Introduction to the Human Factors Implementation Team (HFIT) Process for Payload Developers

Presented by: ***Rich Ellenberger***
Flight Crew Integration (FCI)

Purpose and Background

Purpose

- Provide a background and overview of the Human Factors (HF) Implementation Team (HFIT) process

Background and History

- The HFIT process was developed in 2003 to make Human Factors requirements integration and verification more successful and efficient for PDs
  - Aids the PD in HF requirements integration and compliance (SSP 57000 section 3.12)
  - HFIT is an ISS Program Office-funded service

Purpose and Background

Background and History (cont.)

- *Requirement Examples……*

  - Some human factors requirements are fairly easy to understand, integrate into design, and verify:

    SSP57000

    3.12.4.2.7 PUSH-PULL FORCE

    Payload hardware mounted into a capture-type receptacle that requires a push-pull action shall require a force less than 156 N (35 lbf) to install or remove.

  - Other requirements often are less clear on how a developer can integrate into design and/or verify compliance:

    SSP57000

    3.12.4.3.1 ONE-HANDED OPERATION

    All ORU connectors, whether operated by hand or tool, shall be designed and placed so they can be mated/demated using either hand.

Purpose and Background

Background and History (cont.)

- HFIT results in elimination of costly International Space Station (ISS) Program paperwork for human factors exceptions
  - Before the HFIT process was established, 65% of board-processed exceptions were related to HF requirements
  - With the HFIT process, HF requirements violations are either avoided, resolved, or at the least, minimized. Any unavoidable violations made known/vetted early with the HFIT team can be assessed, accepted and documented on internal HFIT paperwork
- HFIT results in hardware that is easier to safely operate
  - Improves safe and efficient human interaction with the hardware, which *facilitates on-orbit crew operations* and *improves science outcomes*
  - Astronaut Office provides the operator feedback for hardware operability and crew tasks
- HFIT is optional, but virtually all PDs choose it because it's so beneficial
  - HFIT Team identifies potential human factors or operational issues early so design changes can be made easily with little to no cost impact to ensure better requirements compliance at final verification stage

HFIT Function

HFIT Tasks

- HFIT Team reviews available data on Payload HW and drafts preliminary requirements applicability

- Initial evaluation of Payload HW scheduled as early as possible
  - Venue can be SRR, PDR, hardware operations TIM, or similar milestone as coordinated by Payload Integration Manager (PIM)
  - Requirements applicability refined in conjunction with PD; documented on HFIT Form 881
  - HFIT conducts the evaluation with Astronaut Office support
  - Objective is to provide the HFIT team and the PD an early snap-shot of design compliance
  - Quick constructive feedback to PD given via brief written report

HFIT Function

HFIT Tasks (cont.)

- Continue on-going support/feedback for any design iterations during HW development
  - During/in-between formal design milestones and/or developer requested meetings
- Verify HF requirements and provide recommendations for operational efficiencies and success
  - Conducted with HFIT rep, PD rep, and Astronaut Office at designated venue
  - Can be done remotely in some cases
  - Any requirements violations and recommendations documented on HFIT Form 882
- Close HFIT requirements
  - Provide PD with requirements verification documentation
    - Signed HFIT Certificate of Compliance (CoC), with attached Form 882 if needed
  - Document and Archive CoC with Program database, VERITAS

Crew Comments Resource for Payload Developers

- **The FCI Operational Habitability (OpsHab) team collects, identifies and analyzes data from the ISS Post-Flight and On-Orbit Crew Debriefs, from 2-A to current E-39/40**

- ***Confidential Crew Comments Data Base (CCDB) maintained by OpsHab:**
  - Contains more than 63,000 crew comments
  - Post-flight and on-orbit debriefs, 30+ ISS debrief systems
  - Searchable archive (SQL database), official source for all ISS Crew Debrief transcripts
  - Supports current and future program design and development of vehicles, hardware, requirements, procedures, issue resolution, lessons learned & trending

- ***Reports Generated by OpsHab** (Upon Request):
  - **Quick Request Reports**: Customizable report containing all available comments on a specific topic, keyword, or mission (e.g. US Payloads) or a specialized data set (e.g. individual payloads, Payload Training, crew time, etc.) across all debriefs
  - After request, Report delivery approximately 1 week, depending on complexity of search
  - All Reports are reviewed and approved by the Astronaut Office prior to dissemination

***Due to privacy agreements with the Astronaut Office, only the OpsHab team has access to directly search the CCDB and create Reports**

HFIT Points of Contact

Payload HFIT Lead

- Rich Ellenberger: 281.483.5238 (NASA FCI System Manager Deputy and Payload HF Lead)

Payload HFIT Representative

- Jason Beierle: 281.483.7919
- Michael Brown: 281.226.6176
- Chen Deng: 281.226.4264
- Antonius Widjokongko: 281.483.9717
- Wynona Johnson-McAfee: 281.483.8870
- Mai Lee Chang: 281.483.0685

Other FCI Contacts:

- Susan Schuh: 281.483.7487 (FCI OpsHab Lead for Database)
- Laura Duvall: 281.483.0244 (NASA FCI System Manager)

Questions?

