

# Tables of ADES Tags and Structures

October 26, 2023

# 1 Table of ADES Elements

XML elements are the things which appear as XML tags, such as <permID> value </permID>. The ones in this table are all top-level elements, which means they can be the root of their own XML document and thus validated against XSD individually. The last element in the table, “ades,” is intended to be used as the root element for every XML document used for interchange. All elements are written in camelCase with the first character not capitalized.

## Elements and their Descriptions

ADES observation sub-elements		
Name	Type	Description
<b>permID</b>	PermIDType	IAU permanent designation, i.e., IAU number
<b>provID</b>	ProvIDType	MPC provisional designation (unpacked form) for unnumbered object
<b>artSat</b>	StringTypeW25	Name of an artificial satellite
<b>trkSub</b>	TrkSubType	Observer-assigned tracklet identifier, unique within submission batch.
<b>obsID</b>	ObsIDType	Globally Unique Observation ID assigned by MPC.
<b>obsSubID</b>	ObsIDType	Observation identifier, optionally included with the submission, that is unique to a given observing program. This element is intended to support extended analyses associated with major observing programs.
<b>trkID</b>	TrkIDType	Globally Unique alphanumeric tracklet ID assigned by MPC

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<b>trkMPC</b>	TrkIDType	MPC-internal tracklet identifier, used in cases where the value of the trkSub element should be considered deprecated.
<b>mode</b>	ModeType	Mode of optical and offset observations.
<b>stn</b>	StationType	Observatory code from MPC list.
<b>trx</b>	StationType	Station code of transmitting antenna.
<b>rcv</b>	StationType	Station code of receiving antenna.
<b>sys</b>	SysType	Coordinate system for station coordinates and covariance.
<b>ctr</b>	SPICEIDType	Origin of the reference system. Use public SPICE codes, e.g., 399 is the geocenter, 10 is the Sun center. Note; sys=WGS84 implies ctr=399
<b>pos1</b>	DecimalTypeW14	Position of observer per sys, 1st value
<b>pos2</b>	DecimalTypeW14	Position of observer per sys, 2nd value
<b>pos3</b>	DecimalTypeW14	Position of observer per sys, 3rd value
<b>posCov11</b>	DoubleTypeW21	11 covariance per sys
<b>posCov12</b>	DoubleTypeW21	12 covariance per sys
<b>posCov13</b>	DoubleTypeW21	13 covariance per sys
<b>posCov22</b>	DoubleTypeW21	22 covariance per sys
<b>posCov23</b>	DoubleTypeW21	23 covariance per sys
<b>posCov33</b>	DoubleTypeW21	33 covariance per sys
<b>prog</b>	ProgType	Program code as assigned by the MPC.

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<b>obsTime</b>	TimeType	UTC time of the observation in ISO 8601 format, i.e., <i>yyyy-mm-ddThh:mm:ss.ssZ</i> .
<b>rmsTime</b>	PosDecimalTypeW8	Random component of the obsTime $1\sigma$ uncertainty in seconds as estimated by the observer.
<b>ra</b>	RAType	J2000.0 Astrometric equatorial right ascension in decimal degrees.
<b>dec</b>	DeclinationType	J2000.0 Astrometric equatorial declination in decimal degrees. Positive DEC values may optionally include a + sign
<b>raStar</b>	RAType	J2000.0 RA in decimal degrees of the occulted star
<b>decStar</b>	DeclinationType	J2000.0 DEC in decimal degrees of the occulted star
<b>obsCenter</b>	ObsCenterType	Center of offset observation may be planet or other body with PermID or ProvID
<b>deltaRA</b>	DecimalTypeW10	Measured $\Delta(\text{RA} \cos \text{DEC})$ in arcseconds. For offset measurements of a satellite with respect to its primary, or for occultation observations with respect to the star in rectangular coordinates, J2000.0 frame.

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<b>deltaDec</b>	DecimalTypeW10	Measured $\Delta$ DEC in arcseconds. For offset measurements of a satellite with respect to its primary, or for occultation observations with respect to the star in rectangular coordinates, J2000.0 frame
<b>dist</b>	PosDecimalTypeW10	Measured distance in arcseconds. For offset measurements of a satellite with respect to its primary, or for occultation observations with respect to the star in polar coordinates.
<b>pa</b>	RAType	Measured position angle in degrees. For offset measurements of a satellite with respect to its primary, or for occultation observations with respect to the star in polar coordinates.
<b>rmsRA</b>	PosDecimalTypeW7	Random component of the RA cos DEC $1\sigma$ uncertainty in arcseconds as estimated by the observer as part of the image processing and astrometric reduction.
<b>rmsDec</b>	PosDecimalTypeW7	Random component of the DEC $1\sigma$ uncertainty in arcseconds as estimated by the observer as part of the image processing and astrometric reduction.

