Fan Gasket for LLO Rack 6

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Fan Gasket Assembly – Motivation

Robert Schofield has done previous work isolating and removing noise associated with the ventilation fans on LLO Rack 6. For details, see http://ilog.ligo-la.caltech.edu/ilog/pub/ilog.cgi?target_frame=content&task=view&date_to_view=08/06/2009&group=detector&keywords_to_highlight=&text_to_highlight=&anchor_to_scroll_to=2009:08:06:00:40:33-robert

Robert recommended we attempt to find a more permanent solution, and this is the record of that attempt.

A gasket was designed to replace the temporary fix that consisted of rubber tubing and packing tape. Criteria included the need to insulate the rack from fan vibrations while maintaining airflow. A thick, multi-layered gasket assembly was designed that provides a chimney for airflow while it provides for staggered rivet points that secure the fans to the gasket and the gasket to the rack.

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Fan Gasket Assembly – General Description

The Fan Gasket Assembly consists of four rubber sheets that have starting dimensions of 24" x 12". All four sheets are cut down to 20.75" x 10.625".

They have the following thicknesses.

A: 0.5" Polyurethane Rubber – 20A – McMaster-Carr PN 8781K561
B: 0.125" Polyurethane Rubber – 60A – McMaster-Carr PN 8716K526
C: 0.125" Polyurethane Rubber – 60A – McMaster-Carr PN 8716K526
D: 0.5" Polyurethane Rubber – 20A – McMaster-Carr PN 8781K561

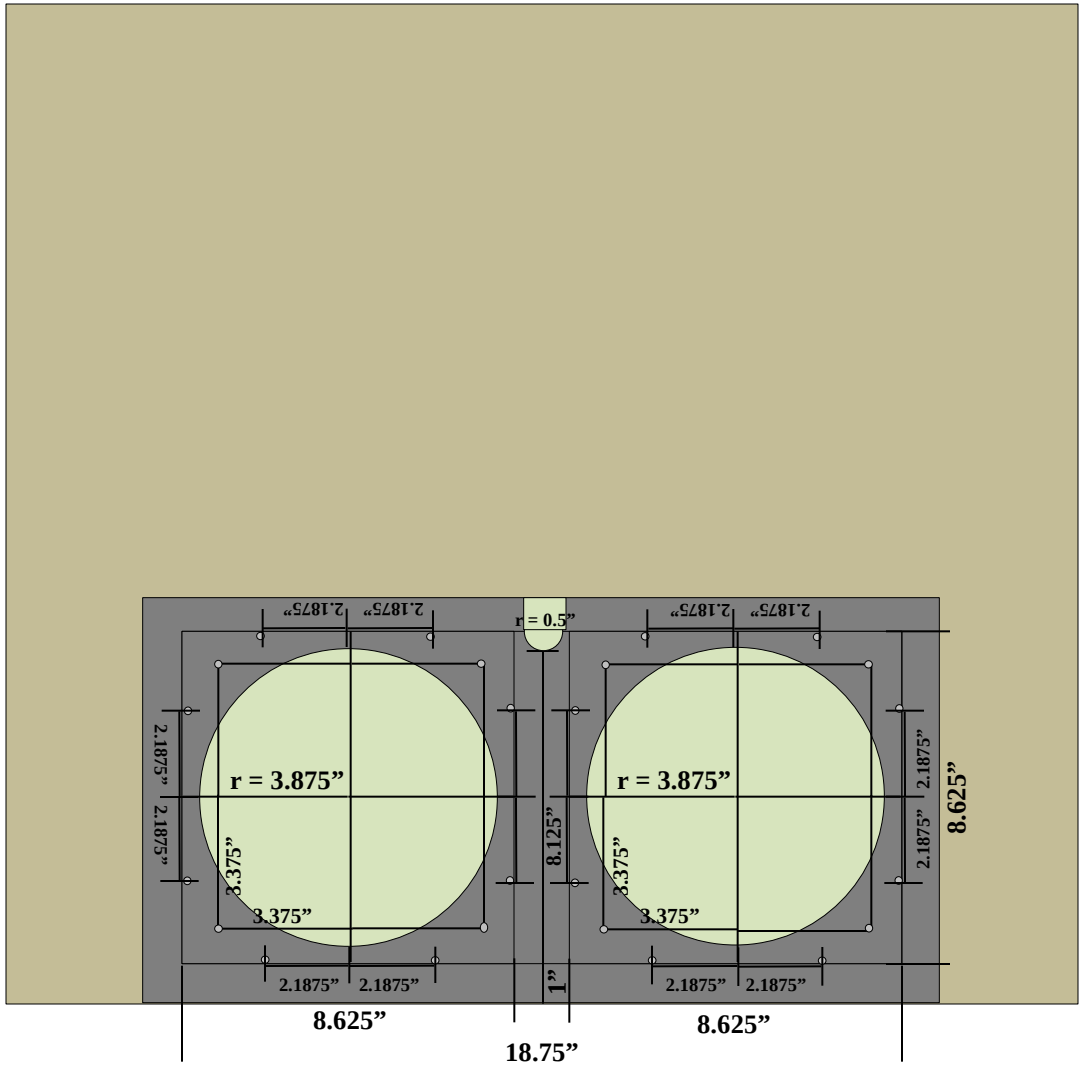
These four sheets create a sandwich that is intended to decouple the vibration of fan motors from the surface to which the fans are mounted.

