

## EARTH ORBITING SATELLITE OBSERVERS CLUB

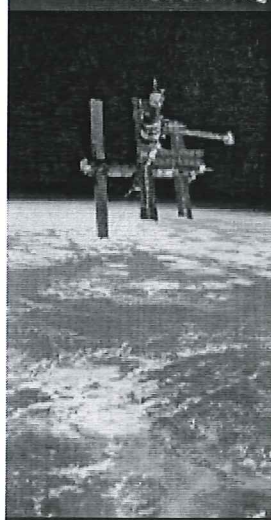
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## INTRODUCTION

The Astronomical League's satellite observing program is called the Earth Orbiting Satellite Observers Club and is administered by Tom DeClue and Gary Frerking of the Colorado Springs Astronomical Society. This club is similar to many of the observing award programs hosted by the League whereby participants record observations for a variety of Earth orbiting satellites. After meeting all of the program requirements, award certificates are issued to the observer.

This observing program is designed to get those new to satellite observing familiar with the terminology, and techniques of tracking satellites. The list of objects required for the basic award include targets that can be easily tracked using the unaided eye or binoculars, including the space shuttle, the international space station - Alpha, several operational vehicles, and numerous rocket bodies. Eventually, an advanced observing program will be created that picks up where the initial observing program leaves off, and will challenge the observer to locate and track more difficult targets such as GPS (Global Positioning System) satellites, Russian Molniya spacecraft, and even geosynchronous/geostationary satellites. Many of the observing targets in the advanced program will require telescopes and/or photographic techniques to identify.

The specifics of the EOSOC observing program are listed on the [EOSOC Tutorial](#) page, and are also on the downloadable observation report forms. We also offer a free propagation program tailored for the needs of EOSOC participants called [EOSOC Tracker](#).

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Excel Observation

For More Info

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## EARTH ORBITING SATELLITE OBSERVERS CLUB

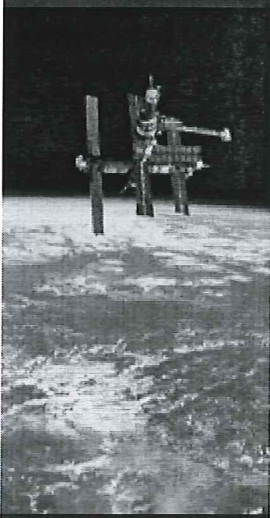
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## EOSOC TUTORIAL

Just as an observer striving to complete the Messier list can *see* those objects without really *understanding* exactly what it is they are observing, so too can a satellite observer *see* satellites without *understanding* what it is that he or she is observing. Unfortunately, this approach will sidestep much of the significance and value of starting this program in the first place. Therefore, it is wise to begin with a brief study of orbital mechanics from an "armchair observers" perspective.

Before you go searching for the "back" button on your browser, please bear with us. This tutorial is NOT a mathematically intensive analysis of orbit determination, but rather a basic summary of the concepts that will give meaning to the observing lists shown above. While not *required* to complete these observing programs, it will provide a foundation upon which you can build your knowledge and understanding of spacecraft geodesy.

## Introduction

The observing tasks for the EOSOC award are listed below.

- Active Payloads - Observe four (4) different active payloads, e.g. weather satellites, communications satellites, scientific payloads, etc. that are currently operational. Examples include the Hubble Space Telescope.
- Manned Spaceflight - Observe two (2) manned spacecraft. These must be spacecraft that are occupied by humans at the time of observation, and might include any of the U.S. space shuttles, space stations, or Soyuz spacecraft. It is preferred that two different spacecraft are observed, but the requirement may be satisfied by observing two separate passes of the same spacecraft until the U.S. Space Shuttles (or other manned spacecraft) are placed in service.
- Multinational Satellites - Observe satellites from four (4) different countries (other than the USA). These spacecraft must be owned by the country noted, but don't have to have been launched by the country that owns the spacecraft (Russia and the USA regularly launch payloads for other countries).
- Rocket Bodies - Observe four (4) rocket bodies. These are usually noted by "R/B" in the satellite name in the element set.
- Iridium Flares - Observe four (4) Iridium flares. At least one of these must be during daylight or civil twilight.
- Multi-pass - Observe two (2) satellites on two separate passes, each pair of passes must be observed in a single night.

