”

The AKV *software revision (D)* identified as “**Rev (Xx)**” indicates the AKV software revision installed in the cycle counter. The “X” (number) indicates a major change to the cycle counting algorithm whereas as the “x” (lower case alphabet) will indicate a software change that has been made for basic bug fixes or a minor changes that does not affect the cycle counting.

NOTE: The **optional Ground Support Programming Kit P/N CC-GSE** allows for maintenance to program the cycle counter with the current engine totals from the log books as well as install software updates. This is useful when the cycle counter is installed in an existing airframe or when an engine change is made.

The kit includes a serial programming cable, USB adapter cable and software CD with programming instructions. The programming kit allows for specific values to be changed associated with items 5, 8, 9 10 & 11 and can be password protected by the end user to prevent any un-authorized changes to be made.

ITEM 2 – Ng, Np speeds and Ng Max

The speed signals for Ng and Np are connected to the cycle counter microprocessor via individual 2 conductor, twisted and shielded wires. These wires are connected in parallel to the tachometer indicator signal wires behind the instrument panel.

Each signal wire is connected to separate channels on the microprocessor via opto-isolators. The analog speed signals from the engine are converted to a digital signal that is scaled to the same designed frequency as the tachometer generators on the engine.

When the aircraft is started the processor waits for a speed $\geq 30\%$ Ng including an additional 5 second delay before the speed is considered as an actual engine start. This filters out any spikes in the incoming Ng signal due to the low frequency at engine start. At this point Ng, Np are indicated and the cycle counter is in an operational state.



The frequency is continuously monitored for change in width and period of the sine-wave and converted to microseconds by the processor. This process is a function of the pulseperiod and changes linearly as the speed changes.

The software conversion of the pulseperiod to the corresponding frequency is displayed on the first data screen as Ng and Np Speed in percentage (%) and is to one decimal place.

The resultant displayed speed corresponds directly with the tachometer indicator or VEMD on the instrument panel + or – 0.5 % and provides the operator confirmation that the cycle counter is operating correctly. This is accomplished by observing and comparing the displayed cycle counter speeds with the tachometer indicators for both Ng and Np.

The “Max” Ng speed indication in percentage on the first data screen and shown below the Np speed is the maximum Ng speed seen by the cycle counter between manual resets. It is useful for determination of the max K1 value accrued by the cycle counter “Flt” cycles.

Since the Ng and Np speed indications are in real time and match the tachometer indicators on the instrument panel, confirmation that the system is operational can be easily confirmed.

ITEM 3 – Ng “Flt”

The “Flt” value on the top line corresponds to the Ng accumulated cycles between resets and is to the right of the Ng speed.

NOTE: A “reset” is accomplished by the red pushbutton on the side of the cycle counter and adds the accumulated “Flt” cycles to the totals on the second data screen. With software revision 2b installed, it requires the pilot to press and release the reset button 3 times in a row. The daily Ng “Flt” values are then reset to zero for the next flight period when the reset button is pressed and released. It is recommended that the operator record the daily “Flt” values in the flight log at the end of each flight day prior to resetting the cycle counter for the next flight day. If the operator neglects to reset the counter, any subsequent recorded flight cycles are added to the prior values.

The following process by which Ng cycles are accumulated is per the SAFRAN Linear interpolation methodology. Table 2 shows the basic overall count methodology for major and minor (partial) cycles whilst Table 2a & 2b shows how the linear process for the major count is applied through the increasing speed range in detail.

NOTE: Ng cycles are not recorded until the Ng speed is $\geq 88\%$ at which point the A/C is light on the skids and is approaching flight. This prevents any cycles from being recorded during ground runs for maintenance purposes.



With Ref to Table 2 (K1 Chart) & Table 2a & 2b (K1 Linear Graph), at 88-93% Ng, a value of 0.500 is recorded and at 94.3% Ng is increased to a value of 0.565 then at 98.2% to a value of 0.820 Ng and so on up to a max value of 1.00 at 100% Ng. This value is the “one time” maximum K1 value between each start – flight – shutdown.