(Note: In the following diagrams LIGHT GREEN is cutout material.)

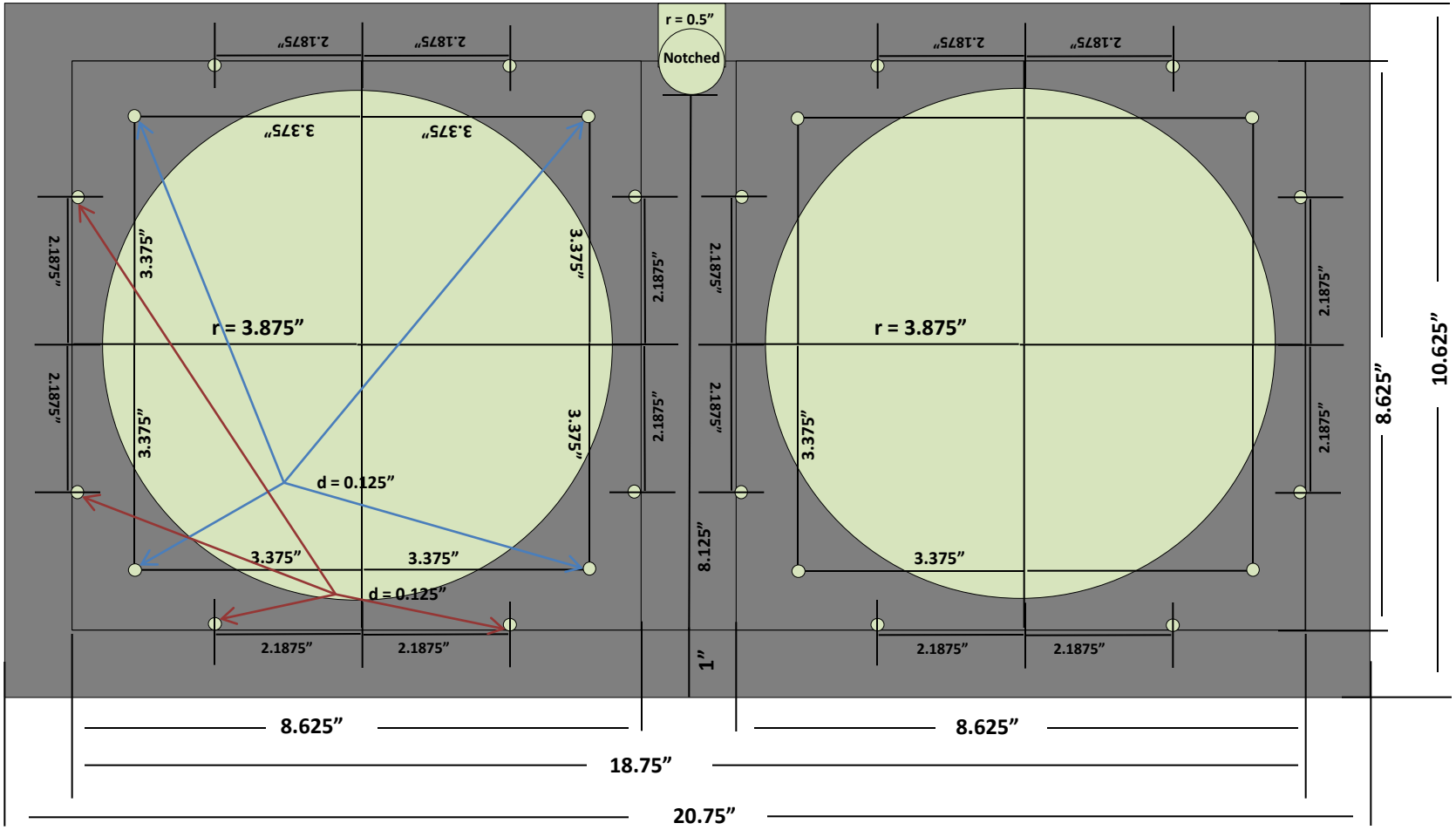
All four layers start with the same 0.125" hole pattern. Then Gaskets A and D have 0.5" holes added according to the patterns shown.