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<b>rmsDist</b>	PosDecimalTypeW6	Random component of the distance $1\sigma$ uncertainty in arcseconds as estimated by the observer as part of the image processing and astrometric reduction.
<b>rmsPA</b>	PosDecimalTypeW6	Random component of the polar angle $1\sigma$ uncertainty in degrees as estimated by the observer as part of the image processing and astrometric reduction.
<b>rmsCorr</b>	CorrDecimalType	Correlation between RA and DEC or dist and PA that may result from the astrometric reduction. This is derived from the RA-DEC or dist-PA covariance matrix, where the off-diagonal term is $\text{rmsCorr} * \text{rmsRA} * \text{rmsDec}$ or $\text{rmsCorr} * \text{rmsDist} * \text{rmsPA}$ .
<b>delay</b>	PosDecimalTypeW14	Observed radar delay value in seconds.
<b>rmsDelay</b>	PosDecimalTypeW6	Measurement $1\sigma$ uncertainty in $\mu\text{s}$ for radar delay
<b>doppler</b>	DecimalTypeW14	observed radar doppler value in Hz
<b>rmsDoppler</b>	PosDecimalTypeW6	Measurement $1\sigma$ uncertainty in Hz for radar doppler
<b>astCat</b>	CatType	Star catalog used for the astrometric reduction or for the occulted star in the case of occultation observations.)
<b>mag</b>	DecimalTypeW8	Apparent Magnitude in specified band

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<b>rmsMag</b>	PosDecimalTypeW6	Apparent magnitude $1\sigma$ uncertainty in magnitudes.
<b>band</b>	BandType	Filter designation for photometry.
<b>photCat</b>	CatType	Star catalog used for photometry measurements.
<b>photAp</b>	PosDecimalTypeW6	Photometric aperture radius in arcseconds.
<b>nucMag</b>	LogicalType	Nuclear magnitude flag for comets. 0 for total magnitude (i.e., for most archival comet observations and all asteroid observations), 1 for nuclear magnitude. Primarily used for archival data as photAp should be used to communicate this information in the new standard
<b>logSNR</b>	DecimalTypeW6	$\log_{10}$ of the signal-to-noise ratio of the source in the image integrated on the entire aperture used for the astrometric centroid.
<b>shapeOcc</b>	LogicalType	For occultation observations, a flag to indicate that the observation reduction assumes a shape-based (non-circular) plane-of-sky cross-section. False implies that a circular cross section was assumed.

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<b>seeing</b>	PosDecimalTypeW6	Size of seeing disc in arcseconds, measured at Full Width Half Maximum (FWHM) of target point spread function (PSF).
<b>exp</b>	PosDecimalTypeW6	Exposure time in s. Total exposure time in the case of stacked image detections
<b>rmsFit</b>	PosDecimalTypeW6	RMS of fit of astrometric comparison stars in arcseconds.
<b>nStars</b>	PosIntegerTypeW6	Number of stars in astrometric fit.
<b>com</b>	LogicalType	Flag to indicate that the observation is reduced to the center of mass. 0 implies a measurement to the peak power position, which is usually interpreted as the leading edge of the target, with the reflection point being modeled one object radius prior to the center of mass.
<b>frq</b>	FrequencyType	Carrier reference frequency in MHz
<b>ref</b>	RefType	Standard reference field used for citations.
<b>disc</b>	DiscType	Discovery flag; '*' marks a new discovery record; '+' marks the first measurement of a previously observed object; otherwise not present

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<b>subFrm</b>	SubFrmType	Reference frame for the original submission of reported angular measurements.
<b>subFmt</b>	SubFmtType	Format in which the observation was originally submitted to the MPC, e.g., M92 for MPC1992 format or A17 for the current standard standard. Filled by the MPC according to a list provided and maintained by the MPC.
<b>precTime</b>	TimePrecType	Precision in millionths of a day of the reported observation time for archived MPC1992 data records
<b>precRA</b>	RaDecPrecType	Precision in seconds of the reported RA for archived MPC1992 data records.
<b>precDec</b>	RaDecPrecType	Precision in arcseconds of the reported DEC for archived MPC1992 data records.

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<b>uncTime</b>	PosDecimalTypeW8	Estimated time uncertainty in seconds. Unlike the preceding RMS fields, which indicate random errors, this field indicates a presumed level of systematic clock error. NB: This field is generally only to be used to communicate exceptions and problems with clock calibration and is not intended to be used in routine submissions where clock errors are not a significant source of astrometric error.
<b>notes</b>	NotesType	A set of one-character note flags to communicate observing circumstances.
<b>remarks</b>	RemarkType	Comment field provided by the observer. This field can be used to report additional information that is not reportable in the notes field, but that may be of relevance for interpretation of the observations.
<b>deprecated</b>	DeprecatedType	Marks deprecated observation.
<b>localUse</b>	LocalUseType	For user-defined fields in observations

