



Smithsonian

National Air and Space Museum

NASM Space Suit Collection X-Ray Photography

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Collection Overview

Repository:	National Air and Space Museum Archives
Title:	NASM Space Suit Collection X-Ray Photography
Date:	(bulk 2007-2008)
Identifier:	NASM.2015.0055
Extent:	1.53 Cubic feet (Two 17 x 23 x 3 inch flat boxes)
Language:	English .
Summary:	This collection consists of x-ray film radiographs made in 2008 by conservator Roland H. "Ron" Cunningham, of the Museum Conservation Institute (MCI), Smithsonian Institution, of 17 artifacts in the Smithsonian National Air and Space Museum (NASM) space suit collection, and derivative digital images created by photographer Mark Avino, Chief of Photographic Services, NASM Office of Communications, by scanning the radiographs on a flatbed graphic film scanner and compositing the resulting scans into digital image files.
Digital Content:	Image(s): NASM Space Suit Collection X-Ray Photography

Administrative Information

Acquisition Information

Mark Avino, Smithsonian National Air and Space Museum Photographic Services, Transfer, 2015, NASM.2015.0055.

Processing Information

Arranged, described, and encoded by Melissa A. N. Keiser, 2021.

Preferred Citation

NASM Space Suit Collection X-Ray Photography, Acc. NASM.2015.0055, National Air and Space Museum, Smithsonian Institution.

Restrictions

No restrictions on access

Conditions Governing Use

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Biographical / Historical

As part of its holdings documenting the history of aviation and space exploration, the Smithsonian National Air and Space Museum (NASM) has a collection of over 1,000 space suits, pressure suits, and suit components (gloves, boots, and helmets); this collection includes early developmental suits and suits used during training and testing as well as most of the space suits worn during the Mercury, Gemini, and Apollo missions. Despite the fact the suits were designed to be robust enough to withstand the dangers of orbital and lunar space operations for the duration of a space flight mission, the suits themselves are extremely fragile. Each suit is constructed of an assortment of natural and man-made materials and metals, and the lifespan of many of the components was not well understood when the suits were first assembled. Most of the space suits from the early United States space programs have deteriorated to the point where they are no longer able to be displayed.

Help arrived in May 1999 when NASM was awarded a Save America's Treasures grant by the White House Millennium Council and the US Department of the Interior's Save America's Treasures Program for a proposal to preserve the "Threatened Artifacts of the Apollo Program." The first part of the grant was for the Apollo space suits (with matching funds provided by Hamilton Sundstrand); the second part was for the preservation of the Saturn V launch vehicle in Houston. In January 2000, the NASM Division of Space History (DSH) began work on an interdisciplinary project to preserve the Apollo era space suits in the NASM collection and to share the results of its research on the deterioration and preservation of space suits with other museums. The project soon grew to encompass all the suits and components then in the museum's collections, and in 2007 and 2008 Amanda Young, the NASM DSH museum specialist then responsible for the collection of space suits and astronaut personal equipment, worked with conservator Roland H. "Ron" Cunningham, of the Smithsonian's Museum Conservation Institute (MCI), and photographer Mark Avino, then Chief of Photographic Services, NASM Office of Communications, to create radiographs (x-ray images) of 17 artifacts in the space suit collection.

Smaller artifacts such as gloves, helmets, and other suit parts were each imaged on a single sheet of film; one larger artifact (the RX-1 Arm) was imaged on three sheets of film overlapped to create a single image. The four space suits (pressure suits) featured in this collection were each imaged by overlapping 15 sheets of x-ray film to form a continuous 3 x 5 sheet grid on a 4 x 8 foot backing board, arranging the suit on top of the film sheets, and positioning the x-ray equipment high enough to allow a single, simultaneous exposure of all 15 sheets. The circular edges of the x-ray exposure can be seen at the top and bottom of some of the full-suit image radiographs, but most of the final composite digital images have been modified by Avino to appear with a continuous background.

