

# Spallation Neutron Source Interface Control Document

## Sample Environment Interface Flanges

WBS 1.7.3.5.1 and WBS 1.7.x  
(x= neutron instrument sub-element)

August 24, 2005



A U.S. Department of Energy Multilaboratory Project

SPALLATION NEUTRON SOURCE  
Argonne National Laboratory • Brookhaven National Laboratory • Thomas Jefferson National Accelerator Facility • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

**Interface Control Document  
Sample Environment Interface Flanges**

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# SNS Interface Control Document

## Sample Environment Interface Flanges

WBS 1.7 STL \_\_\_\_\_

WBS 1.7.3.5 \_\_\_\_\_  
Sample Environment

WBS 1.7.4 \_\_\_\_\_  
Backscattering Instrument

WBS 1.7.5 \_\_\_\_\_  
Magnetism Reflectometer

WBS 1.7.6 \_\_\_\_\_  
Liquids Reflectometer

WBS 1.7.7 \_\_\_\_\_  
ARCS (Document Control Only)

WBS 1.7.8 \_\_\_\_\_  
SANS

WBS 1.7.9 \_\_\_\_\_  
VULCAN - Engineering Instrument (Document Control Only)

WBS 1.7.10 \_\_\_\_\_  
Powder Diffractometer

WBS 1.7.11 \_\_\_\_\_  
CNCS (Document Control Only)

WBS 1.7.12 \_\_\_\_\_  
High pressure diffractometer (Document Control Only)

1.7.13 \_\_\_\_\_  
Disordered materials diffractometer (Document Control Only)

1.7.14 \_\_\_\_\_  
High Resolution Chopper Spectrometer (Document Control Only)

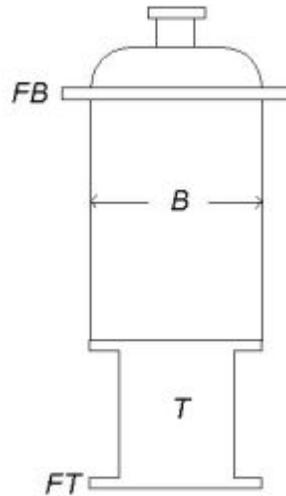
1.7.15 \_\_\_\_\_  
Single Crystal Diffractometer (Document Control Only)

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## 1. SCOPE

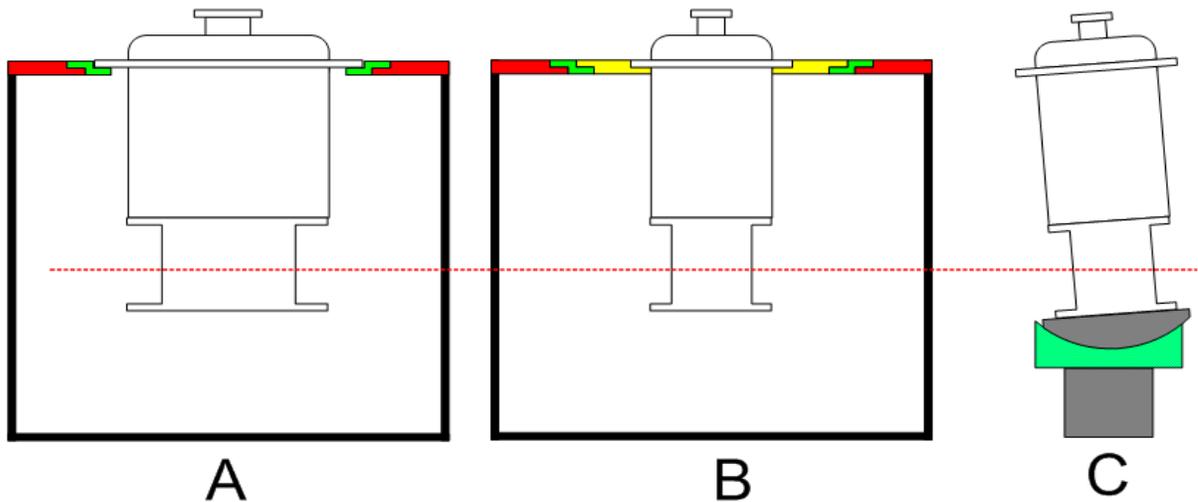
The present document addresses the mechanical mounting interface between neutron instruments and standard sample environment devices at the SNS. Design and installation standards for a set of mounting flanges are specified. Some of the presently defined flanges will be permanently attached to sample environment devices (SNS sample environment team responsibility) and others will be attached to the neutron instruments (instrument team responsibility). This collection of flanges will be standardized, to the extent necessary, to ensure safe mounting and interchangeability among a shared inventory of sample environment devices at the SNS. The present standards will apply to all devices in the shared sample environment inventory and all of the neutron instruments that plan to use the shared inventory, but they will not necessarily apply to neutron instruments with unique, dedicated sample environment resources, such as the fundamental physics beam line.



**Fig. 1. Sample Environment Standardization Scheme:** Sample environment devices come in many shapes and sizes, but standardized flanges will be added to allow safe and reliable mounting to the SNS neutron instruments. The sample environment exterior will generally include a main body ( $B$ ), body flange ( $FB$ ), tail ( $T$ ) and tail flange ( $FT$ ). The size of  $B$  and  $T$  can vary arbitrarily within a wide range, but  $FB$  and  $FT$  are standardized. By equipping each sample environment device with both types of mounting flange, it can be mounted to a table/goniometer (via  $FT$ ) or a tank-style instrument (via  $FB$ ).

## 2. OVERVIEW

Each shared sample environment device (SENV) will be equipped with two types of flanges to allow mounting on either a tank or table-style instrument (fig. 1). Furthermore, each neutron instrument will provide the proper set of flanges and adaptors to accommodate the full range of SENV sizes. Some mounting scenarios are illustrated in figure 2. All tank-style flanges shall be made from stainless steel (grade 304). Aluminum 6061 can be used for table flanges.



**Fig. 2. Selected SENV mounting scenarios:** (A) tank-style mounting, 32-inch (nominal) diameter SENV; (B) tank-style mounting, 16-inch SENV; (C) table-style mounting, 16-inch SENV; dashed red line depicts the neutron beam.

### 2.1 UNIFORM STANDARDS PLUS A VARIETY OF OPTIONS

Uniform standards are imposed only for the essential features that affect interchangeability. Other features, such as precision alignment and insertion guides, are identified as options.

### 2.2 NAMING CONVENTIONS

A hierarchical scheme will be used to name all of the presently defined components. Names consist of multiple elements separated by hyphens (Example: SENV-FB-D32). The first element identifies the parent device type (sample environment, tank instrument, or table instrument), second element identifies the flange type, and the remaining elements specify size and position.

### 2.3 LISTING OF ALL PRESENTLY-DEFINED FLANGES

<b>Table 1. Listing of Presently Defined Interface Flanges</b>	
<b>Name</b>	<b>Description</b>
Tank-Flange-D39	Largest tank flange (newly added in revision 1)
Tank-Reducer-D32	32 inch diameter adapter flange
Tank-Reducer-D16	16-inch diameter adapter flange
Tank-Reducer-D16-H14	16-inch diameter/14-inch height adapter flange
Tank-Thimble-B6	Converts tank into table interface, 6 inches below the beam, emulating Huber model 5204.2
SENV-FB-D39 [std height 29.5 assumed]	Body flange for huge SENV (new in rev. 1)
SENV-FB-D32	Body flange for large SENV
SENV-FB-D16	Body flange for tall and skinny SENV
SENV-FB-D16-H14	Body flange for short and skinny SENV
SENV-FT-D16-B6	Tail flange, small diameter & 6-inch below the beam
SENV-FT-D32-B15	Large tail flange (new in rev. 1)
SENV-FT-D39-B15	Huge tail flange (new in rev. 1)
Table-B6	6-inch below-the-beam table ( <i>e.g.</i> Huber model 5204.2)
Table-B15	15-inch below-the-beam table