Introduction to the ISS Payload Label Approval Team (IPLAT) Process for Payload Developers

Presented by: ***Rich Ellenberger***
ISS Flight Crew Integration

Purpose and Background

Purpose

- Provide a background and overview of the ISS Payload Label Approval Team (IPLAT) process

Background and History

- IPLAT process was originally developed in late 1999 as a mandatory process to facilitate the verification of IVA payload labeling requirements in Appendix C of SSP 57000. Similarly, IPLAT also covers EVA labeling (SSP 57003) and for payloads in EXPRESS racks (SSP 52000).
- SSP 57000 (3.12.7), contains a single label requirement and it points to label requirements in Appendix C. This allows all requirements to be tracked as a convenient single label requirement.
- IPLAT prepares all needed verification paperwork and forwards signed Label Approval Form (732) to formally document verification closure of all labeling requirements.

Standard IPLAT Process

Perform Initial label evaluation for new/modified HW with PD and Astronaut Office:

- Labeling assessment requires information on both Label content and location and orientation. This can be provided in a number of ways:
  - Draft Engineering Drawings that contain label location and content details
  - Draft Engineering Drawings that contain label location info, and label content information provided via a separate "label spec" (spreadsheet). This method reduces changes to engineering drawings if/when label information is updated.
  - Early Engineering Prototype HW (with or without drawings)
- Labeling assessment covers:
  - HW Identification labels—including OpNom, P/N, S/N and barcode
  - Labeling of physical crew interfaces—connectors, switches, ports, cables and hoses, access covers, buttons, ORUs, etc.
  - Caution and Warning, and Hazard Response Labels (if required)
  - Stowage labeling
  - Labels to improve HW usability (e.g., "TOP" label, or alignment marks to assist with equipment orientation and setup)
- Note: A clear understanding of the payload's operations is necessary in order to design labels that meet the requirements and facilitate on-orbit operations.

Standard IPLAT Process

IPLAT provides written feedback to PD:

- Approve the PD's proposed label design (meets requirements)
- Or, provide detailed recommendations on label content, label placement, necessary in order to meet requirements

Perform Final label evaluation

- Verify close-out photos of flight HW with labeling installed
- Or, Inspect flight HW (labels can be applied at this stage)

IPLAT provides required verification closure paperwork to PD:

- Signed 732 form to close label verification

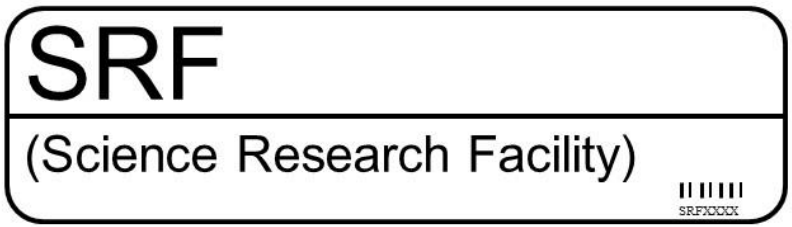
Labeling of Crew Interfaces

IPLAT must review all labels on Payload hardware/equipment that the crew will interface with (nominal operations, planned maintenance, contingency)

- **This includes, but is not limited to:**
  - Rack/subrack front panel type hardware
  - All experiment equipment, loose or mounted other than in rack/subrack formation
  - All equipment cables, fluid lines, hoses, etc.
  - All equipment controls, switches, ports, LEDs, containers, etc

- **This does not include:**
  - Items which the crew will not interface with (e.g. internal circuit boards, etc.)
  - Labels contained within software displays. These are handled by the Payload Display Review Team (PDRT).
  - Procedures, Cue Cards, etc. These are handled by the Payload Operations Data File (PODF).

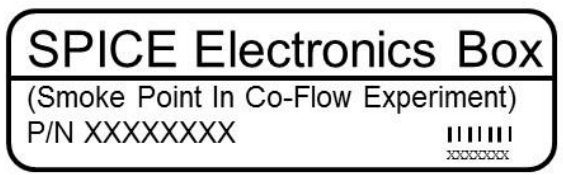
Labeling Examples (Identification, or "OpNom" labels)



Rack "main unit" name example

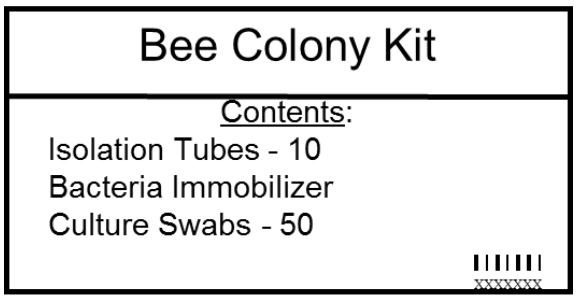
Rack "main unit" name example - vertical space limited

Subrack "main unit" name example



Example of "main unit" name for a "Non-rack self-contained payload"