With Ref to Table 2 (K2 chart), the partial K2 Ng cycles are additional values added to K1 when the Ng speed has initially reached $\geq 88\%$ on takeoff and from thereafter is $\leq 85\%$ then $> 85\%$ Ng. Depending on the speed reached $\leq 85\%$ these values are added to K1 when Ng becomes $> 85\%$ without shutdown.

Table 2 (K2) Example - If the Ng speed decreases to 82% then increases $> 85\%$ then a partial cycle value of 0.05 is added to K1. If the Ng speed decreases again to 79% then increase $> 85\%$ then a partial cycle value of 0.10 is added to K1 and so on.

NOTE: This would also indicate 2 Ng Ops for this example

ITEM 4 – Np “Flt”

The “Flt” value on the second line corresponds to the Np accumulated cycles between resets and is to the right of the Np speed.

NOTE: A “reset” is accomplished by the red pushbutton on the side of the cycle counter and adds the accumulated “Flt” cycles to the totals on the second data screen. With software revision 2b installed, it requires the pilot to press and release the reset button 3 times in a row. The daily Np “Flt” values are then reset to zero for the next flight period when the reset button is pressed and released. It is recommended that the operator record the daily “Flt” values in the flight log at the end of each flight day prior to resetting the cycle counter for the next flight day. If the operator neglects to reset the counter, any subsequent recorded flight cycles are added to the prior values.

The following process by which Np cycles are accumulated is per the SAFRAN Linear interpolation methodology and are shown as an example in Table 3.

Np cycles are not recorded until the Ng speed is $\geq 88\%$ at which point the A/C is light on the skids and is approaching flight. This prevents any cycles from being recorded during ground runs for maintenance purposes.

When Ng $\geq 88\%$ and Np $> 98\%$, a value of 1.0 is recorded for Np. This value is the “one time” maximum F1 value between each start – flight – shutdown.

The partial Np (F2) cycle is an additional value added to F1 when the Np speed has initially reached $> 98\%$ and from thereafter is $\leq 85\%$ then $> 98\%$ Np. Depending on the speed reached $\leq 85\%$ there are four (4) grouped speed ranges that have values associated with the speed range reached during the partial cycle event (see Table 3) . These values are added to the F1 value when Np then goes $> 98\%$ without shutdown.



Table 3 (F2) Example (Arriel 1E2) - If the Np speed decreases to 78% then increases > 98% then a partial cycle value of 0.40 is added to F1. If the Np speed decreases again to 67% then increases >98% then a partial cycle value of 0.6 is added to F1 and so on.

NOTE: This would also indicate 2 Np Ops for this example

ITEM 5 – Engine starts

An engine start is recorded when the Ng speed is $\geq 88\%$ Ng at which point the A/C is light on the skids and is approaching flight. This prevents any starts from being recorded during ground runs for maintenance purposes. It increments by a value of 1 between each start – flight – shutdown. This value does not reset when the reset button is pressed and continues to accumulate all engine starts.

ITEM 6 – Ng “Ops”

The Ng “Ops” (operations) counter corresponds to the Ng partial operations accumulated between resets. The counter increments by a value of 1 whenever an Ng partial cycle event is recorded as described by item 3.

NOTE: A “reset” is accomplished by the red pushbutton on the side of the cycle counter. With software revision 2b installed, it requires the pilot to press and release the reset button 3 times in a row. The daily Ng “Ops” values are reset to zero for the next flight period when the reset button is pressed and released. It is recommended that the operator record the daily Ng “Ops” values in the flight log at the end of each flight day prior to resetting the cycle counter for the next flight day. If the operator neglects to reset the counter, any subsequent recorded operations are added to the prior values.

ITEM 7 – Np “Ops”

The Np “Ops” (operations) counter corresponds to the Np partial operations accumulated between resets. The counter increments by a value of 1 whenever an Np partial cycle event is recorded as described by item 4.