### 2.4 EXTENSIBILITY

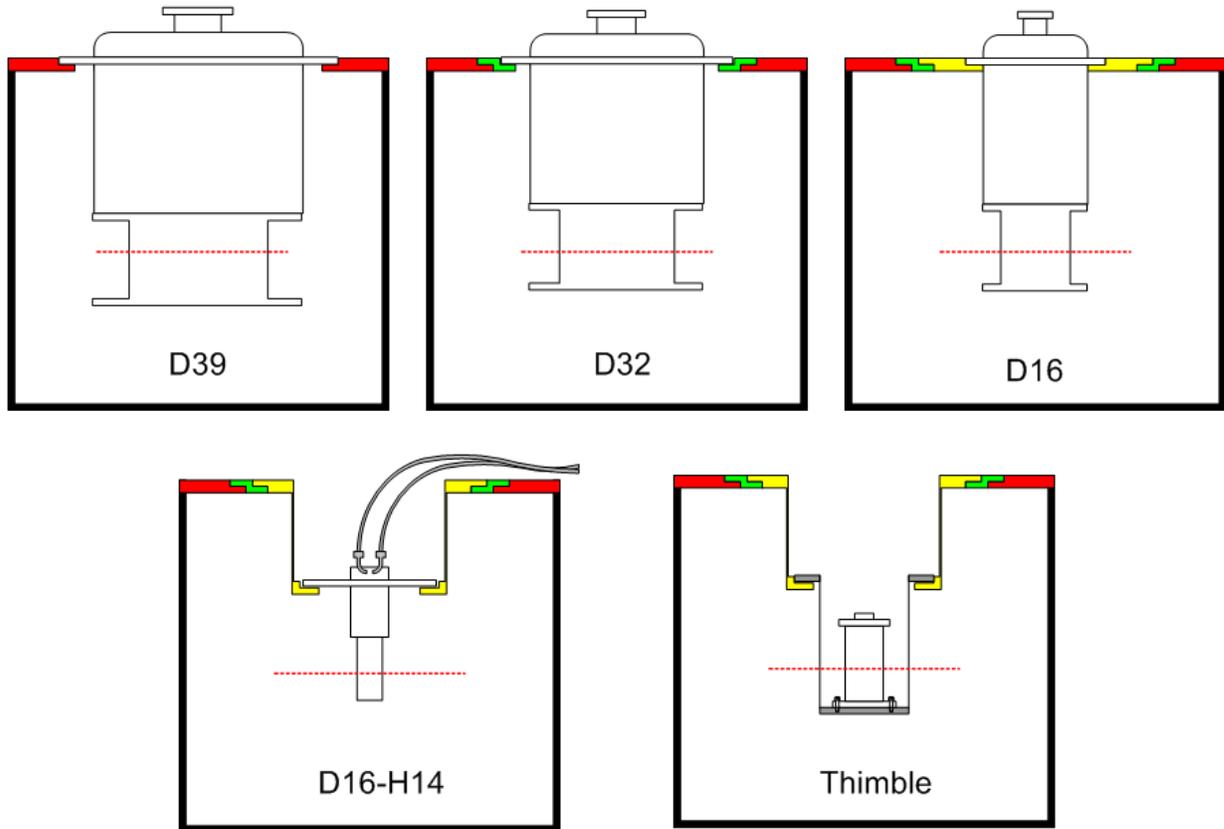
It is expected that new elements, particularly adaptors for short tanks, will be added to the presently defined set. New elements shall be proposed within conventions defined here and reviewed according to SNS guidelines.

### 3. TANK STANDARDS

#### 3.1 PROVIDE MULTIPLE MOUNTING OPTIONS

In order to accommodate the broad range of sample environment equipment, a set of interface flanges and adaptors will be available on each tank-style instruments. Figure 3 shows all of the presently defined flanges.

3.2



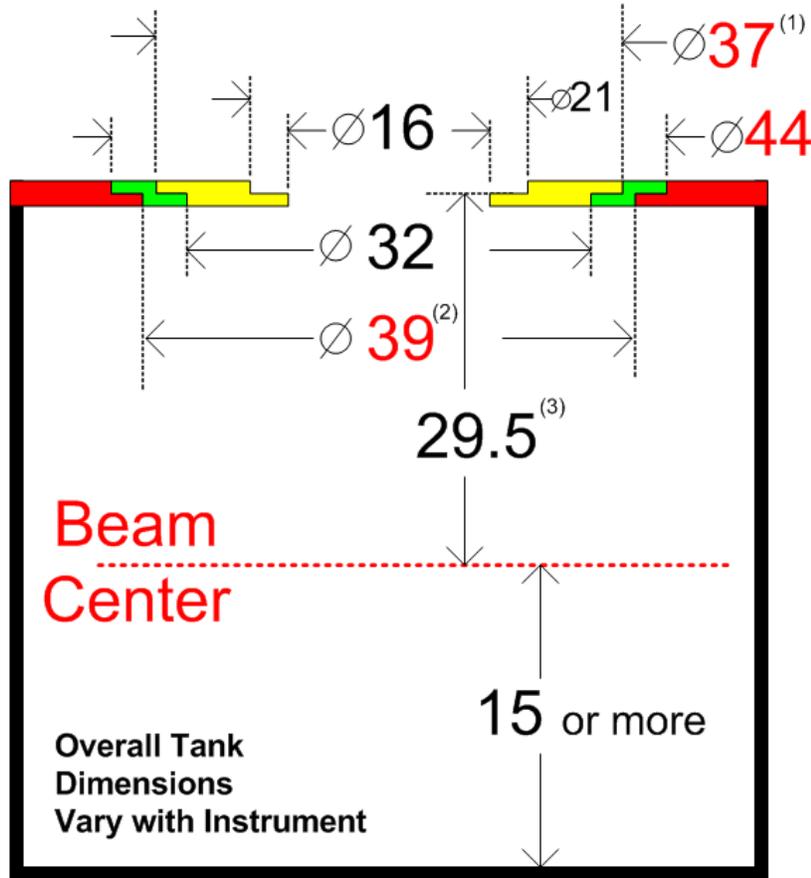
**Fig. 3. Tank-style mounting scenarios:** From top left, *Tank-Flange-D39* provides mounting for the largest SENV (body size between 32 and 39 inches); *Tank-Reducer-D32* for SENV body size between 16 and 32 inch; *Tank-Reducer-D16* for 16-inch or small SENV; *Tank-Reducer-D16-H14* for shorter SENV; finally, *Tank-Thimble-B6* allows mounting of legacy or user-provided SENV which do not have a body flange, but are compatible with a widely-used Huber goniometer (model 5404.2). The dashed red line depicts the neutron beam position.

### NOMINAL DIMENSIONS

Simplified diagrams are shown below. Details such as bolt-circle specifications and tolerances are given in section 4.

#### 3.2.1 Primary Flanges

The standard distance from the tank flange sealing surface to the beam center is 29.5 inches. Three nested flanges are defined for this height (fig. 4)



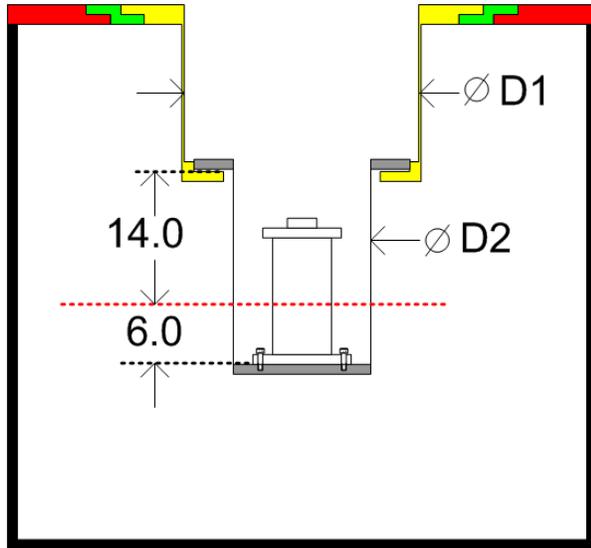
**Fig. 4. Tank flange nominal dimensions and positions [inches]:** Dimensions shown in red are new or have changed since revision 0; see tables below for tolerances; NOTES (1) outer diameter of *Tank-Reducer-D16* was decreased by one inch for consistency, so that OD-ID=5 inches on all flanges; this adaptor flange may alternately be designed to interface directly with largest; (2) newly added larger flange *Tank-Flange-D39* will accommodate compensated magnets; (3) new stepped designs puts all sealing surfaces 29.5 inches about the beam center

### 3.2.2 Additional Tank Adaptor flanges

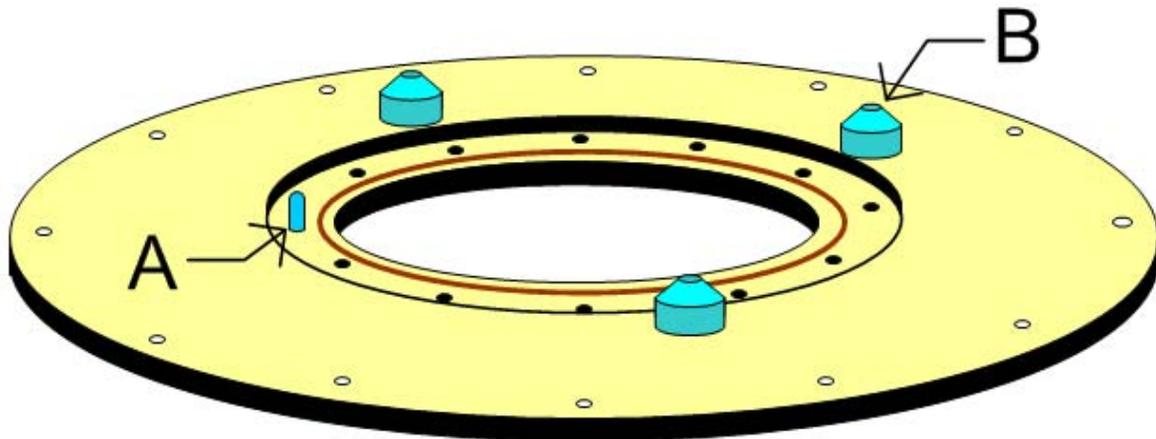
In order to accommodate smaller SENV, two additional adaptor flanges are defined (fig. 5).

