X-Plane

Airport data (apt.dat) file specification

version 1100

Revision History

14 Feb 2018 Minor corrections to Definition of Data Fields

25 Jan 2017 Spec created, based upon prior apt.dat 1050 spec.

Applicability

This specification (APT.DAT 1100) is supported in X-Plane 11.00 and later and by WorldEditor 1.6b1 and later. The prior specification for airport data was APT.DAT 1050, which is recommended for X-Plane 10.50+.

This spec is an extension to 1050 – all features in 1050 are fully supported.

Support for Deprecated File Formats

The deprecated file specifications (APT.DAT 1050, 1000) are still supported. A dwindling quantity of custom airport data exists only in this format. So airports defined according to these specifications can be included in a file otherwise complying with the most recent specification.

Overview & Scope

This specification defines core airport data for X-Plane. This includes the locations of runways, taxiway and apron pavement, basic airport 'furniture' (VASI/PAPIs, windsocks, light beacons and taxiway signage) and communications frequencies. It also includes attributes for each of these features to fully describe them (eg. it includes runway surface type, runway markings, taxiway lighting and markings, approach lighting, taxiway sign text, etc).

This specification (1100) introduces new service truck parking and destination features.

This specification does not include scenery objects (such as buildings, static aeroplanes or underlying terrain textures).

Basic concepts

- Latitudes and longitudes are described in a decimal notation (eg. 20.12345678) up to 8 decimal places.
    - A latitude of 50 degrees 30 minutes south would be defined as -50.50000000

- North latitudes and east longitudes are positive. South latitudes and west longitudes are negative.
- All headings are referenced to true north (not magnetic north).

File Characteristics

The apt.dat files are plain text files:

- Fields in the data can be separated by one or more white space characters (space, tab).
    - By default, the files are generated so that columns of data are consistently aligned, but this is not required.
- Blank rows are permitted and are helpful to differentiate between airports.
- Comments are permitted and are indicated by "#" as the first two characters of a row.

File Structure

It is recommended that all airports be created in WorldEditor ("WED"). This will ensure that all structural requirements listed here for airport data are met. WED version 1.6 is required to support the features in this spec.

In common with most other X-Plane data file specification, header rows of data define the origin ("I" = PC or "A" = Mac) of a particular copy of a file, and define the file specification version. The file specification may be followed by a reference to a sequential release data cycle and build number for the data, and a copyright message:

```
I
1000 Version - data cycle 2012.03, build 20121054, metadata AptXP1100.  Copyright © 2012, Robin A. Peel
(robin@xsquawkbox.net)...
```

The complete copyright message must be left intact if you redistribute this data. The GNU GPL (General Public License) under which this data is released is designed to encourage modifications, enhancements and redistribution, even in commercial derivative products.

Subsequent rows of data follow a hierarchical structure:

- Each row of data has a numeric 'row code' as its first field, to define its content.
- The top level of this hierarchy defines an individual airport, defined by an airport header row (a row code of '1', '16' or '17').
- Subsequent rows define elements of an airport:
    - **Runways** (including helipads) follow the airport header row (one row per runway).
    - **Pavement (taxiway/apron) definitions** have a header row followed by an ordered list of nodes that define its boundaries:
        - Each pavement definition must each have a single boundary with no overlaps with itself.
        - Nodes on this outer boundary must be defined in a counter-clockwise direction.
        - Boundaries must be terminated with a node with a row code '113' or '114'.
        - Pavement definitions may overlap with another pavement chunk. But this is not recommended – instead consider precise alignment of adjacent features by 'snapping' nodes to identical locations in World Editor (WED).
            - A pavement definition can <u>never</u> overlap with itself.
        - The sequencing of the pavement definitions is the layering in which they will be rendered in X-Plane, top-down. So the last piece of pavement in the file will be rendered <u>underneath</u> any others with which it overlaps.
        - **Holes** can be defined for pavement (through which the underlying terrain texture will show):
            - Hole boundaries should follow the termination of the pavement definition in which the hole occurs (starting with a row type '111' or '112').
            - Hole boundaries are defined in a clockwise direction (ie, *opposite* direction to the boundary nodes).
            - Hole boundaries must form a closed loop (ie. must terminate with a row code '113' or '114').
            - Each pavement definition can have zero, one or multiple hole boundaries.
            - Hole boundaries must be contained within the outer boundary of the pavement definition.
            - Holes cannot overlap each other.
            - After creating a hole boundary, it can be 'filled' with a new pavement chunk (probably using a different surface type).
    - **Linear features** also have a header row followed by an ordered list of nodes that define the line:
        - Linear features can be closed loops (terminating in a node of type '113' or '114') or just strings (terminating with '115' or '116').
    - An **airport boundary** is defined with nodes in a counter-clockwise direction. A boundary can contain holes (see above) and <u>must</u> form a closed loop (terminating in a node of type '113' or '114').
    - **Airport traffic flows** have a header row (row code '1000') followed by multiple rows that define rules of multiple classes (time, wind direction, ceiling, visibility, runway in use, VFR traffic pattern) that indicated that a flow should be used (wind rules, minimum ceiling rules, visibility rules, time rules, and operations rules).
        - A flow is acceptable if <u>any</u> rule of a class is acceptable, or if there are <u>no</u> rules of a given class. So to permit a flow with no time restrictions, simply exclude any traffic time rules (row code '1004').
        - Rules use 'or' logic. For example, a flow may have two wind rules (row code '1001') – one for slight winds very generally aligned with a runway, and one with strong winds only if they are almost exactly with the runway.
        - A flow will be used only if <u>all</u> its rule classes are 'passed'.

