ILRS Operations Center Quality Check Specification

Version 1.3

Version	Record Type	Record Name	Field Name	Changes
1.3	20	Meteorological	n/a	Added warning check for at least two meteorological records
	20	Meteorological	n/a	Added warning check for at least one meteorological record per 30 minutes of pass segment (i.e. H4 end - H4 Start / 30 min)
	20	Meteorological	n/a	Added warning check for at least one meteorological record within the start and end times in H4 record +/- 10min
1.2	20	*	*	Corrected spelling of "meteorological"
	20	Meteorological	Seconds of day	Warning if outside header by more than 10 minutes, error if outside header by more than 1 hr (change occurred in 1.0 but wasn't recorded in log properly)
	40	Calibration	Seconds of day	Changed from Error to Warning (change occurred in 1.1 but wasn't recorded in log)
1.1	11	Range (Normal Point)	Seconds of day	Changed from Error to Warning if outside bounds of of H4 record. Allow +/- 1 minute of H4 record
	11	Range (Normal Point)	Normal point window length (sec)	Changed from Error to Warning if bin size does not match satellie on ILRS list
	H4	Session (Pass) Header	Ending *	Changed from Error to Warning
	50	Session (Pass) Statistics	Session RMS from the mean of raw, accepted time of flight values minus the trend function	Changed lower bound to 1e-3 to flag 0 values as warnings
1	C1	Laser Configuration	Beam Divergence (arcsec)	Changed upper beam divergence limit to 400 arcs (this is full angle as in the site logs)
	H4	Session (Pass) Header	Ending *	Removed -1 as an acceptable value for ending of the pass
	20	Meterological	Seconds of day	Added error if Met data is outside of the header more than 1 hr
0.9	*			Original as of 2019-04-27

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H1	Format Header	H1	"H1" or "h1"	"H1" or "h1"	Error	
H1	Format Header	CRD	"CRD" or "crd"	"CRD" or "crd"	Error	
H1	Format Header	Format Version	1, 2	[0 (warning),1,…99]	Error	
H1	Format Header	Year of file production		[1950,…,2100]	Error	
H1	Format Header	Month of file production		[1,…,12]	Error	
H1	Format Header	Day of file production		[1,…,31]	Error	
H1	Format Header	Hour of file production (UTC)		[0,…23]	Error	
H1	Format Header	Other H1 Check	One and only one H1 Record Must Exist	One and only one H1 Record Must Exist	Error	
H1	Format Header	Other H1 Check		Date of file production must be valid	Error	
H1	Format Header	Other H1 Check		Date/time of file production must be before current time (recommended check against system time)	Error	
H1	Format Header	Other H1 Check	Fixed Format	Wrong pattern of record (spaces at wrong positions) or record length not exact 23 characters	Error	
H2	Station Header	H2	"H2" or "h2"	"H2" or "h2"	Error	
H2	Station Header	Station name from official list		Station name exists on official list	Error	
H2	Station Header	Crustal Dynamics Project 4-Digit Pad Identifier				
H2	Station Header	Crustal Dynamics Project 2-digit system number				
H2	Station Header	Crustal Dynamics Project 2-digit occupancy sequence number				
H2	Station Header	Station Epoch Time Scale – indicated the time scale reference	[0,1,…]	[3,4,7] others need advanced authorization	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H2	Station Header	Other H2 Check	One and only one H2 Record Must Exist	One and only one H2 Record Must Exist	Error	
H2	Station Header	Other H2 Check		Station name and pad ID must be from the same station		
H2	Station Header	Other H2 Check		CDP and station occupancy numbers exist in station lists	Error	
H2	Station Header	Other H2 Check	Fixed Format	Wrong pattern of record (spaces at wrong positions) or record length not exact 27 characters	Error	
H3	Target Header	H3	"H3" or "h3"	"H3" or "h3"	Error	
H3	Target Header	Target name from official list		Target name must be found on official target name	Error	
H3	Target Header	Target name from official list		Target name should be in lowercase and right justified	Warning	
H3	Target Header	Target name from official list		Target Information must be correct/SIC must fit to satellite name	Error	
H3	Target Header	ILRS Satellite Identifier (Based on COSPAR ID)		Satellite Identifier must be found in ILRS list	Error	
H3	Target Header	SIC		Target SIC must be found on official target SIC list	Error	
H3	Target Header	SIC		SIC must fit to satellite name	Error	
H3	Target Header	NORAD ID		NORAD ID must be found on official target NORAD ID based in ILRS ID or -1	Error	CDDIS wants to ensure that all data is correct. If the IDs don't match, it'll be an error. If this causes problems, the standard can be revised.