Example of subordinate equipment name



Stowage kit name/contents label

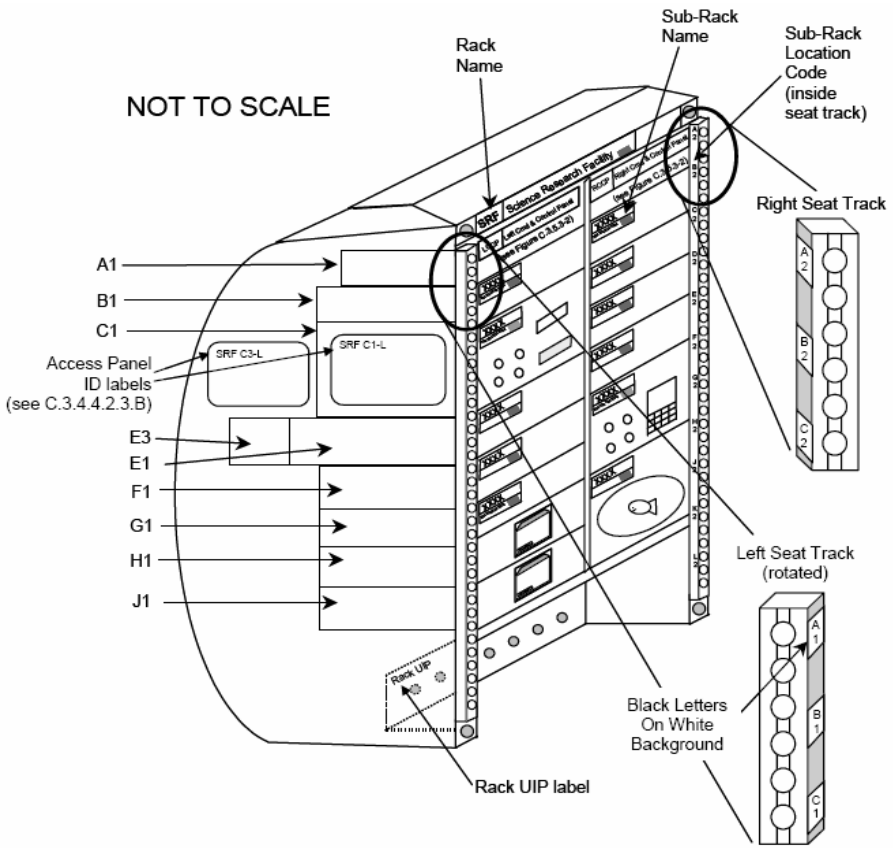
Note 1: These standard labels can be ordered from the Decal Design & Production Facility (DDPF) through the BITS (Barcode Inventory Tracking System) group.

Note 2: Acronyms should be avoided when possible.

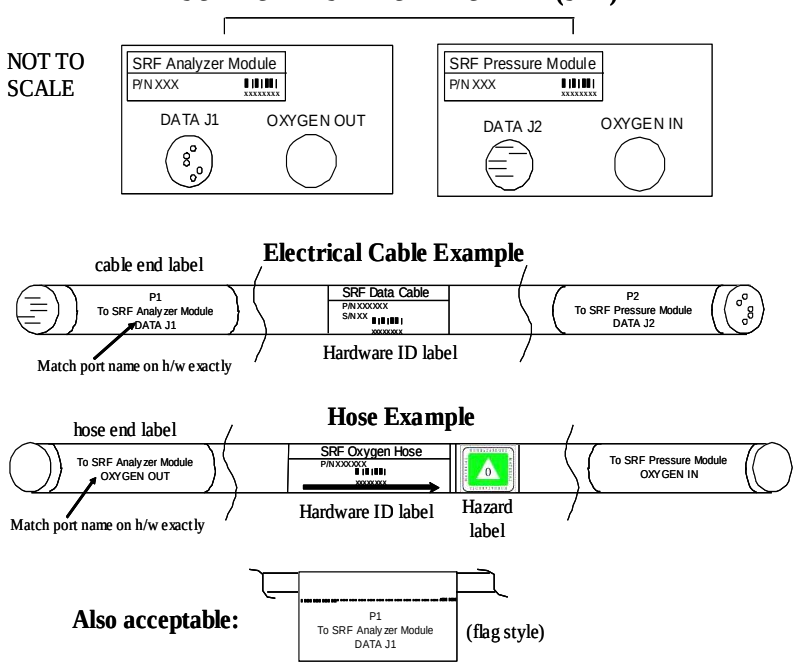
Note 3: To help denote ownership of an object to a specific payload, one can include the acronym in the "smart" barcode such as in the SRF examples above.

Labeling Examples (Rack and cable/hose labels)

Rack level labeling



Connector port/cable & hose labeling



Notes:

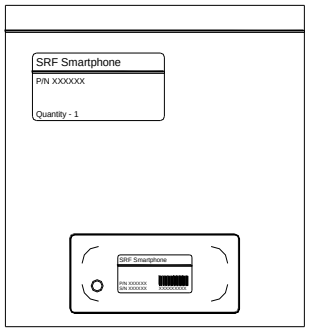
Electrical cables/ports: "P" designates cable end plugs and "J" designates receptacles on hardware regardless of gender (pins/sockets).