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- **Formation** - Observe two (2) sets of formation flights. These will usually be a space shuttle or Soyuz spacecraft flying in formation with the ISS just before or after docking. The two spacecraft should be on the same orbital path, and separated by no more than 30-40 degrees.
- **Aged Element Sets** - Observe two (2) satellites with element sets of different ages. For each satellite, one observation must be with an element set less than one week old, and the second observation must be with an element set at least three weeks old. The purpose is to see the effects of using old element sets, and their effect on the arrival time of the satellite. Taking accurate observation times is especially important in this task.

Notes: A single pass of a satellite can only be used to satisfy a single task. I.e., a single observation of the space shuttle can be used in a manned spaceflight task, an active payload task, or perhaps in a formation task, but only one.

### Collecting Observations

We've attempted to make the process of collecting observations as easy and direct as possible. The first thing to do is to download the observation report form (in Adobe PDF or Microsoft Word format), and print off one per observing task, 28 in total. If you have Microsoft Excel, you might also choose to download the EOSOC Observation Checklist. We'll discuss the observation checklist later.

The observation reporting forms must be completed by each participant, and submitted in order to get credit for each observation. Please note: make copies of your logs, we are not able to return logs submitted for EOSOC credit.

There are a number of fields that must be completed on each observation report form. Some are obvious, like name and date of observation, but others deserve additional clarification. The process of verifying observations is timeconsuming, and we require this information to make our verification process as quick as possible.

- **Observers Name** - Please enter your name here, as you would like it to appear on your certificate.
- **Date of Observation** - Specify the date of the observation, INCLUDING the timezone in effect at the time (EDT, PST, etc.). You are also welcome to use Greenwich or UTC if you like. When you include your time hacks on the sketch, please use the same timezone noted in this field.
- **Satellite Name and ID** - Enter the common name of the satellite AND the satellite id (either the catalog number appearing in the **first field of line 1** of the element set, or the XXXX designator appearing in the **second field of line 1** of the element set). For example, "Cosmos 2533 R/B, 25063U".
- **Date of Element Set Used** - Enter the date of the element set file used for this object. You can include either the date of the element set file, or optionally the date the file was downloaded.

- **Location of Observer** - Enter your observing location. Be sure to use decimal degrees, and not degrees/minutes/seconds.
- **Instrument Used** - Please check the appropriate item.
- **Comments** - Include any comments that would clarify the observation, for example, the satellite brightness, whether it was flashing, if it faded out, satellite was X seconds late, etc.
- **Observation Number** - This field is especially important if you choose to use the optional Excel observation checklist. Please assign a number from 1 to 28, corresponding to the objective on the checklist. If you don't use the Excel checklist, this field is optional.
- **Sketch of Observation** - You must include a full sky sketch of the satellite pass. Please include the following items in your sketch:
  1. A solid line showing the path of the satellite across the sky (use a dashed/dotted line for flashing satellites)
  2. At least two time "hacks" indicating where the satellite was in the sky at those times. As mentioned earlier, the time written on the sketch should be in the timezone noted in the "Date of Observation" field above.
  3. One or two reference constellations to indicate the path of the satellite with respect to the background stars.
- **Observation Objective** - Check which item in the program list is being satisfied by the observation recorded on each form.  
Note that each form should contain only one satellite passage, except the formation flights, which should have both satellites on the same observation reporting form.

### Observation Checklist

An optional observation checklist is provided for your convenience.

This file, in Microsoft Excel format, can be used to assist in keeping track of the observations you are collecting. It has a number of formulas and logical checks in place to help prevent duplicate observations, or allocating a single observation to more than one observing task, etc. To use this spreadsheet, simply enter the target information in the observation table at the top (table 1), and transfer the observation number to the task table at the bottom (table 2). The built-in logic will identify any duplication problems, and will notify you when all tasks are complete. If you use this checklist, please include a printout of the completed checklist with your observations logs when you submit for your award.