H3	Target Header	NORAD ID		NORAD id must fit to satellite name	Error	
H3	Target Header	Spacecraft Epoch Time Scale	[0,1,2]	[0,1,2]	Error	
H3	Target Header	Target type	[1,2,3,4]	[1,…,4]	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H3	Target Header	Target class	[0,1,2,3,4,5]	[0,1,3,4,5]; note that "2" is deprecated, should trigger an error	Error	In version 2, target class replaces target type
H3	Target Header	Target location/dynamics	[-1,0,1,2,…,10]	[-1,0,1,2,…,10]	Error	
H3	Target Header	Other H3 Check	One and only one H3 Record Must Exist	Only one H3 Record Must Exist	Error	
H3	Target Header	Other H3 Check		Target type must be found on official target type based on ILRS ID Target class must be found on official target class based on ILRS ID	Error	
H3	Target Header	Other H3 Check		If Target Type ==3 or ==4 Transponder Configuration C4 Record Required If Target class ==3 or ==4, Transponder Configuration C4 Record Required	Error	
H3	Target Header	Other H3 Check	Fixed Format	Wrong pattern of record (spaces at wrong positions) or record length not exact 40 characters	Error	
H4	Session (Pass) Header	H4	"H4" or "h4"	"H4" or "h4"	Error	
H4	Session (Pass) Header	Data Type	[0,1,2]	[0,1,2,]	Error	
H4	Session (Pass) Header	Data Type		Data type !=1 for normal points (11 record)	Error	
H4	Session (Pass) Header	Data Type		Data type !=0 for fullrate data (10 record)	Error	
H4	Session (Pass) Header	Starting Year		[1950,…,2100]	Error	
H4	Session (Pass) Header	Starting Month		[1,…,12]	Error	
H4	Session (Pass) Header	Starting Day		[1,…,31]	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H4	Session (Pass) Header	Starting Hour		[0,…23]	Error	
H4	Session (Pass) Header	Starting Minute		[0,…,59]	Error	
H4	Session (Pass) Header	Starting Second		[0,…,59]	Error	
H4	Session (Pass) Header	Ending Year		[1950,…,2100]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	Ending Month		[1,…,12]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	Ending Day		[1,…,31]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	Ending Hour		[0,…23]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	Ending Minute		[0,…,59]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	Ending Second		[0,…,59]	Warning	Removed -1 as input, it was causing data center problems
H4	Session (Pass) Header	A flag to indicate the data release	[0, 1, 2,…]	[0,…,99]	Error	
H4	Session (Pass) Header	Tropospheric refraction correction applied indicator	[0,1]	[0,1]; if set to 1, a record 12 must exist	Error	
H4	Session (Pass) Header	Center of mass correction applied indicator	[0,1]	[0,1]; if set to 1, a record 12 must exist	Error	
H4	Session (Pass) Header	Received amplitude correction applied indicator	[0,1]	[0,1]	Error	
H4	Session (Pass) Header	Station system delay applied indicator	[0,1]	[0,1]	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H4	Session (Pass) Header	Spacecraft system delay applied (transponders) indicator	[0,1]	[0,1]	Error	
H4	Session (Pass) Header	Range type indicator	[0,1,2,3,4]	[0,1,2,3,4]	Error	
H4	Session (Pass) Header	Data quality alert indicator	[0,1,2]	[0,1,2]	Error	
H4	Session (Pass) Header	Other H4 Check	One and only one H4 Record Must Exist	Only one H4 Record Must Exist	Error	
H4	Session (Pass) Header	Other H4 Check		Starting date must be valid (e.g. not June 31st)	Error	
H4	Format Header	Other H4 Check		Start date/time must be before current time (recommended check against system time)	Error	