### 3.3 OPTIONAL FEATURES

Uniform standards are required only for those features that directly affect safety and interchangeability. Features such as precision alignment pins and locating guides are not required but may be needed in several cases. These kinds of features may be added as options as long as safety and interchangeability are maintained. Note that the standard bolt circles defined in the present document can be used to hold alignment pins and bushings (fig 6).



**Fig. 5. Basic dimensions of two additional tank adaptors:** *Tank-Reducer-D16-H14* and *Tank-Thimble-B6* (lower) accommodate small and/or table mounting SENV; **D1** may vary between 23 and 32 inches; **D2** between 14 and 16 inches



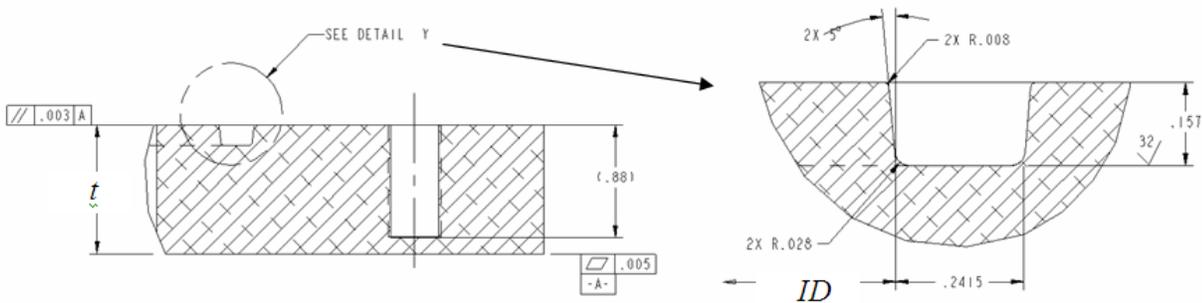
**Fig 6. Optional alignment and locating aids:** Perspective view of *Tank-Reducer-D16* with optional (A) removable alignment pin placed in one of the standard bolt holes, and (B) soft bumpers installed along step perimeter for gross locating; many similar possibilities exist

#### 4. TANK FLANGE SET

Each neutron instrument must provide mounting options using either tank or table flanges. This section specifies tank flanges, which are designed to form vacuum seals with sample environment body flanges (section 5). Table flanges are described in section 7.

##### 4.1 O-RINGS AND RELATED SPECIFICATIONS

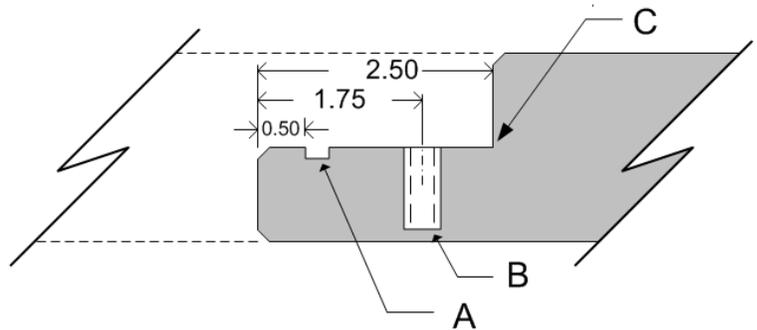
All standard tank flanges shall be high vacuum compatible ( $10^{-3}$  mbar or better) using a face-seal rubber O-ring scheme. Intermediate or adaptor flanges will have both a grooved face (upward-facing) and a smooth face. Some standardized features of the grooved face are shown in figure 7.



**Fig. 7. Standardized Grooved Face:** All O-ring grooves reside on the top face of the tank flanges and are cut to the standardized profile shown above. The tables below specify the nominal O-ring inner diameter (ID) for particular flanges. Other standardized features include bolt size (3/8-16 UNC-2B), face width and relative placement of O-ring groove, bolt circle, and step.

##### 4.2 CONVENTION FOR FACE SEAL SURFACES AND STEPS

Nominal diameters are assigned to all flanges, but the precise dimensions shall be based upon ASME standard B4.1 "Preferred Limits and Fits for Cylindrical Parts". Class LC9 "Locational Clearance Fits" shall be used for standard precision location. Higher precision fits such as class LC6 are optional. The general scheme is that outer diameters are slightly undersized relative to the nominal value and to the mating hole. The figures embedded in the tables below are based upon LC9 fits, but flange suppliers are responsible for verifying and complying with the ASME code. The relative placement of the O-ring groove, bolt circle, and step are standardized (Fig. 8).



**Figure 8. Standardized Face Seal Features:** O-ring groove (A) inner diameter is 1.0 inch greater than the flange ID; All mounting bolt circles (B) are 3/8-16 UNC-2B, blind tap 0.88 deep; use minimum tool radius on inside corner (C) and chamfer outside corners 0.125 X 45°

### 4.3 TANK-FLANGE-D39

This is the largest standard flange which was added in 2005 to accommodate compensated magnet systems. It mates with SENV-FB-D39.

**Table 2. Specifications for Tank-Flange-D39**

Standard features	Specification <sup>a,b</sup>
Material	Stainless Steel 304
Inner diameter	39 (nominal, ref. ASME B4.1 <sup>c</sup> )
O-Ring and groove	40.00 nominal ID; see figure 7
Inner bolt circle (on grooved face)	12 X 3/8-16 UNC-2B, blind tap (0.88 deep) equally spaced on a Ø42.500 B.C.
Top step inner diameter	44 (nominal, ref. ASME B4.1 <sup>c</sup> )
Step height and total flange thickness	1.0 and 2.0 (or greater if needed to withstand force)
Outer diameter	Instrument dependent
Outer bolt circle for tank interface	Instrument dependent
Surface flatness and finish	Suitable for O-ring seal (“32” finish, see fig. 7)
Chamfer all edges	0.125 X 45°
Lifting fixture bolt circle	3 holes sized to handle weight of flange
Installation Requirements [& options]	Description
Mount on horizontal plane 29.5 inches above beam	Measured from face seal to beam center line
Register bolt circles with beam [add alignment & locating options as needed <sup>d</sup> ]	Align two opposing bolt holes co-linearly with beam: Angular/linear tolerance <sup>e</sup> 6 minutes / 0.05 inches

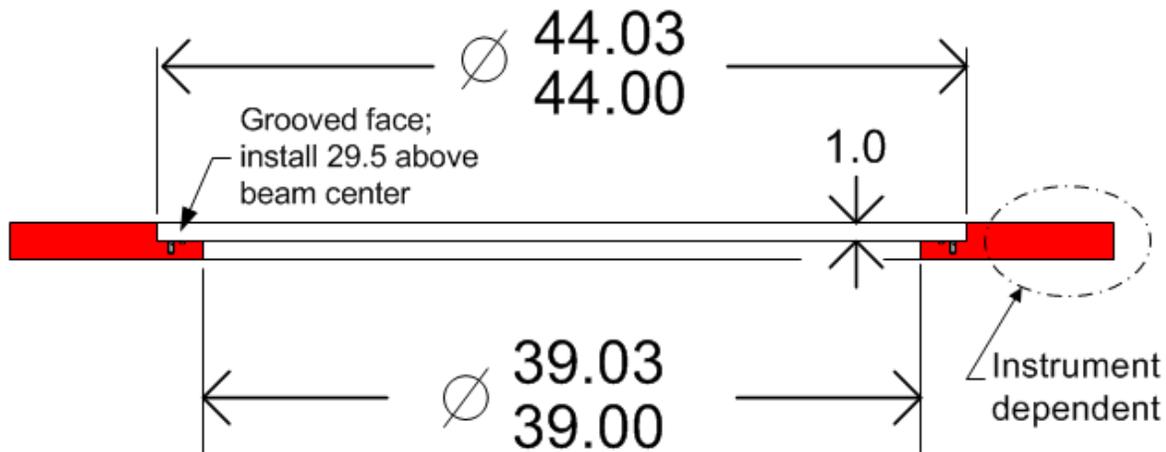
<sup>a</sup> All dimensions in inches unless otherwise noted

<sup>b</sup> Tolerances: X decimal ±0.1 XX decimals ±0.01 XXX decimals ±0.005 otherwise follow “c” below

<sup>c</sup> ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts”, use class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6]; figure below based upon LC9 class

<sup>d</sup> Must preserve compatibility with standard mating flange (see fig. 6)

<sup>e</sup> Installation tolerance chosen to be comparable to the standard mating tolerance between flanges