observations residual sub-elements		
Name	Type	Description

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<b>orbProd</b>	StringTypeW100	Orbit producer. Can be institution, individual, or even email address, e.g. 'MPC'
<b>orbID</b>	StringTypeW25	Local reference for orbit, e.g., 'JPL 7' or 'MPO 12345'.
<b>resRA</b>	DoubleTypeW7	Residuals in RA cos DEC in arcseconds
<b>resDec</b>	DoubleTypeW7	Residuals in DEC in arcseconds
<b>selAst</b>	SelResType	Inclusion/rejection flag for astrometry
<b>sigRA</b>	PosDecimalTypeW7	Adopted RA cos DEC $1\sigma$ uncertainty in arcseconds.
<b>sigDec</b>	PosDecimalTypeW7	Adopted DEC $1\sigma$ uncertainty in arcseconds.
<b>sigCorr</b>	CorrDecimalType	Adopted correlation between RA cos DEC and DEC.
<b>sigTime</b>	PosDecimalTypeW8	Adopted $1\sigma$ time uncertainty in seconds.
<b>biasRA</b>	DecimalTypeW8	Adopted RA cos DEC bias in arcseconds.
<b>biasDec</b>	DecimalTypeW8	Adopted DEC bias in arcseconds.
<b>biasTime</b>	DecimalTypeW10	Adopted time bias in s.
<b>photProd</b>	StringTypeW100	Producer of photometric residuals. Can be institution, individual, or even email address, e.g. 'MPC'
<b>resMag</b>	DoubleTypeW7	Photometric residual in magnitudes
<b>selPhot</b>	SelResType	Inclusion/rejection flag for photometry
<b>sigMag</b>	PosDecimalTypeW6	Adopted $1\sigma$ magnitude uncertainty in magnitudes.

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<b>biasMag</b>	DecimalTypeW6	Adopted photometric bias in magnitudes
<b>photMod</b>	PhotModType	Description of the photometric model.
<b>resDelay</b>	DoubleTypeW7	Residual of the radar measurement in $\mu$ s for delay
<b>selDelay</b>	SelResType	Inclusion/rejection flag for radar astrometry
<b>sigDelay</b>	PosDecimalTypeW6	Adopted uncertainty for the radar measurement in $\mu$ s for delay
<b>resDoppler</b>	DoubleTypeW7	Residual of the radar measurement in Hz for Doppler
<b>selDoppler</b>	SelResType	Inclusion/rejection flag for radar astrometry
<b>sigDoppler</b>	PosDecimalTypeW6	Adopted uncertainty for the radar measurement in Hz for Doppler

observation-context sub-elements		
Name	Type	Description
<b>observatory</b>	ObservatoryType	observatory information block
<b>submitter</b>	SubmitterType	Contact information block
<b>observers</b>	NamesType	list of observer names (initials then surname)
<b>measurers</b>	NamesType	list of measurer names (initials then surnames)
<b>telescope</b>	TelescopeType	Description of telescope
<b>software</b>	SoftwareType	Description of software
<b>coinvestigators</b>	NamesType	list of coinvestigator names (initials then surname)
<b>collaborators</b>	NamesType	list of collaborator names (initials then surname)
<b>fundingSource</b>	StringTypeW100	funding source

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<b>comment</b>	CommentType	comment for observation context
observation types		
Name	Type	Description
<b>optical</b>	OpticalType	optical observation
<b>offset</b>	OffsetType	optical offset
<b>occultation</b>	OccultationType	optical occultation
<b>radar</b>	RadarType	delay or doppler radar
observation-context, obsBlock		
Name	Type	Description
<b>obsContext</b>	ObsContextType	observation context information
<b>obsData</b>	ObsDataType	list of optical or radar observations
<b>obsBlock</b>	ObsBlockType	obsBlock contains an obsContext and obsData
Free-Standing Residuals		
Name	Type	Description
<b>opticalResidual</b>	OpticalResType	optical residual
<b>radarResidual</b>	RadarResType	radar residual
ADES root		
Name	Type	Description
<b>ades</b>	ADESType	document root

## 2 Table of Restricted Simple Types

Restricted simple types are a single XML value with some additional restrictions, such as requiring an decimal value to be in some range (such as 0.0 to 90.0) or requiring a string to be from an enumerated list. Some of these restrictions, such as the possible station string values, will eventually be pulled out of MPC-provided files and referenced over the web.

## Simple Types with their Restrictions

Type	Description
<b>AlphaNumericType</b> base is StringType -pattern: [A-Za-z0-9_]*	AlphaNumericType restricts the field to only the ASCII upper- and lower-case letters, ASCII numbers and underscores
<b>BandType</b> base is AlphaNumericType -maxLength: 3	MPC maintains a list of bands for magnitude observations
<b>CatType</b> base is StringType -pattern: [.A-Za-z0-9_]* -maxLength: 8	MPC maintains a list of current astrometry and photometry catalogs
<b>CorrDecimalType</b> base is xsd:decimal -minInclusive: -1.0 -maxInclusive: 1.0 -pattern: [+\\-]? (0 1) (\\. [0123456789]{0,11})?	Decimal in range [-1.0, 1.0] with no more than 11 digits after the decimal point. Decimal point is optional, but if present the integer portion must be present (i.e., '.1' and '-.1' are invalid.)
<b>DecimalType</b> base is xsd:decimal -pattern: [+\\-]? (0 ([1-9][0-9]*)) (\\. [0-9]*)?	Decimal in range (-inf, +inf). Decimal point is optional, but if present the integer portion must be present (i.e., '.1' and '-.1' are invalid.)
<b>DecimalTypeW6</b> base is DecimalType -pattern: [+\\-]?[0123456789\\.]{1,5}	DecimalType with no more than 5 characters plus optional sign
<b>DecimalTypeW8</b> base is DecimalType -pattern: [+\\-]?[0123456789\\.]{1,7}	DecimalType with no more than 7 characters plus optional sign
<b>DecimalTypeW10</b> base is DecimalType -pattern: [+\\-]?[0123456789\\.]{1,9}	DecimalType with no more than 9 characters plus optional sign
<b>DecimalTypeW14</b> base is DecimalType -pattern: [+\\-]?[0123456789\\.]{1,13}	DecimalType with no more than 13 characters plus optional sign

