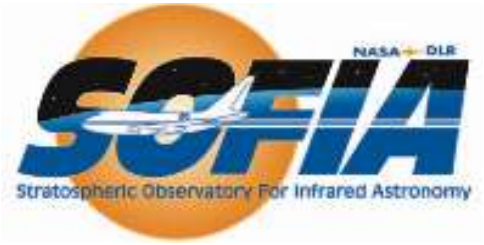

Interface Control Document
Science Instrument Cart to SSMO Facility
SIC_SSMO_01

SCI-AR-ICD-SE03-2017

Date: March 26, 2013
Revision: C

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Interface Control Document
Science Instrument Cart to SSMO Facility, SIC_SSMO_01

PREPARED BY:

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REVISIONS

Revisions to the document from the previous issue are denoted by vertical bars in the margin of the page.

REV	DATE	DESCRIPTION	APPROVAL
A	12/16/2009	Based on USRA ICD SIC_SSMO_01, Revision -. (RAIS Document Number: 96162513-000). The SSMO facility has been changed from NASA Ames N211 to NASA DAOF. The current version also incorporates requirements from the obsolete USRA ICD SIC_SI_01, Revision -. (Document Number: 96162511-000).	SPCB
B	4/24/2012	Updated ICD to reflect lessons learned in Segment 2. Revised title and scope of ICD to include all SI Carts used in the SSMO Ground Support Facility (GSF). Revised dimension information of hallways, PIF, and IRRs based on current SSMO GSF layout. Replaced SI Cart/Aircraft System interface requirements levied on SI Carts used in the SSMO GSF with new requirements based on the physical constraints of the SSMO GSF. Clarified applicability of automatic brake system requirement to SI Carts used to transport a SI Assembly into/out of the aircraft. Revised specific "shall" statements that were not intended to be requirements to operational guidelines instead. Added references to ICD verification process and ICD requirements matrix. Change details and rationale contained in SCI-AR-CMD-PM94-2328.	SPCB; CCR PM94-2328
C	3/26/2013	Incorporated SCI-AR-CMD-PM94-2448 into ICD: revised parking brake requirement, removed reference to SOF-AR-ICD-SE03-205 automatic brake system requirement.	SPCB; CCR-PM94-2448

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Science Instrument Cart to SSMO Facility, SIC_SSMO_01

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1. SCOPE

This document covers all interface requirements between Science Instrument Carts (SIC) and the SSMO Ground Support Facility at DAOF. The interface requirements apply to SI Carts used at DAOF, irrespective of whether or not the cart will also be used on the aircraft.

A separate Interface Control Document, SOF-AR-ICD-SE03-205 (SIC_AS_01), defines the interface requirements between SI Carts and the Aircraft System. SI Carts that will be used on the aircraft must meet the interface requirements of both SCI-AR-ICD-SE03-2017 and SOF-AR-ICD-SE03-205.

There originally existed a third SI Cart ICD (SCI-US-ICD-SE03-204, SIC_SI_01) that defined the interface between Science Instruments and a SOFIA Program-provided SI Cart, however the ICD was later declared obsolete and the responsibility was transferred to SI Developers to provide their own SI Carts for transporting Science Instruments (SI Assembly, elements of the SI Assembly, or SI equipment) within the Ground Support Facility and aircraft. The SI Developer is not responsible for providing ground support equipment for the transport of PI Rack(s) or a Counterweight Rack through the Ground Support Facility or the aircraft. A PI Rack dolly and Counterweight Rack cart are provided by the Program for this purpose.

Note that in addition to the SI Cart interface requirements outlined in SCI-AR-ICD-SE03-2017 and SOF-AR-ICD-SE03-205, there are a number of safety related structural, stability, and pressure system requirements applicable to SI Carts and Stands found within Section 3.5 of SOF-AR-SPE-SE01-2028, SOFIA Science Instrument System Specification.

1.1. Purpose

The purpose of this ICD is to define the interface requirements intended to ensure safe transportation of SI Carts through the SSMO Ground Support Facility, to describe the layout of the Ground Support Facility, and to describe the available GSE and methods for which SI Carts may be transferred to the Scissor Lift Truck during SI installation.

2. REFERENCE AND APPLICABLE DOCUMENTS

The latest revisions of the following documents form a part of this requirement to the extent specified herein.