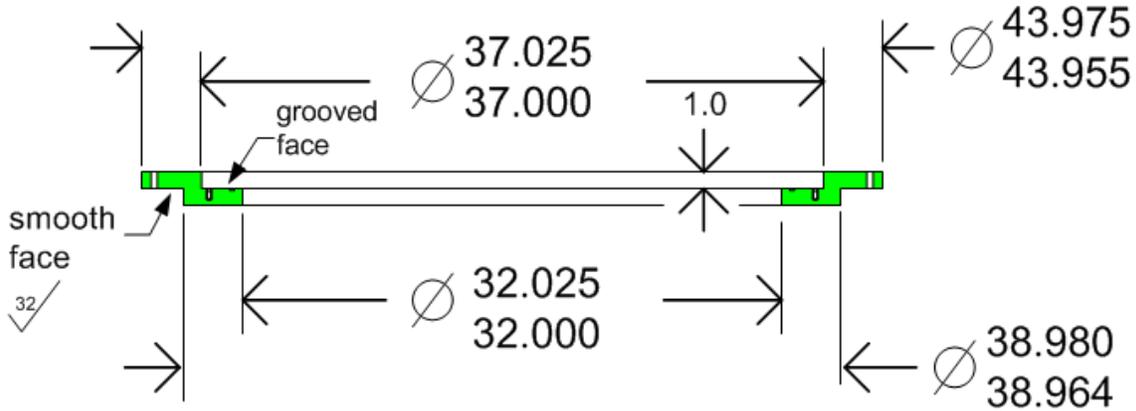


**4.4 TANK-REDUCER-D32**

This large flange has an inner diameter of 32 inches and is installed 29.5 inches above the beam.

<b>Table 3. Specifications for Tank-Reducer-D32</b>	
<b>Standard features</b>	<b>Specification <sup>a,b</sup></b>
Material	SST 304; approximate weight = 245 pounds (110 kg)
Inner diameter	32 (nominal, ref. ASME B4.1 <sup>c</sup> )
O-Ring and groove	33.00 nominal ID, cut to specifications in fig. 7
Inner bolt circle	12 X 3/8-16 UNC-2B, blind tap (0.88 deep) equally spaced on a Ø35.500 B.C.
Top step inner diameter	37 <sup>c</sup>
Bottom step outer diameter	39 <sup>c</sup>
Outer bolt circle (Tank-Flange-D39 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø42.500 B.C.
Outer diameter	44 <sup>c</sup>
<i>Alternate outer B.C./diameter/bottom step</i>	<i>Same as Tank-Flange-D39</i>
Step heights and total flange thickness	1.0 and 2.0
Surface flatness and finish	Suitable for O-ring seal (“32” surface, see fig. 7)
Chamfer edges	0.125 X 45°
Lifting fixture bolt circle	3 holes sized to handle weight of flange
<b>Installation Requirements [&amp; options]</b>	<b>Description</b>
Mount on horizontal plane 29.5 inches above beam	Measured from sealing surface to beam center line
Register bolt circles with beam [add alignment & locating options as needed <sup>d</sup> ]	Align two opposing bolt holes co-linearly with beam: Angular/linear tolerance <sup>e</sup> 6 minutes / 0.05 inches

- <sup>a</sup> All dimensions in inches unless otherwise noted
- <sup>b</sup> Tolerances: X decimal  $\pm 0.1$  XX decimals  $\pm 0.01$  XXX decimals  $\pm 0.005$  otherwise follow “c” below
- <sup>c</sup> ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts”, use class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6]; figure below based upon LC9 class
- <sup>d</sup> Must preserve compatibility with standard mating flange (see fig. 6)
- <sup>e</sup> Installation tolerance chosen to be comparable to the standard mating tolerance between flanges



#### 4.5 TANK-REDUCER-D16

This flange mates with SENV-FB-D16 and weighs about 400 pounds (lifting eyes must be included).

<b>Table 4. Specifications for Tank-Reducer-D16</b>	
<b>Standard features</b>	<b>Specification <sup>a,b</sup></b>
Material	SST 304; Approx. weight 390 pounds (175 kg)
Inner diameter	16 nominal <sup>c</sup>
O-Ring and groove	17 inch nominal ID (Parker-Hannifin 2-386) see fig. 7
Inner bolt circle (SENV-FB-16 interface)	12 X 3/8-16 UNC-2B, blind tap (0.88 deep) on a Ø19.500 B.C.
Top step inner diameter & height	21 nominal <sup>c</sup>
Bottom step outer diameter	32 nominal <sup>c</sup>
Outer bolt circle (Tank-Reducer-D32 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø35.500 B.C.
Outer diameter	37 nominal <sup>c</sup>
<i>Alternate outer B.C., outer diameter &amp; bottom step</i>	<i>Same as Tank-Flange-D39 or D32</i>
Step heights and total flange thickness	1.0 and 2.0
Surface flatness and finish	Suitable for O-ring seal (“32” finish, see fig. 7)
Chamfer edges	0.125 X 45°
Lifting fixture bolt circle	3 holes sized to handle weight of flange
<b>Installation Requirements [&amp; options]</b>	<b>Description</b>
Mount on horizontal plane 29.5 inches above beam	Face seal to beam center line = 29.5
Register bolt circles with beam [add alignment & locating options as needed <sup>d</sup> ]	Align two opposing bolt holes co-linearly with beam: Angular/linear tolerance <sup>e</sup> 6 minutes / 0.05 inches

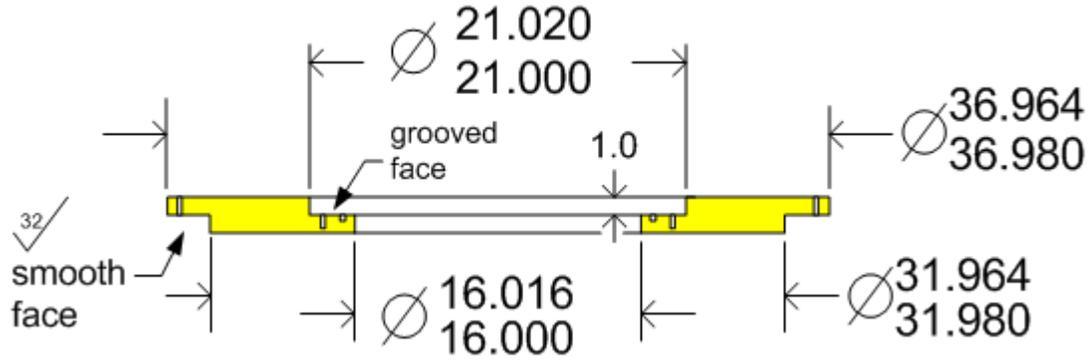
<sup>a</sup> All dimensions in inches unless otherwise noted

<sup>b</sup> Tolerances: X decimal  $\pm 0.1$  XX decimals  $\pm 0.01$  XXX decimals  $\pm 0.005$  otherwise follow "c" below

<sup>c</sup> ASME B4.1 "Preferred Limits and Fits for Cylindrical Parts", use class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6]; figure below based upon LC9 class

<sup>d</sup> Must preserve compatibility with standard mating flange (see fig. 6)

<sup>e</sup> Installation tolerance chosen to be comparable to the standard mating tolerance between flanges



#### 4.6 TANK-REDUCER-D16-H14

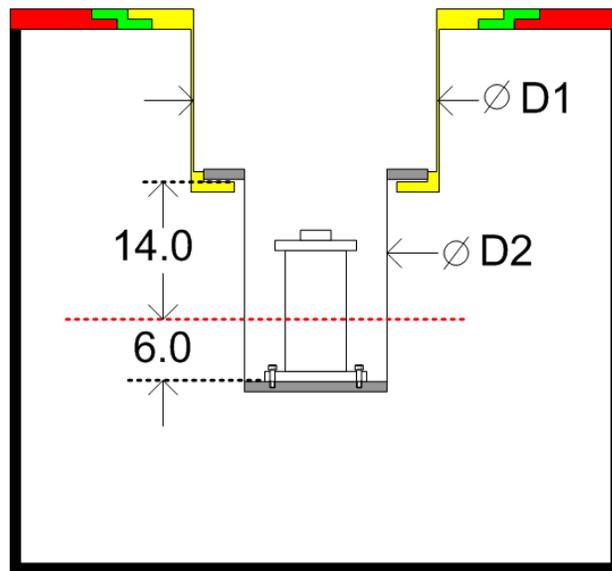
This adaptor flange takes the form of a height reducing well that will be used to mount SENV that are too short for the 28-inch standard. This adaptor is an assembly of 3 pieces welded together in accordance with ASME boiler and pressure vessel codes. Note that this assembly must withstand considerable load from both weight and pressure (atmosphere/vacuum interface). A complete design is not given here. Rather, we specify the essential geometry, but recommend that a qualified vendor carry out the final design, fabrication, and required certification.

<b>Table 5. Specifications for Tank-Reducer-D16-H14</b>	
<b>Standard features</b>	<b>Specification<sup>a,b</sup></b>
Top flange	Same as outer <sup>c</sup> region of Tank-Reducer-D16
Bottom flange	Same as inner region of Tank-Reducer-D16
Cylinder	Outer diameter <b>D1</b> <32.0, Inner diameter >23.0 Length = (14 + <i>x</i> ), where <i>x</i> is the portion used for flange attachment and welding
Final assembly, safety certification	Design to the intent of the ASME Boiler and Pressure Vessel Code
Final assembly, geometrical requirement	When installed onto Tank-Reducer-D32 the sealing surface of the bottom flange must be 14.0 inches above the beam and registered with the beam.

