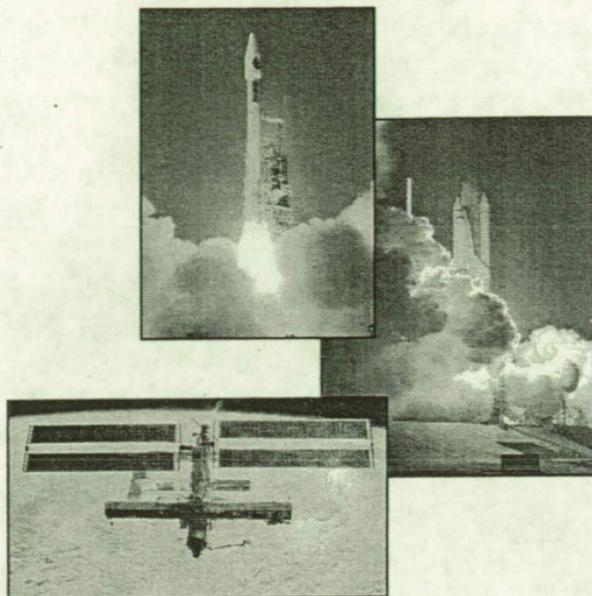




Kennedy Space Center

Materials Science Laboratory

The NASA Materials Science Laboratory (MSL) provides science and engineering services to NASA and Contractor customers at KSC, including those working for the Space Shuttle, International Space Station, and Launch Services Programs.



These services include:

- Independent/unbiased failure analysis
- Support to Accident/Mishap Investigation Boards
- Materials testing and evaluation
- Materials and Processes (M&P) engineering consultation
- Metrology
- Chemical analysis (including ID of unknown materials)
- Mechanical design and fabrication

We provide unique solutions to unusual and urgent problems associated with aerospace flight hardware, ground support equipment and related facilities.

The MSL has, in one form or another, been providing these services to KSC since the Gemini Program. The MSL is currently composed of three Branches:

Failure Analysis & Materials Evaluation Branch

Provides M&P engineering services (e.g. materials selection; non-destructive examination (NDE) requirements/evaluation; specifications and standards development); and the KSC Center Materials Representative, responsible for administering KSC's M&P Control Program.

Laboratory Services:

Materials Failure Analysis Laboratory

- Failure Analysis of metallic and nonmetallic materials
- Stereomacroscopic examination and metallography
- Hardness testing (including portable and micro)
- Scanning Electron Microscope (SEM) with Energy Dispersive Spectroscopy (EDS) and X-Ray Fluorescence (XRF)
- Thermal analysis (TMA; DSC; DMA)

Electrical/Electronic Failure Analysis Laboratory

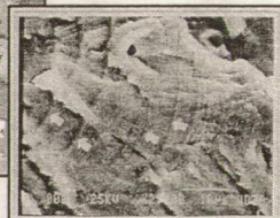
- Failure Analysis of electrical/electronic components
- NDE via real-time radiography and thermography
- Analog, digital & mixed-signal component testing
- High-voltage facility power & high frequency electrical & DC power system testing
- Low-voltage, non-intrusive simulation testing to field parameters
- Field analysis & data acquisition instrumentation/techniques

Mechanical System/Metrology Laboratory

- Failure Analysis of mechanical components
- Pneumatic and hydraulic testing and simulation
- Dissection and disassembly/test, teardown and evaluation
- Precision measurement and dimensional analysis
- Mold impressions of scratches, cracks, defects, etc.



*Failure analysis evaluation
in the field*



SEM photo of fatigue crack

Materials Test & Chemical Analysis Branch

Performs mechanical and physical testing of materials and components, including tensile, vibration and thermal vacuum testing, and compatibility testing of materials. We also perform chemical analyses of materials and contaminant identification, including the identification of unknown solids, liquids and gases.