Scope and Contents

The first series of this collection consists of 17 x 14 inch x-ray film radiographs made in 2007 and 2008 by conservator Roland H. "Ron" Cunningham, of the Museum Conservation Institute (MCI), Smithsonian Institution, of 17 artifacts in the Smithsonian National Air and Space Museum (NASM) space suit collection. There are just over 100 radiographs; exposed films from multiple-film exposures which did not have sufficient overlap were retained in the collection, but were not scanned and used in the creation of composite digital images ("discarded" films). The second series consists of 33 unique derivative negative digital images created by photographer Mark Avino, then Chief of Photographic Services, NASM Office of Communications, by scanning the radiographs on a flatbed graphic film scanner and compositing the resulting scans into high-resolution digital image files.

Arrangement

The 17 x 14 inch film radiographs in the first series are grouped by artifact, with the folders appearing in artifact number order. Discarded radiographs appear in a separate folder at the end of the series. The digital images in the second series are also arranged by artifact number, but have been grouped into three subseries based on the number of film sheets used to x-ray each artifact: one, three, or fifteen. Digital images for each artifact include the original half-sheet or quarter-sheet film radiograph scans as well as the completed composite image, usually presented in both negative and positive versions. Each of the completed composite digital radiograph (negative) images was assigned a NASM Photographic Services image reference number. In the case of the full space suit images, each *positive* version of the completed *negative* composite image was assigned a separate NASM Photographic Services image reference number.

Bibliography

Amanda Young made use of eight radiographs from this collection in her book *Spacesuits: The Smithsonian National Air and Space Museum Collection* (PowerHouse Books; Brooklyn, NY), published just before her retirement in June 2009.

See related NASM Blog Post by photographer Mark Avino, [A Blending of Photography and X-Ray](#) ; posted November 12, 2010.

Names and Subject Terms

This collection is indexed in the online catalog of the Smithsonian Institution under the following terms:

Subjects:

- Astronautics
- Space suits

Types of Materials:

- Digital images
- Radiographs

Container Listing

Radiograph Film

Box 1, Folder 1	A19720536002, RX-1 Arm, Right
Box 1, Folder 2	A19720587000, Pressure Suit, A7-L, Shepard, Apollo 14, Flown
Box 1, Folder 3	A19730811000, Helmet, AH-4H, "Universal"
Box 1, Folder 4	A19730826000, Pressure Suit, Apollo, A1-C, Cunningham
Box 1, Folder 5	A19730838001, Helmet, White, Developmental [Gemini, G3-C]
Box 1, Folder 6	A19730840001, Helmet, SPD-143-1A, January 24, 2008
Box 1, Folder 7	A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown
Box 1, Folder 8	A19761538003, Overshoe, Left, Irwin, Training
Box 2, Folder 1	A19820454000, Pressure Suit, EX-1-A, Constant Volume, AiResearch
Box 2, Folder 2	A19820463001, Helmet, Pressure, Dome, Experimental
Box 2, Folder 3	A19970069000, Pressure Suit, Sokol KV-2, Thagard
Box 2, Folder 4	A19970069001, Glove, Left, Sokol KV-2, Thagard
Box 2, Folder 5	A20040265006/007, Arm, Elbow, Left and Right
Box 2, Folder 6	A20040268001, Helmet, "Lobster Shell" Notes: Test radiographs were made of front and side views of A20040268001, Helmet, "Lobster Shell," but were set aside by Avino in favor of later front and side views made of the same helmet. The second (final) digital images of the helmet were catalogued by Avino in 2008 as SI-2008-1854 (final front view) and SI-2008-1855 (final side view). Scans of the initial test views of the "Lobster Shell" helmet were later catalogued in 2011 by NASM archivists as NASM2011-00911 (test side view) and in 2020 as NASM2011-00911-A (test front view).
Box 2, Folder 7	A20070093000, Helmet, Extravehicular, Apollo, Training
Box 2, Folder 8	Unaccessioned, MOL Glove, Right [A19850101001], January 11, 2008 Notes: This Manned Orbiting Laboratory (MOL) MH-7 glove, listed as "unaccessioned" at the time of radiography, was later identified

as A19850101001, Glove, Manned Orbiting Laboratory, Right,
Serial # 024.

