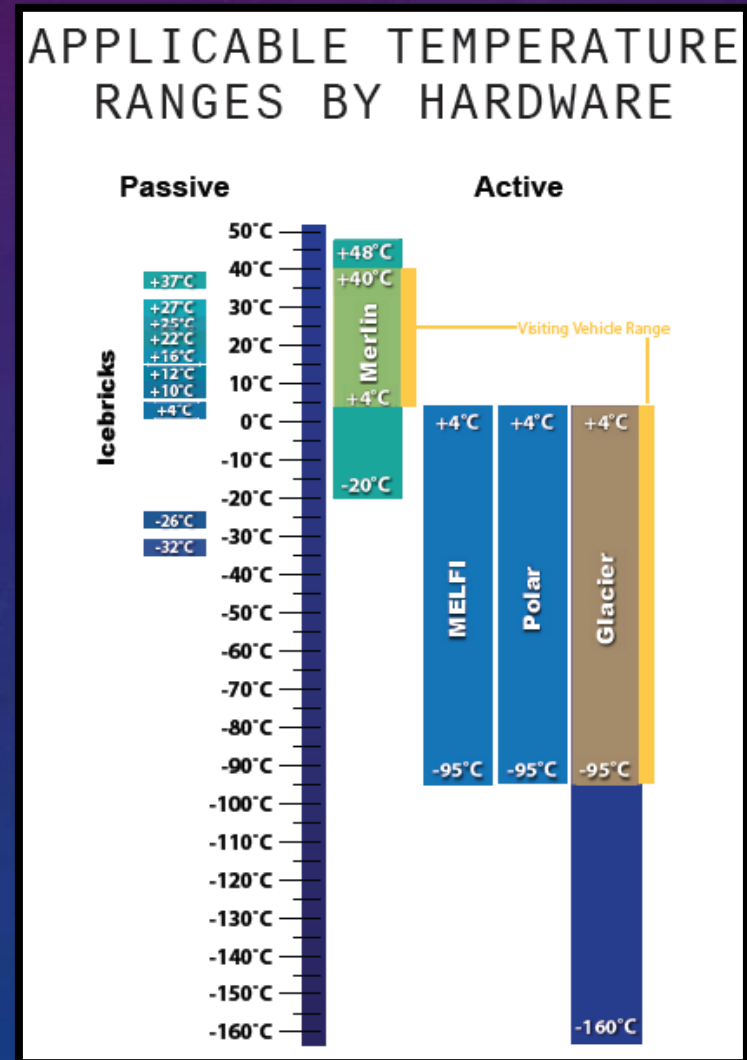




Cold Stowage Operations Overview



- Cold Stowage consists of hardware, both active and passive, that transports science to/from and stows science on the International Space Station (ISS) in a temperature controlled environment
 - Active and passive systems provide more flexibility and redundancy
 - Temperature range for science support is +48°C to -160°C on ISS and +40°C to -95°C for launch and return
 - All hardware is compatible with SpaceX and Orbital/ATK (OA) vehicles; some hardware is compatible with Soyuz, Progress, ATV, and HTV
 - Cold Stowage hardware is maintained by a joint effort between ESA, University of Alabama at Birmingham (UAB), and the JSC Cold Stowage team which prepares the hardware for flight, including launch and landing support
 - The Cold Stowage team is based out of Johnson Space Center in Houston TX





Cold Storage Hardware Overview



➤ Cold Storage Active Hardware

- MELFI is a freezer/refrigerator located on ISS which has 4 insulated dewars that can be set to $+2^{\circ}\text{C}$, -35°C , or -95°C
- Glacier is a freezer/refrigerator that supports samples from -95°C to $+4^{\circ}\text{C}$ for launch/return and from -160°C to $+4^{\circ}\text{C}$ on ISS
- Polar is a freezer/refrigerator that supports samples from -95°C to $+4^{\circ}\text{C}$
- Merlin is an incubator/refrigerator/freezer that supports samples from $+4^{\circ}\text{C}$ to $+40^{\circ}\text{C}$ for launch/return and from -20°C to $+48^{\circ}\text{C}$ on ISS



