1.1 Argo cycle timing variables for the trajectory file

Each Argo float cycle is composed of programmed events. Depending on float type, some of these events can be dated and associated CTD measurements can be provided. The following figure shows an example cycle, with the times ordered for Argos satellite communications. For Iridium floats, the order of surface events may be different.

The sixteen following timed events can be highlighted.

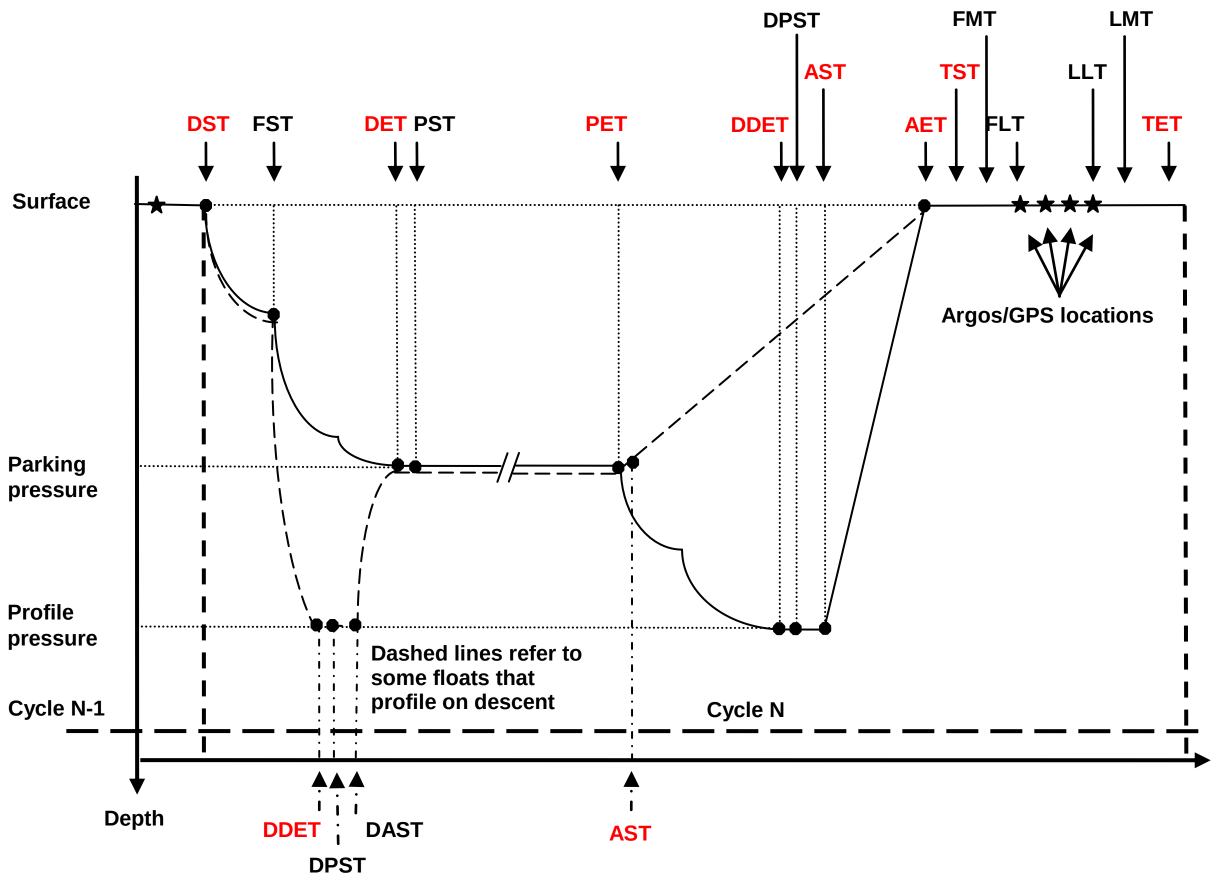

Figure 1: Figure showing float cycle and the cycle timing variables with mandatory ones in red. Floats can profile either on descent or ascent. Most floats profile on ascent. Their path is shown with a solid black line. Some floats profile on descent. One such float, the new SOLO-II Deep float, has a cycle as shown by the dashed line.