Box 2, Folder 9 Discarded Films, Insufficient Overlap

Box 2, Folder 10 Hand-Colored Digital Print Photograph, Unidentified Glove [possibly a David
Clark Company Gemini G4-C glove]

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Digital Images (Composite Radiographs)

Single-Sheet Radiographs

A19730811000, Helmet, AH-4H, "Universal"

SI-2008-1843: [A19730811000, Helmet, AH-4H, "Universal" \(front view\), February 14, 2008](#)

SI-2008-1844: [A19730811000, Helmet, AH-4H, "Universal" \(side view\), February 15, 2008](#)

[Quarter-Sheet Radiograph Scans, A19730811000, Helmet, AH-4H, "Universal"](#)

A19730838001, Helmet, White, Developmental [Gemini, G3-C]

SI-2008-1852: [A19730838001, Helmet, White, Developmental \[Gemini, G3-C\] \(front view\), February 15, 2008](#)

SI-2008-1853: [A19730838001, Helmet, White, Developmental \[Gemini, G3-C\] \(right side view\), February 15, 2008](#)

[Half-Sheet Radiograph Scans, A19730838001, Helmet, White, Developmental \[Gemini, G3-C\]](#)

A19730840001, Helmet, SPD-143-1A

SI-2008-1862: [A19730840001, Helmet, SPD-143-1A \(front view\), February 15, 2008](#)

SI-2008-1863: [A19730840001, Helmet, SPD-143-1A \(right side view\), February 15, 2008](#)

[Quarter-Sheet Radiograph Scans, A19730840001, Helmet, SPD-143-1A](#)

A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown

Notes: Views of the A7-LB glove imaged on the original 17 x 14 inch x-ray sheet films were small enough to be able to be scanned in one pass on the 11 x 17 inch flatbed scanner used by photographer Mark Avino to create his original radiograph scans; Avino did not create half-sheet or quarter-sheet radiograph scans for this artifact.

SI-2008-1839: [A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown \(left side view\), February 20, 2008](#)

SI-2008-1842: A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown (right side), February 20, 2008

SI-2008-1840: A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown (plan view, palm up), February 20, 2008

SI-2008-1841: A19740183006, Glove, Right, A7-LB, Extravehicular, Apollo 17, Schmitt, Flown (plan view, palm down), February 20, 2008

A19761538003, Overshoe, Left, Irwin, Training

SI-2008-14045: A19761538003, Overshoe, Left, Irwin, Training (left side view), October 7, 2008

SI-2008-14047: A19761538003, Overshoe, Left, Irwin, Training (top view), October 7, 2008

Half-Sheet Radiograph Scans, A19761538003, Overshoe, Left, Irwin, Training

A19820463001, Helmet, Pressure, Dome, Experimental

SI-2008-1859: A19820463001, Helmet, Pressure, Dome, Experimental (left side view), February 20, 2008

Quarter-Sheet Radiograph Scans, A19820463001, Helmet, Pressure, Dome, Experimental

A19850101001, Glove, Manned Orbiting Laboratory, Right, Serial # 024

SI-2008-1856: A19850101001, Glove, Manned Orbiting Laboratory, Right, Serial # 024 (plan view, palm down), January 24, 2008

SI-2008-1857: A19850101001, Glove, Manned Orbiting Laboratory, Right, Serial # 024, Right (plan view, palm up), January 24, 2008

SI-2008-1858: A19850101001, Glove, Manned Orbiting Laboratory, Right, Serial # 024, MOL Glove, Right (left side view), January 24, 2008

Half-Sheet Radiograph Scans, A19850101001, Glove, Manned Orbiting Laboratory, Right, Serial # 024

A19970069001, Glove, Left, Sokol KV-2, Thagard

SI-2008-1861: A19970069001, Glove, Left, Sokol KV-2, Thagard (plan view, palm down), February 14, 2008

Half-Sheet Radiograph Scans, A19970069001, Glove, Left, Sokol KV-2, Thagard

A20040265006/007, Arm, Elbows

SI-2008-1848: [A20040265006, Arm, Elbow, Left \(front view on end\), February 14, 2008](#)