2.1. SOFIA Documents

SCI-AR-HBK-OP03-2000	Science Instrument Developers' Handbook

SCI-AR-PLA-SV05-2014	Science Instrument System Specification and ICD Requirements Matrix Template
SOF-AR-ICD-SE03-205	Interface Control Document Science Instrument Cart to Aircraft System, SIC_AS_01
SOF-AR-PLA-PM17-2000	SOFIA Science and Mission Operations Plan
SOF-AR-SPE-SE01-2028	SOFIA Science Instrument System Specification
SOF-DA-ICD-SE03-002	ICD GLOBAL_09, SI Instrument Envelope
SOF-DA-ICD-SE03-004	ICD GLOBAL_07, Aircraft Floor Loading Interface Requirements
SOF-DF-PD-PD-2009	SOFIA Lexicon
USRA-DAL-1026-00	Requirements Document for Building Site 9

2.2. Standards

DI-E-30141	Interface Reference Document

3. INTERFACE REQUIREMENTS

This ICD describes the constraints of the SSMO Ground Support Facility (Instrument Readiness rooms, Pre-Flight Integration Facility, Hangar, Scissor Lift Truck, and Forklift Truck) and defines the interface requirements for Science Instrument Carts used in the Ground Support Facility.

The Instrument Readiness Rooms (IRR) are designated rooms where Science Instrument teams can work on Science Instruments. The Pre-Flight Integration Facility (PIF) is an alignment and calibration facility for Science Instruments. A Science Instrument team may move a Science Instrument from an IRR to the PIF as needed before moving the instrument to the aircraft for installation. There are three hallways within the IRR and PIF area. The hallway beside IRR1 and IRR2 has direct access to the hangar and has a width of 6 feet, 11½ inches. The hallway between IRR3 and IRR5 has direct access to the hangar and has a width of 6 feet, 4½ inches. The hallway between IRR3 and the Electronics/Optics Lab has a width of 5 feet. Note the access points to these hallways are constrained by the size of door openings to the hallway. Door types and door-opening sizes are described in Section 3.1A. Figure 1 shows a section of DAOF first floor with designated IRRs and PIF shown.