H4	Session (Pass) Header	Other H4 Check		Ending date must be valid	Error	
H4	Format Header	Other H4 Check		End date/time must be before current time (recommended check against system time)	Error	
H4	Format Header	Other H4 Check		End date/time must be after start date/time	Error	
H4	Session (Pass) Header	Other H4 Check	Fixed Format	Wrong pattern of record (spaces at wrong positions) or record length not exact 62 characters	Error	
H4	Session (Pass) Header	Other H4 Check		End Year - Start Year must be <=1, (iff end year != -1)	Error	
H4	Session (Pass) Header	Other H4 Check		Duration must be less than one day (MJD or unix or whatever)	Error	
H5	Prediction Header	H5	"H5" or "h5"	"H5" or "h5"	Error	
H5	Prediction Header	Prediction Type	[0,1,2]	[0,1,2]	Warning	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
H5	Prediction Header	Year of century from CPF or TLE	[0,1,…99]	[0,1,…99]	Warning	
H5	Prediction Header	Date and Time	CPF H2 starting date and hour (MMDDHH); TLE epoch day/fraction from line 1	If Prediction Type ==1, then MMDDHH; If Prediction Type ==2, then [1.000000,…366.999999]	Warning	
H5	Prediction Header	Prediction Provider	From CPF "H1" or TLE source			
H5	Prediction Header	Sequence Number	CPF sequence number from "H1" or TLE revolution number from line 2	[1, 2,…, 99999] (TLEs give 5 digits for revolutions)	Warning	
H8	End of Session Footer	H8	"H8" or "h8"	"H8" or "h8"	Error	
H8	End of Session Footer	Other H8 Check		Must contain H8 before H9	Error	
H8	End of Session Footer	Other H8 Check		One and only one H8 Record Must Exist in single pass file	Error	
H8	End of Session Footer	Other H8 Check		Must have same number of H4 and H8 records		
H9	End of File Footer	H9	"H9" or "h9"	"H9" or "h9"	Error	
H9	End of File Footer	Other H9 Check	One and only one H9 Record Must Exist	One and only one H9 Record Must Exist at the end of file	Error	
C0	System Configuration	C0	"C0" or "c0"	"C0" or "c0"	Error	
C0	System Configuration	Detail Type	0	0	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C0	System Configuration	Transmit Wavelength (nm)		[354, 423, 532, 694, 847, 1064] with any decimal value permitted	Error	List based on JCET and EDC lists of values seen in data.
C0	System Configuration			C0 record Transmit Wavelength < = C1 Primary Wavelength		
C0	System Configuration			C0 record Transmit Wavelength < = C2 Applicable Wavelength		
C0	System Configuration	System Configuration ID				
C0	System Configuration	Component A configuration ID				
C0	System Configuration	Component B configuration ID				
C0	System Configuration	Component C configuration ID				
C0	System Configuration	Component D configuration ID				
C0	System Configuration	Component E configuration ID				
C0	System Configuration	Component F configuration ID				
C0	System Configuration	Other C0 Check		The record length must be at least 4 characters	Error	
C1	Laser Configuration	C1	"C1" or "c1"	"C1" or "c1"	Error	
C1	Laser Configuration	Detail Type	0	0	Error	
C1	Laser Configuration	Laser Configuration ID		Laser configuration id match C0 record Component A configuration id	Warning	
C1	Laser Configuration	Laser Type				

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C1	Laser Configuration	Primary wavelength (nm)		[354, 423, 532, 694, 847, 1064, 2000] with any decimal value permitted	Error	List based on JCET and EDC lists of values seen in data. Note that 2000 is included here and not under transmit wavelength.