<sup>a</sup> All dimensions in inches

<sup>b</sup> Tolerances: X decimal ±0.1

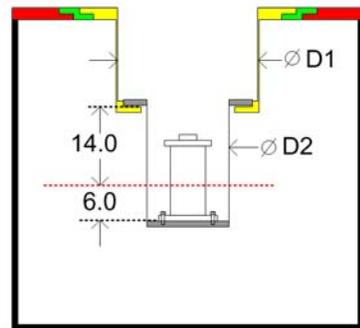
<sup>c</sup> division between inner and outer regions defined by a cylinder of diameter **D1**, where 23<**D1**<32



**4.7 TANK-THIMBLE-B6**

The primary purpose of this piece is to accommodate SENV that to not include any of the presently specified body flanges, but are equipped to mount to a commonly used goniometer (Huber 5204.2). This goniometer has a 6-inch distance from table to arc-center, and is used at the HFIR and NIST.

<b>Table 6. Specifications<sup>a,b</sup> for Tank-Thimble-B6</b>	
<b>Standard features (top flange)</b>	<b>Specification</b>
Outer bolt circle (Tank-Reducer-D16-H14 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø19.500 B.C.
Outer diameter	21 nominal (20.970 to 20.982 for standard fit) <sup>c</sup>
Inner diameter	As needed for welding to cylinder
Surface flatness and finish	O-ring compatible (reference fig. 7)
Chamfer edges	0.125 X 45°
Thickness	As needed to meet remaining specifications
Lifting fixture bolt circle	3 holes sized to handle weight of flange
<b>Standard features (cylinder, plate &amp; assembly)</b>	<b>Specification</b>
Cylinder material	Any tubing, pipe, or rolled sheet that satisfies safety and other requirements listed here
Cylinder dimensions	Outer diameter <16.0, Inner diameter >14.0 (a thin “beam window” region may be needed, but must satisfy safety certification) Length as needed to correctly place bottom plate
Final assembly, safety certification	Design to the intent of the ASME Boiler and Pressure Vessel Code
Final assembly, geometrical requirement	When installed onto Tank-Flange-D32-H28, the sealing surface of the bottom flange must be 14.0 inches above the beam (i.e. 14 inch offset between the sealing surfaces of top and bottom flanges) and registered with the beam.
<p><sup>a</sup> All dimensions in inches unless otherwise noted  <sup>b</sup> Tolerances: X decimal ±0.1 XX decimals ±0.01 XXX decimals ±0.005 otherwise follow “c” below  <sup>c</sup> ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts”, use class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6]</p> <p>Cylinder diameter <b>D2</b>, where 14 &lt; <b>D2</b> &lt;14</p>	

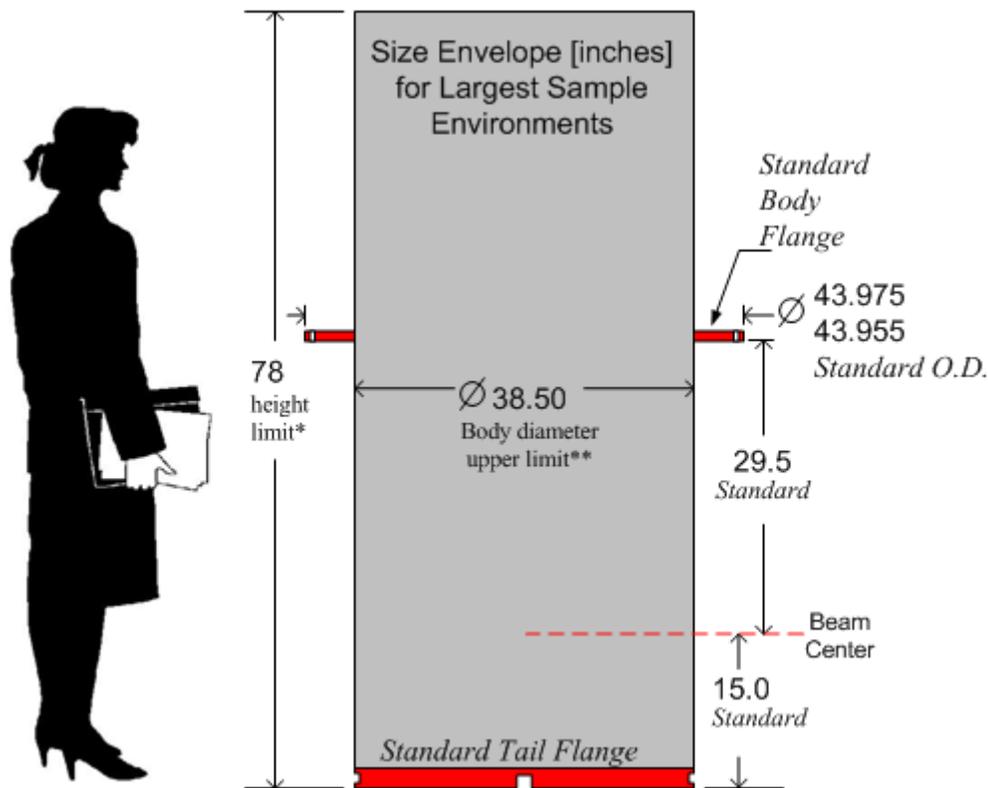


## 5. SAMPLE ENVIRONMENT BODY FLANGES

Each sample environment device must have a body flange and tail flange. Body flanges are specified in this section

### 5.1 SENV-FB-D39

This flange is attached to the largest sample environment devices such as cryomagnets (fig. 9 and table 7.).