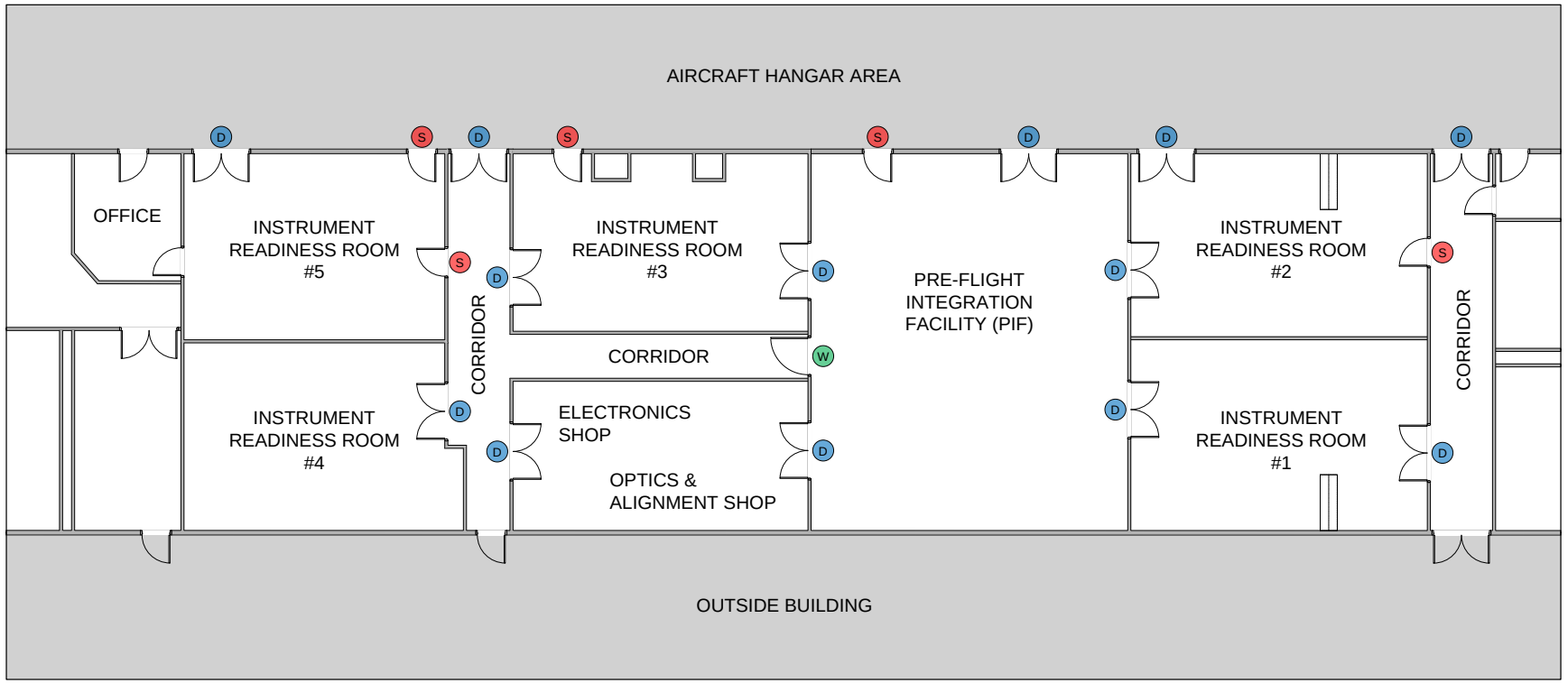

Figure 1. Section of DAOF first floor with Pre-Flight Integration Facility (PIF) and five Instrument Readiness Rooms (IRR) shown

3.1. Physical

The following physical items will be controlled as part of this ICD.

3.1.1. IRR and PIF

A) There are three types of doors in the IRR/PIF area: standard single door, wide single door, double door. The innermost dimensions of the door openings are listed below and include the door thickness contribution from doors opened to the ninety-degree swing position. Figure 1 identifies the door locations in the PIF and IRRs.

Standard Single-Door Opening Dimensions:
Width: 2 feet, 8¼ inches
Height: 6 feet, 11 inches

Wide Single-Door Opening Dimensions:
Width: 3 feet, 9¼ inches
Height: 6 feet, 11 inches

Double-Door Opening Dimensions:
Width: 5 feet, 8¾ inches
Height: 8 feet, 11 inches

B) Table 1 lists the dimensions of the PIF and each IRR.

Room	Area	Height
PIF	34 feet x 41 feet	11 feet, 10 inches
IRR1	20 feet x 32 feet	11 feet, 10 inches
IRR2	20 feet x 32 feet	11 feet, 10 inches
IRR3	19 feet x 31.5 feet	10 feet
IRR4	20 feet x 28 feet	11 feet, 10 inches
IRR5	20 feet x 28 feet	10 feet

Table 1. IRR and PIF dimensions

Note there are two diagonal structural braces that protrude into the space of IRR1 and IRR2. Each brace has a width of 22 inches. Each brace protrudes 10 inches into the room at floor level to 6 feet 10 inches at ceiling level.

C) The floors of the IRR and PIF are made of concrete slab-on-grade with a vinyl composition tile surface. These floors can support 10,000 lbs concentrated load.

3.1.2. Hangar Floor

Hangar Floor Loads:

The floor in the hangar is thick concrete capable of withstanding a concentrated load of 10,000 lbs. The surface is smooth cement.

Constraints:

There are 42-inch wide troughs that traverse both the length and width of the hangar floor at regular intervals. These troughs are covered by steel grates with a rectangular grate spacing of 1 inch x 3.5 inch. Covers for the steel grates have been fabricated and have been positioned in locations of frequent SI Cart traffic in the hangar area where carts traverse grates, so that carts will not encounter the grates. It is still encouraged that the wheels of SI Carts be sized large enough to override this concern. The troughs are shown in Figure 2, four across the width and three across the length of the hangar.