C1	Laser Configuration	Nominal Fire Rate (Hz)		[-1,0,1,…10000] or not in [> 0] (n.a. -1)	Warning	
C1	Laser Configuration	Pulse Energy (mJ)		[-1,0,1,…1000] or not in [> 0] (n.a. -1)	Warning	
C1	Laser Configuration	Pulse Width (FWHM in ps)		[-1,0,1,…10000] or not in [> 0] (n.a. -1)	Warning	
C1	Laser Configuration	Beam Divergence (arcsec)		[-1,0,1,…400] (n.a. -1)	Warning	Full angle
C1	Laser Configuration	Number of pulses in outgoing semi-train		[-1,0,1,…1000] or not in [> 0] (n.a. -1)	Warning	
C1	Laser Configuration	Other		The record length must contain 10 fields	Error	
C2	Detector Configuration	C2	"C2" or "c2"	"C2" or "c2"	Error	
C2	Detector Configuration	Detail Type	0	0	Error	
C2	Detector Configuration	Detector Configuration ID		Detector Configuration ID match C0 record Component B configuration id	Warning	
C2	Detector Configuration	Detector Type				
C2	Detector Configuration	Applicable wavelength (nm)		[354, 423, 532, 694, 847, 1064] with any decimal value permitted	Error	List based on JCET and EDC lists of values seen in data.

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C2	Detector Configuration	Quantum efficiency at applicable wavelength (%)		[-1,…,100]	Warning	
C2	Detector Configuration	Applied voltage (V)		[-1.e4,…,1e4]	Warning	
C2	Detector Configuration	Dark Count (kHz)		[-1,…,1e3]	Warning	
C2	Detector Configuration	Output pulse type				
C2	Detector Configuration	Output pulse width (ps)		[-1,…,1e6]	Warning	
C2	Detector Configuration	Spectral Filter (nm)		[-1,…,1064]	Warning	
C2	Detector Configuration	% Transmission of Spectral Filter		[-1,…,100]	Warning	
C2	Detector Configuration	Spatial Filter (arcsec)		[-1,…,3600]	Warning	
C2	Detector Configuration	External Signal processing				
C2	Detector Configuration	Amplifier Gain				
C2	Detector Configuration	Amplifier Bandwidth (kHz)				
C2	Detector Configuration	Amplifier in Use	[-1,0,1]	[-1,0,1]	Warning	
C2	Detector Configuration	Other		The record length must contain 14 (17) fields	Error	Only catches lunar data from Matera
C3	Timing Configuration	C3	"C3" or "c3"	"C3" or "c3"	Error	
C3	Timing Configuration	Detail Type	0	0	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C3	Timing Configuration	Timing System Configuration ID		Timing system configuration id match C0 record Component C configuration id	Warning	
C3	Timing Configuration	Time Source				
C3	Timing Configuration	Frequency Source				
C3	Timing Configuration	Timer				
C3	Timing Configuration	Timer Serial Number				
C3	Timing Configuration	Epoch Delay Correction (µs)		[-1,-5.e5,...,5.e5]	Warning	
C3	Timing Configuration	Other		The record length must contain 8 fields	Error	
C4	Transponder (Clock)	C4	"C4" or "c4"	"C4" or "c4"	Error	
C4	Transponder (Clock)	Detail Type	0	0	Error	
C4	Transponder (Clock)	Transponder Configuration ID		Transponder configuration if match C0 record Component D configuration id	Warning	
C4	Transponder (Clock)	Estimated Station UTC offset (ns)		[-1000, ..., 1000]	Warning	
C4	Transponder (Clock)	Estimated Station Oscillator Drift (in parts in 10^{15})		[-1000,...,1000]	Warning	
C4	Transponder (Clock)	Estimated Transponder UTC offset (ns)		[-100,...,100]	Warning	
C4	Transponder (Clock)	Estimated Transponder Oscillator Drift (in parts in 10^{15})		[-1e8,...,1e8]	Warning	
C4	Transponder (Clock)	Transponder Clock Reference Time (seconds, scaled or unscaled)		[-100,...100]	Warning	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C4	Transponder (Clock)	Station clock offset and drift applied indicator	[0,1,2,3]	[0,1,2,3]	Warning	
