HENEX Acceptance Test Plan

John Seely

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HENEX Components

The High Energy Electronic X-Ray Spectrometer (HENEX) diagnostic instrument consists of the following components:

Spectrometer Hardware
Nosecone with alignment pointer
Lead and high-density polyethylene shielding
X-ray entrance aperture filters
Pin-hole open/closed and filter selection assembly on the transmission crystal channel
Transmission crystal crossover point step-wedge filter assembly
Hard x-ray shielding (Pb) for the crystals and sensors
Cylindrically bent crystal assemblies
CMOS sensor assemblies with light-tight x-ray transmission filters

Drive Electronics (DE)
CMOS sensor readout/drive boards
Foreman Control Processor board
Power management board
House keeping board
Fiber-optic data in/out board
Trigger fiber-optic board

Instrument Insertion Module Interface Plate (MIP)
Functions as the support structure for the Drive Electronics (DE) and the spectrometer hardware. The MIP has lifting handles and interfaces to the Instrument Insertion Module (IIM, either a TIM or DIM). The cooling of the HENEX instrument is accomplished by interfacing to the LLE/NIF coolant connectors.

Internal Battery Pack (IBP)
Supplies 7.2 VDC power to the HENEX DE. The IBP contains 42 Nickel Cadmium 1.2 VDC (4400 mA-H) batteries housed in a hermetically-sealed enclosure mounted in the rear of the IIM boat. The IBP hardware has captive screws and lifting handles.

Diagnostic Control Processor (DCP)

Consists of a PC computer which is remotely located in the control room. The DCP is powered by 110 VAC and interfaces to the facility Data Acquisition System (DAS) via an Ethernet connection.

Diagnostic Interface Unit (DIU)
Converts the facility trigger pulse to a light pulse that is transmitted to the HENEX instrument by the trigger fiber optic cable. Interfaces with the DE and commands the sensor functions via a second fiber optic, the data fiber optic cable. All communications with the HENEX instrument are accomplished by these two fiber optics cables. The DIU is powered by 110 VAC.

Battery Recharge Interface Control Keeper (BRICK)
Recharges the IBP off-line.

Operating Modes

Wake-Up Mode is activated when the power cable is connected between the IBP and the DE. A self test is carried out via the data in/out SMA fiber optic cable from the DCP. The DE responds with self-test information. If the self test is satisfactory, the Standby Mode is activated.

Ready-for-Shot Mode occurs at the completion of the Ready-for-Shot handshake that is initiated by the facility.

Shot Mode is initiated by the facility trigger pulse. The trigger pulse is sent by the facility on a 50 ohm coax BNC that is connected to the DIU. The DIU command triggers a fiber optic transmitter, which sends a light pulse via the fiber optic cable to the instrument. The HENEX instrument utilizes the existing fiber optic cables that are contained in the IIM umbilical, which we term the trigger fiber optic and the data fiber optic.

The trigger activation pulse on the trigger fiber optic initiates the sensor's clearing operation which clears the residual charge. The trigger fiber optic pulse also starts a countdown timer, inside the DE, that will trigger the sensor ~300 ms before T_o. The sensor's integration time will be ~600 ms. The x-ray data image is acquired by the sensor driver board.

Readout-of-Data Mode is activated after the shot. The x-ray images and dark images are downloaded via the data fiber optic to the DIU.

Standby Mode occurs after the x-ray data images and dark images have been received by the DIU and stored by the DCP. The HENEX instrument remains in the Standby Mode until commanded by the DCP.

Off-Line Tests

The HENEX shipping case has a support interface that simulates the IIM (TIM or DIM) instrument support structure and can serve as the storage container for the instrument.

The off-line testing includes the simulation and verification of the functions carried out in the five instrument modes: Wake-Up activation and self tests, Standby, Ready-for-Shot handshakes, Shot (data acquisition), and Readout-of-Data (data download).

In preparation for the off-line tests, the HENEX instrument is placed near the DCP and the DIU. Connect the two SMA fiber optic cables in the following manner: (1) The data in/out SMA fiber optic connects to the DCP. (2) The trigger SMA fiber optic connects to the DIU.

Connect the right-angle HD 44 pin D-sub male connector cable to the Internal Battery Pack (IBP). This action initiates the instrument's Standby Mode.

The DCP is connected to the facility DAS via an Ethernet cable. The DAS conducts a normal shot sequence with the HENEX instrument riding along off-line. The handshake commands are tested, and the facility trigger pulse is routed to the off-line testing area. The HENEX instrument records an integrated (dark) exposure on the sensor with the normal integration time. Based on experience with the sensor, the dark image has a background level that is easily recognized and serves to verify the data transfer function.

Deployment in the Instrument Insertion Module (IIM)

The following instrument components are carried to the IIM (TIM or DIM) for deployment: Internal Battery Pack (IBP) in its hermetically-sealed enclosure, assembled spectrometer/nosecone, Drive Electronics (DE), Module Interface Plate (MIP), and the pointer assembly.

The HENEX components are assembled into the IIM in the following order:

The IBP has lifting handles and is installed on the instrument support structure in the TIM or DIM. The IBP has spring-loaded captive 10-32 PEM hardware to interface with the existing mounting holes.

The assembled spectrometer and MIP attaches to the instrument support structure with spring-loaded captive 10-32 PEM hardware.

The two vacuum-side SMA fiber optics, Jack cable assembles approximately 36” long, are routed to the SMA fiber optic connectors that are located on the top side of the DE. The facility OTIS F/O SMA functions as the HENEX trigger fiber optic. The Fiducial F/O SMA functions as the HENEX data fiber optic (routed through the opening in the handles of the DE).

Insert the mating Parker dry connectors from the MIP structure to complete the connection of the cooling loop (routed through the opening in the handles of the IBP).

Connect the right-angle HD 44 pin D-sub male connector cable from the DE to the IBP. This action initiates the HENEX instrument's Standby Mode.

Connect the atmosphere-side SMA fiber optic Jack cables to the remotely located DIU.

Instrument Start-Up

In the remote location of the DIU and the DCP:

Power-up the DCP, which initiates the HENEX instrument's Wake-Up Mode. The instrument's self test is performed.

Connect the DCP to the facility Ethernet.

Conduct the DAS system test of the HENEX instrument. Conduct the sensor aliveness test as discussed above Off-Line Tests section. Proceed if the test image is acquired.

At the IIM location:

Verify that all cables are safely routed inside the IIM space envelope and that the HD 25 pin D-sub connector RF cover is installed.

Install the HENEX instrument's pointer and proceed with the normal diagnostic instrument pointing operation. Save the deployed position values, retract the instrument, remove the pointer, and stow the pointer. Pump down the IIM and deploy the HENEX instrument to the previously saved position in preparation for the laser shot.