        - The flows are evaluated in sequence. The first flow to 'pass' will be used. So, the most specific-but-useful rule should be listed first (eg. parallel VFR approaches on a clear, calm day) and the most general (but least useful) rules should be listed last (eg. a single ILS cat III approach to a single runway).
        - If the rules prevent any defined flow from being 'passed' then X-Plane's AI engine will create a flow.
        - 'Runway in use' rules (row code 1100) are also evaluated in sequence. The first 'runway in use' rule to 'pass' will be used for the parent flow. So rules should be listed in preferential sequence.
    - **Airport taxi routes & networks** begin with a row code '1200' and are defined by a set of nodes (row code '1201') and 'edges' (the taxi routing) that connect two nodes (row code '1202'):
        - Nodes can be defined as 'init' (a point at which X-Plane will try to start a taxi route), 'end' (where X-Plane will try to end a taxi route), or 'both'. 'junc' can also be used for junctions between taxi routes.
        - Edges must specify an allowed width, sizes A-E, and may be followed by multiple rows (row code '1204) defining an 'active zone' 'for that parent edge (eg. if the edge conflicts with arrival or departure runways, or an ILS-critical area).
        - Taxi routings begin or end at ramp locations (row code '1300'), which are also available as startup-locations in X-Plane. These locations may not be directly connected to the taxi route network – X-Plane's ATC engine will calculate how to direct an airplane between the taxi route network and each location.
        - Ground truck route edges (row code '1206'), parking locations (row code '1400'), and destinations (row code '1401') are included under row code header '1200' for taxi networks.
    - **Other airport features** are defined with one row for each feature.

The file is terminated by a '99':

```
99
```

Row Codes

Each row of data begins with an integer code that defines the type of data:

Row Code	Meaning	Comment
1	Land airport header	
16	Seaplane base header	
17	Heliport header	
100	Runway	
101	Water runway	
102	Helipad	
110	Pavement (taxiway or ramp) header	Must form a closed loop

120	Linear feature (painted line or light string) header	Can form closed loop or simple string
130	Airport boundary header	Must form a closed loop
111	Node	All nodes can also include a “style” (line or lights)
112	Node with Bezier control point	Bezier control points define smooth curves
113	Node with implicit close of loop	Implied join to first node in chain
114	Node with Bezier control point, with implicit close of loop	Implied join to first node in chain
115	Node terminating a string (no close loop)	No “styles” used
116	Node with Bezier control point, terminating a string (no close loop)	No “styles” used
14	Airport viewpoint	One or none for each airport
15	Aeroplane startup location	*** Convert these to new row code 1300 ***
18	Airport light beacon	One or none for each airport
19	Windsock	Zero, one or many for each airport
20	Taxiway sign (inc. runway distance-remaining signs)	Zero, one or many for each airport
21	Lighting object (VASI, PAPI, Wig-Wag, etc.)	Zero, one or many for each airport
1000	Airport traffic flow	Zero, one or many for an airport. Used if following rules met (rules of same type use ‘or’ logic, rules of a different type use ‘and’ logic). First flow to pass all rules is used.
1001	Traffic flow wind rule	Zero, one or many for a flow. Multiple rules use ‘or’ logic.
1002	Traffic flow minimum ceiling rule	Zero or one rule for each flow
1003	Traffic flow minimum visibility rule	Zero or one rule for each flow
1004	Traffic flow time rule	Zero, one or many for a flow. Multiple rules use ‘or’ logic.
1100	Runway-in-use arrival/departure constraints	First constraint met is used. Sequence matters!
1101	VFR traffic pattern	Zero or one pattern for each traffic flow
1200	Header indicating that taxi route network data follows	
1201	Taxi route network node	Sequencing must be 0 based, ascending by ID. Must be part of one or more edges.
1202	Taxi route network edge	Must connect two nodes
1204	Taxi route edge active zone	Can refer to up to 4 runway ends
1205	Taxi route edge control	Replaces 1203
1206	Taxi route edge	Ground vehicles only
1300	Start up location (deprecates code 15)	Not explicitly connected to taxi route network
1301	Start up location metadata	Consists of an ICAO width code, an operations type code and zero or more space separated 3-letter airline codes
1302	Airport identification metadata	Zero, one or many for each airport
1400	Truck Parking Location	Not explicitly connected to taxi route network
1401	Truck Destination Location	Must not allow car pile ups due to bad one way designs
50 – 56	Communication frequencies	Zero, one or many for each airport

