

Brief Introduction To TLEs And Satellite IDs

Keplerian or Two-Line Element Sets (TLEs) are distributed in the form shown in the example below:

THOR ABLESTAR R/B 1

```
1 00047U 60007C 96198.95303667 -.00000008 +00000-0 +24803-4 005026 2
2 00047 066.6626 011.9766 0252122 190.4009 169.1818 14.34618735877842
```

Line 0 (the top line) provides the catalog and/or common name of the satellite object. Not all TLEs have common names associated with them, but they are an additional enhancement provided by some TLE distributors to allow the tracking program to provide a common name for the satellite in addition to the Satellite Catalog Number and/or International ID. Note, "R/B is an acronym for "rocket body".

The epoch date is the third element (96198.95303667) in line 1 of the TLE. The epoch is the sequential calendar date when the satellite crossed the equator in an ascending (northerly) direction subsequent to a series of observations that were made to calculate the elements. In the above example, observations were made near the time on which the satellite was calculated to have crossed the equator on calendar date 198.95303667 in the year 1996. Universal Time (UT), formally known as Greenwich Mean Time (GMT), is the time standard used. Jim Varney explains the concept in a response to a question found in the SeeSat-L e-mail archive.

Specifically, the equatorial crossing was calculated for day 198 of the year 1996 at 22:52 UT [24 (hours) x 0.95303667 = 22.87288 hours, and 60 (minutes) x 0.87288 = 52.3728 minutes]. Most tracking programs will inform the user how old the element is by using the epoch date element. This tells the user if an old and possibly unreliable TLE is being used.

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The first element in line 1 (00047U) and in line 2 (00047) is the Satellite Catalog Number assigned by USSPACECOM. The "U" designates the element as unclassified or for public distribution. The official title for this identifier is "Satellite Catalog Number". However, many acronyms are used because of their brevity and past history of use. These include NORAD (North American Air Defense), NSSC (NORAD Space Surveillance Center), Cat # (Catalog Number), Object Number, USSPACECOM (US Space Command) number, and so on.

Thus the satellite in the example TLE was 47th satellite ever cataloged by the USSPACECOM.

"Satellite Catalog Number" comes from the early days of satellite identification done at Hanscom Field, Massachusetts, USA in the late 1950's, where they kept track of the satellites they identified, by giving them the next ascending number in a log that began with the number 00001 for the Sputnik launch. When NORAD took over the responsibility for tracking, they continued using the sequence. Now USSPACECOM continues the assignment.

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The second element in line 1 (60007C) indicates the International Designation and corresponds to the numerical format designation of 60-007C. This indicates a launch in 1960 and it was the 7th successful orbital launch for that year. "C" designates the third object catalogued for that launch. Launches in 2000, 2001, 2002 and later start with 00-xxxx, 01-xxxx, 02-xxxx while launches from 1957 and later until the year 2000 start with the numbers 57 to 99. The International Designation is also described by terms such as International ID, COSPAR (Committee for Space Research) number, and COSPAR/WWAS (COSPAR World Warning Agency for Satellites) number. The World Warning Agency (WWAS) is the body authorized by the United Nations to issue the International ID. WWAS issues the International Designation for the payload but not for any of the other objects placed in orbit as a result of the launch. Subsequent International Designations for non-payload objects are normally assigned by USSPACECOM using the same designation as the payload, but using the next higher English letter in the alphabet.

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The second element in Line 2 (066.6626) is the inclination of the orbit which is measured counter-clockwise from true East to true West. The values of inclination can be from 0 to 180 degrees. Thus, this satellite will be seen moving in a NNE direction as it crosses the Earth's equator going in an ascending direction (south to north).

An inclination of less than 90 degrees would mean that the satellite is in an orbit less than polar and is in a prograde orbit. That is, the satellite moving in an easterly direction takes advantage of the Earth's easterly rotation and requires less energy to be placed into orbit. The minimum energy needed to place a satellite into orbit would be a launch from the equator in a due easterly direction. Such a launch would have the satellite have an inclination of 0 degrees. Additional energy must be expended by the rocket to maneuver a satellite into an orbital inclination of zero degrees if launched from a latitude other than zero degrees.

An inclination of 90 degrees would mean the satellite crosses the Earth's equator at a right

			tle_guide.txt
65	68	4	Element Number
69	69	1	Check Sum, Modulo 10

Line 2

Column First	Numbers Last	Number of Characters	Description
-----	-----	-----	-----
1	1	1	Line No. Identification
3	7	5	Catalog No.
9	16	8	Inclination
18	25	8	Right Ascension of Ascending Node
27	33	7	Eccentricity with assumed leading decimal
35	42	8	Argument of the Perigee
44	51	8	Mean Anomaly
53	63	11	Revolutions per Day (Mean Motion)
64	68	5	Revolution Number at Epoch
69	69	1	Check Sum Modulo 10

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