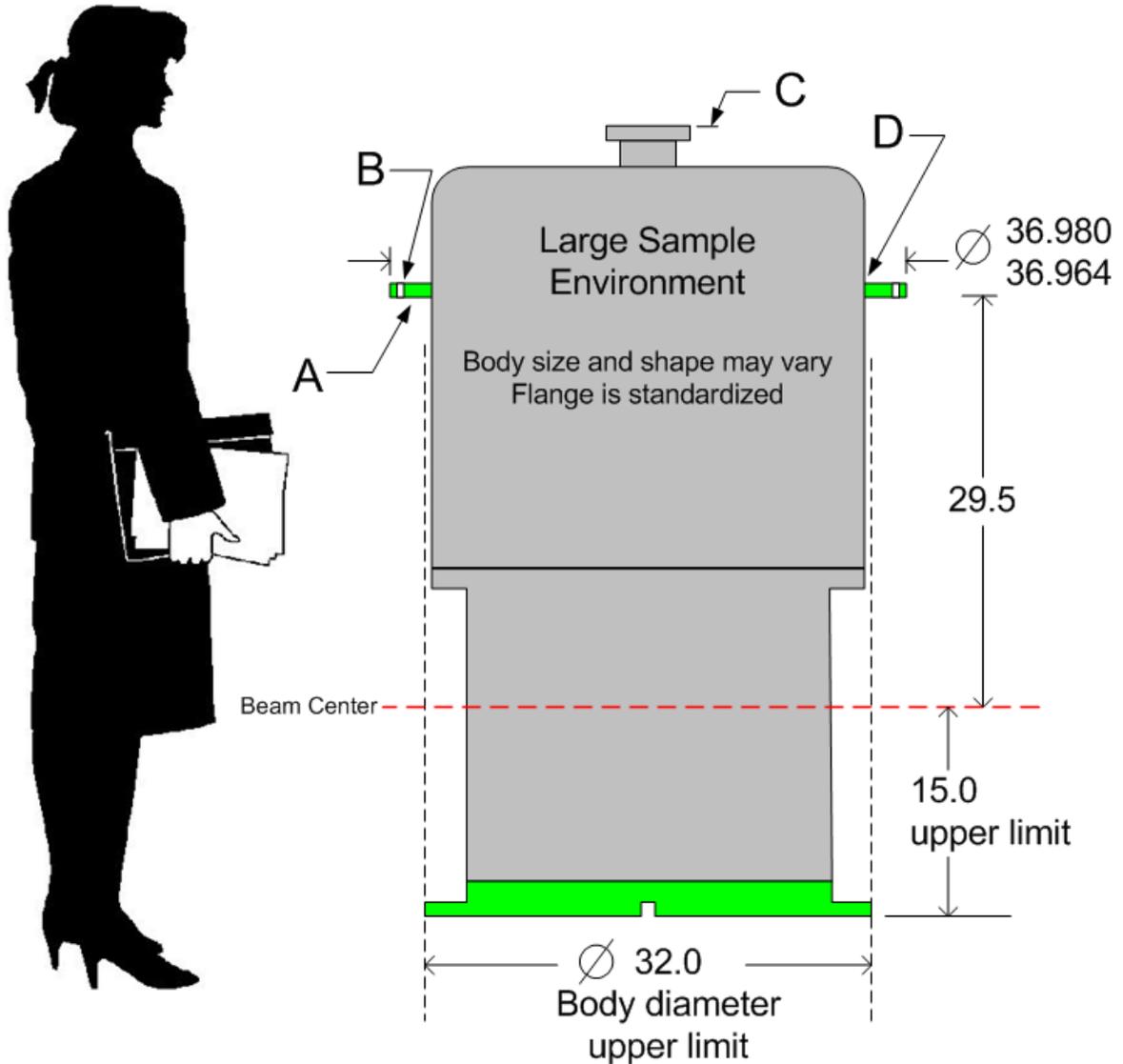


**Figure 9. Large sample environment body flange (SENV-FB-D39):** This flange is welded to the main body of a large sample environment, such that it may form a vacuum seal and bear a load of 22,900 pounds (10,390 kg)! This large load is due mainly to the downward force of atmospheric pressure when the device is mounted to a large vacuum vessel. Other features include a smooth, flat sealing surface suitable for mating with an O-ring face seal; 12 equally spaced clearance holes for 3/8-inch screws ( $\text{Ø}0.411$  for normal fit, tighter fits may be requested) on a  $\text{Ø}42.500$  B.C; 78 inch height limit (\* taller environments may be considered - consult SNS Sample Environment Team); the main body diameter limit of 38.50 inches is mandatory below the body flange (\*\* above the body flange, exceptions may be considered - consult SNS-SENV Team)

<b>Table 7. Specifications for SENV-FB-D39</b>	
<b>Standard features</b>	<b>Specification<sup>a</sup> / Description</b>
Flange outer diameter	43.955 to 43.975 <sup>b</sup>
Bolt circle (Tank-Flange-D39 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø42.500 B.C.
Minimum thickness	Must withstand 22,900 pounds (10,390 kg) force, satisfying safety <sup>c</sup> and deflection <sup>d</sup> standards.
Surface flatness and finish	High vacuum face seal compatible (32 finish)
Chamfer outer edges	0.125 X 45°
Lifting fixture bolt circle	3 equally spaced, blind-tapped holes, sized to handle weight load
Material	Stainless Steel 304
<b>Installation requirements</b>	<b>Specification / Description</b>
29.5 Inches above nominal sample center	Measured from bottom surface (sealing surface) of the flange to the horizontal plane intersecting the sample center
Final assembly must meet safety <sup>c</sup> and deflection <sup>d</sup> standards	Certify for 22,000 lbs (10,000 kg) total load (weight plus pressure load)
<b>Application-specific features</b>	<b>Specification</b>
Flange I.D.	Must mate with SENV body
Register bolt circle if applicable	Opposing bolt holes should be co-linear with preferred beam direction
<b>Options</b>	<b>Description</b>
Bolt-on mounting and self-alignment aids; interface to personnel protection system (PPS)	User determined; must work in conjunction with standard features, without any permanent modifications to standards features
<sup>a</sup> All dimensions in inches; Tolerances: X decimal ±0.1 XX decimals ±0.01 XXX decimals ±0.005 <sup>b</sup> Nominal 44-inch shaft diameter, sized according to ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts” using class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6] <sup>c</sup> Safety reference: Design to the intent of the “ASME Boiler and Pressure Vessel Code” <sup>d</sup> Maximum deflection = 0.020 when fully loaded and interfaced to Tank-Flange-D39	

## 5.2 SENV-FB-D32

This flange will be permanently attached to any SENV with a body diameter between 16 and 32 inches (fig. 10 and table 8).

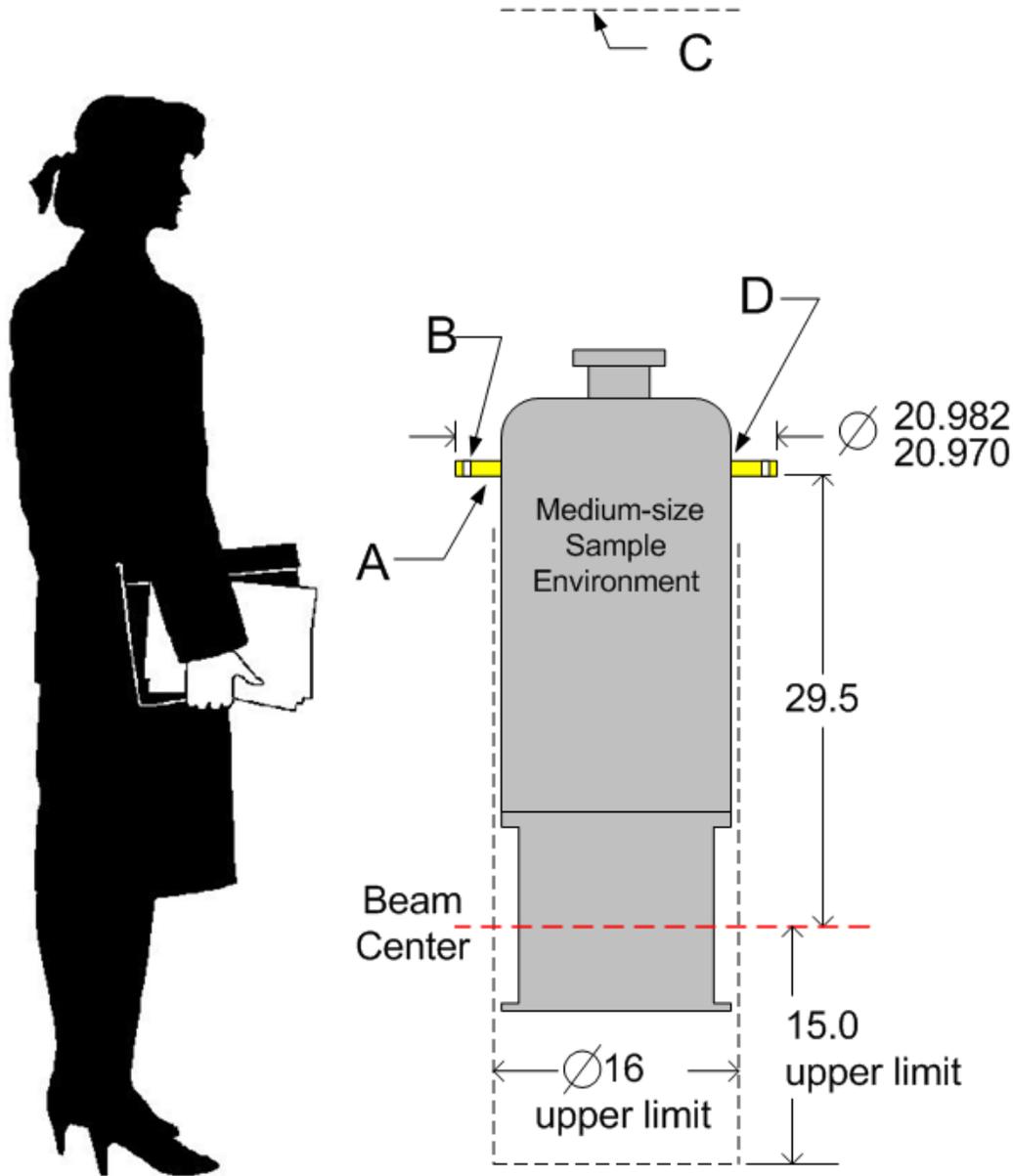


**Figure 10. Body flange SENV-FB-D32:** This flange is welded to the main body of a large sample environment, such that it may form a vacuum seal and bear a load of 14,000 pounds (6400 kg). This large load is due mainly to the downward force of atmospheric pressure when the device is mounted to a large vacuum vessel. Other features include: (A) a smooth, flat sealing surface suitable for mating with an O-ring face seal; (B) 12 X clearance holes for 3/8-inch screws ( $\text{Ø}0.411$  for normal fit, tighter fits may be requested) equally spaced  $\text{Ø}35.500$  B.C; (C) height limit of 78 inches (taller environments considered upon request of SNS SENV Team); (D) vacuum-tight weld to sample environment body, rated for 14,000 lbs (6400 kg)

<b>Table 8. Specifications for SENV-FB-D32</b>	
<b>Standard features</b>	<b>Specification<sup>a</sup> / Description</b>
Flange outer diameter	36.964 to 36.980 <sup>b</sup>
Bolt circle (Tank-Flange-D39 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø35.500 B.C.
Minimum thickness	Must withstand 14,000 pounds (6400 kg) force satisfying safety <sup>c</sup> and deflection <sup>d</sup> standards.
Surface flatness and finish	Suitable for high vacuum face seal
Chamfer outer edges	0.125 X 45°
Lifting fixture bolt circle	3 equally spaced, blind-tapped holes, sized to handle weight load [alternate: weld hooks directly to SENV body]
Material	Stainless Steel 304
<b>Installation requirements</b>	<b>Specification / Description</b>
29.5 Inches above nominal sample center	Measured from bottom surface (sealing surface) of the flange to the horizontal plane intersecting the sample center
Final assembly must meet safety <sup>c</sup> and deflection <sup>d</sup> standards	Certify for 14,000 lbs (6400 kg) total load (weight plus pressure load)
<b>Application-specific features</b>	<b>Specification</b>
Flange I.D.	Must mate with SENV body
Register bolt circle if applicable	Opposing bolt holes should be co-linear with preferred beam direction
<b>Options</b>	<b>Description</b>
Bolt-on mounting and self-alignment aids; interface to personnel protection system (PPS)	User determined; must work in conjunction with standard features, without any permanent modifications to standards features
<sup>a</sup> All dimensions in inches; Tolerances: X decimal ±0.1 XX decimals ±0.01 XXX decimals ±0.005 <sup>b</sup> Nominal 37-inch shaft diameter, sized according to ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts” using class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6] <sup>c</sup> Safety reference: Design to the intent of the “ASME Boiler and Pressure Vessel Code” <sup>d</sup> Maximum deflection = 0.020 when fully loaded and interfaced to Tank-Flange-D39	

### 5.3 SENV-FB-D16

This flange will be permanently attached to any SENV with a body diameter 16 inches or less (fig. 11 and table 9).