Example Data

Here is some example data for KBFI. It is not real and is very incomplete, but it illustrates examples of most types of data found in an apt.dat file. This data includes an airport header, runway, water runway, helipad, PAPI, taxiway definition, painted line, viewpoint, startup location, light beacon, windsock, taxiway sign and an ATC communications frequency:

```
1    21 1 0 KBFI Boeing Field King Co Intl
100  29.87   1   0 0.15 0 2 1 13L  47.53801700 -122.30746100   73.15    0.00 2  0 0 1 31R  47.52919200 -122.30000000  110.95    0.00 2  0 0 1
101 49 1 08 35.04420900 -106.59855700 26 35.04420911 -106.59855711
102  H1   47.53918248 -122.30722302   2.00   10.06   10.06   1 0   0 0.25 0
21   47.53666659 -122.30585255  2 150.28   3.30 13L PAPI-2L
110  1 0.25 150.29 A2 Exit
111  47.53770968 -122.30849802
111  47.53742819 -122.30825844   3
112  47.53752190 -122.30826710  47.53757385 -122.30824831   3 102
114  47.53768630 -122.30834929  47.53768690 -122.30838150   3 102
120  Line B1
111  47.53969864 -122.31276189  51
111  47.53977825 -122.31255145   1
115  47.54002296 -122.31189878
14   47.52917900 -122.30434900  100 0 ATC Tower
15   47.52926674 -122.29919589 304.16 A8 Run Up
18   47.52920400 -122.30412800 1 BCN
19   47.53900921 -122.30868700 1 WS
20   47.54099177 -122.31031317 235.71  0 2 {@L}A1{@R}31R-13L
50   12775 ATIS
```

Here is some example data for KSEA showing the 1000 version traffic flow and taxi route data:

```
1000 Calm and South flow
1001 KSEA   000 359 5
1001 KSEA   070 250 999
1002 KSEA   0
1003 KSEA   0
1004 0000 2400
1100 16C 11920 arrivals jets|turboprops|props 160340 161161 Arrival 16C
1100 16R 11920 arrivals jets|turboprops|props 341159 161161 Arrival 16R
1100 16L 11920 arrivals heavy 000359 161161 Arrival Heavy Jets
1101 16R right
1200
1201  47.46360812 -122.30613338 both 5416 A_stop
1202 5258 5266 twoway taxiway B
1204 ils 34R
1300  47.43931757 -122.29806851  88.78 gate jets|turboprops A10
```

Here is some example data for KSEA showing the 1050 metadata and 1100 ground truck additions:

```
1302 city Seattle
1302 country United States
1302 datum_lat 47.449888889
1302 datum_lon -122.311777778
1302 faa_code SEA
1302 iata_code SEA
1302 icao_code KSEA
1206 107 11 twoway  C
1300  47.44158755 -122.30116873  44.78 gate jets A3
1301 D airline dal
1400  47.44374472 -122.30463464  88.1 baggage_train 3 Svc Baggage
1401  47.44103438 -122.30382493  0.0 baggage_train Luggage Train Destination South 2
```

Definition of Data Fields

Each column in each row code is defined below, using the example data from KBFI & KSEA shown above. Note that:

- Some row codes store data in an identical specification, and these have been grouped together in the table below.
- The specification aims to be consistent. For example, the format or latitudes and longitudes is always the same, and all headings/orientations are defined as <u>true</u> (not magnetic) degrees.

Row	Meaning	Comment	
	Example value	*Explanation*	*Valid values*
1	Land airport header	Row codes 1, 16 and 17 share a common format (see below)	
16	Seaplane base header	Row codes 1, 16 and 17 share a common format (see below)	
17	Heliport header	Row codes 1, 16 and 17 share a common format (see below)	
	1	Row code for an airport, seaplane base or heliport	1, 16 or 17
	21	Elevation of airport in feet above mean sea level (AMSL)	
	1	Deprecated. Use default value (“0”)	Use 0
	0	Deprecated. Use default value (“0”)	Use 0
	KBFI	Airport ICAO code. If no ICAO code exists, use X + local identifier to create fictional code.	Maximum seven characters. Must be unique.
	Boeing Field King Co ...	Airport name. May contain spaces.	Text string (up to 40 characters)
100	Land Runway		
	100	Row code for a land runway (the most common)	100

