

ENGINEERING CHANGE ORDER			ECO No. COS-059	
Center for Astrophysics & Space Astronomy University of Colorado, Boulder			Date 12 March 2001	
			Sheet 1 of 6	
Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	
				Stop Production Now
				<input type="checkbox"/> Yes
				<input type="checkbox"/> No

Description of Change:

1. Section 5.2.1, p. 111 of Rev 11, paragraph right before “Phase 1 Configuration”:

Modify the second sentence to say, “The Phase 1 Configuration and Phase 2 Target Search phases are applicable to all COS TA modes, then the discussion...”

2. Section 5.2.1, p. 111 of Rev 11, add the following text right BEFORE the paragraph on “Phase 1 Configuration”:

Four observing modes are provided for target acquisition:

- ACQ mode (target search)
- ACQ/PEAKXD mode (cross-dispersion pickup)
- ACQ/PEAKD mode (dispersion pickup)
- ACQ/IMAGE mode (TA1 imaging acquisition)

Observers may specify any combination of these modes in any order, and some of the steps (notably the target search) may be repeated. ACQ/PEAKXD and ACQ/PEAKD modes require dispersed light and will be used in conjunction with one or more of the COS gratings (G130M, G160M, G140L; G185M, G225M, G285M, G230L). (Although there is nothing in the target acquisition FSW that would prevent one

Reason for Change: Updates to COS operations in OP-01.	Disposition/Effectivity				
	To Comply With ECO				
	Use As Is				
	Rework To ECO				
	Scrap And Rebuild				
	Record change Only				
	Other (See Above)				
Prepared By: Jon Morse	Date: 12 March 2001	CCB Required		<input type="checkbox"/> Approved	
Approved By: _____	Date: _____	<input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> NotApproved	
Approved By: _____	Date: _____	<input type="checkbox"/> Class I <input type="checkbox"/> Class II		Immediate	
Approved By: _____	Date: _____			Incorporation	
Approved By: _____	Date: _____	<input type="checkbox"/> Yes <input type="checkbox"/> No			
Approved By: _____	Date: _____	Completion			
Project Mgr: _____	Date: _____	Date			

ENGINEERING CHANGE ORDER			ECO No.	COS-059
Center for Astrophysics & Space Astronomy			Date	12 March 2001
University of Colorado, Boulder			Sheet	2 of 6
Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	
				Stop Production Now
				<input type="checkbox"/> Yes
				<input type="checkbox"/> No

from using the NUV TA1 mirror with the ACQ/PEAKXD and ACQ/PEAKD modes, doing so would merely duplicate the functionality of the ACQ/IMAGE mode. Therefore, proposers should not be allowed to specify the TA1 mirror as the spectral element during the ACQ/PEAKXD and ACQ/PEAKD modes.) ACQ/IMAGE mode uses undispersed light and requires the use of the NUV mirror (TA1, TA1-RVMM). At the end of the ACQ/IMAGE procedure, a “confirmation image” will automatically be taken in ACCUM mode and downlinked to the ground to facilitate diagnosis of target acquisition problems. ACQ mode (target search) may be done in either dispersed or undispersed light, depending on whether a grating or the NUV mirror is selected as the spectral element.

The peakup and image acquisition modes are designed to center a target within a science aperture that already contains appreciable flux from the target. Acquisitions for which the initial pointing uncertainty is greater than 1.7 arcseconds should begin with a target search to locate the target in the aperture. If the target can already be placed in the aperture with high confidence, this step may be skipped. Centering the target in the aperture can be accomplished either by repeating the target search, carrying out the two peakup steps (normally an ACQ/PEAKXD followed by an ACQ/PEAKD sequence of exposures), or performing an ACQ/IMAGE exposure. The strategy selected will depend on factors such as the brightness of the source, the morphology of the source (i.e., point source vs. diffuse), the initial pointing uncertainty, and the detector and spectral elements to be used for the subsequent science.

3. Section 5.2.1, p. 111 of Rev 11, add the following text right AFTER the paragraph on “Phase 1 Configuration”:

Phase 2 Target Search (ACQ mode)

HST initially slews to the nominal target position, regardless of whether a target search is executed or whether the target search is even-ordered or odd-ordered. For even-ordered search patterns, the target acquisition FSW will compute the small slew necessary to move HST from the nominal target position to the first dwell point of the spiral, such that the nominal target position is the geometric center of the completed spiral. The target search may be performed in dispersed or undispersed light.