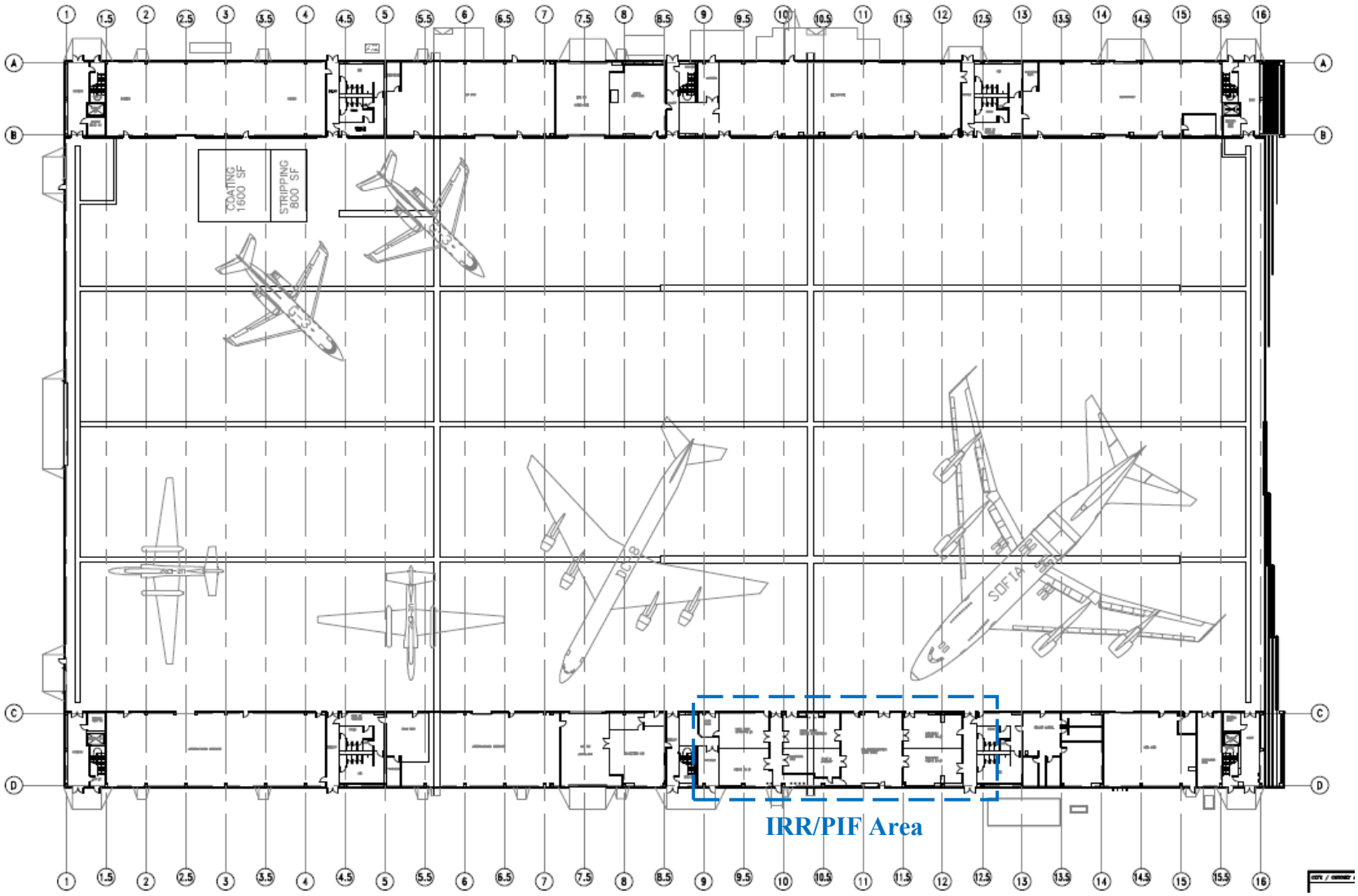

Figure 2. Hangar trough locations

VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

3.1.3. Scissor Lift Truck Loading Restraints

In addition to being used in the IRR/PIF, certain SI Carts will also be used on the aircraft. SI Carts used on the aircraft are subject to the interface requirements in SCI-AR-ICD-SE03-2017 (this ICD) and SOF-AR-ICD-SE03-205. SI Carts and SI equipment that will be transported into and out of the aircraft will be raised to aircraft Door1L using a Scissor Lift Truck. These SI Carts will be transported to the bed of the Scissor Lift Truck using the lift gate of the Scissor Lift Truck, using the SI Loading Platform, or by being directly forklifted. The bed of the Scissor Lift Truck has protective railings and personnel representatives will ride up with the equipment to ensure its safety. The SI Cart will be secured to D-rings installed in the bed. The truck bed is fairly large, but maneuverability may be limited.