**Figure 11. Body flange SENV-FB-D16:** This flange is welded to the main body of medium-size sample environments, such that it may form a vacuum seal and bear a load of 4,000 pounds (1800 kg). This load is due mainly to the downward force of atmospheric pressure when the device is mounted to a large vacuum vessel. Other features include: (A) a smooth, flat sealing surface suitable for mating with an O-ring face seal; (B) 12 X clearance holes for 3/8-inch screws ( $\text{\O}0.411$  for normal fit, tighter fits may be requested) equally spaced  $\text{\O}19.500$  B.C; (C) height limit of 78 inches (taller environments considered upon request of SNS SENV Team); (D) vacuum-tight weld to sample environment body, rated for 4,000 lbs (1800 kg)

<b>Table 9. Specifications for SENV-FB-D16</b>	
<b>Standard features</b>	<b>Specification<sup>a</sup> / Description</b>
Flange outer diameter	20.970 to 20.982 <sup>b</sup>
Bolt circle (Tank-Flange-D39 interface)	12 X 0.411 (ASME B18.2.8 normal fit clearance holes for 3/8 screws) equally spaced Ø19.500 B.C.
Minimum thickness	Must withstand 4,000 pounds (1800 kg) force satisfying safety <sup>c</sup> and deflection <sup>d</sup> standards.
Surface flatness and finish	Suitable for high vacuum face seal
Chamfer outer edges	0.125 X 45°
Lifting fixture bolt circle	3 equally spaced, blind-tapped holes, sized to handle weight load [alternate: weld hooks directly to SENV body]
Material	Stainless Steel 304
<b>Installation requirements</b>	<b>Specification / Description</b>
29.5 Inches above nominal sample center	Measured from bottom surface (sealing surface) of the flange to the horizontal plane intersecting the sample center
Final assembly must meet safety <sup>c</sup> and deflection <sup>d</sup> standards	Certify for 4,000 lbs (1800 kg) total load (weight plus pressure load)
<b>Application-specific features</b>	<b>Specification</b>
Flange I.D.	Must mate with SENV body
Register bolt circle if applicable	Opposing bolt holes should be co-linear with preferred beam direction
<b>Options</b>	<b>Description</b>
Bolt-on mounting and self-alignment aids; interface to personnel protection system (PPS)	User determined; must work in conjunction with standard features, without any permanent modifications to standards features
<sup>a</sup> All dimensions in inches; Tolerances: X decimal ±0.1 XX decimals ±0.01 XXX decimals ±0.005 <sup>b</sup> Nominal 21-inch shaft diameter, sized according to ASME B4.1 “Preferred Limits and Fits for Cylindrical Parts” using class LC9 locational clearance fits for default precision [optional: use tighter fit such as LC6] <sup>c</sup> Safety reference: Design to the intent of the “ASME Boiler and Pressure Vessel Code” <sup>d</sup> Maximum deflection = 0.020 when fully loaded and interfaced to Tank-Flange-D39	

#### 5.4 SENV-FB-D16-H14

The flange has the same specifications as SENV-FB-D16 except for the placement. The present flange is attached with the sealing surface (bottom) 14.0 inches above the plane of the sample center.

SENV-FT-H6 The small tail flange is a well-established standard used at existing facilities such as the HFIR and NIST. It is designed to mate with the widely used Huber Model 5204.2 goniometer which has a mounting surface 6 inches below the nominal beam center. Note that this flange is typically an integral part of a custom tail that serves as a removable outer vacuum can.

## 6. SAMPLE ENVIRONMENT TAIL FLANGES

Each sample environment device must have both a body flange and a tail flange. Tail flanges are specified in this section

### 6.1 SENV-FT-D39-B15

This tail flange is used with large diameter (39 inch nominal) bodies and is mounted 15 inches below the beam center. It will be needed for devices such as high field cryomagnets.

<b>Table 10. Specifications for SENV-FT-39-15</b>	
Standard features	Specification
Mounting groove or step	See figure below
Centered locating hole	Nominal 1 inch diameter, ASME B18.2.8 class 11 tolerance; tighter tolerances are optional
Flange Position	Bottom of flange to sample plane = 15.0

All dimensions in inches; Tolerances: X decimal  $\pm 0.1$  XX decimals  $\pm 0.01$