Hose End Labels: The first line of the end label may be left off (as shown above) if the hose end does not have a specific identifier. In this case, only the second and third lines are needed. If hose ends must be identified, do not use a "P" number.

Hose Identifying Labels: Flow direction should be shown if the hose ends are not interchangeable.

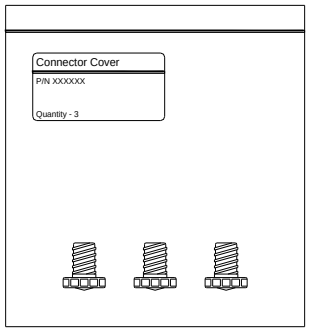
Labeling Examples (Stowage container labels)

Ziplock Example (Not tracked)



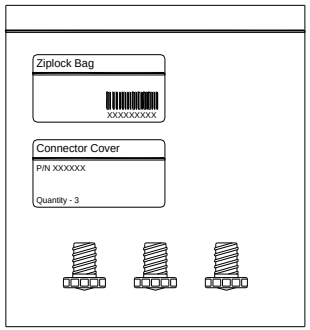
Note: This is an example of an item that does need to be tracked on orbit. The hardware can be labeled with an IMS barcode. If the item(s) will not be returned to the ziplock bag then only an identification label is used.

Ziplock Example (Not tracked)



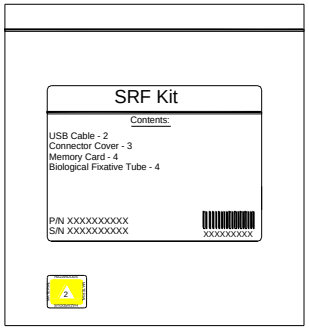
Note: This is an example of a small item(s) that does not need to be tracked on orbit. JF1345 Form (IMS Exemption) has been approved. If the item(s) will not be returned to the ziplock bag then only an identification label is used.

Ziplock Example (Tracked)



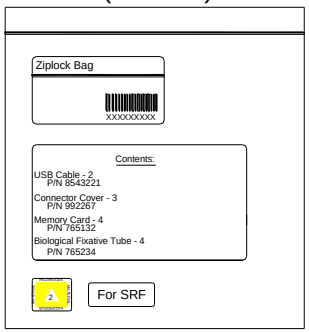
Note: This is an example of a small item(s) that does need to be tracked on orbit because the hardware needs to be returned to the ziplock bag (ziplock is not thrown away). JF1345 Form (IMS Exemption) has been approved. The ziplock bag is manifested in this case and it should have a barcode on it. The part number for the ziplock itself is not necessary.

Kit Example (Preferred)



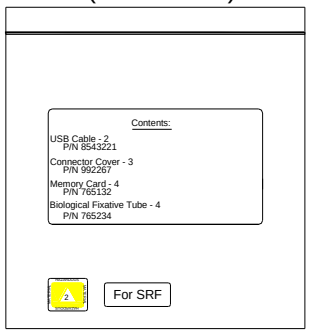
Note: This is an example of stowage items that have been organized into a manifested kit.

Multiple Individually Manifested Items Example (Tracked)



Note: This is an example of a stowage items that have not been organized in a manifested kit. These stowage items need to be tracked on orbit because the hardware needs to be returned to the ziplock bag. If a ziplock bag is manifested in this case it should have a barcode on it, but the part number for the ziplock itself is not necessary because it's hardware inside that is relevant.

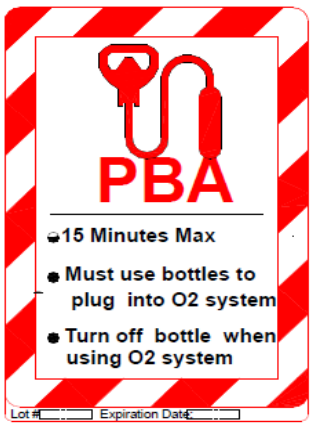
Multiple Individually Manifested Items Example (Not tracked)



Note: This is an example of stowage items that have not been organized into a manifested kit. These stowage items will not be returned to the ziplock bag.

Labeling Examples (Caution/Warning/Emergency Use labels)

Standard C&W labels



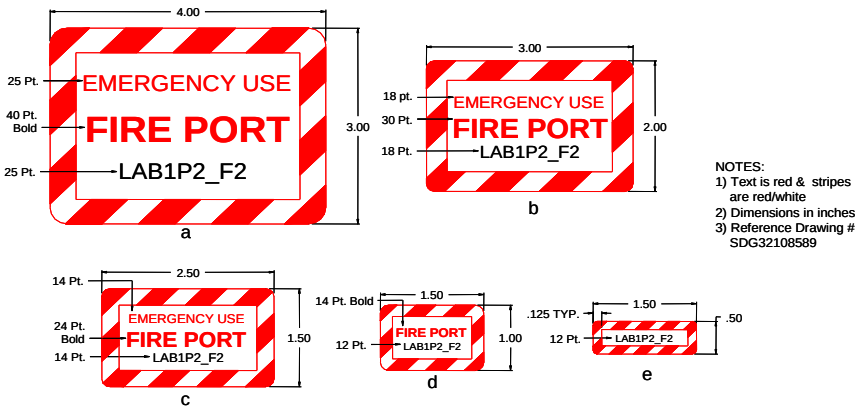
Emergency Use Label Example

Caution/Warning Label Example

Toxicology labels

Toxic Hazard Label Examples

Fire port location code labeling



Additional IPLAT Services

In addition to identifying and verifying labeling requirements, IPLAT can provide these services to the Payload Developer:

- Provide Assistance with NASA Operational Nomenclature (OpNom) approval
- Provide information on accessing and using the NASA Inventory Management System (IMS) Barcode Inventory Tracking System (BITS) (Barcode labels)
- Bar Code Exemption requests completed and submitted
- Create unique Label Drawings (accepted by NASA Decal Lab (DDPF)) when a standard label does not exist
- Guidance on selecting and ordering labels from the NASA Decal Catalog
- Label application at Final Label Evaluation

PD vs. IPLAT Responsibilities

Payload Developer Responsibilities:

- Contact IPLAT early in your design cycle
- Provide IPLAT with your HW development schedule, including design reviews, on-dock dates, etc.
- Notify IPLAT of any schedule changes
- Provide IPLAT with complete set of all label drawings/information
- Notify IPLAT if design or configuration changes are made, and for providing those updated drawings to IPLAT for review

IPLAT Responsibilities:

- Upon receipt of Engineering Drawings from PD, IPLAT will evaluate and respond to PD within 10 working days
  - Approval cycle begins when all of the drawings/information are received
  - IPLAT may negotiate for more time if the number of drawings is large or the payload is complex (many crew interfaces with labels)
- IPLAT will maintain a record of which drawings were reviewed and approved
- IPLAT will provide Label verification per agreed-to schedule, provided PD has met all above PD responsibilities

IPLAT Points of Contact

Payload IPLAT Lead

- Rich Ellenberger: 281.483.5238 (NASA FCI System Manager Deputy and Payload HF Lead)

Payload IPLAT Representatives

- David Segovia: 281.483.7566
- Antonius Widjokongko: 281.483.9717
- Wynona Johnson-McAfee: 281.483.8870
- Mai Lee Chang: 281.483.0685 (eLabel Database POC)

Other FCI Contacts:

- Laura Duvall: 281.483.0244

Questions ?

HFIT

Back-Up Charts

Benefits of HFIT Process

Hardware Usability Improvements Gained

- The HFIT process saves on-orbit crew time by improving the usability of Science HW. Standard usability testing on as-built HW is performed to reduce need for potential exceptions.
- HW is evaluated under nominal and planned contingency scenarios with the Astronaut Office, to identify operational improvements and efficiencies related to stow/de-stow, experimental setup, and conducting experiments.
- Because HFIT typically evaluates HW early in the design process, we are able to suggest improvements that don't impact the critical design path, and often with minimal or no cost impacts to the PD.
- The payload is rendered more usable as a result of early integration of the HFIT process, therefore on-orbit operation of HW will likely require less crew time and better science outcomes are more probable.

Benefits of HFIT Process (cont.)

Schedule Impacts Reduced

- Starting in 2003, the HFIT process allowed the HFIT team to process requirements violations internally, thus eliminating the need for time-consuming board processing of exceptions by PDs

Cost Savings to PDs

- PDs that utilize the HFIT process do not have to perform independent verification of HF requirements. The HFIT Team works closely with the PD to complete the requirements verification matrix and provides approved verification documentation for inclusion into the final certification package