Since we cannot be 100% certain that the initial pointing of the HST will place the target in the aperture, a search can be performed to move the target into the aperture. This phase can be used for targets intended to be observed with either the Primary Science Aperture or the Bright Object Aperture. The PSA and BOA are separated in the cross-dispersion direction by 3.7 mm = 13.2 arcseconds. In addition to screening target regions to verify no bright source would fall into the aperture not being used, the size of the search pattern for the BOA must not exceed ~10 arcseconds in the direction of the PSA in order to minimize the chance that light from a bright target could spill into the un-attenuated primary aperture. This condition is satisfied if the maximum offset between dwell points in the cross-dispersion direction is ≤ 2 arcseconds.

ENGINEERING CHANGE ORDER			ECO No.	COS-059
Center for Astrophysics & Space Astronomy			Date	12 March 2001
University of Colorado, Boulder			Sheet	3 of 6
Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	
				Stop Production Now
				<input type="checkbox"/> Yes
				<input type="checkbox"/> No

The external shutter will remain open for the target search phase. It shall remain open during the small angle maneuvers between dwell points. The same exposure time should be used at all dwell points. BOP checks are performed at each dwell point of the target search and peakup phases.

2a. The search consists of moving the telescope through a square spiral pattern of 2 – 5 dwell points on a side. The dwell points of a spiral search will therefore cover an area on the sky of $\{[\Delta DW \times (n-1)] + (2 \times 1.25)\}^2$ arcseconds², where ΔDW is the offset in arcseconds between dwell point centers, n is the number of dwell points on a side of the spiral search, and 1.25 arcseconds is the radius of the aperture. (In reality, the area covered is a few arcseconds larger on a side because the aberrated wings of a target centered outside the aperture can still be detected.) Simulations show that dwell point offsets larger than 2 arcsecs will introduce target acquisition errors due to unsampled areas within the search pattern. Therefore the square area on the sky covered should be less than $[2 \times (n-1)] + 2.5$ arcseconds on a side. TAACOS simulations indicate the optimum dwell point offset is $\Delta DW_{\text{optimum}} = 1.767$ arcsecs, the largest dwell point offset which leaves no interior sky positions unsampled. The choice of the number of dwell points on a side (2, 3, 4, or 5) should be left to the observer and should be made based upon their assessment of the quality of the target coordinates. The flight software algorithm for commanding the search pattern will be adapted from STIS. Note that including even numbered spiral searches requires an offset from the nominal target coordinates to the center of the first dwell point.

Two flux measurements are made at each dwell point. The first is a check of the count rate against the BOP limit. The BOP check sums the counts over the entire detector, not just the sub-array for the spectrum or image. If the BOP check is passed, the second is a measurement of the count rate summed over the sub-array(s) that include the dispersed target spectrum (see Table 5.2-2 for FUV grating sub-arrays and Table 5.2-4 for NUV grating sub-arrays) or the undispersed target image produced by TA1 (see Table 5.2-7 for TA1 and TA1-RVMM sub-arrays). This is a measure of the brightness of the target at the current dwell point.

If the BOP check fails, the flight software will close the external shutter and the TA software will exit. This response to BOP violation will ensure the safety of the detector and will preserve the current timeline. The shutter will be re-opened by a command inserted by the ground system at the start of the next phase of target acquisition or, if subsequent phases are not performed, at the start of the next science exposure.

2b. After completing the search pattern, the series of flux measurements are analyzed and the preferred position is computed. The flight software will compute a flux-weighted centroid of all of the positions whose flux exceeds a patchable threshold. This will be the default algorithm. An alternative, “return to brightest point” procedure will also be available.

ENGINEERING CHANGE ORDER			ECO No. COS-059	
Center for Astrophysics & Space Astronomy University of Colorado, Boulder			Date 12 March 2001	
			Sheet 4 of 6	
Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	
				Stop Production Now
				<input type="checkbox"/> Yes
				<input type="checkbox"/> No

2c. Request a slew to point the telescope at the preferred position, starting at its current pointing at the last dwell point in the spiral. After the slew, the target will be in the aperture, but not necessarily well centered. Note that when the centroid algorithm is used, the pointing of the HST after this phase will probably not be one of the dwell points visited during the search.

The total flux detected at each dwell point should be retained for downlink. It is not necessary to save the entire spectrum or image from each point. The location of the computed centroid and the parameters of the requested slew should be downlinked.