NOTE: A “reset” is accomplished by the red pushbutton on the side of the cycle counter. With software revision 2b installed, it requires the pilot to press and release the reset button 3 times in a row. The daily Np “Ops” values are reset to zero for the next flight period when the reset button is pressed and released. It is recommended that the operator record the daily Np “Ops” values in the flight log at the end of each flight day prior to resetting the cycle counter for the next flight day. If the operator neglects to reset the counter, any subsequent recorded operations are added to the prior values.



ITEM 8 – Ng Total

When the “reset” button on the side of the cycle counter is pressed and released 3 times in a row, the accumulated Ng “Flt” cycles are added to the Ng Total which represents the accumulative Ng total for the engine.

ITEM 9 – Np Total

When the “reset” button on the side of the cycle counter is pressed and released 3 times in a row, the accumulated Np “Flt” cycles are added to the Np Total which represents the accumulative Np total for the engine.

ITEM 10 – Flight (Flt) time

This is a timer representing flight time which is also used for determining maintenance intervals. It accumulates time in 0.1 hour (6 minute) increments.

The flight time starts to accumulate when the engine is running and the collective is up (C1) or unlocked (C2). The prior saved accumulated timer value and count down timer is loaded from non-volatile memory and continues the process of counting down from 360 seconds (6 minutes). When it reaches zero, the accumulative timer increments by a value 0.1 and the count-down timer starts again at 360 seconds. When the collective is full down (C1) and locked (C2), the timer stops counting down and saves the accumulated and count-down timers until the collective is unlocked again and the process repeats.

Confirmation of the correct operation of the flight timer and collective interface signal can be observed by noting the change from (OFF) to (ON) when the collective is up (C1) or unlocked (C2) and from (ON) to (OFF) when the collective is full down (C1) and locked (C2).

NOTE: If the collective wiring interface is not used then alternate Cycle Counter software is available that controls the flight timer as follows:

When the Ng speed is $\geq 88\%$ Ng at which point the A/C is light on the skids and is approaching flight. The prior saved accumulated timer value and count down timer is loaded from non-volatile memory and continues the process of counting down from 360 seconds (6 minutes). When it reaches zero the accumulative timer increments by a value 0.1 and the countdown timer starts again at 360 seconds. When $Ng < 75\%$ the timer stops counting down and saves the accumulated timer and count down timer until $Ng \geq 91\%$ at which point they are reloaded and counting continues. The OFF/ON indication is not shown with this software version.



ITEM 11 – Run time

This is a timer representing engine run time. It accumulates time in 0.1 hour (6 minute) increments. Run time is controlled when the Ng speed is $\geq 30\%$ Ng at which point the A/C engine is running. The prior saved accumulated timer value and count down timer is loaded from non-volatile memory and continues the process of counting down from 360 seconds (6 minutes). When it reaches zero, the accumulative timer increments by a value 0.1 and the countdown timer starts again at 360 seconds. When $Ng < 30\%$ the timer stops counting down and saves the accumulated timer and count down timer. When the engine started again and $Ng \geq 30\%$ they are reloaded and counting continues.

Confirmation of the run timer operation can be observed by noting the change from (OFF) to (ON) when the engine is started and from (ON) to (OFF) when the engine is shutdown.

NOTE: With the alternate software installed (see Note under Item 10 – Flight Time) the OFF/ON indication is not shown with this software version.

ITEM 12 – (Clock) Flight (Flt) time HH:MM

With Rev 2b software installed this is a timer representing flight time in Hours and Minutes HH:MM.

NOTE: The clock time will be reset along with the flight cycles when the red reset pushbutton is pressed and released 3 times in a row.