HFIT Team Roster

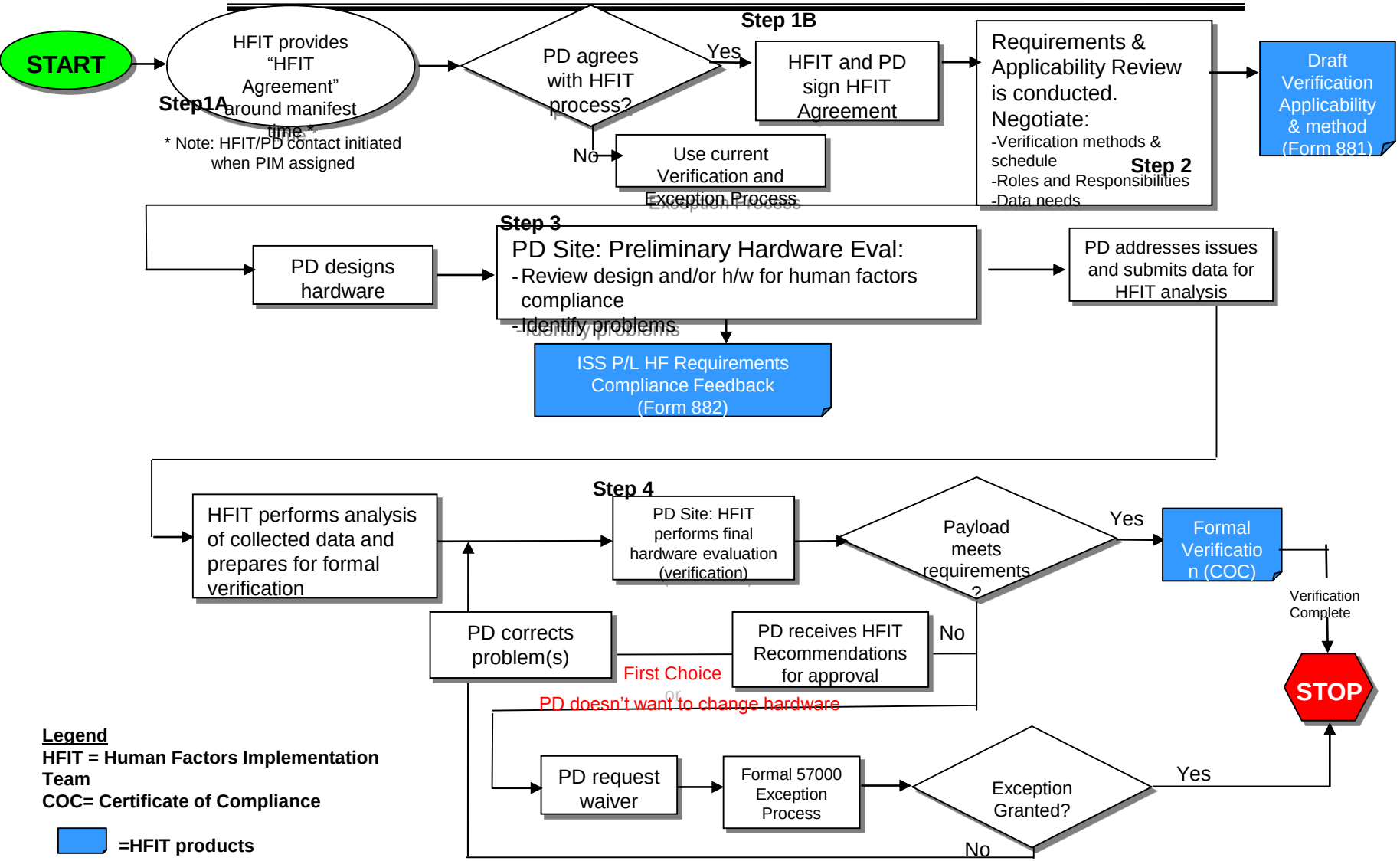
HFIT Core Team

- NASA/SF3 Flight Crew Integration-Payloads (JSC)
- Boeing ISS Crew Cargo Configuration
- Astronaut Office (JSC)

Other Teams with potential HFIT interaction

- IPLAT (SF/FCI's ISS Payloads Label Approval Team)
- IMS/BITS (OC's Inventory Management Sys./Barcode Inventory Tracking Sys.)
- OpNom (OD's Operational Nomenclature team)
- DDPF (OC's Decals Design and Production Facility)
- Payload Stowage Integration (OZ)
- VITT (Vehicle Integration Test Team)
- Safety (NT)
- CMC Shipping (OC's Cargo Mission Contract)
- PIM (Payload Integration Managers)

HFIT Payload Human Factors Approval Process



Legend
HFIT = Human Factors Implementation Team
COC= Certificate of Compliance

=HFIT products

HFIT Forms and Documentation

HFIT Agreement

- Defines the roles and responsibilities of the PD and HFIT
- Is signed by both parties (HFIT Rep and Payload Rep)

Form 881

- Documents 57000 requirements and verification methods, requirements applicability, and closure status
- This document is INTERNAL to HFIT

Initial HFIT Evaluation Memo

- Initial HFIT evaluations are typically done in memo format and contain recommendations to meet requirements, and/or human factors best practices and operations success strategies based on ISS astronaut experience operating payloads.

Form 882

- Tracks any deviations from requirements and documents closure of resolution for these deviations
- Signed by HFIT Rep, Payload Rep, & the Astronaut Office

CoC (Certificate of Compliance)