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Type	Description
<b>DeclinationType</b> base is xsd:decimal -minInclusive: -90.0 -maxInclusive: 90.0 -pattern: <code>[+\-]?([1-9]?[0-9])?(\.[0123456789]{0,9})?</code>	DEC in degrees in range [-90.0, 90.0] with no more than 9 characters after the decimal
<b>DeprecatedType</b> base is xsd:string -enumeration: x	X marks the use of deprecated data
<b>DiscType</b> base is xsd:string -enumeration: * -enumeration: +	Used to mark the discovery record – must be ‘*’ or ‘+’ if present
<b>DoubleTypeW7</b> base is xsd:double -pattern: <code>[+\-]?[+\-Ee0123456789\.\.]{1,6}</code>	Double (i.e., decimal or exponential) in range (-inf, +inf) with no more than 6 characters plus optional sign
<b>DoubleTypeW21</b> base is xsd:double -pattern: <code>[+\-]?[+\-Ee0123456789\.\.]{1,20}</code>	Double (i.e., decimal or exponential) in range (-inf, +inf) with no more than 20 characters plus optional sign
<b>SubFrmType</b> base is StringType -pattern: <code>([BJ]\d{4}.0) APP\.</code>	The submission frame, usually B1950.0 or earlier. If this field is not present, the submission frame was J2000.0

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Type	Description
<b>LeapSecondsHelp</b> base is xsd:string -pattern: 19(72 81 82 83 85 92 93 94 97)-06-30T23:59:60(\.\d+)?Z -pattern: 19(72 73 74 75 76 77 78 79 87 89 90 95 98)-12-31T23:59:60(\.\d+)?Z -pattern: 20(12 15)-06-30T23:59:60(\.\d+)?Z -pattern: 20(05 08 16)-12-31T23:59:60(\.\d+)?Z -pattern: (2[1-9]\d{2} 20[2-9]\d 201[7-9])-12-31T23:59:60(\.\d+)?Z -pattern: (2[1-9]\d{2} 20[2-9]\d 201[7-9])-06-30T23:59:60(\.\d+)?Z -pattern: [3-9]\d{3}-06-30T23:59:60(\.\d+)?Z -pattern: [3-9]\d{3}-12-31T23:59:60(\.\d+)?Z	Allowed leap seconds before 2017 are valid leap-seconds; for 2017 and later are all allowed June and December leap-second opportunities.
<b>LogicalType</b> base is xsd:integer -enumeration: 0 -enumeration: 1	0 for false, 1 for true to match C and FORTRAN
<b>ModeType</b> base is AlphaNumericType -maxLength: 3	The MPC maintains a list of mode values
<b>ObsCenterType</b> union of PermIDType ProvIDType PlanetNameType ----- Submissions Only Allow: ----- union of PermIDType ProvIDType PlanetNameType	May be PlanetNameType, PermIDType or ProvIDType for both submissions and in general
<b>NotesType</b> base is AlphaNumericType -maxLength: 6	up to six single-character notes from MPC table

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Type	Description
<b>ObsIDType</b> base is AlphaNumericType -maxLength: 25	An obsID is up to twenty-five alphanumeric characters
<b>PermIDType</b> base is StringTypeW25 -pattern: <code>\d+([IPD](-[A-Z]{1,2})?)? ((Mars Jupiter Saturn Uranus Neptune)\d{1,3} (\d+) \d{1,3})</code>	A permID (permanent ID) string may be a positive integer, a positive integer followed by P or D or I (P is for periodic comets; D is for defunct comets; I is for interstellar objects), a planet name followed by a positive integer, or a positive integer in parentheses followed by a positive integer. These indicate a minor planet, a comet or interstellar object, a natural satellite of a planet, and a natural satellite of a minor planet respectively.
<b>PhotModType</b> base is AlphaNumericType -maxLength: 8	Photometric model is up to eight alphanumeric characters
<b>PlanetNameType</b> base is StringTypeW25 -enumeration: Mercury -enumeration: Venus -enumeration: Earth -enumeration: Moon -enumeration: Mars -enumeration: Jupiter -enumeration: Saturn -enumeration: Uranus -enumeration: Neptune	List of planet names, including Earth's Moon
<b>PosDecimalType</b> base is xsd:decimal -minExclusive: 0.0 -maxExclusive: 100000.0 -pattern: <code>(0 ([1-9][0-9]*))(\.[0-9]*)?</code>	Unsigned positive decimal in range (0.0, 100,000). Decimal point is optional, but if present the integer portion must be present (i.e., '.1' is invalid.)
<b>PosIntegerTypeW6</b> base is xsd:positiveInteger -maxExclusive: 1000000	Positive integer in range (0, 1,000,000). Thus no more than 6 characters.