		29.87	Width of runway in metres	Two decimal places recommended. Must be >= 1.00
		1	Code defining the surface type (concrete, asphalt, etc)	Integer value for a **Surface Type Code** (see below)
		0	Code defining a runway shoulder surface type	0=no shoulder, 1=asphalt shoulder, 2=concrete shoulder
		0.15	Runway smoothness (not used by X-Plane yet)	0.00 (smooth) to 1.00 (very rough). Default is 0.25
		0	Runway centre-line lights	0=no centerline lights, 1=centre line lights
		2	Runway edge lighting (also implies threshold lights)	0=no edge lights, 2=medium intensity edge lights
		1	Auto-generate distance-remaining signs (turn off if created manually)	0=no auto signs, 1=auto-generate signs
		The following fields are repeated for each end of the runway		
		13L	Runway number (eg. "31R", "02"). Leading zeros are required.	Two to three characters. Valid suffixes: "L", "R" or "C" (or blank)
		47.53801700	Latitude of runway end (on runway centerline) in decimal degrees	Eight decimal places supported
		-122.30746100	Longitude of runway end (on runway centerline) in decimal degrees	Eight decimal places supported
		73.15	Length of displaced threshold in metres (this is included in implied runway length) A displaced threshold will always be inside (between) the two runway ends	Two decimal places (metres). Default is 0.00
		0.00	Length of overrun/blast-pad in metres (not included in implied runway length)	Two decimal places (metres). Default is 0.00
		2	Code for runway markings (Visual, non-precision, precision)	Integer value for **Runway Marking Code** (see below)
		0	Code for approach lighting for this runway end	Integer value for **Approach Lighting Code** (see below)
		0	Flag for runway touchdown zone (TDZ) lighting	0=no TDZ lighting, 1=TDZ lighting
		1	Code for Runway End Identifier Lights (REIL)	0=no REIL, 1=omni-directional REIL, 2=unidirectional REIL
101	Water runway			
		101	Row code for a water runway	101
		49	Width of runway in metres	Two decimal places recommended. Must be >= 1.00
		1	Flag for perimeter buoys	0=no buoys, 1=render buoys
		The following fields are repeated for each end of the water runway		
		08	Runway number. Not rendered in X-Plane (it's on water!)	Valid suffixes are "L", "R" or "C" (or blank)
		35.04420911	Latitude of runway end (on runway centerline) in decimal degrees	Eight decimal places supported
		-106.59855711	Longitude of runway end (on runway centerline) in decimal degrees	Eight decimal places supported
102	Helipad			
		102	Row code for a helipad	101
		H1	Designator for a helipad. Must be unique at an airport.	Usually "H" suffixed by an integer (eg. "H1", "H3")
		47.53918248	Latitude of helipad centre in decimal degrees	Eight decimal places supported
		-122.30722302	Longitude of helipad centre in decimal degrees	Eight decimal places supported
		2.00	Orientation (true heading) of helipad in degrees	Two decimal places recommended
		10.06	Helipad length in metres	Two decimal places recommended (metres), must be >=1.00

	10.06	Helipad width in metres	Two decimal places recommended (metres), must be >= 1.00
	1	Helipad surface code	Integer value for a **Surface Type Code** (see below)
	0	Helipad markings	0 (other values not yet supported)
	0	Code defining a helipad shoulder surface type	0=no shoulder, 1=asphalt shoulder, 2=concrete shoulder
	0.25	Helipad smoothness (not used by X-Plane yet)	0.00 (smooth) to 1.00 (very rough). Default is 0.25
	0	Helipad edge lighting	0=no edge lights, 1=yellow edge lights
110	Pavement (taxiways)	Defines an arbitrary pavement shape	
	110	Row code for a pavement chunk header (must be followed by a set of nodes)	110
	1	Code defining the surface type (concrete, asphalt, etc)	Integer value for a **Surface Type Code** (see below)
	0.25	Runway smoothness (not used by X-Plane yet)	0.00 (smooth) to 1.00 (very rough). Default is 0.25
	150.29	Orientation (true degrees) of pavement texture 'grain'	Two decimal places recommended
	A2 Exit	Description of pavement chunk (not used by X-Plane)	Text string
120	Linear feature	Painted surface markings & light strings	
130	Airport boundary	Boundary for future terrain 'flattening'	
	120	Row code for a linear feature or airport boundary	120 or 130
	Line B1	Description of feature or boundary (not used by X-Plane)	Text string
111	Node	Node (plain)	
112	Node	Node with Bezier control point	
113	Node	Node (close loop), to close boundary	
114	Node	Node (close loop) with Bezier control point	
115	Node	Node (end) to terminate a line	
116	Node	Node (end) with Bezier control point	
	112	Row code for a node. First node must follow an appropriate header row	111 thru 116
	47.53752190	[All nodes] Latitude of node in decimal degrees	Eight decimal places supported
	-122.30826710	[All nodes] Longitude of node in decimal degrees	Eight decimal places supported
	47.53757385	[112, 114, 116 only] Latitude of Bezier control point in decimal degrees	Eight decimal places supported. Ignore for 111, 113, 115
	-122.30824831	[112, 114, 116 only] Latitude of Bezier control point in decimal degrees	Eight decimal places supported. Ignore for 111, 113, 115
	3	[Not for 115 or 116] Code for painted line type on line segment starting at this node	Integer **Line Type Code** (see below). Not for 115 or 116
	102	[Not for 115 or 116] Code for lighting on line segment starting at this node	Integer **Line Type Code** (see below). Not for 115 or 116
14	Viewpoint	Maximum of one viewpoint for each airport	
	14	Row code for a viewpoint	14
	47.52917900	Latitude of viewpoint in decimal degrees	Eight decimal places supported
	-122.30434900	Longitude of viewpoint in decimal degrees	Eight decimal places supported
	100	Height (in feet) of viewpoint above ground level	Integer
	0	Code deprecated. Use '0'	0