- Issued by HFIT to close SSP 57000 3.12 requirements with PE&I

Sample of 881 Form

Payload:									Issue Date:
Location:									
Line Item #	SSP 57000 Requirement	Description	ICD A or N/A	Verification Method	P/L VP VRDS Number	Rack IDD Number	Closed via Form 882	Closed	Applicability Rationale
1	3.12	HUMAN FACTORS INTERFACE REQUIREMENTS	N/A	Title					
2	3.12.1.A	Strength Requirements		Analysis or Test					
3	3.12.1.B	Strength Requirements		Analysis or Test					
4	3.12.2	BODY ENVELOPE AND REACH ACCESSIBILITY	N/A	Title					
5	3.12.2.1	Adequate Clearance		Analysis or Demo					
6	3.12.2.2.A	Accessibility		Analysis or Demo					
7	3.12.2.2.B	Accessibility		Analysis or Test					
8	3.12.2.3	Full Size Range Accommodation		Analysis or Demo					
9	3.12.3	HABITABILITY	N/A	Title					
10	3.12.3.1	HOUSEKEEPING	N/A	Title					
11	3.12.3.1.1	Closures and Covers		Inspection					
12	3.12.3.1.2.A	Built-In Control		Inspection					
13	3.12.3.1.2.B	Built-In Control		Analysis or Demo					
14	3.12.3.1.5	One-Handed Operation		Demo					
15	3.12.3.2	Touch Temperature		Follow formal 57000 process					
16	3.12.3.2.1	Continuous/Incidental Contact – High Temperature		Follow formal 57000 process					
17	3.12.3.2.2	Continuous/Incidental Contact – Low Temperature		Follow formal 57000 process					
18	3.12.3.3	Acoustics Requirement		Follow formal 57000 process					
19	3.12.3.3.1.A	Continuous Noise Limits – Integrated Rack Whose Sub-rack Equipment Will Not Be Changed Out		Follow formal 57000 process					
20	3.12.3.3.1.B	Continuous Noise Limits – Integrated Rack Whose Sub-rack Equipment Will Be		Follow formal 57000 process					

Sample of 882 Form

Form 882-X

DATE
Baseline / Revision X

ISS Payload Human Factors Requirements Compliance Feedback Form

Payload evaluated: _____

Date of Preliminary Evaluation: _____ Date of Final Evaluation: _____

**Note: VoR denotes violation of requirement.

Acceptable			882 Line Item #	Requirements Section / VRDS # / IDD # (if needed)	Human Factors/Crew Interface Problem:	Suggested Resolution:	Consequences if not fixed:	HFIT Disposition:
VoR	Yes	No						

Sample of Certificate of Compliance (CoC)–
Requirements Pages (p 1 of 5)

Payload Name

DATE
Baseline / Revision X

Hardware Certificate of Compliance (COC)

I hereby certify compliance with the verification requirements as specified in ######-**ICD for Payload (P/L Acronym).** I also certify that the identified as-built hardware was manufactured in accordance with the design drawings, parts lists, applicable waivers and deviations. All supporting data is valid, applicable, and complete. This data is maintained in our files and will be made available upon request.

Stage Effectivity **xxx** and subsequent with no drawing changes.

SSP 57000 Requirement	Applicable and Verified	Method	Applicable Document / Rev. Date	Drawings, Parts Lists, Waivers, Deviations, Procedures, Etc. (Attach correlated list as needed)
3.12.1.A	☐	Reference HFIT Form 881	SSP ##### Baseline/Rev DATE __/__/__	
3.12.1.B	☐			
3.12.2.1	☐			
3.12.2.2.A	☐			
3.12.2.2.B	☐			
3.12.2.3	☐			
3.12.3.1.1	☐			
3.12.3.1.2.A	☐			
3.12.3.1.2.B	☐			
3.12.3.1.5	☐			
3.12.3.4.A	☐			
3.12.3.4.B	☐			
3.12.3.4.C	☐			
3.12.3.4.D	☐			
3.12.3.4.E	☐			
3.12.4.2.1	☐			
3.12.4.2.2	☐			
3.12.4.2.5	☐			
3.12.4.2.6	☐			
3.12.4.2.7	☐			
3.12.4.2.8	☐			
3.12.4.2.8.1.A	☐			