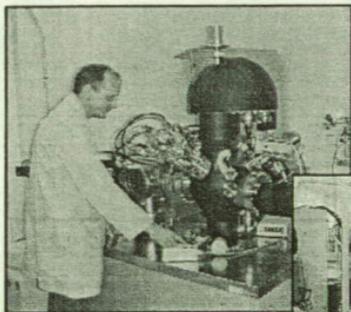
Laboratory Services:

Chemical Test and Analysis Laboratory

- Fourier transform Infrared Spectroscopy (FTIR)
- SEM with EDS
- X-ray Fluorescence Spectroscopy (XRF)
- X-ray Photoelectron Spectroscopy (XPS) with Auger Scanning Electron Spectrometer (AES)
- Inductively Coupled Plasma (ICP) Spectroscopy
- Optical Emission Metal Analyzer
- Gas Chromatography – Mass Spectrometry
- Ion Chromatography
- X-ray Diffraction (XRD)
- Polarized Light Microscopy
- Wet chemistry techniques
- Non-volatile residue (NVR) characterization

Materials Test and Analysis Laboratory

- Tensile, compression and fatigue testing
- Vibration testing
- Thermal vacuum and environmental chamber testing
- Materials compatibility testing (flammability; electrostatic discharge; hypergols; oxygen)



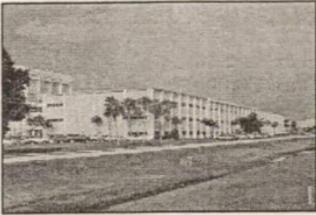
XPS



Thermal Vacuum Chamber

The MSL is a Division within the Spaceport Engineering and Technology Directorate (YA), and is staffed with 50+ engineers, scientists and technicians having degrees and/or expertise in the following disciplines:

- Materials Science and Engineering (metallic and nonmetallic)
- Mechanical Engineering
- Electrical Engineering
- Welding Engineering
- Chemistry and Chemical Engineering
- Metallurgy
- Corrosion Engineering
- Metrology
- Nondestructive Evaluation
- Machining
- Welding
- Mechanical and Electrical Fabrication



The MSL has laboratories physically located in the Operations and Checkout (O&C) Building (Bldg. M7-355) and the "Prototype" Building (M7-581) adjacent to the Launch Equipment Test Facility (LETF). The MSL typically operates on one shift; however, 24 hour "around-the-clock," weekend and holiday support is provided whenever necessary.

Materials Science Laboratory (YA-F)
Scott H. Murray, Division Chief
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Failure Analysis and Materials Evaluation Branch (YA-F1)
Steven J. McDanel, Chief
Phone: (321) 861-8969 E-mail: steve.mcdanels@nasa.gov

Materials Test and Chemical Analysis Branch (YA-F2)
Louis G. MacDowell, Chief
Phone: (321) 867-4550 E-mail: louis.g.macdowell@nasa.gov

Design and Development Integration Branch (YA-F3)
Dr. Eric A. Thaxton, Chief
Phone: (321) 867-8267 E-mail: eric.a.thaxton@nasa.gov

MSL Customer Service Office, O&C Bldg. Room 1219
Edrick Jackson Phone: (321) 867-3207
MSL Work Control System: http://wvsp/wcs_doc/index_cust.html

Design & Development Integration Branch

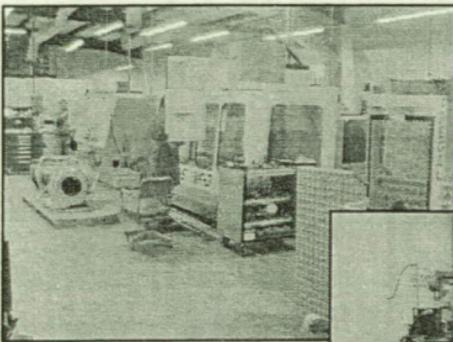
Performs mechanical design alongside mechanical and electrical fabrication to provide rapid solutions to complex problems for our customers. We take an existing problem and deliver a complete documented solution. Services include: conceptual design, engineering drawings, structural and thermal analysis packages, hardware fabrication, hardware modifications, hardware testing, and rapid prototyping.