	ATC Tower	Name of viewpoint (not used by X-Plane)	Descriptive text string (optional)
15	Startup location	Startup locations for airplanes at an airport	**Should be converted to new row code 1300**
	15	Row code for a startup location	15
	47.52926674	Latitude of startup location in decimal degrees	Eight decimal places supported
	-122.29919589	Longitude of startup location in decimal degrees	Eight decimal places supported
	304.16	Heading (true) of an aeroplane when positioned at startup location	Two decimal places recommended
	A6 Run Up	Name of startup location (list will be displayed in X-Plane for each airport)	Short descriptive text string – ten characters or less
18	Light beacon	Maximum of one beacon for each airport	
	18	Row code for an airport light beacon	18
	47.52920400	Latitude of beacon in decimal degrees	Eight decimal places supported
	-122.30412800	Longitude of beacon in decimal degrees	Eight decimal places supported
	1	Code for type of light beacon. Determines colors of beacon.	Integer **Beacon Type Code** (see below)
	BCN	Name of viewpoint (not used by X-Plane)	Descriptive text string (optional)
19	Windsock	Multiple windsocks permitted for each airport	
	19	Row code for a windsock	19
	47.53900921	Latitude of windsock in decimal degrees	Eight decimal places supported
	-122.30868700	Longitude of windsock in decimal degrees	Eight decimal places supported
	1	Flag for windsock lighting	0=unlit, 1=illuminated
	WS	Name of viewpoint (not used by X-Plane)	Descriptive text string (optional)
20	Signs	Taxiway signs or runway distance-remaining signs	
	20	Row code for a sign	20
	47.54099177	Latitude of sign in decimal degrees	Eight decimal places supported
	-122.31031317	Longitude of sign in decimal degrees	Eight decimal places supported
	235.71	Orientation of sign in true degrees (heading of someone looking at sign's front)	Two decimal places recommended
	0	Reserved for future use. Ignore.	0
	2	Code for sign size	Integer **Sign Size Code** (see below)
	{@L}A1{@R}31R-13L	Text to be rendered on sign front and/or back	Text string formatted by **Sign Text Definition** (see below)
21	Lighting objects	VASI, PAPI, wig-wags, etc.	
	21	Row code for a lighting object	21
	47.53666659	Latitude of lighting object in decimal degrees	Eight decimal places supported
	-122.30585255	Longitude of lighting object in decimal degrees	Eight decimal places supported
	2	Code for type of lighting object	Integer **Lighting Object Code** (see below)
	150.28	Orientation of lighting object in true degrees (looking toward object)	Two decimal places recommended
	3.30	Visual glideslope angle in degrees	Two decimal places. 0.00 if not required. Default is 3.00

	13L	Associated runway number (required for VASI/PAPI, etc)	One to three characters
	PAPI-2L	Description of lighting object (not used by X-Plane	Short text string (optional)
1000	Traffic flow	Arrival and departure traffic flows	
	1000	Row code for an arrival/departure traffic flow	1000
	Calm and south flows	Traffic flow name	Descriptive name (max 50 characters)
1001	Traffic flow wind rule	Zero or multiple wind rules permitted per flow	
	1001	Row code for a traffic flow wind rule	1001
	KSEA	METAR reporting station (may be a remote airport, eg KSEA for KBFI)	ICAO code, up to 7 characters
	000	Wind direction minimum (magnetic)	000 - 359
	359	Wind direction maximum (magnetic)	000 - 359
	5	Maximum wind speed. Use 999 for 'all' wind speeds.	0 - 999
1002	Traffic flow ceiling rule	Zero or one ceiling rule permitted per flow	
	1002	Row code for a traffic flow ceiling rule	1002
	KSEA	METAR reporting station (may be a remote airport, eg KSEA for KBFI)	ICAO code, up to 7 characters
	0	Minimum reported ceiling in feet AGL at reporting station	Positive integer
1003	Traffic flow visibility rule	Zero or one visibility rule permitted per flow	
	1003	Row code for a traffic flow visibility rule	1003
	KSEA	METAR reporting station (may be a remote airport, eg KSEA for KBFI)	ICAO code, up to 7 characters
	0	Minimum reported visibility in statute miles	Float (eg. "1.5")
1004	Traffic time rule	Zero or multiple time rules permitted per flow	
	1004	Row code for a traffic flow time rule	1004
	0000	UTC time from which rule is valid	0000 - 2400
	2400	UTC time at which rule ends	0000 - 2400
1100	Runway-in-use rule	Multiple rules for each flow. First to 'pass' is used	
	1100	Row code for a runway-in-use rule	1100
	34C	Runway end identifier	Two to three characters. Valid suffixes: "L", "R" or "C" (or blank)
	11920	Arrival or departure frequency	Five digit integer, rounded DOWN where necessary
	arrivals	Rule type (arrivals, departures)	Pipe separated list ("|"). 'arrivals' and/or 'departures'
	jets|turboprops	Airplane types to which rule applies	Pipe-separated list ("|"). Can include "heavy", "jets", "turboprops", "props" and "helos"
	181359	On course heading range ((ie. first leg of flight plan for departures, last leg for arrivals)	000000 - 359359