This centroid process may place the target in the aperture with precision that is sufficient for many science observations. If additional precision is needed, two autonomous pickup steps are available for dispersed light (ACQ/PEAKXD and ACQ/PEAKD) or the autonomous imaging target acquisition sequence is available for undispersed light (ACQ/IMAGE). A spiral search could also be repeated with the same or fewer dwell points. The precision of the centroid algorithm and the need for additional target search or pickup steps will be determined during SMOV. Note that while the target search phase places the target within the science aperture, the location of the target or aperture on the detector is not known until the science data are downlinked and analyzed, or the "Calibrate Aperture Location" phase is executed as part of a subsequent ACQ/PEAKXD or ACQ/IMAGE sequence.

4. Section 5.2.1.1, p. 111 of Rev 11:

Change the first line to:

Phase 3 Calibrate aperture location in detector pixel coordinates (ACQ/PEAKXD mode)

Then change "2a." and "2b." to "3a." and "3b." at the beginning of the subsequent paragraphs.

Delete the subsequent text on "Phase 3 Target Search", which was modified and moved in item #3 above.

5. Section 5.2.1.1, change the titles of Phase 4 (pg. 114 in Rev 11) and Phase 5 (pg. 115 in Rev 11) to:

Phase 4 Pickup in cross-dispersion direction (ACQ/PEAKXD mode)

Phase 5 Pickup in dispersion direction (ACQ/PEAKD mode)

6. Section 5.2.1.1, p. 115 of Rev 11:

ENGINEERING CHANGE ORDER			ECO No. COS-059	
Center for Astrophysics & Space Astronomy			Date 12 March 2001	
University of Colorado, Boulder			Sheet 5 of 6	
Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	
				Stop Production Now
				<input type="checkbox"/> Yes
				<input type="checkbox"/> No

At the bottom of the page, DELETE the paragraph that begins, “Three lines on the observing proposal exposure logsheet...”, and also DELETE the next short paragraph that begins, “It should be noted...”

7. Section 5.2.1.2, p. 116 of Rev 11, add the following sentence to the end of the first paragraph:

If the target coordinates are not good enough to place the target in the aperture with high confidence, then a target search must be performed, either with the TA1 mirror or a grating, prior to executing the imaging target acquisition sequence.

8. Section 5.2.1.2, p. 116 of Rev 11, modify the beginning of the first sentence of the second paragraph:

Assuming the target coordinates are good enough to place the target within the aperture with the initial HST slew, the Phase 1 Configuration will place the NCM1 mirror on OSM1...

9. Section 5.2.1.2, p. 116 of Rev 11, change the phase titles to:

Phase 3 Calibrate Aperture Location (LTAIMCAL of ACQ/IMAGE)

Phase 4 Science Image Centering (LTAIMAGE of ACQ/IMAGE)

Then change the associated “2a.” and “2b.” to “3a.” and “3b.” for Phase 3, and “3a.” – “3d.” to “4a.” – “4d.” for Phase 4.

10. Section 5.2.2.3, p. 126 of Rev 11, paragraph before Table 5.2-7, modify the first sentence to:

Table 5.2-7 gives the sub-arrays needed for isolating the science target on the NUV detector during a target search with the TA1 mirror (ACQ) or during TA1 imaging target acquisition (LTAIMAGE of ACQ/IMAGE).

11. Section 5.2.2.3, p. 126 of Rev 11, change the title of Table 5.2-7 to:

Table 5.2-7: TA1 Science TA Sub-arrays for ACQ and ACQ/IMAGE

12. Section 5.2.2.3, p. 126 of Rev 11, in Table 5.2-7 change the entries for “Pixel Coordinates of NUV TA1 Sub-array Vertices” to those shown in the table below to correct a typo in the current version.

ENGINEERING CHANGE ORDERCenter for Astrophysics & Space Astronomy
University of Colorado, Boulder**ECO No.** **COS-059**Date **12 March 2001**Sheet **6** of **6**

Drawing/Document Title	Drwg/Doc No.	Revision Letter		Special Distribution
		Current	New	
OP-01	COS-01-0001	11	12	Stop Production Now <input type="checkbox"/> Yes <input type="checkbox"/> No

Aperture/Mirror	λ Coverage (Å)	Sub-array Sizes (pixels)	Pixel Coordinates of NUV TA1 Sub-array Vertices
PSA or BOA/TA1	1700-3200	345 × 816	(561,123),(561,938),(904,938),(904,123)
PSA or BOA/TA1-RVMM	1700-3200	345 × 816	(451,123),(451,938),(794,938),(794,123)