C4	Transponder (Clock)	Spacecraft clock offset and drift applied indicator	[0,1,2,3]	[0,1,2,3]	Warning	
C4	Transponder (Clock)	Spacecraft time simplified	[0,1]	[0,1]	Warning	
C4	Transponder (Clock)	Other		The record length must contain 11 fields	Error	
C5	Software Config	C5	"C5" or "c5"	"C5" or "c5"	Error	
C5	Software Config	Detail Type	0	0	Error	
C5	Software Config	Software Configuration ID				
C5	Software Config	Tracking Software in Measurement Path	(if more than one program, comma delimited)			
C5	Software Config	Tracking Software Version(s)	(if more than one program, comma delimited)			
C5	Software Config	Processing Software in Measurement Path	(if more than one program, comma delimited)			
C5	Software Config	Processing Software Version(s)	(if more than one program, comma delimited)			
C6	Meteorological Intrumentation Configuration	C6	"C6" or "c6"	"C6" or "c6"	Error	
C6	Meteorological Intrumentation Configuration	Detail Type	0	0	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
C6	Meteorological Intrumentation Configuration	Meteorological Configuration ID	unique within the file			
C6	Meteorological Intrumentation Configuration	Pressure Sensor Manufacturer				
C6	Meteorological Intrumentation Configuration	Pressure Sensor Model				
C6	Meteorological Intrumentation Configuration	Pressure Sensor Serial Number				
C6	Meteorological Intrumentation Configuration	Temperature Sensor Manufacturer				
C6	Meteorological Intrumentation Configuration	Temperature Sensor Model				
C6	Meteorological Intrumentation Configuration	Temperature Sensor Serial Number				
C6	Meteorological Intrumentation Configuration	Humidity Sensor Manufacturer				
C6	Meteorological Intrumentation Configuration	Humidity Sensor Model				
C6	Meteorological Intrumentation Configuration	Humidity Sensor Serial Number				
10	Range (Full rate)	10	"10"	"10"	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
10	Range (Full rate)	Seconds of day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
10	Range (Full rate)	Seconds of day		Time falls between the start and end times in H4 record. E.g. H4 start date/time ≤ H4 start date + 10 record seconds of day ≤ H4 end date/time	Error	LLR exempt because much LLR data is delivered as many sessions in one file.
10	Range (Full rate)	Time of flight in seconds		[-1,0, …,3]	Error	Round trip time to the moon is under 3 seconds; if we will receive data to a distant object, we should revisit.
10	Range (Full rate)	System configuration id		System configuration ID must be in C0-record	Error	
10	Range (Full rate)	Epoch event	[0,1,2,3,4,5,6]	[0,1,2,3,4,5,6]	Warning	
10	Range (Full rate)	Filter flag	[0,1,2]	[0,1,2]	Warning	
10	Range (Full rate)	Detector channel		[0,1,…, 99]	Error	
10	Range (Full rate)	Stop number	[0,1,…]	[0,1,…, 99]	Error	
10	Range (Full rate)	Receive Amplitude		[-1, 0,…,99999]	Warning	
10	Range (Full rate)	Transmit Amplitude		[-1, 0,…,99999]	Warning	
10	Range (Full rate)	Other 10 Check		The record length must contain 9 (10) fields	Error	
11	Range (Normal Point)	11	"11"	"11"	Error	
11	Range (Normal Point)	Seconds of day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
11	Range (Normal Point)	Seconds of day		Time falls between the start and end times in H4 record, +/- 1 minute E.g. H4 start date/time - 1 minute ≤ H4 start date + 11 record seconds of day ≤ H4 end date/time + 1 minute	Warning	LLR exempt because much LLR data is delivered as many sessions in one file.