	341341	Initial ATC assigned departure heading range. Not used for arrivals.	000000 - 359359
	Arrival 34C	Rule name	Descriptive name (max 50 characters)
1101	VFR pattern rule	Zero or one VFR pattern rule permitted per flow	
	1101	Row code for a VFR traffic pattern	1101
	34L	Runway end identifier	Two to three characters. Valid suffixes: "L", "R" or "C" (or blank)
	left	VFR traffic pattern direction	"left" or "right"
1200	Taxi routing network	(for readability only)	
1201	Taxi routing node	All nodes must be used in at least one edge	
	1201	Row code for taxi routing network node	1201
	47.53752190	Latitude of node in decimal degrees	Eight decimal places supported
	-122.30826710	Longitude of node in decimal degrees	Eight decimal places supported
	both	Usage of node in network (begin or end a taxi path, or both)	"dest", "init", "both" or "junc"
	5416	Node identifier (defined in 0 based sequence, ascending)	Integer. Must be unique within scope of an airport.
	A_start	Node name. Not currently used.	String (max 16 characters)
1202	Taxi routing edge	Segment in taxi routing network	
	1202	Row code for taxi routing network edge	1202
	5416	Node identifier for start of edge	Integer. Must refer to valid node (row code '1201')
	5417	Node identifier for end of edge	Integer. Must refer to valid node (row code '1201')
	twoway	Edge can be used in both directions	"twoway" or "oneway"
	taxiway	Node is on a regular taxiway. If on "runway" a clearance is needed from ATC	"taxiway" or "runway"
	A	Taxiway identifier. Used to build ATC taxi clearances (eg. ".. .taxi via A, T, Q")	String. Taxiway or runway identifier (eg. "A" or "16L/34R")
1204	Edge active zone	Identifies an edge as in a runway active zone.	
	1204	Row code for an edge entering a runway active zone	1204
	arrival	Active zone classification	"arrival" or "departure" or "ils"
	16L,16C	Runway(s) to which active zone refers	Comma-separated list up to 4 runway identifies
1206	Taxi routing edge (ground vehicles)	Segment in taxi routing network (ground vehicles only)	
	1206	(See 1202)	(See 1202)
	107	(See 1202)	(See 1202)
	11	(See 1202)	(See 1202)
	twoway	(See 1202)	(See 1202)
1300	Start up location	Start or end point for aircraft. Not linked to taxi routing network by edges (row code 1202)	

	1300	Row code for taxi route start/end point	1300
	47.44158755	Latitude of location in decimal degrees	Eight decimal places supported
	-122.30116873	Longitude of location in decimal degrees	Eight decimal places supported
	44.78	Heading (true) of airplane positioned at this location	Decimal degrees, true heading
	gate	Type of location	“gate”, “hangar”, “misc” or “tie-down”
	jets	Airplane types that can use this location	Pipe-separated list (“|”). Can include “heavy”, ”jets”, “turboprops”, “props” and “helos” (or just “all” for all types)
	A3	Unique name of location	Text string, must be unique within a single airport
1301	Row Code	For ramp start metadata	
	1301		1301
	d	ICAO width code	A, B, C, D, E, F
	airline	Operation type	none, general_aviation, airline, cargo, military
	dal	Airline permitted to use this ramp	3-letter airline codes (AAL, SWA, etc)
1302	Row Code	Airport metadata	
	1302	row code	Takes zero, any or all applicable Key_values
	icao_id	key_value for ICAO code	icao_id, faa_id, iata_id, city_id, country_id, region_id
	KSEA	ICAO for airport	Unique identifier up to 7 characters long
1400	Truck Parking		
	1400	row code	
	47.44374472	Latitude of location in decimal degrees	Eight decimal places supported
	-122.30463464	Longitude of location in decimal degrees	Eight decimal places supported
	88.1	Heading (true) of the OBJ positioned at this location	Decimal degrees
	baggage_train	type string	baggage_loader, baggage_train, crew_car, crew_ferrari, crew_limo, pushback, fuel_liners, fuel_jets, fuel_props, food, gpu
	3		0 to 10 if type is baggage_train, 0 if not
	Svc Baggage	Name of parking	Text string
1401	Truck Destination		
	1401	row code	
	47.44103438	Latitude of location in decimal degrees	Eight decimal places supported
	-122.30382493	Longitude of location in decimal degrees	Eight decimal places supported
	0.0	Heading (true) of the positioned at this location	Decimal Degrees, true heading
	baggage_train	Truck types allowed to end up at this destination	Pipe separated list (“|”). Include 1 or more of the following baggage_loader, baggage_train, crew_car, crew_ferrari, crew_limo, pushback, fuel_liners, fuel_jets, fuel_props, food, gpu
	Luggage Train Destination South 2	Name of Truck Destination	Text string
50	ATC – Recorded	AWOS, ASOS or ATIS	
51	ATC – Unicom	Unicom (US), CTAF (US), Radio (UK)	

52	ATC – CLD	Clearance Delivery	
53	ATC – GND	Ground	
54	ATC – TWR	Tower	
55	ATC – APP	Approach	
56	ATC - DEP	Departure	
	51	Row code for an ATC COM frequency	50 thru 56 (see above)
	12775	Frequency in MHz x 100 (eg. use "12322" for 123.225MHz)	Five digit integer, rounded DOWN where necessary
	ATIS	Descriptive name (displayed on X-Plane charts)	Short text string (recommend less than 10 characters)

CODES

Codes used to define airport data:

Codes		Comment	
	Code value	*Code meaning*	*Code applicability*
Surface Type Code		Surface type of runways or taxiways	
	1	Asphalt	
	2	Concrete	
	3	Turf or grass	
	4	Dirt (brown)	
	5	Gravel (grey)	
	12	Dry lakebed (eg. At KEDW)	Example: KEDW (Edwards AFB)
	13	Water runways	Nothing displayed
	14	Snow or ice	Poor friction. Runway markings cannot be added.
	15	Transparent	Hard surface, but no texture/markings (use in custom scenery)
Runway Marking Code		Markings on runway	
	0	No runway markings	Disused runways appear like taxiways
	1	Visual markings	
	2	Non-precision approach markings	
	3	Precision approach markings	
	4	UK-style non-precision approach markings	UK uses distinctive touch-down zone markings
	5	UK-style precision approach markings	UK uses distinctive touch-down zone markings
Approach Lighting Code		Approach lighting systems	
	0	No approach lighting	
	1	**ALSF-I** • High intensity Approach Light System with sequenced flashing lights	

	2	**ALSF-II** ● High intensity Approach Light System with sequenced Flashing lights ● Red side bar lights (barettes) the last 1000', that align with TDZ lighting.	
	3	**Calvert** ● British - High intensity	
	4	**Calvert ILS Cat II and Cat II** ● British - High intensity with red side bar lights (barettes) the last 1000' ● Barettes align with TDZ lighting	
	5	**SSALR** ● High intensity, Simplified Short Approach Light System ● With Runway Alignment Indicator Lights (RAIL)	
	6	**SSALF** ● High intensity, Simplified Short Approach Light System ● With sequenced flashing lights	
	7	**SALS** ● High intensity, Short Approach Light System	
	8	**MALSR** ● Medium-intensity Approach Light System ● With Runway Alignment Indicator Lights (RAIL)	
	9	**MALSF** ● Medium-intensity Approach Light System with sequenced flashing lights	
	10	**MALS** ● Medium-intensity Approach Light System	
	11	**ODALS** ● Omni-directional approach light system ● Flashing lights, not strobes, not sequenced	
	12	**RAIL**	

		• Runway Alignment Indicator Lights • Sequenced strobes and green threshold lights, with no other approach lights	
Line Type Code		Painted lines and light strings	
		Note that for all linear features that involve runway entrance hold lines and associated lights (4, 5, 6, 103 & 104 below), the runway is assumed to be to the LEFT of the string and the taxiway to the RIGHT (looking along string from its first node)	
	0	Nothing.	
	1	Solid yellow line	Taxiway centre lines
	2	Broken yellow line	Miscellaneous boundaries
	3	Double solid yellow lines	Taxiway edge lines
	4	Two broken yellow lines and two solid yellow lines. Broken line on left of string.	Runway hold positions
	5	Broken yellow line with parallel solid yellow line. Broken line on left of string.	Other (non-runway) hold locations
	6	Yellow cross-hatched line	ILS hold
	7	Solid yellow line with broken yellow line on each side	Taxiway centerlines in runway safety zones
	8	Widely separated, broken yellow line	Mark 'lanes' for queuing aeroplanes
	9	Widely separated, broken double yellow line	Mark 'lanes' for queuing aeroplanes
	51-59	Line types 1-9 above with a black border	Use on concrete surfaces for higher contrast
	20	Solid white line	Roadway markings
	21	White chequerboard pattern	Roadway markings
	22	Broken white line	Roadway centreline
		Note that lights added to the edge boundary of a piece of pavement (or hole) will be placed off the edge of the pavement (about one meter).	
	101	Green embedded lights, bidirectional along string axis	Taxiway centrelines
	102	Blue lights, omnidirectional	Taxiway edge
	103	Closely spaced, embedded amber lights. Unidirectional to right of string	Hold lines
	104	Closely spaced, pulsating embedded amber lights. Unidirectional to right of string	Runway hold lines
	105	Alternating green and amber embedded lights, bidirectional along string axis	Centrelines in runway safety zones
	106	Red lights, omnidirectional	Edge lights in dangerous/critical zones (eg. on bridges)
Beacon Type Code		Airport light beacons	
	0	No beacon. Suppresses automatic creation of beacon by X-Plane.	Use a dummy airport lat/lon for the location.
	1	White-green flashing	Civilian land airport
	2	White-yellow flashing	Seaplane base
	3	Green-yellow-white flashing	Heliport
	4	White-white-green flashing	Military airport
Sign Size Code		Taxiway sign sizes & types	
	1	Small taxiway sign	
	2	Medium taxiway sign	
	3	Large taxiway sign	
	4	Large distance-remaining sign on runway edge	Alternatively, can be auto generated for a runway
	5	Small distance-remaining sign on runway edge	Alternatively, can be auto generated for a runway
Lighting Object Code		Lighting objects	
	1	VASI	Location is centre point between the two VASI units
	2	PAPI-4L (four-light) on left of runway	Left-handed: red indication appears first on right 2 lights
	3	PAPI-4R (four light) on right of runway	Right-handed: red indication appears first on left 2 lights
	4	Space Shuttle PAPI, 20 degree glidepath	Deprecated. Use normal PAPI with an appropriate angle.

	5	Tri-colour VASI	
	6	Runway guard (“wig-wag”) lights	Pulsating double amber lights alongside runway entrances

Taxiway Sign Text Definition

The text on taxiway signs follows a specification shared with the FlightGear flight simulator.