A) Scissor Lift Truck Dimensions:

Area:	18.5 feet x 8 feet
Load Capacity:	10,000 lbs

B) Lift Gate Information:

Area:	8 feet x 47 inches
Tilt:	When lifted, the lift gate becomes tilted towards the Scissor Lift Truck bed. At the final meeting point between lift gate and Scissor Lift Truck bed the angle is approximately 5 degrees.
Lip:	The lift gate has an initial 21-degree beveled lip that has a height of 2.7 inches. The main surface of the lift gate has a 3.8-degree slope when the bottom of the lift gate is in full contact with the floor.
Securing Points:	Four D-rings located at each corner of the lift gate to which the cart will be secured
Load Capacity:	2000 lbs

C) Fork Lift Information:

Forks:	2 in. x 5 in. x 72 in. (thickness x width x length)
Min Fork Spacing:	9.8 inches (outer-to-outer)
Max Fork Spacing:	39 inches (outer-to-outer)
Load Capacity:	4000 lbs
Securing Points:	SI Cart will be tied to the forks with straps

D) SI Loading Platform

Inside Area:	72-inch width, 80-inch length
Incline:	8.4 degrees, 3.5-inch height, 84-inch width
Securing Points:	Four D-rings located at each corner of the platform surface

Given the load limit of the Scissor Lift Truck lift gate, if a loaded SI Cart weighs more than 2000 lbs the cart must be transported to the bed of the Scissor Lift Truck by either the SI Loading Platform or direct forklift.

3.2. Functional

The following functional items will be controlled as part of this ICD.

A) The physical constraints of the SSMO Ground Facility (IRR/PIF area) dictate the allowable size of SI Carts that can be maneuvered through the ground facility. A SI Cart may need to negotiate multiple turns in order to get from the hangar area into a specific IRR, and vice versa. SI Carts and cart payload should not interfere with any part of the SSMO Ground Facility during movement. A SI Cart including cart payload shall be able to maneuver through a double-door opening without any physical interference. The dimensions of a double-door opening in the IRR/PIF area are provided in Section 3.1.1A. The dimensions and geometry of the most constraining turn inside the IRR/PIF area is shown in Figure 3. A SI Cart including cart payload shall be able to negotiate the turn identified in Figure 3 without any physical interference. It is recommended that SI Carts utilize swiveling casters for greater maneuverability and to enable a cart to perform smaller radii turns. It is also recommended that swiveling casters have the ability to lock into fixed, angular positions to enable a cart to travel in a consistent direction when maneuvering through narrow passageways.

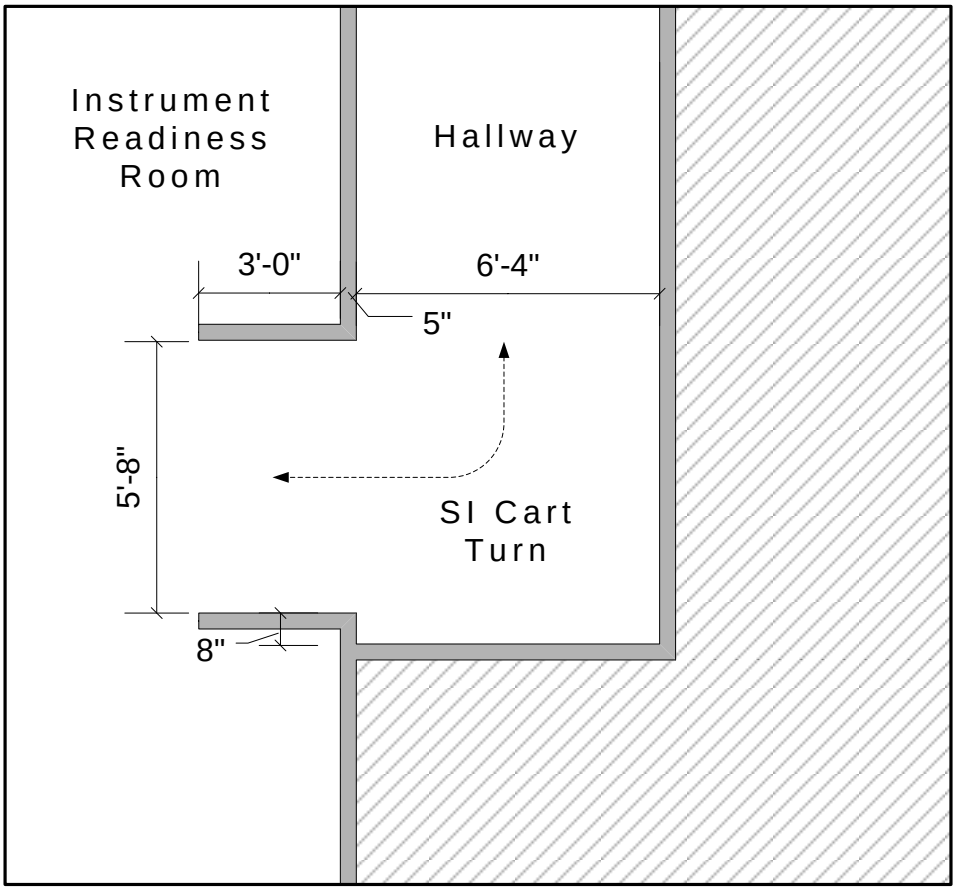

Figure 3. Dimensions and geometry of constrained SI Cart turn (Top view)

The interface requirements defined in Section 3.2B and Section 3.2C apply specifically to SI Carts that will be used on the aircraft.