11	Range (Normal Point)			Must be in same revolution	Error	
11	Range (Normal Point)	Time of flight in seconds		[-1,0, …,3]	Error	Round trip time to the moon is under 3 seconds.
11	Range (Normal Point)	System configuration id		Valid System Configuration ID/ System configuration ID must be in C0-record	Error	
11	Range (Normal Point)	Epoch event	[0,1,2,3,4,5,6]	[0,1,2,3,4,5,6]	Warning	
11	Range (Normal Point)	Normal point window length (sec)		[0,1,…300]	Error	LLR exempt; satellites have specific bins, LLR is highly variable
11	Range (Normal Point)	Normal point window length (sec)		Must match bin size for satellite from ILRS list	Warning	
11	Range (Normal Point)	Normal point window length (sec)		Each normal point must be from a different bin.	Warning	
11	Range (Normal Point)	Number of raw ranges	6-digit integer	[0,1,…]	Warning	
11	Range (Normal Point)	Bin RMS from mean of raw accepted time of flight values minus the trend function (ps)		[0,…6667]	Warning	Equivalent to 1m RMS

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
11	Range (Normal Point)	Bin skew from mean of raw accepted time of flight values minus the trend function		[-2,…,2]	Warning	
11	Range (Normal Point)	Bin kurtosis from mean of raw accepted time of flight values minus the trend function		[-2,…,3]	Warning	LLR exempt
11	Range (Normal Point)	Bin peak – mean (ps)		[-1000,..,1000]	Warning	LLR exempt
11	Range (Normal Point)	Return rate		[-1,0,1,…,100]	Warning	
11	Range (Normal Point)	Detector channel	[0, 1,…]	[0,1,…, 99]	Error	
11	Range (Normal Point)	Signal-to-Noise Ratio (S:N)				
11	Range (Normal Point)	Other 11 Check		The record length must contain 13 (14) fields	Error	
12	Range Supplement	12	"12"	"12"	Error	
12	Range Supplement	Seconds of day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
12	Range Supplement	Seconds of day		Time falls between the start and end times in H4 record. E.g. H4 start date/time ≤ H4 start date + 12 record seconds of day ≤ H4 end date/time	Error	
12	Range Supplement	System configuration id		Valid system configuration id/ System configuration id must be in C0 record	Error	
12	Range Supplement	Tropospheric refraction correction, ps, one-way		[-1,0,..,1e4]	Warning	Comments indicate 2.5m/c, which is 8.34ns.

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
12	Range Supplement	Target center of mass correction, m, one-way		[-1,0,...,100]	Warning	
12	Range Supplement	Neutral density filter value		[-1,0,...,100]	Warning	
12	Range Supplement	Time bias applied (seconds)		[-10,...,10]	Warning	
12	Range Supplement	Range Rate (seconds/seconds)				
12	Range Supplement	Other 12 Check		The record length must contain 7 (8) fields	Error	
20	Meteorological	20	"20"	"20"	Error	
20	Meteorological	Seconds of day		[0,...,86400]	Error	Note: Normal data would be 00000 through 86399. A leap second would use 86400.
20	Meteorological	Seconds of day		Time falls between the start and end times in H4 record +/- 1 hr E.g. H4 start-1 hr < 20 record sec of day < H4 end +1 hr	Error	
20	Meterological	Seconds of day		Time falls between the start and end times in H4 record +/- 10min. E.g. H4 start-10min < 20 record sec of day < H4 end +10min	Warning	
20	Meteorological	Surface pressure		[700,...,1100]	Error	
20	Meteorological	Surface temperature (K)		[240,...,330]	Error	
20	Meteorological	Relative humidity (%)		[0,...,100]	Error	
20	Meteorological	Origin of values	[0,1]	[-1 ,0,1]	[0,1]	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
20	Meteorological	Other 20 Check		The record length must contain 6 fields	Error	
20	Meteorological			There must be at least one meteorological record	Error	
20	Meteorological			There must be at least two meteorological records	Warning	
20	Meteorological			There must be at least one meteorological record per 30 minutes of pass segment (i.e. H4 end - H4 Start / 30 min)	Warning	