In summary, the text and images on a taxiways sign are represented in X-Plane by:

- **Instructions** define the style of the text and images on the sign. These are always prefixed with the "@" symbol:
  - Black lettering on a yellow background (direction signs) ("@Y").
  - Yellow lettering on a black background (location signs) ("@L").
  - White lettering on a black background (runway distance-remaining signs) ("@B").
  - White lettering on a red background (runway holding point signs) ("@R").
  - Instructions must be included inside curly braces (eg. “{@Y}”)
- **Single-character glyphs** define a series of numbers or characters on the sign. These translate one-to-one to the text on the sign. The only allowable single characters are:
  - The numbers "0" through "9", for all sign styles.
  - The uppercase letters "A" through "Z". Only UPPERCASE characters are allowed! No letters are allowed on distance remaining signs.
  - The following single-character symbols are allowed for runway ("@R") and location ("@Y") signs only:
    - Space (represented by an underscore "_")
    - Large dot (represented by an asterisk ("*")
    - Vertical separator (represented by the vertical bar "|") (also referred to as a "frame separator")
    - Period, comma, slash and hyphen (".", ",", "/" and "-")
- **Multi-character glyphs** define symbols:
  - Directional arrows (eg. "^lu" for a left-up arrow, "^rd" for a right-down arrow) are allowed for red ("@R") and yellow ("@Y") signs only.
  - The only allowable arrows are: "^l", "^r", "^u", "^d", "^lu", "^ld", "^ru", "^rd"
    - Note that for diagonal arrows, the left/right must precede the up/down. For example, "^dr" is invalid.
  - ILS-critical boundary ("critical"). These do not require a sign style.
  - Runway safety zone boundary ("safety"). These do not require a sign style.
  - No-entry symbols ("no-entry"). These do not require a sign style.
  - Hazard (end of taxiway) ("hazard"). These do not require a sign style.
  - Switch sides - flip to the back of the sign and start a new text string for the back ("@@")
  - Roman numerals (for ILS categories, such as "CAT III") ("r1", "r2" and "r3") are allowed for red ("@R") and yellow ("@Y") signs only.
  - Multi-character glyphs must be included inside curly braces (eg. “{r1}”)

There are rules about how these three types of data must be structured on a taxiway sign:

- Instructions and single-character glyphs must be UPPERCASE.
- Multi-character glyphs must be lowercase
- Instructions and multi-character glyphs must be enclosed in curly braces ("{}"), to distinguish them from a set of single-character glyphs.
    - If there are multiple consecutive instructions and/or multi-character glyphs, they can be separated within the same set of curly braces by a comma (eg. "{@Y,^l}")
- Spaces are not allowed. Spaces on the sign itself are represented by the underscore ("_") character.

Examples of sign text:

Sign	Sign type	Text to generate this sign
	Direction sign	{@Y}A{^r}
	Location sign	{@L}T
	Location and direction sign	{@L}A{@Y,^l}E{^r}
	Complex sign	{@Y,^l}E|{^lu}F{@L}A{@Y}T{^ru}|E{^r}
	Direction sign	{@Y}MIL{^r}
	Direction to runway	{@Y}27*33{^r}
	Direction to multiple runways	{@Y}{^l}5|13{^u}
	Runway hold	{@R}15-33
	Runway crossing	{@R,^ld}5-23{^ru}|{^lu}9-27{^rd}
	Runway approach area	{@R}15-APCH
	Location & runway hold	{@L}T{@R}18-36
	Runway safety area boundary	• {safety} • If on back of a runway hold sign (above) would be: {@L}T{@R}18-36{@@}{safety}

	ILS critical zone boundary	{critical}
	Hazard (end of taxiway)	{hazard}
	Distance remaining	• {@B}3 • Distance from opposite end of runway might be on back of sign: {@B}3{@@}7

Common errors in sign text:

These are the most common errors found in airport submissions:

- Using a space instead of an underscore symbol for a space in direction (@Y) and runway (@R) signs (eg. "{@Y}RWY 04{^ru}")
- Using spaces or underscores in location (@L) signs (eg. “{@L}STAND_24”). These are not allowed.
- Forgetting the "@" symbol that prefixes an instruction (eg. "{Y}RWY_04{^ru}")
- Using lower case text for single-character glyphs (eg. "{@Y}Rwy_04{^ru}")
- Invalid diagonal arrows - the left/right must precede the up/down (eg. "{@Y}RWY_04{^ur}")
- Forgetting the "^" symbol that prefixes an arrow (eg. "{@Y,ru}B{@L}B")
- Mismatched curly braces (do not use regular parentheses) (eg. "{@Y}RWY_04(^ru}"). These are hard to spot!

If there are errors in the text on a taxiways sign, then X-Plane will not render the sign. Such errors are identified and logged in the log.txt file in your X-Plane system folder. Look for log entries such as:

```
Syntax error - unknown glyph at B{@L}B
Syntax error - missing closing brace.
 (in sign '{@L}B5{@R}NO_ENTRY{@Y}{@@}{@Y,ru}B{@L}B')
```

Further Information

Resources are available for airport designers at the X-Plane Scenery Gateway at http://gateway.x-plane.com/