The flight time starts to accumulate when the engine is running and the collective is up (C1) or unlocked (C2). The prior saved accumulated HH:MM timer value and the 60 sec. count down timer is loaded from non-volatile memory and continues the process of counting down from 60 seconds. When it reaches zero, the accumulative timer increments by a value of 1 minute and the count-down timer starts again at 60 seconds. When the collective is full down (C1) and locked (C2), the timer stops counting down and saves the accumulated timer and count-down timers until the collective is unlocked again and the process repeats.

Confirmation of the correct operation of the flight timer and collective interface signal can be observed by noting the change from (OFF) to (ON) when the collective is up (C1) or unlocked (C2) and from (ON) to (OFF) when the collective is full down (C1) and locked (C2).



ITEM 13 – (Clock) Run time HH:MM

With Rev 2b software installed this is a timer representing engine run time in Hours and Minutes HH:MM

NOTE: The clock time will be reset along with the flight cycles when the red reset pushbutton is pressed and released 3 times in a row.

Run time is controlled when the Ng speed is $\geq 30\%$ at which point the A/C engine is running. The prior saved accumulated HH:MM timer value and the 60 sec. count down timer is loaded from non-volatile memory and continues the process of counting down from 60 seconds.

When it reaches zero, the accumulative timer increments by a value of 1 minute and the count-down timer starts again at 60 seconds. When $Ng < 30\%$ the timer stops counting down and saves the accumulated timer and count down timer. When the engine started again and $Ng \geq 30\%$ they are reloaded and counting continues.

Confirmation of the run timer operation can be observed by noting the change from (OFF) to (ON) when the engine is started and from (ON) to (OFF) when the engine is shutdown.

End “ITEM” description

General information

All the accrued data is stored in non-volatile memory and is accomplished on engine shut when the Ng speed $\leq 30\%$.

When the red “reset” button is pressed and released 3 times, the newly updated Ng and Np totals are re-saved and the Ng and Np “Flt”, Ng Max, Ng and Np “Ops” and both (Clock) Flight and Run time will reset to zero. The black “screen” button changes the screens between the first and second data screen.

NOTE: The cycle counter uses a single computer input for both the red “reset” button and the collective up signal functions. When the engine is running, the input controls the flight time with the collective up signal via our supplied external relay as part of the installed kit. When $N1 < 30\%$ it reverts to a reset function. If the collective micro switch is out of adjustment and still producing a signal when the collective is down, then when $N1 < 30\%$ it immediately resets the counter. You might notice the second screen totals increasing in cycles with nothing showing on the first screen.

When running the engine and the collective is full down, check the Flight time on the second data screen shows (OFF). Raise the collective and confirm it then shows (ON). If it does not, then the collective micro switch needs to be looked at.



All saved data is re-loaded from the non-volatile memory when the engine is started and $N_g \geq 30\%$ plus 5 seconds.

28V DC power is provided via a dedicated 2 conductor, twisted and shielded wire and via a 2 amp circuit breaker.

Author: Jonathan Gunn

A handwritten signature in blue ink, appearing to read "Jonathan Gunn", with a long horizontal flourish extending to the right.

Engineering

Max Ng	K1
100	1.000
99	0.900
98.2**	0.820
97	0.700
96	0.650
94.3*	0.565
94.0	0.550
<=93	0.500

Formula $N = K1 + n. K2$

$$N = 0.82 + n. 0.05 + 0.10 = \underline{\underline{0.97 \text{ Ng FLT Cycles}}}$$



Min Ng	K2
<=85 84 83 82 81	0.05
<81 80 79 78 77 76	0.10
<76 75 74 73 72 71 70	0.15