B) The SI Cart shall be capable of being transported to the bed of the Scissor Lift Truck via lift gate, forklift, or SI Loading Platform.

C) A SI Cart that will be transported to the bed of the Scissor Lift Truck using the SI Loading Platform shall be able to negotiate the ramp angle specified in Section 3.1.3(D).

3.2.1. Electronics

Not Applicable

3.2.2. Electrical Power

Not Applicable

3.2.3. Hydraulic, Pneumatic, Pumping, and Water Systems

Not Applicable

3.3. Environmental

Not Applicable

3.4. Safety

In order to safeguard the aircraft, the SI, the SSMO Ground Support Facility, and most importantly, the people using them, certain precautions must be taken when operating SI Carts. This section will present the safety features required in SI Carts and provide guidance for SI Cart handling and operation.

3.4.1. Cart Maneuvering

Science Instruments are generally heavy, unwieldy and fragile. Therefore, great care should be taken when maneuvering a loaded SI Cart. If care is not exercised, serious damage and injury may result. The following precautions should be taken:

- Caution must be used when manually maneuvering SI Carts to maintain control.
- SI Cart procedures should ensure that there are sufficient numbers of appropriately trained personnel controlling and monitoring movement of the cart, particularly when the cart is being moved over ramps and/or through doorways, to ensure that the risk of a loss of control is adequately mitigated.
- To optimize SI Cart stability and minimize the hazard of tipping, SI Cart designs and operational procedures should keep payload and therefore the CG of the loaded SI Cart, as low as possible except when it is necessary to raise a SI Assembly in order to clear objects or for SI installation/removal.
- Prior to moving a loaded SI Cart, the entire SI Cart pathway should be inspected for any potential hazards (e.g., missing grate covers, cable trays).

3.4.2. Securing the Cart

A SI Cart used to support the load of a Science Instrument shall have brakes that are integral to the cart to prevent inadvertent movement of a parked cart. The braking mechanism shall be integral to at least one left wheel/caster and one right wheel/caster, relative to the typical direction of travel of the SI Cart when the cart is moved. Due to hazards and risk of injury, neither engagement nor disengagement of the brakes of the SI Cart shall require personnel to reach near or manipulate the wheels/casters directly by

hand.

Notes:

- Wheel/caster locks are one form of an integral brake mechanism that is widely available from a number of manufacturers.

- The brakes of a SI Cart do not necessarily need to be actuated simultaneously by a single control system; the brakes may be operated independently (e.g., locking one caster first and then locking another caster).

- Casters can be acquired through many manufacturers including Albion Industries Inc., E.R. Wagner Manufacturing Co., Hamilton Caster & Mfg. Co., and Payson Caster Inc.

3.4.3. Safety Personnel

A SOFIA Safety Representative will be present to witness the moving of a SI Cart from the IRR/PIF onto the Aircraft and SI installation to ensure no oversights are made.

4. QUALITY ASSURANCE PROVISIONS

The process for verifying SI compliance with the specified requirements of Section 3 is described in the *Science Instrument Developers' Handbook* (SCI-AR-HBK-OP03-2000). The *Science Instrument System Specification and ICD Requirements Matrix Template* (SCI-AR-PLA-SV05-2014) contains a complete list of requirements from the Science Instrument System Specification and the electrical and mechanical SI ICDs, and includes all SI interface requirements within this ICD. The template specifies verification method listed by development phase, expected verification activity, and the SI compliance authority for each SI interface requirement.

5. ACRONYMS

The definitions, abbreviations, and acronyms used in this document are referenced in the SOFIA Lexicon, SOF-DF-PD-PD-2009.

DAOF	Dryden Aircraft Operations Facility
ICD	Interface Control Document
IRR	Instrument Readiness Room
NASA	National Aeronautics and Space Administration
PIF	Pre-Flight Integration Facility
SI	Science Instrument
SIC	Science Instrument Cart
SSMO	SOFIA Science and Mission Operations
USRA	Universities Space Research Association