**Detail A:** Mounting groove or step

**Detail B:** Centered locating hole

6.2 EXAMPLE CRYOMAGNET DESIGN WITH SENV-FT-D39-B15

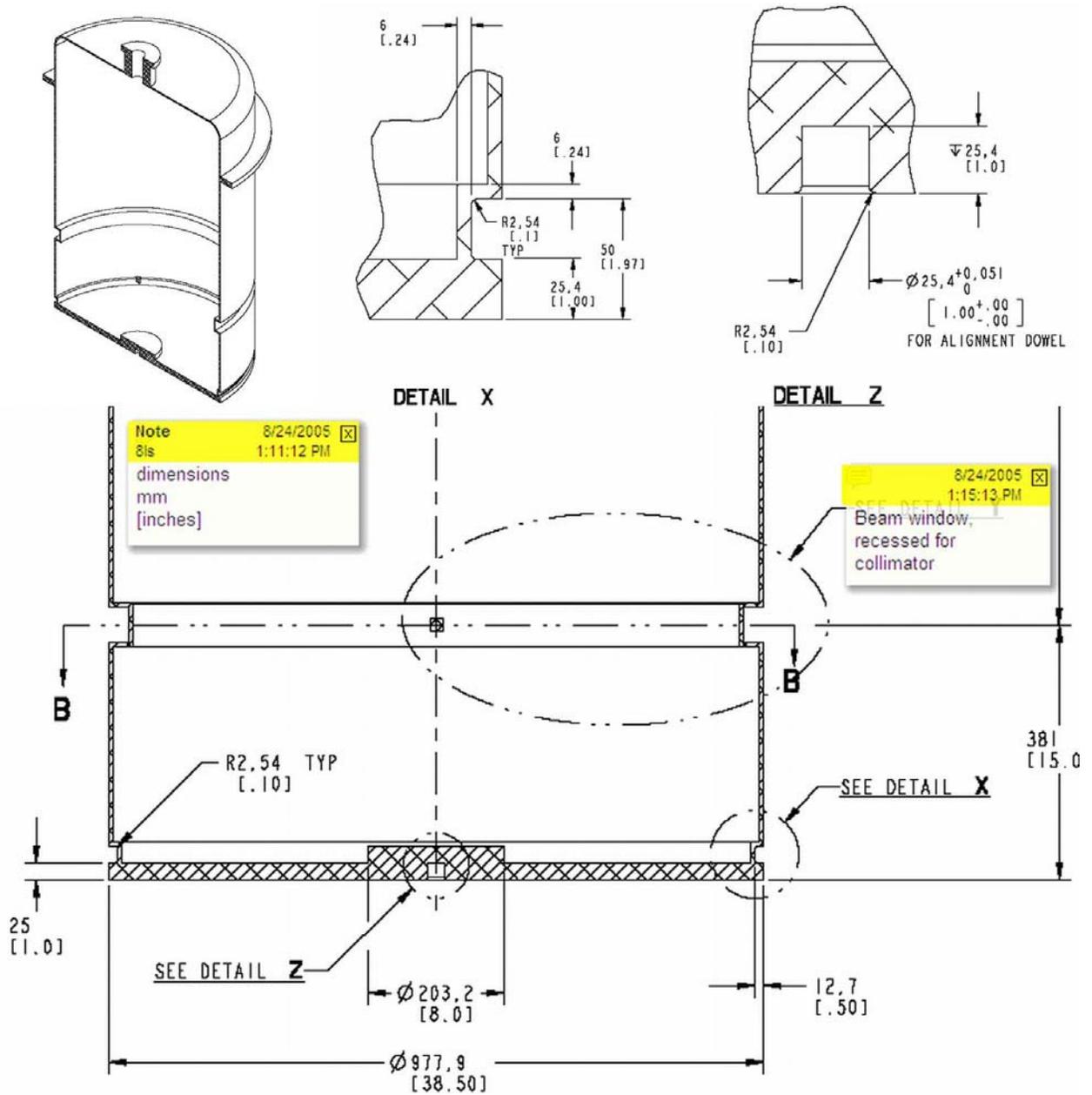


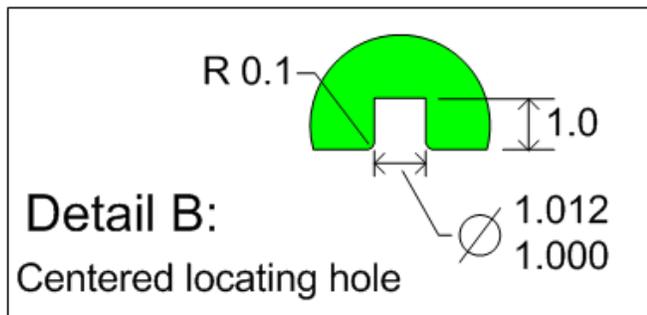
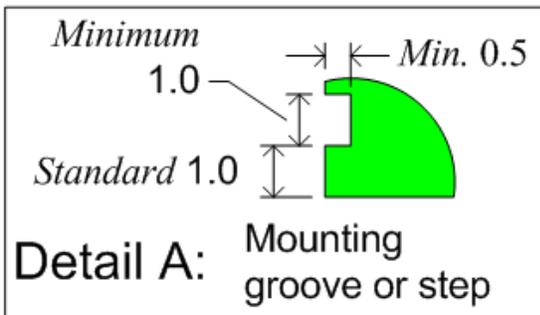
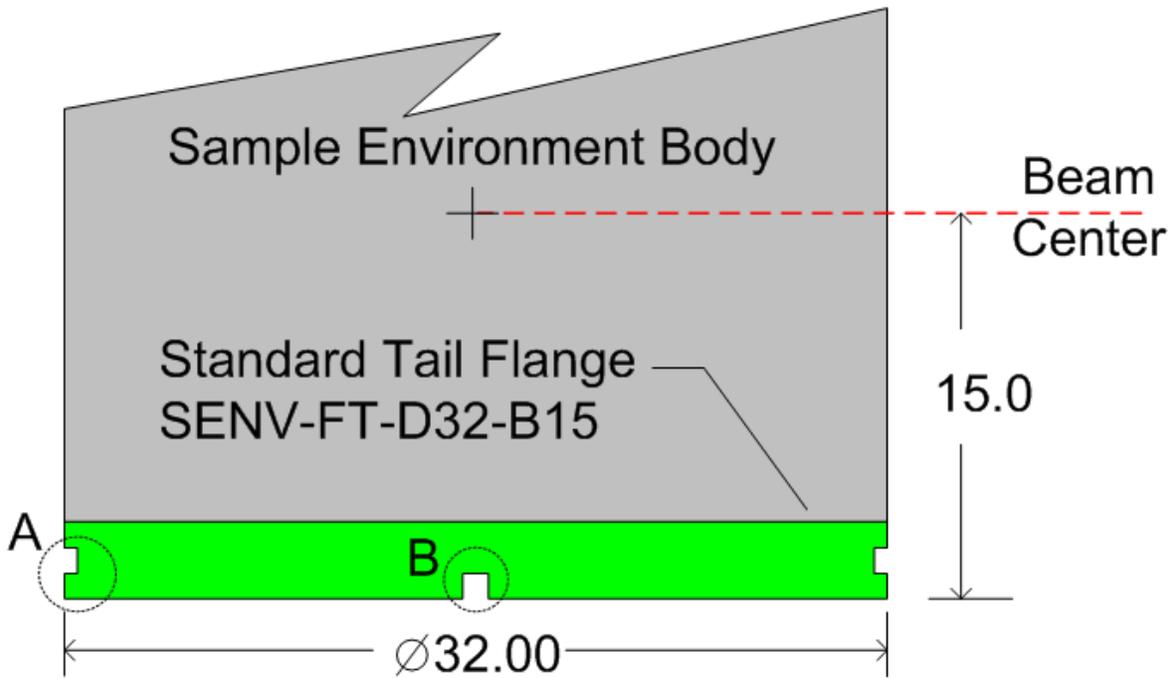
Figure 12. Example Design from the SNS Magnetism Reflectometer Team

6.3 SENV-FT-D32-B15

**Table 11. Specifications for SENV-FT-D32-D15**

Standard features	Specification
Mounting groove or step	See figure below
Locating hole	Nominal 1 inch diameter, ASME B18.2.8 class 11 tolerance; tighter tolerances are optional
Flange Position	Bottom of flange to sample plane = 15.0

All dimensions in inches; Tolerances: X decimal  $\pm 0.1$  XX decimals  $\pm 0.01$



**6.4 SENV-FT-D16-B15**

This tail flange is one of two that are compatible with 15.5-inch body sizes.

<b>Table 12. Standard Tail Flange</b>	
<b>Standard features</b>	<b>Specification</b>
Mounting groove or step	See figure below
Centered locating hole	Nominal 1 inch diameter, ASME B18.2.8 class 11 tolerance; tighter tolerances are optional
Flange Position	Bottom of flange to sample plane = 15.0

All dimensions in inches  
Tolerances  $\pm 0.01$  unless otherwise noted

*Minimum*  
1.0

*Standard* 1.0

**Detail A:** Mounting groove or step

R 0.1

1.0

**Detail B:**  
Centered locating hole

$\varnothing$  1.012  
1.000

### 6.5 SENV-FT-D16-B6

This small tail flange is compatible with 16-inch body sizes and is placed 6 inches below beam. It is compatible with the widely used Huber model 5204.2 goniometer. Vendors such as *A.S. Scientific* offer it as a standard option (known as the NIST tail).

<b>Table 13. Specifications for SENV-FT-D16-B6</b>	
<b>Standard features</b>	<b>Specification<sup>a,b</sup></b>
Bolt circle (M6 clearance)	4X M6-clearance holes (Ø 0.265 inch or Ø 6.7 mm) on a Ø 12.806 B.C. (Huber spec: 230 mm square pattern)
Flange position	Bottom of flange to sample plane = 5.98 (Huber spec. = 152mm)

<sup>a</sup> Dimensions in inches, unless otherwise noted  
<sup>b</sup> Tolerances: X decimal ±0.1    XX decimals ±0.01    XXX decimals ±0.005

The diagram illustrates the assembly of the SENV-FT-D16-B6. It shows a grey 'Sample Environment Body' at the top, which is connected to a yellow 'Vacuum Can with integrated tail flange'. A red dashed line indicates the 'Beam Position' is 6.0 inches above the bottom of the flange. The main body of the vacuum can has an outer diameter of 15.5 inches, while the flange at the bottom has an outer diameter of 13.5 inches. Four M6 clearance holes are located on the flange, spaced on a 12.806 inch bolt circle.

## 7. TABLE FLANGE SET

Certain neutron instruments will provide tables, goniometers, or similar devices which interface with sample environment tail flanges.

### 7.1 TABLE-B15

<b>Table 14. Specifications for Table-B15</b>	
<b>Standard feature</b>	<b>Specification</b>
Clamping system	Claw-style clamps or similar fixtures compatible with SENV-FT-D39-B15 <u>and</u> SENV-FT-D32-B15; Clamp design must pass review of SNS instrument safety committee
Centered dowel	Removable locating dowel, nominal 1 inch diameter, tolerance as per ASME B18.2.8 class 11 fit: 0.978 to 0.990 diameter, 0.80 to 0.95 height above table
Installation requirement	Top surface to beam = 15.00 inches

The diagram illustrates the assembly of the Table-B15. A grey rectangular base labeled 'Table-B15' is shown. On top of this base, a green rectangular 'Sample Environment Tail Flange' is positioned. A red 'Centered dowel' is inserted into the center of the tail flange. On either side of the tail flange, a 'Clamping system' consisting of red and silver components is used to secure it to the table. A dashed red line with a crosshair at its center is labeled 'Beam Center'. A vertical double-headed arrow indicates the distance from the top surface of the table to the beam center, which is specified as 15.0 inches.

**7.2 TABLE-B6 (LEGACY STANDARD)**

Table-style instruments will provide a way to mimic the widely used Huber model 5204.2 goniometer in order to accommodate SENV from other facilities or certain user-supplied SENV. SNS has chosen against adopting this particular Huber geometry and hardware as standards because of size (6 inch table-to-beam distance) and load (200 kg max) limitations.

**Table 15. Specifications for Table-B6**

Standard feature	Specification
Bolt circle (M6)	4X M6 on a Ø12.806 inch B.C. (Huber spec: 230 mm square pattern)
Installation requirement	Top surface to beam = 5.98 inches (Huber spec. = 152mm)