Design Engineering

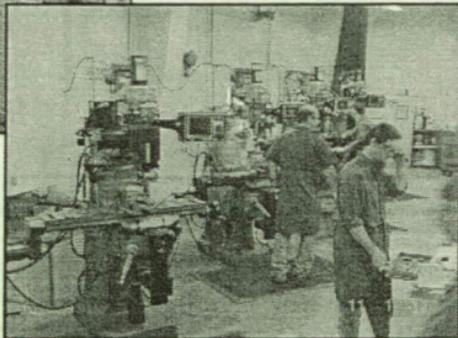
- Mechanical Engineering Design
- Mechanisms and Kinematics
- ProE CAD/CAM
- Structural and Finite Element Analysis/FEA (ANSYS)

Development Integration Laboratory (Mechanical and Electrical)

- Pneumatic, hydraulic, and cryogenic fabrication
- Rapid Prototyping
- Mechanical and structural fabrication and testing
- Computer Numeric Control (CNC) machining
- Sheet metal fabrication
- Welding, including pressure vessels and cryogenic systems
- Electrical Fabrication
- Data acquisition and LabVIEW software programming
- Power and electrical systems (digital and analog)
- PC Board fabrication (double sided)



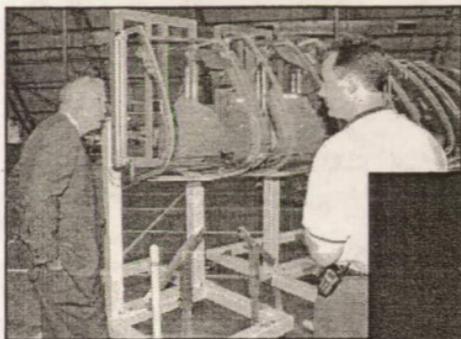
CNC Milling Machines



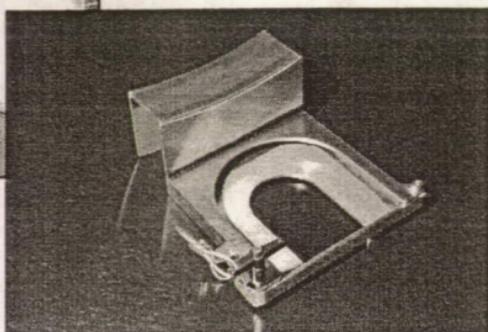
Bridgeport Milling Machines

Recent Activities:

- M&P, chemical analysis & rapid prototype support to the Columbia Accident Investigation Board
- Design and fabrication of a contamination witness plate used inside the Delta II payload fairing (SWIFT vehicle)
- Precision measurements of ISS Node 2 debris shield spherical bearing



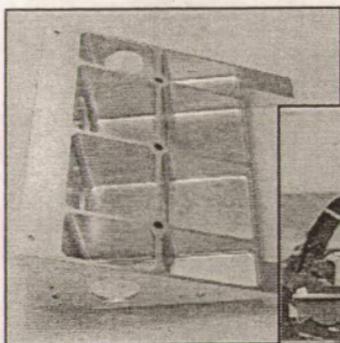
Scaled Lexan wing model fabricated to reconstruct debris from Columbia's left wing leading edge



SWIFT contamination witness plate

Return To Flight Activities:

- Ongoing Columbia debris analysis
- Failure analysis of Crawler Transporter treadbelt shoes
- Design and fabrication of 3 camera pan/tilt brackets (flight hardware for each Orbiter's robotic arm)
- Failure analysis of OV-105 o-ring from leaking LH₂ flow control valve



Camera pan/tilt bracket



Visual inspection of Columbia debris on Hangar floor