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Type	Description
<b>SPICEIDType</b> base is xsd:integer -maxExclusive: +1000000000 -minExclusive: -1000000000	Integer having absolute value strictly less than 1,000,000,000.
<b>PosDecimalTypeW6</b> base is PosDecimalType -pattern: [0123456789\.\.]{1,6}	PosDecimalType with no more that 6 characters
<b>PosDecimalTypeW7</b> base is PosDecimalType -pattern: [0123456789\.\.]{1,7}	PosDecimalType with no more that 7 characters
<b>PosDecimalTypeW8</b> base is PosDecimalType -pattern: [0123456789\.\.]{1,8}	PosDecimalType with no more that 8 characters
<b>PosDecimalTypeW10</b> base is PosDecimalType -pattern: [0123456789\.\.]{1,10}	PosDecimalType with no more that 10 characters
<b>PosDecimalTypeW14</b> base is PosDecimalType -pattern: [0123456789\.\.]{1,14}	PosDecimalType with no more that 14 characters
<b>FrequencyType</b> base is xsd:decimal -minExclusive: 0.0 -pattern: [0123456789\.\.]{1,16}	Unsigned decimal in range (0.0, +inf) with no more that 16 characters
<b>ProgType</b> base is AlphaNumericType -maxLength: 2	MPC maintains a list of 1 and 2 character program codes

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Type	Description
<b>BaseProvIDType</b> base is StringTypeW25 -pattern: \d{4} [A-HJ-Y] [A-HJ-Z] \d*   \d{4} (P-L T-[123])   [ADCPX] / \d{4} [A-Z]{1,2} \d* (-[A-Z])?   S / \d{4} ((M J S U N)   \((\d+   \d{4}	A provID (provisional ID) may be a minor planet provid, which is a 4-digit year followed by a space followed by two letters followed optionally by digits; or a comet id, which is C/ or P/ or D/ or X/ or A/ (for asteroids with comet numbers, which may not have fragments) followed by a 4-digit year followed by a space followed by one or two digits optionally followed by one or two digits optionally followed by "-[A-Z]" (for a comet fragment); or a satellite, which is S/ followed by a 4-digit year followed a space followed either (by a minor planet PermID in parentheses or the bare letter M, J, S, N, U) followed by a space followed by digits.
<b>OldProvIDType</b> base is StringTypeW25 -pattern: A[89] \d{2} [A-HJ-Y] [A-HJ-Z]	An old-style provID (provisional ID) for object recorded before 1925 is of the form A903 AA, where A903 means 1903, A888 means 1888. and the two letters are the same as currently

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Type	Description
<b>ProvIDType</b> union of BaseProvIDType OldProvIDType <hr/> Submissions Only Allow: <hr/> union of BaseProvIDType	A provID (provisional ID) is may be a minor planet provid, which is a 4-digit year followed by a space followd by two letters followed optinally by digits; or a comet it, which is C/ or P/ or D/ or X/ or A/ (for asteroids with comet numbers, which may not have fragments) followed by a 4-digit year follwed by a space followed by one or two digits optinally followed by one or two digits optionally followed by "-[A-Z]" (for a commet fragment); or a satellite, which is S/ followed by a 4-digit year followed a space followed either (by a minor planet PermID in parentheses or the bare letter M, J, S, N, U) followed by a space followed by digits. For data before 1926, the OldProvIDType may occur – this is not allowed in new submissions
<b>RaDecPrecType</b> base is xsd:decimal –enumeration: 0.1 –enumeration: 0.6 –enumeration: 0.01 –enumeration: 0.001 –enumeration: 60 –enumeration: 6 –enumeration: 1	RaDecPrecType is used to describe the precision of a historical decimal value when the orignal measurement was made in sexagesimal. The allowed values are applied to the last sexagesimal element, which may be seconds or arcseconds, and mean (for time) the value is accurate to an hour, 10 minutes, 1 minute, 6 seconds, 1 second, .1 second and so forth. This is not allowed in new submissions
<b>RAType</b> base is xsd:decimal –minInclusive: 0.0 –maxExclusive: 360.0 –pattern: ([1-3][0-9]{2} [1-9]?[0-9])?(\.[0-9]{0,9})?	Unsigned RA in degrees limited to [0.0, 360.0) with no more that 9 characters after the decimal
<b>RefType</b> base is StringType –maxLength: 16	MPC-assigned reference, up to sixteen characters

