

Measuring Extractor X-ray limit

This tech note details the procedure for measuring x-ray limits of extractor gauges.

Motivation

The x-ray limit of an extractor gauge determines the lowest pressure that the gauge is capable of reading that has a physical meaning. Soft x-rays generated by electrons hitting the gauge envelope will cause excess ions (or neutral atoms) to be desorbed from the gauge surroundings, and in turn a portion of these extra ions will be collected in the gauge giving an erroneously high pressure measurement.

Equipment Required

- Extractor gauge
 - Extractor gauge controller
 - optional: Electrometer
 - Jumper cables for the gauge
 - Voltage supply for 0-500V
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Procedure

1. Install the extractor gauge in a chamber, pump down and bake
2. Turn the gauge on, degas, and let the reading stabilize- preferable a few days
3. Turn extractor gauge off and unplug controller
4. Connect pins B, D, E, F, G, H, J with jumpers through to extractor gauge. See figure 1 diagram
5. Turn extractor on, verify operation
6. Turn extractor off, connect E (reflector) to external voltage supply
7. Vary reflector bias at desired steps up to 500V.
8. Measure current on either electrometer (use special “no-ground” BNC connector) or on Leybold controller

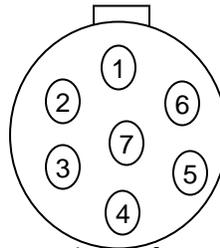
Table 1: Pinouts and applied voltages

Controller pin	Connector pin	function	Nominal settings	
1	H	Cathode	100V	1.89 V, 2.54W
2	G	Cathode	102V	1.34 A for filament
3	F	Anode (grid)	220 V	
4	E	Reflector	Vary for x-ray limit	0-500V supply
5	D	Bridge 1		
6	J	Bridge 2		
7	B	Protective earth	Ground	no insulator

Pinouts

To bypass Leybold controller and control all biases:

- F, 3, anode
 E, 4, reflector
 G, 2, cathode
 D, 5, Bridge 1
 H, 1, cathode
 C, -
 filament power source (custom)
 I, -
 B, 7, ground
 J, 6 Bridge 2
 A, -
 filament supply:
- a. connect earth ground to negative,
 - b. positive terminal of first HP supply to negative lead of 2V,
 - c. 2A filament supply to positive output of 100V supply



Designation	Function
1	Cathode
2	Cathode
3	Anode
4	Reflector
5	Bridge 1
6	Bridge 2
7	Ground

Figure 1: Pin assignments looking at extractor cable end. Controller end diagram from page 26 of extractor manual, showing pins as they appear on controller connector (opposite of looking at the cable)

- a. connect earth ground to negative,
 - b. positive terminal to grid (220V)
 4. Variable 0-500 V supply to the reflector
 5. Ground pin to ground of all 3 commercial supplies
 6. Collector pin on BNC to Keithley electrometer
 7. Turn on filament:
 - a. adjust bias to 100V,
 - b. with ammeter inline, adjust filament power supply using variac or filament supply to 1.34A and 1.89V or as determined from Leybold controller
 8. Turn on grid (anode) bias to 220V
 9. Turn on reflector bias to 205.4 V to get 205V out
 10. Measure current on Keithley picoammeter after gauge warms up
 11. Turn extractor off, connect E (reflector) to external voltage supply
 12. Vary reflector bias at desired steps up to 500V.
 13. Measure current on either electrometer (use special “no-ground” BNC connector) or on Leybold controller
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14. Vary reflector in steps – background current should be flat above about 350V
 15. Turn off variac (filament power) and repeat background measurement as a function of bias to get no-emission offset.
 16. Use gauge sensitivity factor to convert amps into Torr.
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Conclusion

X-ray limit measurements will vary between gauges, and will vary with geometry of the envelope surrounding a nude extractor gauge. Periodic measurement of the extractor gauge x-ray limits allows verification of the contribution of the x-ray effect to the total pressure measured. While at higher pressures, this contribution is small, at low pressures, the x-ray effect can dominate the measured pressure.