SI-2008-1851: [A20040265007, Arm, Elbow, Right \(side view\), February 19, 2008](#)

SI-2008-1849: [A20040265006, Arm, Elbow, Left \(side view\), February 14, 2008](#)

SI-2008-1850: [A20040265007, Arm, Elbow, Right \(front view, curve down\), February 14, 2008](#)

[Half-Sheet Radiograph Scans, A20040265006/007, Arm, Elbows](#)

A20040268001, Helmet, "Lobster Shell"

Notes: Digital images of the first test radiographs of the "Lobster Shell" helmet were later catalogued by NASM archivists as NASM2011-00911 (test side view) and NASM2011-00911-A (test front view). Digital images of the final radiographs of the helmet were catalogued by Avino as SI-2008-1854 (final front view) and SI-2008-1855 (final side view).

NASM2011-00911-A: [A20040268001, Helmet, "Lobster Shell" \(test front view, visor up\), December 26, 2007](#)

SI-2008-1855: [A20040268001, Helmet, "Lobster Shell" \(final left side view, visor up\), February 20, 2008](#)

NASM2011-00911: [A20040268001, Helmet, "Lobster Shell" \(test left side view, visor up\), December 26, 2007](#)

SI-2008-1854: [A20040268001, Helmet, "Lobster Shell" \(final front view, visor up\), February 14, 2008](#)

[Quarter-Sheet and Half-Sheet Radiograph Scans, A20040268001, Helmet, "Lobster Shell"](#)

A20070093000, Helmet, Extravehicular, Apollo, Training

SI-2008-1845: [A20070093000, Helmet, Extravehicular, Apollo, Training \(front view 1 with gold visor down\), January 24, 2008](#)

SI-2008-1847: [A20070093000, Helmet, Extravehicular, Apollo, Training \(side view with gold visor up\), January 23, 2008](#)

SI-2008-1846: [A20070093000, Helmet, Extravehicular, Apollo, Training \(front view 2 with gold visor down\), January 24, 2008](#)

[Quarter-Sheet Radiograph Scans, A20070093000, Helmet, Extravehicular, Apollo, Training](#)

Three-Sheet Radiograph, A19720536002, RX-1 Arm, Right

SI-2008-1860: [A19720536002, RX-1 Arm, Right \(plan view\), January 23, 2008](#)

[Half-Sheet Radiograph Scans, A19720536002, RX-1 Arm, Right](#)

Fifteen-Sheet Radiographs

[A19720587000, Pressure Suit, A7-L, Shepard, Apollo 14, Flown](#)

SI-2008-13656: [A19720587000, Pressure Suit, A7-L, Shepard, Apollo 14, Flown \(plan view\), September 30, 2008](#)

[Half-Sheet Radiograph Scans, A19720587000, Pressure Suit, A7-L, Shepard, Apollo 14, Flown](#)

[A19730826000, Pressure Suit, Apollo, A1-C, Cunningham \[Used for Apollo Training\]](#)

SI-2009-964: [A19730826000, Pressure Suit, Apollo, A1-C, Cunningham \(plan view\), September 18, 2008](#)

[Half-Sheet Radiograph Scans, A19730826000, Pressure Suit, Apollo, A1-C, Cunningham](#)

[A19820454000, Pressure Suit, EX-1-A, Constant Volume, AiResearch](#)

SI-2008-14049: [A19820454000, Pressure Suit, EX-1-A, Constant Volume, AiResearch \(plan view\), October 8, 2008](#)

[Half-Sheet Radiograph Scans, A19820454000, Pressure Suit, EX-1-A, Constant Volume, AiResearch](#)

[A19970069000, Pressure Suit, Sokol KV-2, Thagard](#)

SI-2009-966: [A19970069000, Pressure Suit, Sokol KV-2, Thagard \(plan view\), September 20, 2008](#)

[Half-Sheet Radiograph Scans, A19970069000, Pressure Suit, Sokol KV-2, Thagard](#)

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