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Type	Description
<b>RemarkType</b> base is StringType -maxLength: 300	A remark is a String limited to 300 characters
<b>SelResType</b> base is xsd:string -enumeration: A -enumeration: a -enumeration: D -enumeration: d	SelRes must be “A,” (automatic accept) “a,” (manual accept) “D,” (automatic delete) or “d” (manual delete)
<b>StationType</b> base is AlphaNumericType -minLength: 3 -maxLength: 4	A stn, rov, trx or tcv station. Values vary and are checked by MPC
<b>StringType</b> base is xsd:string -pattern: [^ ]*[^\s][^ ]*	String follows the ADES specification in that the pipe character is disallowed in PSV. To allow data conversion from XML, it must disallow in XML as well. Also disallow blank elements. Therefore, all elements must match this pattern
<b>StringTypeW25</b> base is StringType -maxLength: 25	A StringType limited to 25 characters
<b>StringTypeW100</b> base is StringType -maxLength: 100	A StringType limited to 100 characters
<b>SubFmtType</b> base is AlphaNumericType -maxLength: 4	MPC maintains a list of allowed submission formats with no extra fields, up to four alphanumeric characters
<b>SysType</b> base is xsd:string -enumeration: WGS84 -enumeration: ITRF -enumeration: IAU -enumeration: ICRF_AU -enumeration: ICRF_KM	Coordinate system for station coordinates. This is used by the pos[123] and poscov[123][123] elements to determine the meaning of coordinates. WGS84, ITRF and IAU are for ground-based stations, ICRF_AU and ICRF_KM are for space-based stations.

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Type	Description
<b>TimeHelp</b> base is xsd:dateTime -pattern: \d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}(\.\d{1,6})?Z	Restrict dateTime to 4-digit positive years and Z for UTC. Allow no more than microsecond precision.
<b>TimePrecType</b> base is xsd:decimal -enumeration: 100000 -enumeration: 10000 -enumeration: 1000 -enumeration: 100 -enumeration: 10 -enumeration: 1 -enumeration: 41667 -enumeration: 4167 -enumeration: 694 -enumeration: 69	TimePrecType is used to describe the precision of a historical Time value when the original measurement was made in fractional days. The accuracy is in millionths of decimal day, so 10 means 1/100,000 of a day, a little better than a second. The large values are only for historic data on comets. Historic data may also have been reported to integer hours (41667), tenths of hours (4167), integer minutes (694) or tenths of minutes (69). This is not allowed in new submissions.
<b>TimeType</b> union of TimeHelp LeapSecondsHelp ----- Submissions Only Allow: ----- union of TimeHelp LeapSecondsHelp	TimeType is an ISO8601 UTC time in the format yyyy-mm-ddThh:mm:ss(.s+)Z. The trailing Z means it is interpreted as UTC. It is not a restriction of xsd:dateTime because that does not properly validate leapseconds. It allows positive 4-digit years and validates the Gregorian calendar for all dates. Note this works because xsd or's all the restrictions and accepts any match. LeapSecondsHelp matches any leapsecond before 2017 and any potential new leapseconds from 2017.
<b>TrkIDType</b> base is StringType -pattern: [-A-Za-z0-9_]* -maxLength: 12	A trkID is up to twelve alphanumeric characters
<b>BaseTrkSubType</b> base is StringType -pattern: [-A-Za-z0-9_]* -maxLength: 8	A trkSub is up to eight alphanumeric or - characters

to be cont'd on next page

(continued)

Type	Description
<b>OldTrkSubType</b> base is StringType -pattern: [- ?+@.()\\A-Za-z0-9_]* -maxLength: 8	A trkSub is up to eight funky characters
<b>TrkSubType</b> union of BaseTrkSubType OldTrkSubType ----- Submissions Only Allow: ----- union of BaseTrkSubType	A trkSub is up to eight characters. For new submission, the allowed character set is alphanumeric with "-". For older data, a wider character set was allowed
<b>VersionType</b> base is xsd:string -enumeration: 2022	Version attribute for the current ADES schema must be "2022"

### 3 Groups

This is the documentation for the groups. Groups are a convenient way of organizing rules in complicated structures, used as components of other groups or of complex types. Unlike complex types, groups may appear inside other complex types or groups with no tag. Because groups act a bit like types, their names are all CamelCase with the first letter capitalized.

## grouptype: MPCID

MPCID	permID or provID or both in that order, or artSat		
choice	sequence		
	element	permID	
	element	provID	(Optional)
	sequence		
	element	provID	
	sequence		
	element	artSat	

## grouptype: OpticalID

OpticalID	An MPCID group or trkSub or both in that order. Of permID, provID, artSat or trkSub at least one must be present in an optical observation but all three might be present. Also, MPC will assign unique obsID and trkID fields for distribution		
sequence	choice		
	sequence		
	group	MPCID	
	element	trkSub	(Optional)
	sequence		
	element	trkSub	
	element	obsID	(NoSubmit)
	element	obsSubID	(Optional)
	element	trkID	(NoSubmit)
	element	trkMPC	(NoSubmit)



## **grouptype: RadarID**

<b>RadarID</b>	<b>An MPCID group only; radar has no equivalent of the optical “trkSub” field. MPC will add a unique obsID field for distribution</b>		
sequence			
	group	MPCID	
	element	trkSub	(Optional)
	element	obsID	(NoSubmit)