### Propagation Software

There are a wide range of planetarium programs and specialized satellite tracking programs available to those interested in tracking satellites, some of which are listed on the EOSOC Resources page. We have created propagation program called "EOSOC Tracker" that is tailored for the needs of EOSOC. You can download this free program from the EOSOC Resources page. A word of caution here... this program is currently undergoing development, and changes are being made on a regular basis. Be sure to check back for updates.

# Astronomical League

## Earth Orbiting Satellite Observers Club

### Observation Report Form, Version 1.3

Observers Name \_\_\_\_\_

Date of Observation \_\_\_\_\_

Satellite Name and  
Element Set Satellite ID \_\_\_\_\_

Date of Element Set Used \_\_\_\_\_

Location of Observer

Latitude \_\_\_\_\_  
(use decimal degrees only)

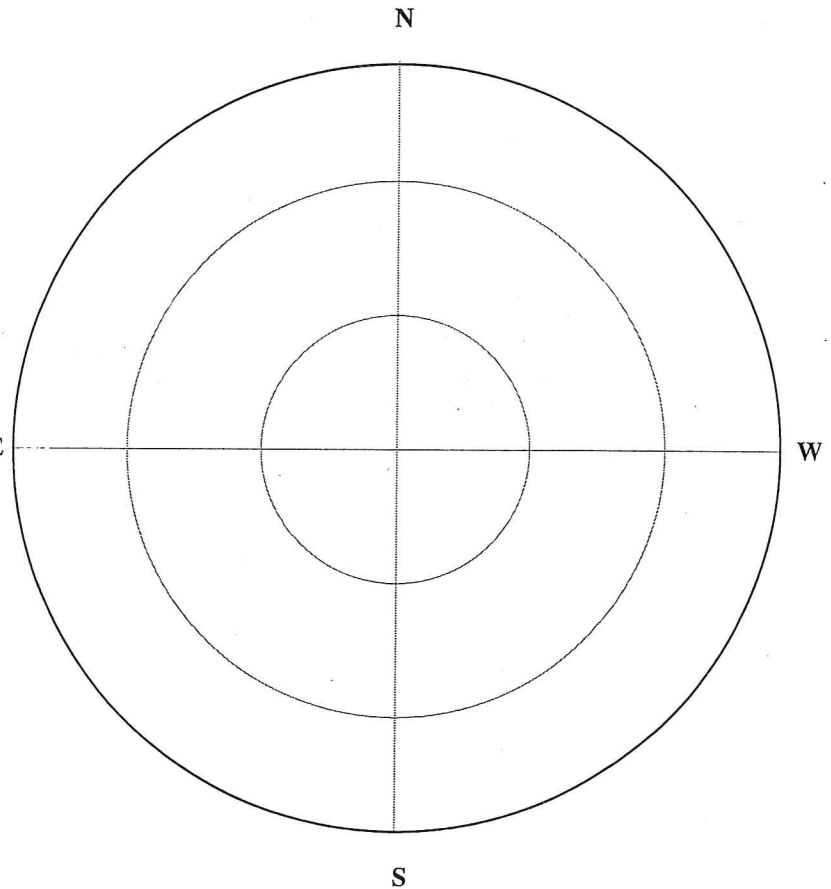
Longitude \_\_\_\_\_  
(use decimal degrees only, east is negative)

Elevation \_\_\_\_\_  
(specify feet or meters)

Instrument Used (check one)

☐ Unaided Eye  
☐ Binoculars  
☐ Telescope – specify aperture \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Draw or sketch the path of the satellite across the sky relative to bright stars. The outer ring represents the horizon.

**IMPORTANT** - Place time "hacks" on at least two locations on the satellite track, *including the timezone and daylight/standard time references*, for example 01:20:50 UTC, 19:30:40 EST, 23:10:59 PDT, etc.).

