Torion Plasma Corporation

6001A-S1-02

Nickel Bed (Ni Bed)

Features & Benefits

Triple Use:	Reduced state: capture O_2 Oxidized state: capture H_2 Continuous Recombination
Inherently safe:	No ignition source, reaction is catalyzed
Robust:	Catalyst is tolerant of high temperature
Tritium compatible:	Bellow Sealed valves, full Stainless-Steel construction, high leak tightness
Pressure Vessel:	Registered to ASME Section VIII Div 1

Typical Uses

- Secondary Enclosure Cleanup Systems
- protect hydrogen getter beds from oxidation
- remove hydrogen from inert gas streams
- continuous hydrogen recombiner for sampling

Overview

The Nickel Bed (Ni Bed) is a fully integrated device designed to remove either trace oxygen or hydrogen from inert gas streams.

When operating in the reduced state, trace oxygen is trapped as nickel oxide within the bed with no release of water vapor. This is ideal for removing oxygen from an inert gas stream before the gas is directed over components that are sensitive to damage by oxidation.

When operating in the oxidized state, hydrogen at low partial pressures will be converted to water vapor. This is ideal for recombining trace amounts of tritiated hydrogen from an inert gas stream for capture on a downstream drier bed for removal.

When operating in the recombiner mode, trace tritium in a stoichiometric mix with oxygen in a carrier gas can be converted to water vapor and condensed into a continuous water sample for sensitive activity measurements.

High temperature operation ensures a fast system response time and a large capacity.

Design Benefits

The Nickel Bed is designed for robustness. The ability to operate at high temperatures ensures that unexpected concentration spikes in the stream will not damage the bed. 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 450°C without damage.

The Nickel 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 $1x10^{-9}$ scc/sec at the operating temperature which is suitable for tritium service.

Specifications

Operating Conditions	100 g Bed	1 kg Bed
Carrier gas flow	1 to 10 SLPM	1 to 30 SLPM
Reduced State Capacity	3.5 SL of O_2	30 SL of O_2
Oxidized State Capacity	7 SL of H_2	60 SL of H_2
Bed Residence time	2.1 s @ 5 SLPM	3 s @ 30 SLPM
Modified Reynolds number	0.5 @ 5 SLPM	0.9 @ 30 SLPM
Pressure	0 – 200 psig	
Temperature	100 – 450°C	
Humidity	0 – 90%	
Pressure Drop	< 0.3 psig at full flow	
Carrier gas composition	Inert gases, He NOT recommended: streams containing sulfur and/or potassium, volatile organic compounds	
Continuous Hydrogen conversion efficiency using > 0.6 O_2/H_2 molar ratio	> 99% @ 5 sLPM, 250°C	
Maximum Conditions		
Max Operating Pressure	200 psig	
Max Operating Temperature	496°C	
Physical	**100 g Bed**	**1 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	Nickel, alumina, 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	**100 g Bed**	**1 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

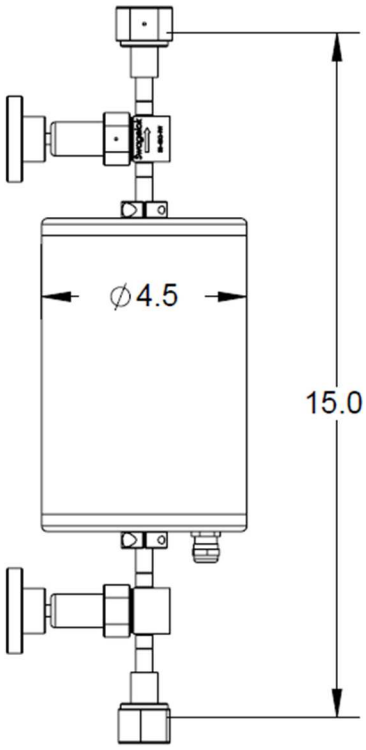

Figure 1: 100g Nickel Bed

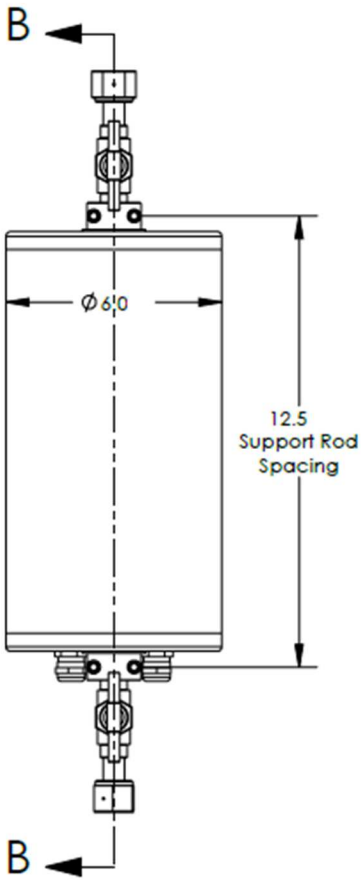

Figure 2: 1kg Nickel Bed