Page 1 of 5

Sample of Certificate of Compliance (CoC)–
Signature Page

Payload Name

DATE
Baseline / Revision X

_____

Print Name/Signature/Date
HFIT - Responsible Person
Organization – HFIT

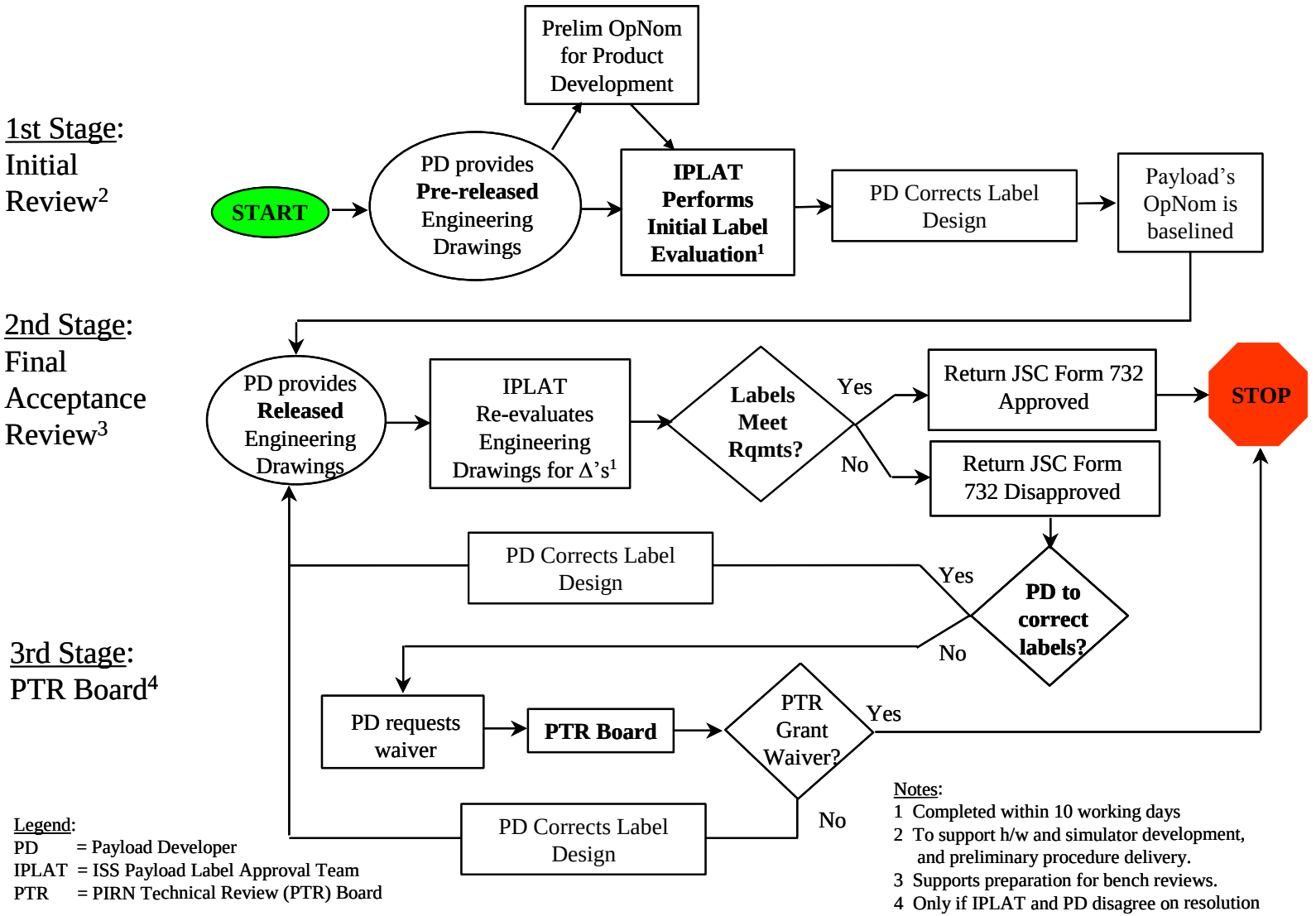
_____

Print Name/Signature/Date
Payload Developer - Responsible Person
Organization – Payload

IPLAT

Back-Up Charts

IPLAT Payload Process Diagram



Fairness Principle (for both PDs and IPLAT)

- IPLAT has a “fairness principle” in its process. This means that, if a payload developer implements all of the recommendations from the initial label evaluation, IPLAT does not “change the rules” or recommendations for the final label evaluation.
  - IPLAT needs just one opportunity to make label recommendations. Logical exceptions to this would be for cases where a safety issue exists.
  - This principle applies only to hardware IPLAT has actually reviewed and already given recommendations for. New hardware is treated as an initial label evaluation.

- The other side of this principle is that it is not acceptable for a payload developer to come for an initial label evaluation saying the drawings and hardware are already baselined and not open to comment. IPLAT needs one opportunity to make label recommendations.

Final Acceptance of Payload Labels

- Once the payload's design matures to the point where the developer has released engineering drawings and desires final acceptance of the label designs, the developer will contact IPLAT to request the final evaluation.
- Developer supplies IPLAT with formal released engineering drawings.
- IPLAT reviews released drawings to ensure IPLAT's previous recommendations were implemented and checks any additional changes made to the labels. The developer should inform IPLAT of such changes prior to the review. The Final Disposition Form (JSC Form 732) is the formal record of whether or not the labels are approved.
- If the released drawings contain no label requirements violations, Form 732 will be returned listing the drawings that were approved.
- If the released drawings contain label requirements violations, Form 732 will be returned citing the drawings that are disapproved.

Final Acceptance (cont.)

- It is possible for some drawings to be approved, and some disapproved, on the same Form 732.

- If there is a good reason the letter of a requirement can't be met, IPLAT will make a determination as to whether or not the violation is serious enough to warrant disapproval. The developer and IPLAT will try to work toward a solution that is acceptable to both parties.

- If there are any outstanding disagreements between IPLAT and the developer, the developer can appeal to the appropriate payload board for disposition.

IPLAT Team Interactions

IPLAT Core Team

- NASA/SF3 Flight Crew Integration-Payloads (JSC)
- Astronaut Office (JSC)

Other Related Teams

- HFIT (Human Factors Implementation Team)
- OpNom (MSFC's EO Operational Nomenclature team)
- IMS/BITS (OC's Inventory Management Sys./Barcode Inventory Tracking Sys.)
- DDPF (OC's Decals Design and Production Facility)
- Payload Stowage Integration (OZ)
- Safety (NT)
- CMC Shipping (OC's Cargo Mission Contract)
- PIM (Payload Integration Managers)