20	Meteorological			There must be at least one meteorological record within the start and end times in H4 record +/- 10min	Warning	For short passes this might be satisfied by the same record
21	Meteorological Supp	21	"21"	"21"	Error	
21	Meteorological Supp	Seconds of Day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
21	Meteorological Supp	Seconds of day		Time falls between the start and end times in H4 record +/- 10min. E.g. H4 start-10min < 20 record sec of day < H4 end +10min	Warning	
21	Meteorological Supp	Wind Speed (m/s)		[-1,…,33]	Warning	Hurricane threshold
21	Meteorological Supp	Wind Direction (deg az, north=0)		[-1, -180, … , 360]	Warning	
21	Meteorological Supp	Precipitation type				
21	Meteorological Supp	Weather Condictions	two-digit SYNOP/WMO code or description, e.g. "rain"			replaces Precipitation Type

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
21	Meteorological Supp	Visibility (km)		[-1,…,100]	Warning	
21	Meteorological Supp	Sky Clarity (zenith extinction coeff)		[-1,…,100]	Warning	
21	Meteorological Supp	Atmospheric seeing (arcsec)		[-1,…,100]	Warning	
21	Meteorological Supp	Cloud cover (%)		[-1,…,100]	Warning	
21	Meteorological Supp	Sky Temperature (deg K)		[220,…300]	Warning	
21	Meteorological Supp	Other 21 Check		The record length must contain 9 (10) fields	Error	
30	Pointing Angles	30	"30"	"30"	Error	
30	Pointing Angles	Seconds of Day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
30	Pointing Angles	Seconds of day		Time falls between the start and end times in H4 record. E.g. H4 start date/time ≤ H4 start date + 30 record seconds of day ≤ H4 end date/time	Error	
30	Pointing Angles	Azimuth in degrees		[-1, -180, … , 360]	Warning	
30	Pointing Angles	Elevation in degrees		[-1,…,90]	Warning	
30	Pointing Angles	Direction Flag	[0,1,2]	[-1,…,2]	Warning	
30	Pointing Angles	Angle origin indicator	[0,1,2,3]	[0,…,3]	Warning	
30	Pointing Angles	Refraction corrected	[0,1]	[0,1]	Warning	
30	Pointing Angles	Azimuth rate (deg/sec)				
30	Pointing Angles	Elevation rate (deg/sec)				
30	Pointing Angles	Other 30 Check		The record length must contain 7 (9) fields	Error	
40	Calibration	40	"40"	"40"	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
40	Calibration	Seconds of day		[0,…,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
40	Calibration	Seconds of day		Within 2 hours of the pass E.g. H4 start date/time - 2hr ≤ 40 record seconds of day ≤ H4 end date/time + 2hr	Warning	
40	Calibration	Type of data	[0,1,2,3,4,5]	[0,…,5]	Error	
40	Calibration	System configuration id		Valid System configuration ID must be in C0 record	Error	
40	Calibration	Number of data points recorded	[-1,0,1,…]	[-1,…,1.e8]	Warning	
40	Calibration	Number of data points used	[-1,0,1,…]	[-1,…,1.e8]	Warning	
40	Calibration	One way target distance (m)	[-1,0,1,…]	[-1,0.0,…1.e4]	Warning	
40	Calibration	Calibration System Delay (ps)		[-1.e5,…,1.e6]	Error	
40	Calibration	Calibration Delay Shift (ps)		[-6671,…,6671]	Error	Based on 1m
40	Calibration	RMS of raw system delay	[-1,…,2.e5]	[-1,0,…,667]	Error	Based on 10cm
40	Calibration	Skew of raw system delay values from the mean		[-2,…,2]	Warning	
40	Calibration	Kurtosis of raw system delay values from the mean		[-2,…,3]	Warning	
40	Calibration	System delay peak – mean		[-1000,..,1000]	Warning	
40	Calibration	Calibration Type Indicator	[0,1,2,3,4,5,6]	[0,1,2,3,4,5,6]	Warning	
40	Calibration	Calibration Shift Type Indicator	[0,1,2,3,4]	[0,1,2,3,4]	Warning	
40	Calibration	Detector channel	[0,1,…]	[0,…,99]	Warning	
40	Calibration	Calibration Span	[0,1,2,3,4]	[0,1,2,3,4]	Warning	
40	Calibration	Return Rate	[-1,0,…100]	[-1,0,…100]	Warning	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
40	Calibration	Other 40 Check		The record length must contain 16 (18) fields	Error	
41	Calibration	41	"41"	"41"	Error	
41	Calibration	Seconds of day		[0,...,86400]	Error	Normal data would be 00000 through 86399. A leap second would use 86400.