## **grouptype: RadarValue**

RadarValue	A RadarValue is used for doppler or delay values and errors in a radar observation.	
choice		
sequence	element	doppler
	element	rmsDoppler
sequence	element	delay
	element	rmsDelay

## **groupstype: Precision**

<b>Precision</b>	<b>Precision is primarily for M92 and M47 formats. However, it may be used generally to describe data originally obtained with a certain sexagesimal precision instead of a decimal precision</b>	
sequence	element	precTime
	element	precRA
	element	precDec

## **groupstype: Location**

<b>Location</b>	<b>location data for a rover station.</b>	
sequence	element	sys
	element	ctr
	element	pos1
	element	pos2
	element	pos3
	element	posCov11 (Optional)
	element	posCov12 (Optional)
	element	posCov13 (Optional)
	element	posCov22 (Optional)
	element	posCov23 (Optional)
	element	posCov33 (Optional)

## **grouptype: Photometry**

<b>Photometry</b>	<b>The Photometry group is optional in all optical observation types (optical, offset, and occultation). The "mag" and "band" fields must be present; the rest are optional but can only occur if "mag" and "band" are present to define this as a Photometry group</b>		
<hr/>			
sequence			
	element	mag	
	element	rmsMag	(Optional)
	element	band	
	element	photCat	(Optional)
	element	photAp	(Optional)
	element	nucMag	(NoSubmit)

## **grouptype: OffsetVal**

OffsetVal	OffsetVal allows either rectangular or polar coordinates for the offset measurement. The rectangular coordinates are deltaRA and deltaDec; the polar coordinates are dist and polar angle.		
<hr/>			
choice			
<hr/>			
sequence			
<hr/>			
element		deltaRA	
element		deltaDec	
element		rmsRA	(Optional)
element		rmsDec	(Optional)
element		rmsCorr	(Optional)
<hr/>			
sequence			
<hr/>			
element		dist	
element		pa	
element		rmsDist	(Optional)
element		rmsPA	(Optional)
element		rmsCorr	(Optional)
<hr/>			

## group type: OpticalRes

OpticalRes	OpticalRes is optional for the OpticalResiduals group	
sequence		
element	resRA	
element	resDec	
element	selAst	
element	sigRA	
element	sigDec	
element	sigCorr	(Optional)
element	sigTime	(Optional)
element	biasRA	(Optional)
element	biasDec	(Optional)
element	biasTime	(Optional)

## group type: OpticalResMag

OpticalResMag	OpticalRes is optional for the OpticalResiduals group	
sequence		
element	photProd	(Optional)
element	resMag	
element	selPhot	
element	sigMag	
element	biasMag	(Optional)
element	photMod	(Optional)

## **grouptype: OpticalResiduals**

OpticalResiduals	The OpticalResiduals group is optional for adding residuals to optical observations, or as a separate obsResidual element tagged by obsID		
sequence			
element	orbProd		
element	orbID		
group	OpticalRes	(Optional)	
group	OpticalResMag	(Optional)	

## **grouptype: RadarResiduals**

<b>RadarResiduals</b>	<b>The RadarResiduals group is optional for adding residuals to optical observations, or as a separate obsResidual element tagged by obsID</b>		
sequence			
element	orbProd		
element	orbID		
choice	sequence		
	element	resDelay	
	element	selDelay	
	element	sigDelay	
	sequence		
	element	resDoppler	
	element	selDoppler	
	element	sigDoppler	

## 4 Complex Types

This is the documentation for the complex types, which may be used directly as similarly-named elements or as components of other complex types and groups. Unlike a group, a complex type is always the only thing inside a tag. The names of complex types, like groups and simple types, are all CamelCase with the first letter capitalized.

### complextypes: **NamesType**

<b>NamesType</b>	<b>List of one or more names of type String</b>
sequence	
	type StringTypeW100 name (Unbounded)

### complextypes: **ObservatoryType**

<b>ObservatoryType</b>	<b>Observatory Identification</b>
all	
	type StationType mpcCode
	type StringTypeW100 name (Optional)

### complextypes: **SubmitterType**

<b>SubmitterType</b>	<b>Submitter information. A name field (initials plus surname), an institution string</b>
all	
	type StringTypeW100 name
	type StringTypeW100 institution (Optional)

### complextype: TelescopeType

TelescopeType	telescope information		
all			
type StringTypeW100	name	(Optional)	
type StringTypeW25	design		
type PosDecimalTypeW6	aperture		
type StringTypeW25	detector		
type PosDecimalTypeW6	fRatio	(Optional)	
type StringTypeW25	filter	(Optional)	
type StringTypeW25	arraySize	(Optional)	
type PosDecimalTypeW6	pixelScale	(Optional)	

### complextype: SoftwareType

SoftwareType	information about software used in processing		
all			
type StringTypeW100	astrometry	(Optional)	
type StringTypeW25	fitOrder	(Optional)	
type StringTypeW100	photometry	(Optional)	
type StringTypeW100	objectDetection	(Optional)	

### complextype: CommentType

CommentType	List of one or more lines of type String		
sequence			
type StringTypeW100	line	(Unbounded)	



### complexttype: LocalUseType

LocalUseType	This element is to allow arbitrary fields for private data interchange
sequence	
any	