Floats that profile on ascent would have the following primary & mandatory cycle timings:

DST, DET, PET, DDET, AST, AET, TST, all surface times and TET

Floats that profile on descent might have the following cycle timings:

DST, DDET, DAST, DET, PET, AST, AET, TST, all surface times and TET

NOTE: if a float is programmed to experience a primary cycle timing event, but no timing information is sent back and no estimate is possible, fill value should be inserted in the JULD array with the measurement code corresponding to the primary cycle timing event. Examples of this include:

- SOLO and APEX APF8 floats which send back no cycle timing information should have fill value for the primary measurement codes unless an estimated time can be determined

- Ice detection floats that detect ice at the surface and then do not surface should have fill value for measurement codes 600-704 for the affected cycles.

NOTE: the diagram above shows the chronological order of timing events for an Argos float. Iridium floats have a different chronological order of timing events. In either case, times in the JULD variable should be arranged chronologically.

Time	MC	Long name	N_CYCLE variable name	Description
DST	100	Descent Start Time	JULD_DESCENT_START JULD_DESCENT_START_STATUS	Time when float leaves the surface, beginning descent.
FST	150	First Stabilization Time	JULD_FIRST_STABILIZATION JULD_FIRST_STABILIZATION_STATUS	Time when a float first becomes water-neutral.
DET	200	Descent End Time	JULD_DESCENT_END JULD_DESCENT_END_STATUS Note: Float may approach drift pressure from above or below.	Time when float first approaches within 3% of the eventual drift pressure. Float may be transitioning from the surface or from a deep profile. This variable is based on pressure only and can be measured or estimated by fall-rate. In the case of a float that overshoots the drift pressure on descent, DET is the time of the overshoot.
PST	250	Park Start Time	JULD_PARK_START JULD_PARK_START_STATUS	Time when float transitions to its Park or Drift mission. This variable is based on float logic based on a descent timer (i.e. SOLO), or be based on measurements of pressure (i.e. Provor).
Note on DET and PST: DET and PST might be near in time or hours apart depending on float model and cycle-to-cycle variability. PI has judgment call whether DET~=PST.				
PET	300	Park End Time	JULD_PARK_END JULD_PARK_END_STATUS	Time when float exits from its Park or Drift mission. It may next rise to the surface (AST) or sink to profile depth (DDET)
DDET	400	Deep Descent End Time	JULD_DEEP_DESCENT_END JULD_DEEP_DESCENT_END_STATUS	Time when float first approaches within 3% of the eventual deep drift/profile pressure. This variable is based on pressure only and can be measured or estimated by fall-rate.
DPST	450	Deep Park Start Time	JULD_DEEP_PARK_START JULD_DEEP_PARK_START_STATUS	Time when float transitions to a deep park drift mission. This variable is only defined if the float enters a deep drift phase (i.e. DPST not defined in cases of constant deep pressure due to bottom hits, or buoyancy issues)
DAST	550	Deep Ascent Start Time	JULD_DEEP_ASCENT_START JULD_DEEP_ASCENT_START_STATUS	Time when float begins its rise to drift pressure. Typical for profile-on-descent floats.
AST	500	Ascent Start Time	JULD_ASCENT_START JULD_ASCENT_START_STATUS	Time when float begins to return to the surface.
AET	600	Ascent End Time	JULD_ASCENT_END JULD_ASCENT_END_STATUS	Time when float reaches the surface.
TST	700	Transmission Start Time	JULD_TRANSMISSION_START JULD_TRANSMISSION_START_STATUS	Time when float begins transmitting.
FMT	702	First Message Time	JULD_FIRST_MESSAGE JULD_FIRST_MESSAGE_STATUS	Earliest time of all received float messages.
FLT	703	First Location Time	JULD_FIRST_LOCATION JULD_FIRST_LOCATION_STATUS	Earliest location of all float locations.
LLT	703	Last Location Time	JULD_LAST_LOCATION JULD_LAST_LOCATION_STATUS	Latest location of all float locations.
LMT	704	Last Message Time	JULD_LAST_MESSAGE JULD_LAST_MESSAGE_STATUS	Latest time of all received float messages.
TET	800	Transmission End Time	JULD_TRANSMISSION_END	Time when floats stops transmitting.

			JULD_TRANSMISSION_END_STATUS	

Table 1: Descriptions of cycle times shown in the previous figure. Mandatory cycle times are shown in red.