Observation Number (1-28) \_\_\_\_\_

Observation Objective (subject to change - check only one task per observation)

Active Payload (4) 1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_

Manned Spaceflight (2)  
STS \_\_\_\_\_  
ISS \_\_\_\_\_  
Other \_\_\_\_\_

Multinational (4)  
Russia \_\_\_\_\_  
China \_\_\_\_\_  
Japan \_\_\_\_\_  
Brazil \_\_\_\_\_  
Other \_\_\_\_\_

Rocket Bodies (4) 1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_

Iridium Flares (4) 1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_ (one during daylight or civil twilight hours)

Multipass (2) 1 a \_\_\_\_\_ b \_\_\_\_\_  
2 a \_\_\_\_\_ b \_\_\_\_\_

Formation (2) 1 a \_\_\_\_\_ b \_\_\_\_\_  
2 a \_\_\_\_\_ b \_\_\_\_\_

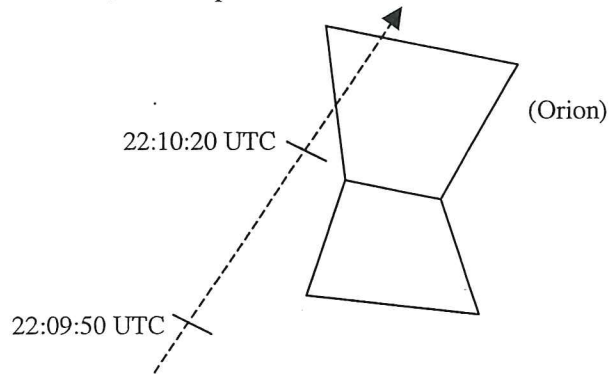
Aged Elsets (2) 1 a \_\_\_\_\_ b \_\_\_\_\_  
2 a \_\_\_\_\_ b \_\_\_\_\_



## Observing Guidelines and Suggestions

### General Rules (subject to change)

- 1) Provide one observation sheet for each observation task shown.
- 2) Be sure to state both the spacecraft name and id (Satellite Number or International Designation) on each observation sheet.
- 3) Sketch the path of the satellite's motion across the sky, being sure to include at least two time hacks and reference constellations, for example:



- 4) Record the time of observations as accurately as possible. Use WWV or the U.S. Naval Observatory web site to set your clock before observing.
- 5) Any single observation (pass) can only be used to satisfy one task, for example, observing the Space Shuttle flying in formation with the Space Station Alpha (ISS) can be used as an STS observation and an ISS observation, OR as a formation pass, but not both.
- 6) If you have any questions, visit the EOSOC web site ([http://www.rmss.org/eosoc/EOSOC\\_Intro.htm](http://www.rmss.org/eosoc/EOSOC_Intro.htm)), submit them to the EOSOC listserv on the Internet (see the web site), or contact the EOSOC program administrator ([eosoc@earthlink.net](mailto:eosoc@earthlink.net)).
- 7) Verification of observations can be time consuming. After submitting *copies* of your observing logs, please allow 4 weeks to receive your EOSOC certificate. NOTE: Observing logs will NOT be returned - please submit copies only to:

Steve Bygren  
EOSOC Administrator  
2822 Front Royal Drive  
Colorado Springs, CO, USA 80919

**Active Payloads** - Observe four *different* operational spacecraft. For example, HST, weather/imaging satellites, communications satellites, etc.

**Rocket Bodies** - Observe four *different* rocket bodies. These can often be seen as "flashers", and are usually denoted by "r/b" in the elset.

**Multinational** - Observe objects from four *different* countries, other than the USA. If the country is not listed, record the name of the country on the observation form.

**Manned Spaceflight** - Observe two *different* manned spacecraft, e.g. two space shuttles, or one shuttle and one space station, etc.

**Iridium Flares** - Observe four Iridium flares (while available).

**Multipass** - Observe an object (2) on multiple passes on a single night (pass "a" and pass "b").

**Aged Elsets** - Observe an object (2) with elsets less than 1 week old, and 3 or more weeks old (pass "a" and pass "b").

**Formation** - Observe 2 (or more) objects flying in formation, e.g. STS and ISS (or HST) prior to docking or after separation (object "a" and object "b"). Record multiple objects flying in formation on a single observation report form.