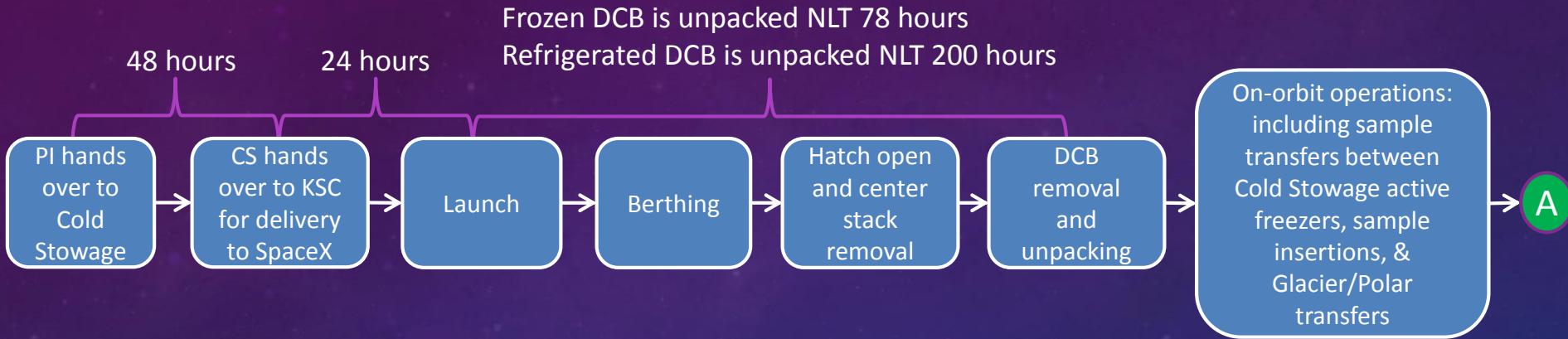
➤ Cold Storage Passive Hardware

- Double Coldbags are insulated stowage bags used to transport samples to and from ISS on visiting vehicles
- Mini Coldbag is a smaller version of a Double Coldbag that was designed for Soyuz return
- Ice Bricks provide cooling or incubation to samples stored inside Double Coldbags/Mini Coldbags
 - Ice Brick temperatures include -32°C , -26°C , $+4^{\circ}\text{C}$, $+10^{\circ}\text{C}$, $+12^{\circ}\text{C}$, $+16^{\circ}\text{C}$, $+22^{\circ}\text{C}$, $+25^{\circ}\text{C}$, $+27^{\circ}\text{C}$, and $+37^{\circ}\text{C}$

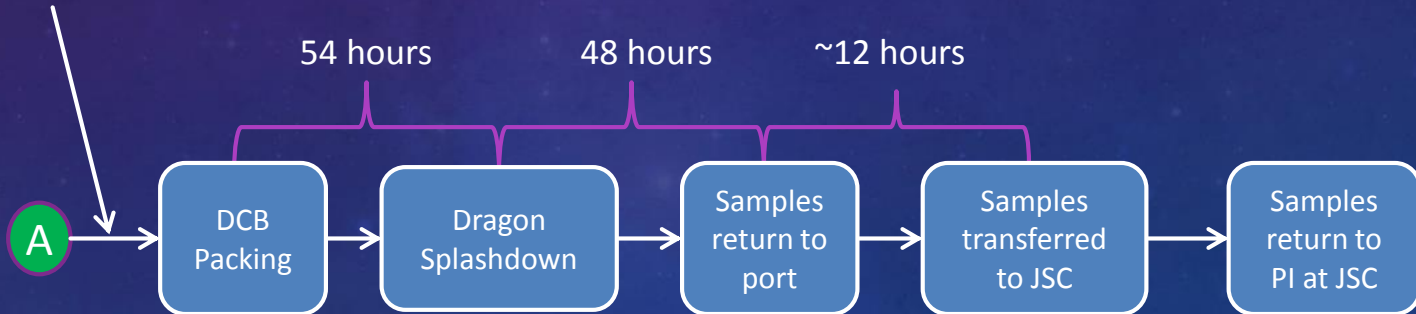




Cold Storage SpaceX Mission Flow



Last sample insertion
NLT 24 hours from DCB packing*



*Note: Durations will vary, final determination is done on a case-by-case basis and must take into account the entire ops flow for the mission



Cold Stowage Do's & Don'ts

DO

- Accurately document ascent, on orbit, and return requirements on the Cold Stowage form
 - Accurately documenting sample dimensions and temperature requirements allows for the maximum amount of science to fly each mission
- Request input from the Cold Stowage Team when developing packing solutions and complete fit checks with CS assets early in the development process
- Keep Cold Stowage in the loop with payload specific real time ops planning
- Remove unnecessary air pockets inside sealed bags/ziplocs, space is limited inside cold assets

DON'T

- Use large unnecessary bagging materials
- Stick labels on outer bagging material, labels may fall off when frozen
- Change sample container size/dimensions or bundle samples together without informing Cold Stowage
- Handover dimensionally incorrect hardware for late load into the vehicle

➤ For more information on Cold Stowage, including existing Cold Stowage Forms, a current Cold Stowage Plan, and to request Cold Stowage verification testing support, visit the following website: <https://iss-www.jsc.nasa.gov/nwo/payload/oz2/web/ColdStow.shtml>