(Note: This work was done by Elevating Boats LLC of Ponchatoula, LA.)

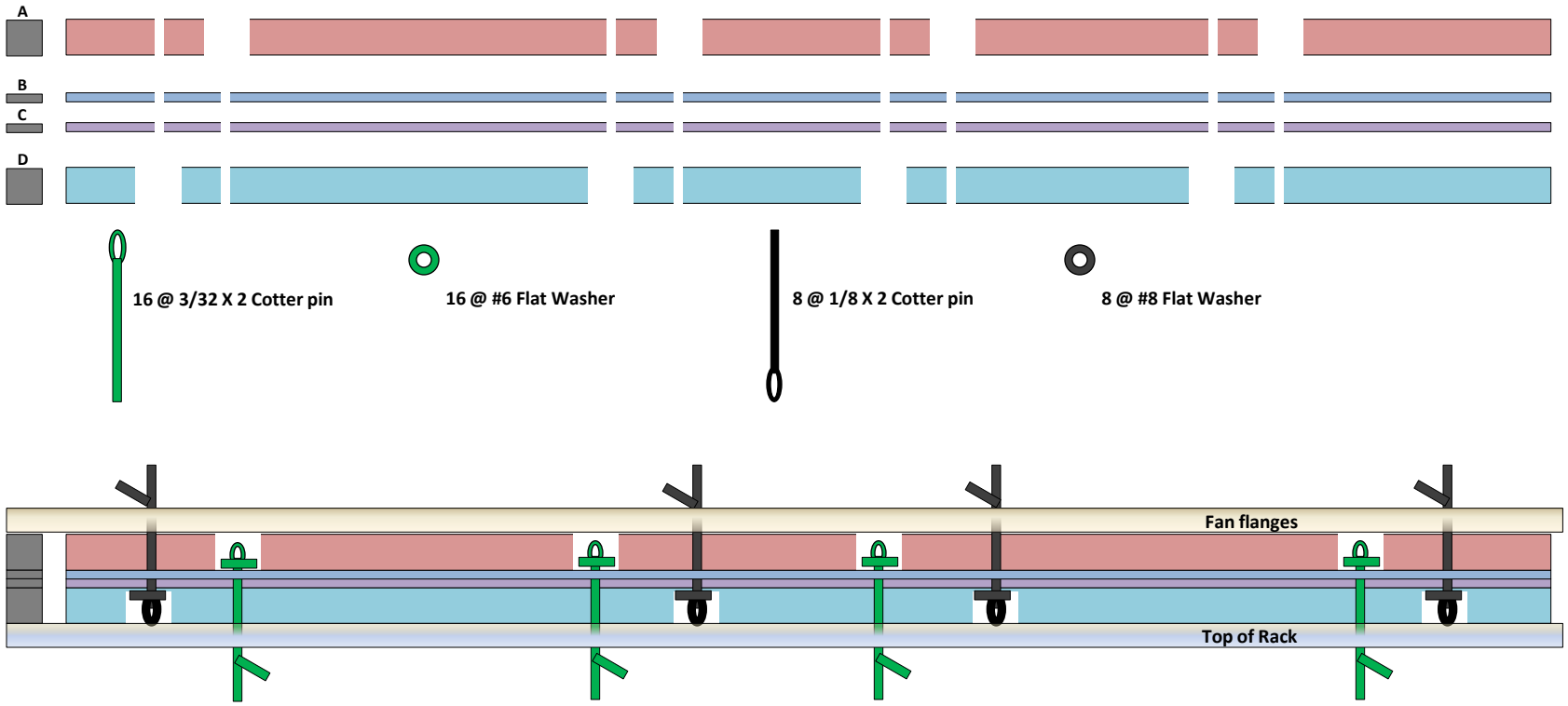
Fan Openings on Rack 6



