

Zirconium-Iron Bed (ZrFe Bed)



❖ Features & Benefits

H ₂ Stripper:	High H ₂ capture efficiency
Reusable:	Zirconium alloy which can be easily regenerated
Robust:	Package designed for high temperature regeneration
Tritium compatible:	Bellow Sealed valves, full Stainless-Steel construction, high leak tightness
Pressure Vessel:	Registered to ASME Section VIII Div 1

❖ Typical Uses

- Reduce tritiated gas emissions to the environment
- Extract tritium from inert gas streams
- Provide integrated quantitative measure of tritium loads in gas flow streams

❖ Overview

The ZrFe bed is a pressure vessel charged with a zirconium alloy that has a high capacity for hydrogen isotopes. As an inert gas stream containing tritium passes through the bed, the bed absorbs the hydrogen.

The mass transfer zone of the bed is short by comparison to the bed length for the operating conditions specified. Once the bed is loaded and the mass transfer zone penetrates the bed exhaust, the activity of the gas leaving the bed rises gradually which provides sufficient warning to operators that the bed is exhausted.

Regenerations can be performed by directing a heated inert purge stream through the scavenger bed in the reverse direction to recover the hydrogen for purification and re-use. The ZrFe bed heaters can be engaged to provide additional heat of desorption to the system and to reduce the regeneration time. Typically, the bed is ready for re-use once 9000 bed volumes of gas are passed through while it is at the regeneration temperature of 540°C.

❖ Design Benefits

The ZrFe Bed is designed for robustness. The stainless steel welded vessel, rugged band heater, sheathed thermocouples, insulation and protective stainless-steel jacket ensure a clean package that can operate continuously at 540°C without damage.

The ZrFe Bed comes standard with metal bellows isolation hand valves fitted with copper stem tips and VCR-8 female nuts. The unit is helium leak tight to 1×10^{-9} scc/sec at the operating temperature which is suitable for tritium service.

❖ Specifications

Operating Conditions	500 g Bed	5 kg Bed
Carrier gas flow	1 to 10 SLPM	1 to 30 SLPM
Hydrogen Capacity without exceeding an effluent concentration of 10 mCi/m ³	1.5 kCi of tritium 0.6 SL of H ₂ gas	15 kCi of tritium 5.8 SL of H ₂ gas
Bed Residence time	2.1 @ 5 SLPM	3 s @ 30 SLPM
Modified Reynolds number	1.3 @ 5 SLPM	2.6 @ 30 SLPM
Pressure	0 – 200 psig	
Temperature	400°C	
Humidity	0 – 80% non-condensing	
Pressure Drop	< 0.3 psig at full flow	
Carrier gas composition	Inert gases, hydrogen isotopes NOT recommended: oxygen, streams containing sulfur and/or potassium, volatile organic compounds	
Maximum Conditions		
Max Operating Pressure	200 psig	
Max Operating Temperature	540°C	
Physical		
	500 g Bed	5 kg Bed
Dimensions	4.5” Dia x 15” length	6” Dia x 19.5 Length
Isolation Valves	Bellows sealed, manual, copper stem tip	
Wetted Materials	Zirconium-iron alloy, 304/316L Stainless Steel, Copper stem tip	
Leak Tightness	1x10 ⁻⁹ cc/sec helium with 1 atm helium upstream	
Pressure Vessel	ASME Section VIII Div 1	
Electrical		
	500 g Bed	5 kg Bed
Number of Heaters	1	2
Heater Power	300 W	400 W
Heater Current	2.5 A	3.33 A ea, 6.66 A Total
Heater Voltage	120 VAC	
Thermocouple	3 - Type K welded, braided wire, standard mini-connector, ungrounded	

Drawings

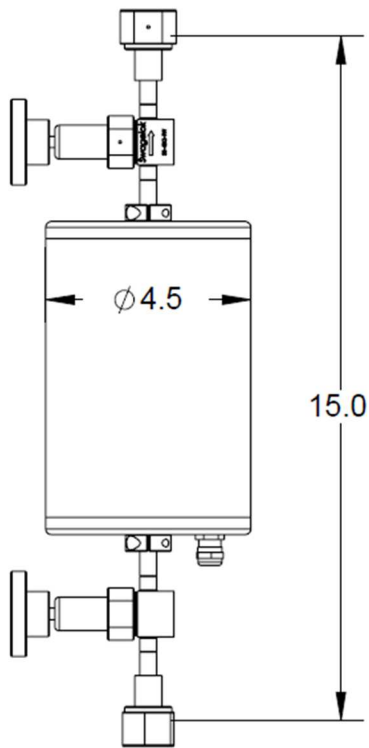


Figure 1: 500g ZrFe Bed

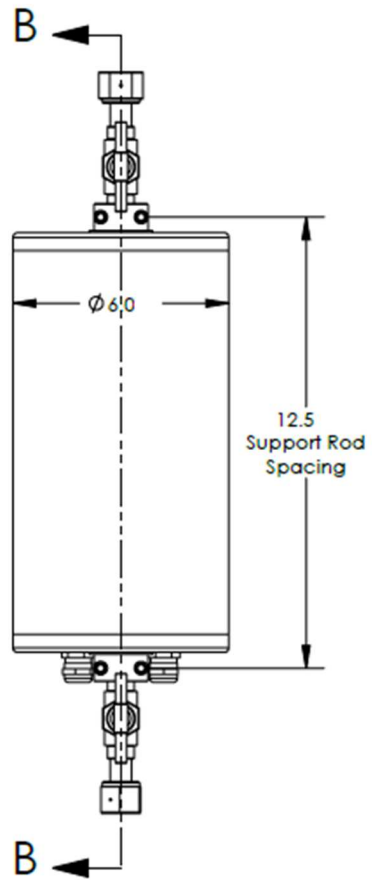


Figure 2: 5kg ZrFe Bed