## complextype: OpticalType

OpticalType	Optical Observation with RA and Dec		
sequence			
group	OpticalID		
element	mode		
element	stn		
group	Location	(Optional)	
element	prog	(NoSubmit)	
element	obsTime		
element	rmsTime	(Optional)	
element	ra		
element	dec		
element	rmsRA	(Optional)	
element	rmsDec	(Optional)	
element	rmsCorr	(Optional)	
element	astCat		
group	Photometry	(Optional)	
element	logSNR	(Optional)	
element	seeing	(Optional)	
element	exp	(Optional)	
element	rmsFit	(Optional)	
element	nStars	(Optional)	
element	ref	(NoSubmit)	
element	disc	(Optional)	
element	subFrm	(NoSubmit)	
element	subFmt	(NoSubmit)	
group	Precision	(NoSubmit)	
element	uncTime	(Optional)	
element	notes	(Optional)	
element	remarks	(Optional)	
group	OpticalResiduals	(NoSubmit)	
element	deprecated	(NoSubmit)	
element	localUse	(NoSubmit)	

## complextype: OffsetType

OffsetType	Optical Offset Observation with RA and Dec		
sequence			
	group	OpticalID	
	element	mode	
	element	stn	
	group	Location	(Optional)
	element	prog	(NoSubmit)
	element	obsTime	
	element	rmsTime	(Optional)
	element	obsCenter	
	group	OffsetVal	
	group	Photometry	(Optional)
	element	logSNR	(Optional)
	element	seeing	(Optional)
	element	exp	(Optional)
	element	rmsFit	(Optional)
	element	nStars	(Optional)
	element	ref	(NoSubmit)
	element	disc	(Optional)
	element	subFrm	(NoSubmit)
	element	subFmt	(NoSubmit)
	group	Precision	(NoSubmit)
	element	uncTime	(Optional)
	element	notes	(Optional)
	element	remarks	(Optional)
	group	OpticalResiduals	(NoSubmit)
	element	deprecated	(NoSubmit)
	element	localUse	(NoSubmit)

## complextype: OccultationType

OccultationType		Optical Occultation Observation with deltaRA, deltaDec, raStar and decStar	
sequence			
	group	OpticalID	
	element	mode	
	element	stn	
	group	Location	(Optional)
	element	prog	(NoSubmit)
	element	obsTime	
	element	rmsTime	(Optional)
	element	raStar	
	element	decStar	
	group	OffsetVal	
	element	astCat	
	group	Photometry	(Optional)
	element	logSNR	(Optional)
	element	shapeOcc	(Optional)
	element	seeing	(Optional)
	element	ref	(NoSubmit)
	element	disc	(Optional)
	element	subFrm	(NoSubmit)
	element	subFmt	(NoSubmit)
	group	Precision	(NoSubmit)
	element	uncTime	(Optional)
	element	notes	(Optional)
	element	remarks	(Optional)
	group	OpticalResiduals	(NoSubmit)
	element	deprecated	(NoSubmit)
	element	localUse	(NoSubmit)

## complextype: RadarType

RadarType	Radar Observation using either doppler or delay values from RadarValue	
sequence		
group	RadarID	
element	trx	
element	rcv	
element	prog	(NoSubmit)
element	obsTime	
group	RadarValue	
element	logSNR	(Optional)
element	com	(Optional)
element	frq	
element	ref	(NoSubmit)
element	remarks	(Optional)
group	RadarResiduals	(NoSubmit)
element	localUse	(NoSubmit)

## complextype: ObsContextType

ObsContextType	observation context header type	
all		
element	observatory	
element	submitter	
element	observers	
element	measurers	
element	telescope	
element	software	(Optional)
element	coinvestigators	(Optional)
element	collaborators	(Optional)
element	fundingSource	(Optional)
element	comment	(Optional)

### complexttype: ObsDataType

ObsDataType	A list of all optical or all radar observations		
choice			
	element	optical	(Unbounded)
	element	offset	(Unbounded)
	element	occultation	(Unbounded)
	element	radar	(Unbounded)

### complexttype: ObsBlockType

ObsBlockType	A list of all optical or all radar observations, with context		
sequence			
	element	obsContext	
	element	obsData	

### complexttype: OpticalResType

OpticalResType	Optical Residual outside of the optical/occultation/offset structure		
sequence			
	group	OpticalID	
	element	obsTime	
	group	OpticalResiduals	

## complexttype: RadarResType

<b>RadarResType</b>	<b>Radar Residual outside of the radar structure</b>	
sequence		
	group	RadarID
	element	obsTime
	group	RadarResiduals

## complexttype: ADESType

<b>ADESType</b>	<b>This is what is allowed in ades documents – any of these in any order</b>		
attribute	version	VersionType	(requiredAttribute)
choice	(Unbounded)		
	element	optical	(NoSubmit)
	element	offset	(NoSubmit)
	element	occultation	(NoSubmit)
	element	radar	(NoSubmit)
	element	opticalResidual	(NoSubmit)
	element	radarResidual	(NoSubmit)
	element	obsBlock	