General Fan Gasket Layout



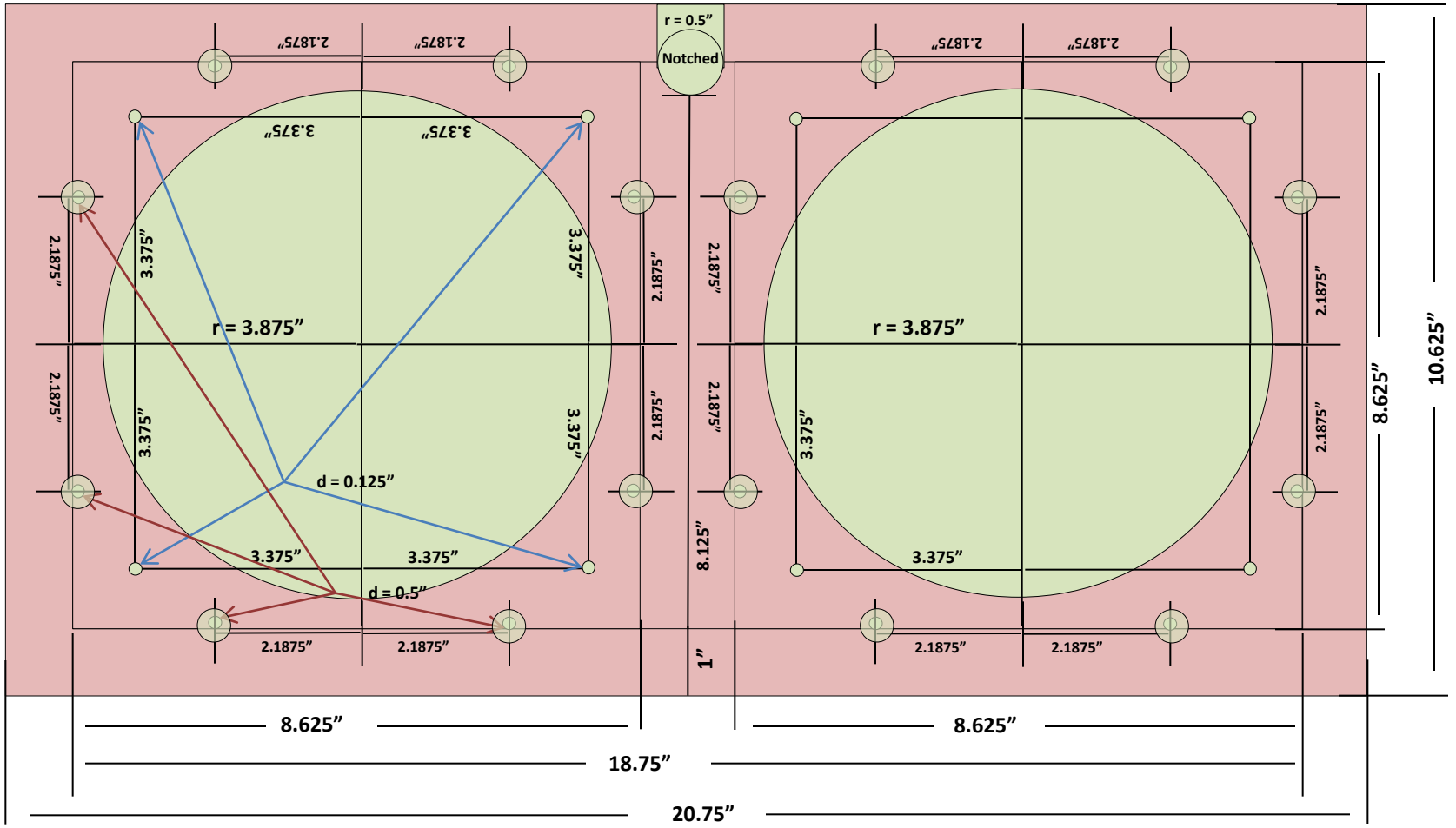
Fan Gasket Construction Concept



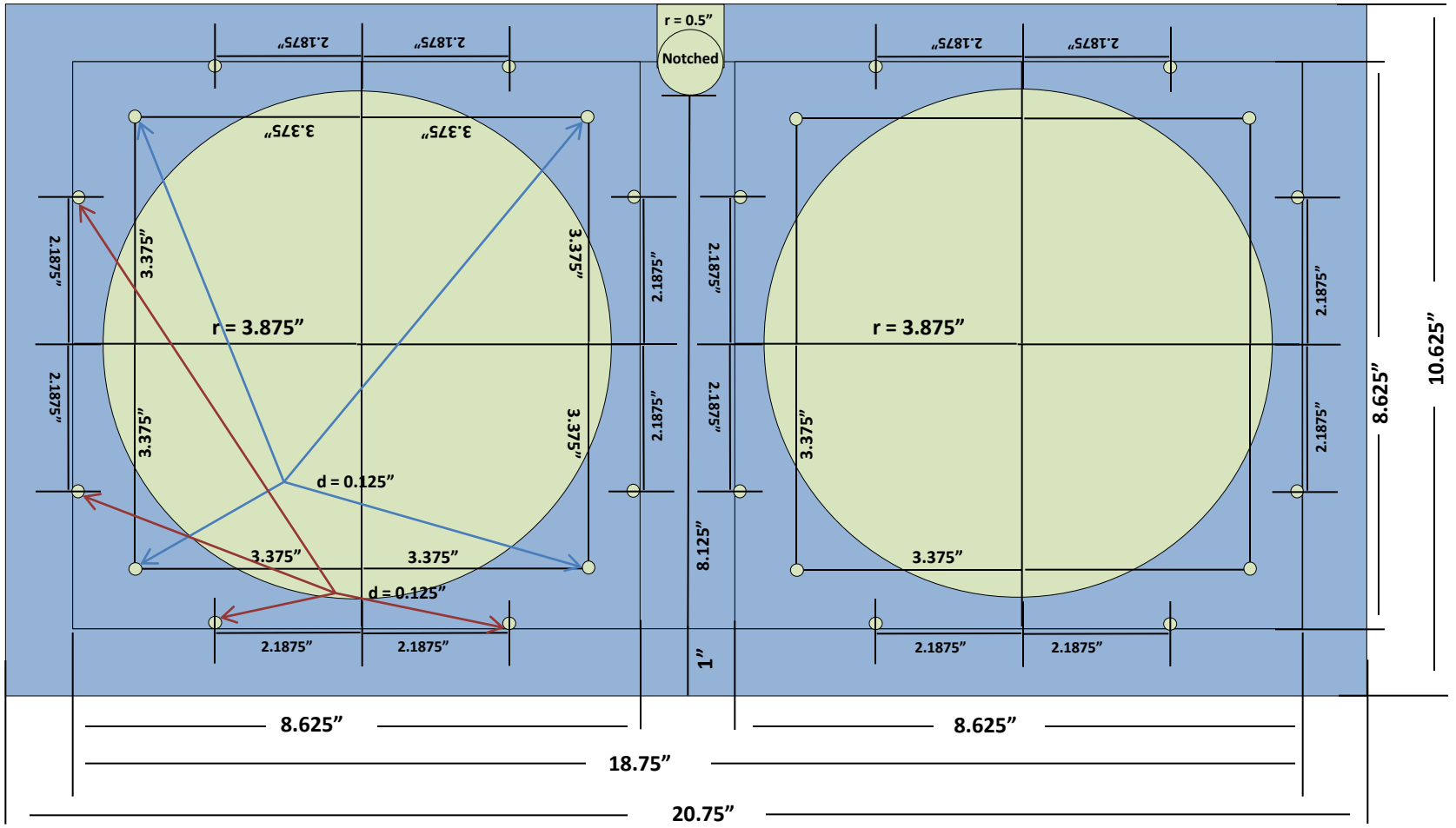
Screws will not work due to the double-blind nature of the gasket. Cotter pins will work if gasket material is removed so they fit. This is the purpose of the 0.5" holes.

