# Student Astronaut Challenge

## De-Orbit Procedure for Apollo Division (only)

**Introduction**

A returning orbiter's glide back to a landing facility begins on the opposite side of the planet. A de-orbit burn of the OMS engines must be made to move the vehicle into a reentry position. In the SAC simulation, this usually occurs between 23 and 25 minutes into the mission (MET).

Note: During SAC flight simulations, after the de-orbit burn is completed, a reentry system check is done after which other reentry maneuvers are skipped and the mission proceeds directly to landing. This is done to save flight time during the competition.

**Mission Procedure**

The procedure for completing a de-orbit burn is a multi-step process:

1) The mission control team receives flight dynamics and attitude information from the flight director. This information will consist of a current distance to the landing site (DTLS) as well as a current reentry angle (RA). This step will occur at the beginning of Comm block 35 of the mission checklist.
2) The mission control team will then use the chart provided to calculate the de-orbit burn time.
3) While the mission control team calculates the burn duration, the flight crew will set the left and right OMS $N_2$ control valves to enable (This step is located in Comm block 35 of the mission checklist).
4) The de-orbit burn time will be communicated to the flight crew in case communication is lost with the orbiter.
5) The mission control team will advise the flight crew that they are go for performing the de-orbit procedure.
6) A 10-second countdown to the beginning of the burn will be given to the mission commander by the mission control team.
7) At the end of the 10-second countdown, the mission commander will set the OMS engine throttle to maximum.
8) The burn will continue for the duration of the full burn time given by the mission control team.
   > Note: The mission control team will need to calculate backwards from the full burn time in order to give a 10-second countdown to the completion of the burn.
9) At the marked time for a full de-orbit burn, the mission commander will set the OMS engine throttle to off.

### Example de-orbit burn procedure:

- The flight director gives the mission director a DTLS of 240,000km and an RA of 3.6 degrees.
- The mission director will then use the provided burn data table to calculate a de-orbit burn of 37 seconds.
- Burn data is then relayed to the flight crew.
- MET is noted as T+23:25.
- The mission director is allowed to wait up to 1 minute to begin the de-orbit burn after the go advisement has been given. In this case the director will wait unit T+24:00 to start the burn.
- T+23:50 a 10-second countdown will be given by mission control to begin the burn.
- T+24:00 the mission commander will set the OMS throttle to maximum.
- T+24:27 a 10-second count down will be given by mission control to terminate the burn.
- T+24:37 the mission commander will set the OMS throttle to off.

# De-Orbit Burn Data Table (Apollo Division)

| | | Reentry Angle (RA) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.8° | 1.2° | 1.6° | 2.0° | 2.4° | 2.8° | 3.2° | 3.6° | 4.0° | 4.4° |
| **Distance to Landing Site (DTLS)** | **90,000 km** | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 |
| | **120,000 km** | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 |
| | **150,000 km** | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
| | **180,000 km** | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 |
| | **210,000 km** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 |
| | **240,000 km** | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 |
| | **270,000 km** | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 |
| | **300,000 km** | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 |
| | **330,000 km** | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 |
| | **360,000 km** | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 | 53 |
| | **390,000 km** | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 |
| | **420,000 km** | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 |
| | **450,000 km** | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 |
| | **De-Orbit Burn Time (in seconds)** | | | | | | | | | | |