For detailed K1
linear graph values
* See Table 2a
** See Table 2b

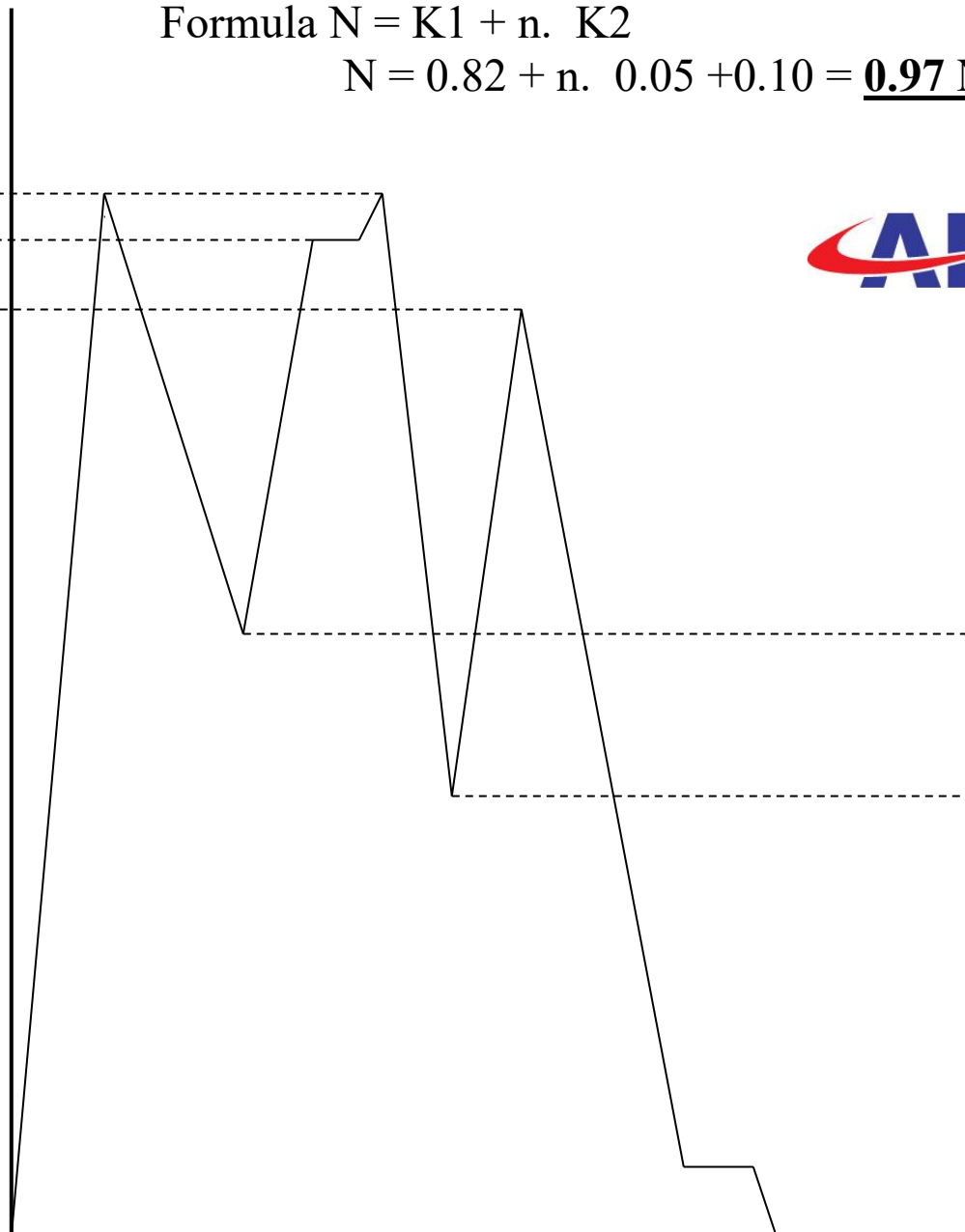


Table 2
Cycle Counter Ng example flight

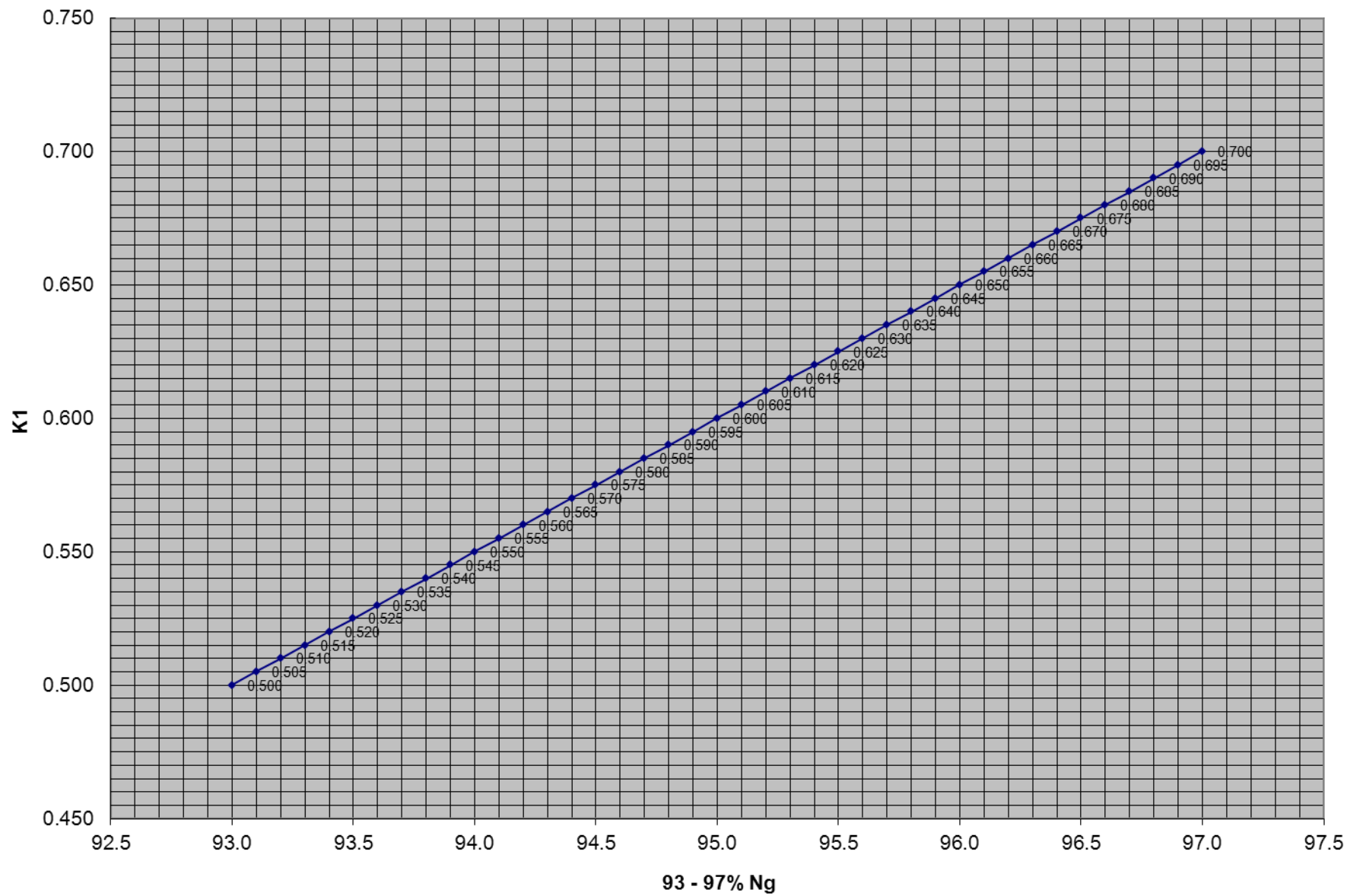


Table 2a