1) Making sure all Cotter pins and Washers are in place, mount BCD gaskets to Top of Rack.
2) Mount Fan flanges to remaining Cotter pins.

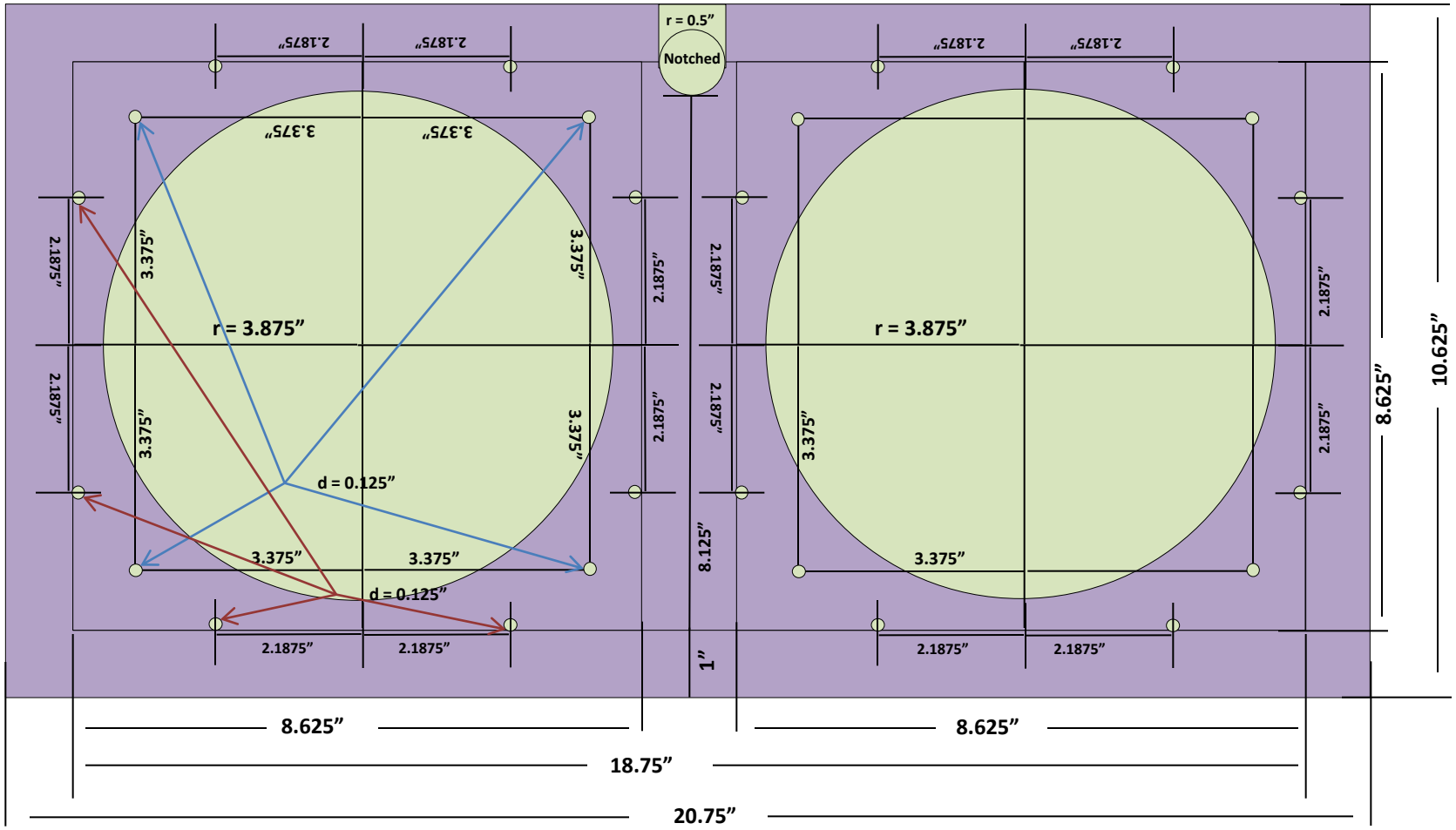
Fan Gasket Layout – 0.5" Gasket A



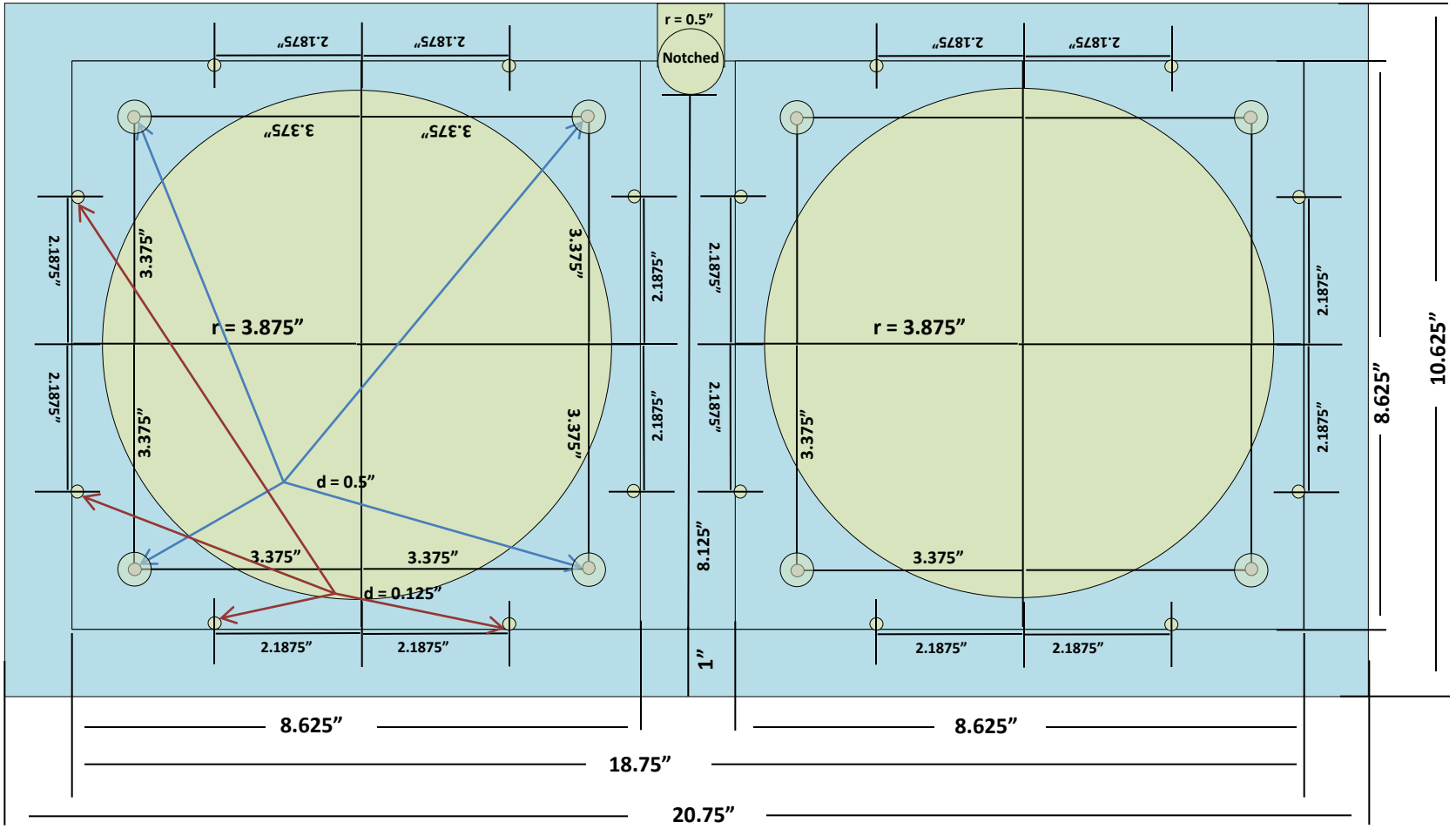
Fan Gasket Layout – 0.125" Gasket B (same as C)