41	Calibration	Seconds of day		Within 2 hours of the pass E.g. H4 start date/time - 2hr ≤ 41 record seconds of day ≤ H4 end date/time + 2hr	Warning	
41	Calibration	Type of data	[0,1,2,3,4,5]	[0,...,5]	Error	
41	Calibration	System configuration id		Valid System configuration ID must be in C0 record	Error	
41	Calibration	Number of data points recorded	[-1,0,1,...]	[-1,...,1.e8]	Warning	
41	Calibration	Number of data points used	[-1,0,1,...]	[-1,...,1.e8]	Warning	
41	Calibration	One way target distance (m)	[-1,0,1,...]	[-1,0.0,...1.e4]	Warning	
41	Calibration	Calibration System Delay (ps)		[-1.e5,...,1.e6]	Error	
41	Calibration	Calibration Delay Shift (ps)		[-6671,...,6671]	Error	Based on 1m
41	Calibration	RMS of raw system delay	[-1,...,2.e5]	[-1,0,...,667]	Error	Based on 10cm
41	Calibration	Skew of raw system delay values from the mean		[-2,...,2]	Warning	
41	Calibration	Kurtosis of raw system delay values from the mean		[-2,...,3]	Warning	
41	Calibration	System delay peak – mean		[-1000,..,1000]	Warning	
41	Calibration	Calibration Type Indicator	[0,1,2,3,4,5,6]	[0,1,2,3,4,5,6]	Warning	
41	Calibration	Calibration Shift Type Indicator	[0,1,2,3,4]	[0,1,2,3,4]	Warning	
41	Calibration	Detector channel	[0,1,...]	[0,...,99]	Warning	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
41	Calibration	Calibration Span	[0,1,2,3,4]	[0,1,2,3,4]	Warning	
41	Calibration	Return Rate	[-1,0,…100]	[-1,0,…100]	Warning	
41	Calibration	Other 41 Check		The record length must contain 16 (18) fields	Error	
50	Session (Pass) Statistics	50	"50"	"50"	Error	
50	Session (Pass) Statistics	System Configuration id		Valid system configuration ID/ System configuration ID must be in C0-record	Error	
50	Session (Pass) Statistics	Session RMS from the mean of raw, accepted time of flight values minus the trend function		[-1,1e-3,…,667]	Warning	Based on 10cm
50	Session (Pass) Statistics	Session skewness from the mean of raw accepted time of flight values minus the trend function		[-2,…,2]	Warning	
50	Session (Pass) Statistics	Session Kurtosis from the mean of raw accepted time of flight values minus the trend function		[-2,…,5]	Warning	
50	Session (Pass) Statistics	Session peak – mean		[-1000,..,1000]	Warning	
50	Session (Pass) Statistics	Data quality assessment indicator	[0,1,2,3,4,5]	[0,1,2,3,4,5]	Warning	
50	Session (Pass) Statistics	Other 50 Check		The record length must contain 7 fields	Error	
60	Compatibility Record	60	"60"	"60"	"60"	
60	Compatibility Record	System configuration id		"Valid System Configuration ID" or "Valid system configuration ID/ System configuration ID must be in C0-record"	Error	

Record Type	Record Name	Field Name	CRD Format Specification	New Spec	Error Type	Notes
60	Compatibility Record	System change indicator	[0,1,2,3,4,5,6,7,8,9]	[-1,0,…,9]	Warning	
60	Compatibility Record	System Configuration indicator		[-1,0,…,9]	Warning	
60	Compatibility Record	Other 60 Check		The record length must contain 4 fields	Error	
9X	User-defined	9X	"9"+[0,1,2,3,4,5,6,7,8,9]	not in ['9x']	Error	
00	Comment	00	"00"	"00"		
00	Comment	Other Comment Check		Length of Line must be less than or equal to 80 characters	Error	
global	Other Format Check	Other Format Check	Record type must be recognized	Record type must be recognized	Error	
global	Other Format Check	Other Format Check	There must be a C1-3 or 60 record	There must be a C1-3 or 60 record	Error	