2 ANNEX F: Measurement code table

2.1 General Measurement Code Table Key

All Measurement Codes in RED are MANDATORY

Measurement code type	Definition
Any code evenly divisible by 100 (e.g. 100, 200, 300, etc)	**Primary Measurement Codes (MC)**. Each marks a mandatory-to-fill cycle timing variable. These are very important for determining trajectory estimates. All are found in both the N_MEASUREMENT and N_CYCLE data arrays.
Any code evenly divisible by 50 but not evenly divisible by 100 (e.g. 150, 250, 450, etc)	**Secondary Measurement Codes (MC)**. Each marks a suggested-to-fill cycle timing variable. Secondary MC are not always applicable to all floats, but are very useful in determining trajectory estimates.
Any code that falls in between any Primary or Secondary Measurement Code (span of 50 values). These codes describe data that are important cycle timing information but are not as important as the primary or secondary timing variables. The value span is subdivided into two halves. Measurement codes in this section will be described relative to the values of the Primary and Secondary codes.	**Relative Generic Codes**. Values spanning from MC minus 24 to MC minus 1: Measurement codes that have lower value and within 24 of a Primary or Secondary Measurement Code. These code definitions are phrased generally, so can be attached to data from many different floats. These code values (MC minus 24 to MC minus 1) are assigned when a float records a measurement while transitioning TOWARDS the MC. The definitions of the MC from MC minus 24 to MC minus 1 are repeated for all Primary and Secondary MC. An example, most floats record pressure/temperature/salinity during drift. The float is transitioning towards PET (MC=300) during this period. Thus the pressure/temperature/salinity measurements will have an MC between MC minus 24 and MC minus 1 where MC=300 (thus between MC=276 and MC=299). Which value is chosen is determined by the measurement itself (See table below). **Relative Specific Codes**. Values spanning from MC plus 1 to MC plus 25: These are specific measurements that are generally NOT recorded by multiple float types. They are believed to be valuable enough in trajectory estimation that they are defined here, and not within the generically defined MC minus 24 to MC minus 1 span. MC codes in this span will be specific to the MC code, and will NOT be repeated for other Primary and Secondary MCs. An example, APEX floats report the "Down-time end date", which is important in determining the start of ascent (MC=500). The MC for "Down-time end date" is recorded with MC plus 1 (MC=501).

2.2 Relative Generic Code Table Key (from MC minus 24 to MC minus 1)

This table pertains to any measurement code that has lower value and within 24 of a Primary or Secondary Measurement Code (see below). These definitions apply relative to every Primary and Secondary code. For example, AST (time of ascent start, MC=500) and AET (time of ascent end, MC=600) are both Primary MCs. There exists a measurement code MC minus 4 for both AST and AET which is assigned to any averaged measurement that is taken while transitioning towards the MC. If an averaged measurement is recorded while transitioning towards AST, the correct MC=496. If an averaged measurement is recorded while transitioning towards AET, the correct MC=596.

Relative Measurement code	Meaning
MC minus 1	Any single measurement transitioning towards MC (see MC-10 for a 'series' of measurements)
MC minus 2	Maximum value while float is transitioning towards an MC (e.g. pressure)
MC minus 3	Minimum value while float is transitioning towards an MC (e.g. pressure)
MC minus 4	Any averaged measurements made during transition to MC
MC minus 5	Median value while float is transitioning towards an MC
MC minus 6 to MC minus 9	currently unassigned
MC minus 10	Any "series" of measurements recorded while transitioning towards MC. (e.g. Provor 'spy' measurements, SOLOII pressure-time pairs, etc).
MC minus 11	Active adjustment to buoyancy made at this time
MC minus 12 to MC minus 24	currently unassigned

2.3 Measurement Code Table

Measure-ment code	Variable	Meaning	Transmitted by listed float type. Value can be estimated in other floats
0		Launch time and location of the float	All float types
76-99	see above table	Any measurement recorded during transition towards DST	
100	**DST**	**All measurements made when float leaves the surface, beginning descent.** Time (JULD_DESCENT_START)	Time: PROVOR, ARVOR, SOLO-II, WHOI SOLOIR, NEMO, NEMOIR, APEX APF9, APEXIR APF9
101-125	unassigned	Reserved for specific timing events around DST.	
126-149	see above table	Any measurement recorded during transition towards FST	
150	**FST**	**All measurements made at time when a float first becomes water-neutral.** Time (JULD_FIRST_STABILIZATION)	PROVOR, ARVOR
151-175	unassigned	Reserved for specific timing events around FST.	
176-199	see above table	Any measurement recorded during transition towards DET	
200	**DET**	**All measurements made at time when float first approaches within 3% of the eventual drift pressure.** Float may be transitioning from the surface or from a deep profile. This variable is based on measured or estimated pressure only In the case of a float that overshoots the drift pressure on descent, DET is the time of the overshoot. Time (JULD_DESCENT_END)	Time: PROVOR, ARVOR, SOLO-II, NEMO, NEMOIR
201-202 & 204-225	unassigned	Reserved for specific timing events around DET.	
203		Deepest bin reached during descending profile	
226-249	see above table	Any measurement recorded during transition towards PST	
250	**PST**	**All measurements made at time when float transitions to its Park or Drift mission**. This variable is based on float logic based on a descent timer (i.e. SOLO), or be based on measurements of pressure (i.e.	APEX non APF9, APEX APF9, APEX APF9i, SIO SOLO, SOLO-II, NEMO, NEMOIR CTD:

		Provor). Time(JULD_PARK_START)	WHOI SOLO NINJA
251-275	unassigned	Reserved for specific timing events around PST.	
276-299	see above table	Any measurement recorded during transition towards PET	
300	**PET**	**All measurements made at time when float exits from its Park or Drift mission.** It may next rise to the surface (AST) or sink to profile depth Time (JULD_PARK_END)	Time: PROVOR (excluding PROVOR MT), ARVOR, SOLO-II, NEMO, NEMOIR, POPS CTD: WHOI SOLO
301		Representative Park <PARAM> found either from measurements taken during drift or from metafile information	
302-325	unassigned	Reserved for specific timing events around PET.	
376-399	see above table	Any measurement recorded during transition towards DDET	
400	**DDET**	**All measurements made at time when float first approaches within 3% of the eventual deep drift/profile pressure**. This variable is based on pressure only and can be measured or estimated. Time (JULD_DEEP_DESCENT_END)	Time: APEX APF9a or APF9t, APF9i, PROVOR CTS3, ARVOR, SOLO-II, POPSm
401-425	unassigned	Reserved for specific timing events around DDET.	
426-449	see above table	Any measurement recorded during transition towards DPST	
450	**DPST**	**All measurements made at time when float transitions to a deep park drift mission.** This variable is only defined if the float enters a deep drift phase (i.e. DPST not defined in cases of constant deep pressure due to bottom hits, or buoyancy issues).	
451-475	unassigned	Reserved for specific timing events around DPST.	
476-499	see above table	Any measurement recorded during transition towards AST	
500	**AST**	**All measurements made at the start of the float's ascent to the surface** Time (JULD_ASCENT_START)	Time: APEX APF9, PROVOR, ARVOR, SOLO-II, NEMO, NEMOIR, POPS
501		Down-time end time: end date of the down-time parameter reported by APEX floats	APEX
502		Ascent start time directly transmitted by APEX floats	APEX
503		Deepest bin reached during ascending profile	
504-525	unassigned	Reserved for specific timing events around AST.	
526-549	see above table	Any measurement recorded during transition towards DAST	
550	**DAST**	**All measurements made at the start of the float's ascent from profile pressure to drift pressure**. Used for floats that profile on descent and then move back up to drift pressure. Time (JULD_DEEP_ASCENT_START)	Time: Deep SOLO-II
551-575	unassigned	Reserved for specific timing events around DAST.	
576-599	see above table	Any measurement recorded during transition towards AET	
600	**AET**	**All measurements made at the end of**	PROVOR, ARVOR, SOLO-II,

		ascent. Time (JULD_ASCENT_END)	NEMO, NEMOIR, POPS
601-625	unassigned	Reserved for specific timing events around AET.	
676-699	see above table	Any measurement recorded during transition towards TST	
700	**TST**	**Time and location of the start of transmission for the float.** Time (JULD_TRANSMISSION_START)	APEX APF9, APEXIR APF9, PROVOR, ARVOR, SOLO-II, NEMO, NEMOIR, POPS
701		Transmission start time directly transmitted by APEX float	APEX
702	**FMT**	**Earliest time of all messages received by telecommunications system** – may or may not have a location fix. Time (JULD_FIRST_MESSAGE)	All floats
703		Surface times and locations (if available) during surface drift. Should be listed in chronological order.	All floats
704	**LMT**	**Latest time of all messages received by telecommunications system** – may or may not have a location fix. Time (JULD_LAST_MESSAGE)	All floats
705-725	unassigned	Reserved for specific timing events around TST	
776-799	see above table	Any measurement recorded during transition towards TET	
800	**TET**	**Time and location of the end of transmission for the float.** Time (JULD_TRANSMISSION_END)	PROVOR, ARVOR, SOLO-II, APEXIR APF9
801-825	unassigned	Reserved for specific timing events around TET	
901		Grounded flag Configuration phase	
902		Last time before float recovery. For floats that have been recovered, it is important to know when this occurred. This time in the JULD array will be the last time before the float was recovered. Determined by inspection of data	