 K1 detailed linear graph example range 93 – 97% Ng

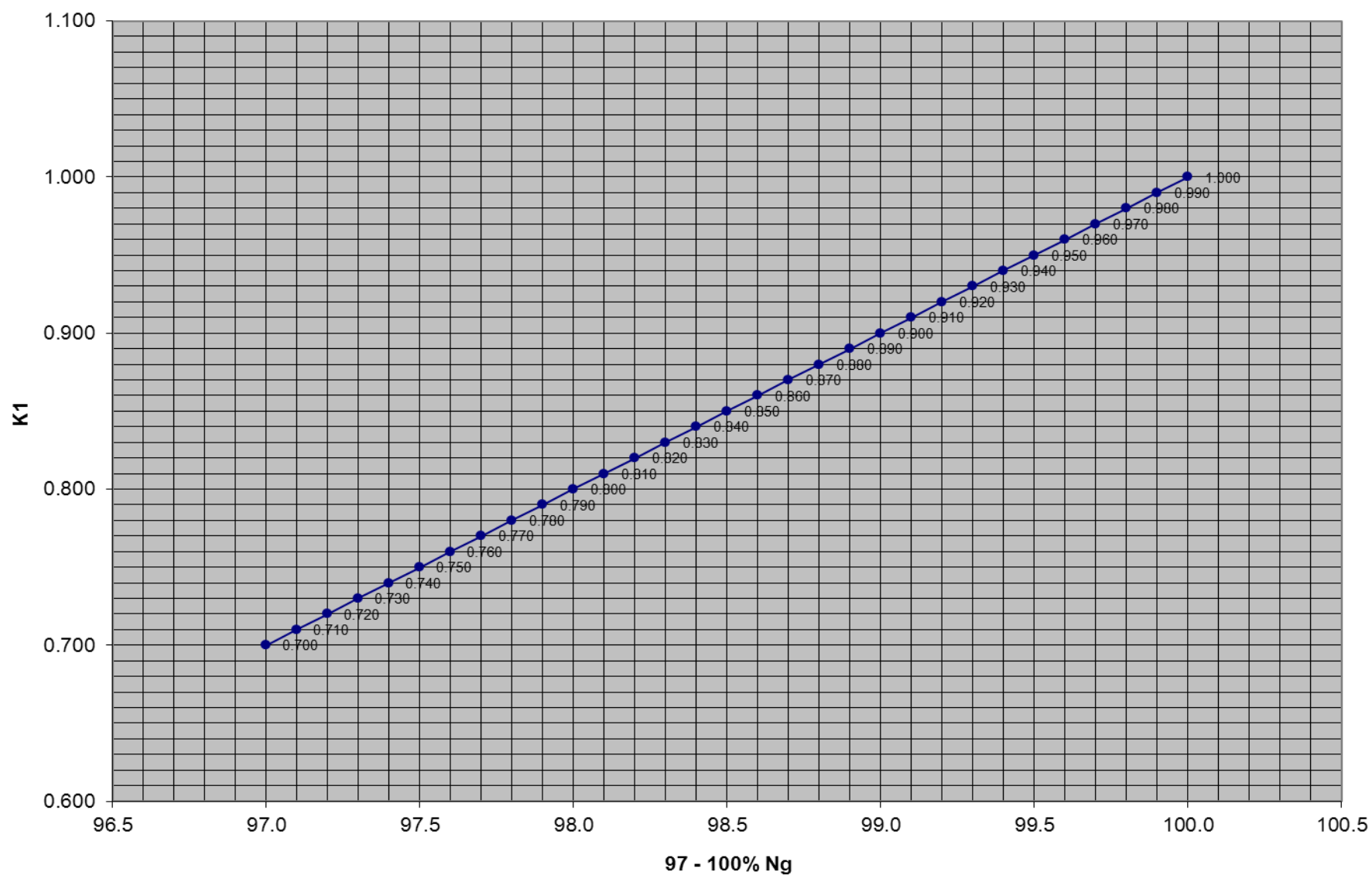


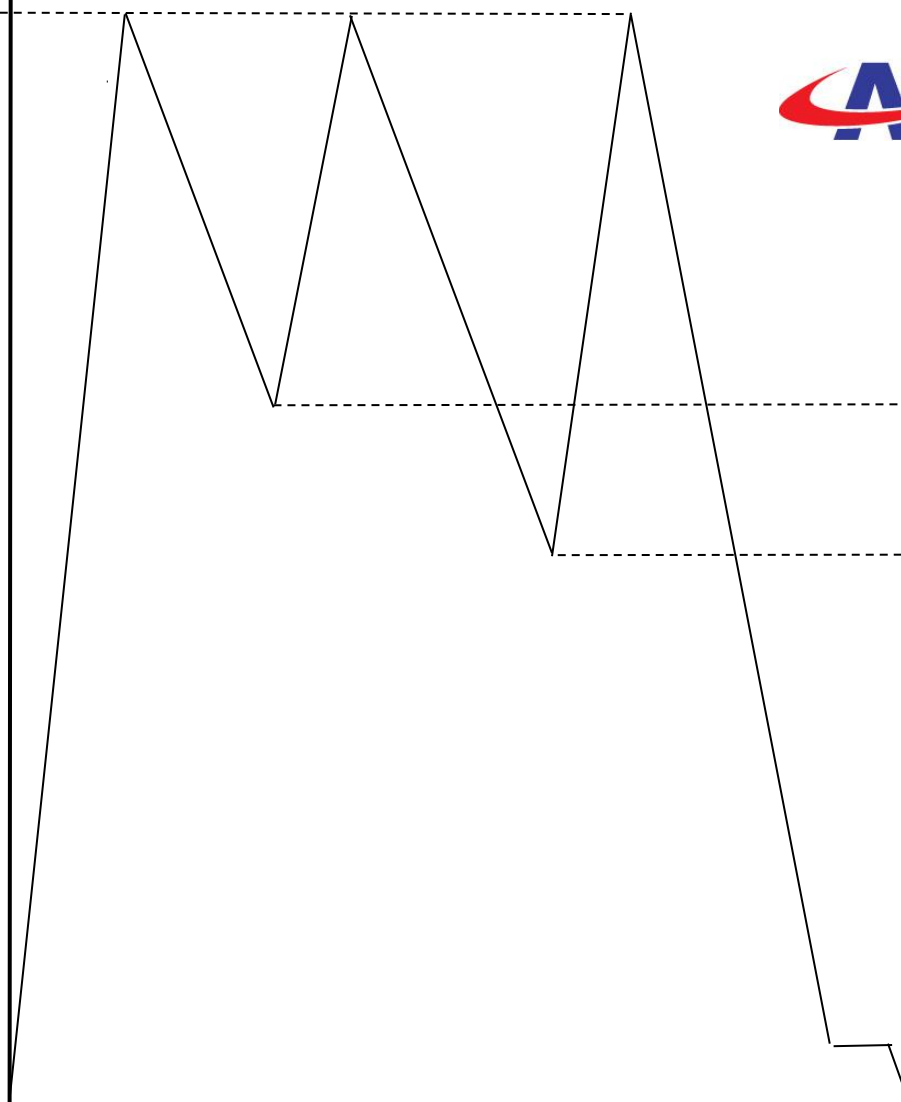
Table 2b

K1 detailed linear graph example range 97 – 100% Ng

Max Np	F1
100 99 >98	1

Formula $N = F1 + n \cdot F2$ (Arriel 1E2)

$$N = 1.0 + n \cdot 0.4 + 0.6 = \underline{2.0 \text{ Np FLT Cycles}}$$



Min Np	F2
≤ 85 ↓ ≥ 70	See "A"
< 70 ↓ ≥ 65	See "B"
< 65 ↓ ≥ 60	See "C"
< 60	1.0

"A" "B" "C"
 0.1 0.2 0.3 for A, A1, A2, B (Pre TU77)
 0.3 0.5 0.6 for A, A1, A2, B (Post TU77)
 0.4 0.5 0.6 for C, C1, C2
 0.3 0.5 0.6 for D, D1, K, K1
 0.4 0.6 0.7 for E2
 1.0 1.0 1.0 for S, S1

Table 3
Cycle Counter Np example Flight