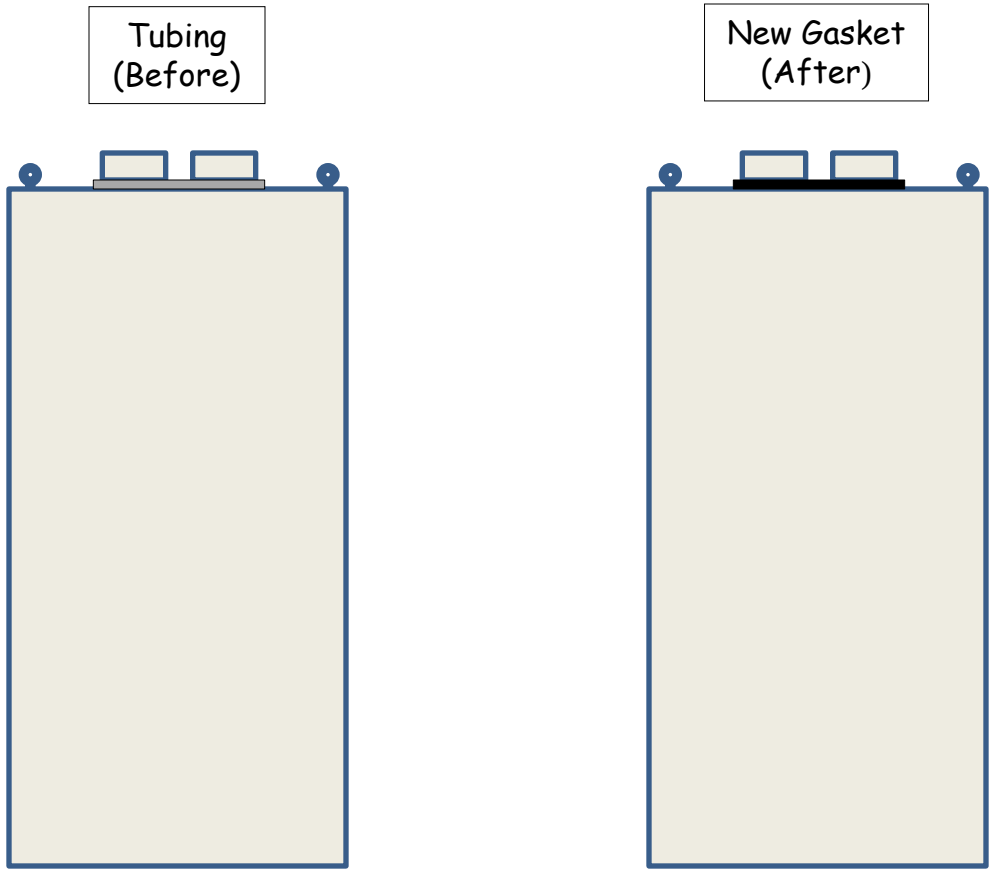
Fan Gasket Layout – 0.125" Gasket C (same as B)



Fan Gasket Layout – 0.5" Gasket D



Planned Installation on Rack 6



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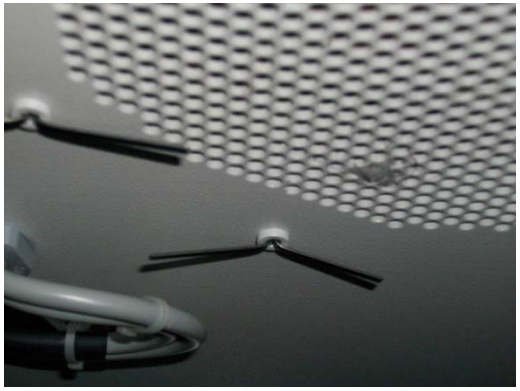
New Gasket Installation

Gaskets in place showing "chimney"

Fans in place

Upward-facing Cotter Pin Detail



Downward-facing Cotter Pin Detail

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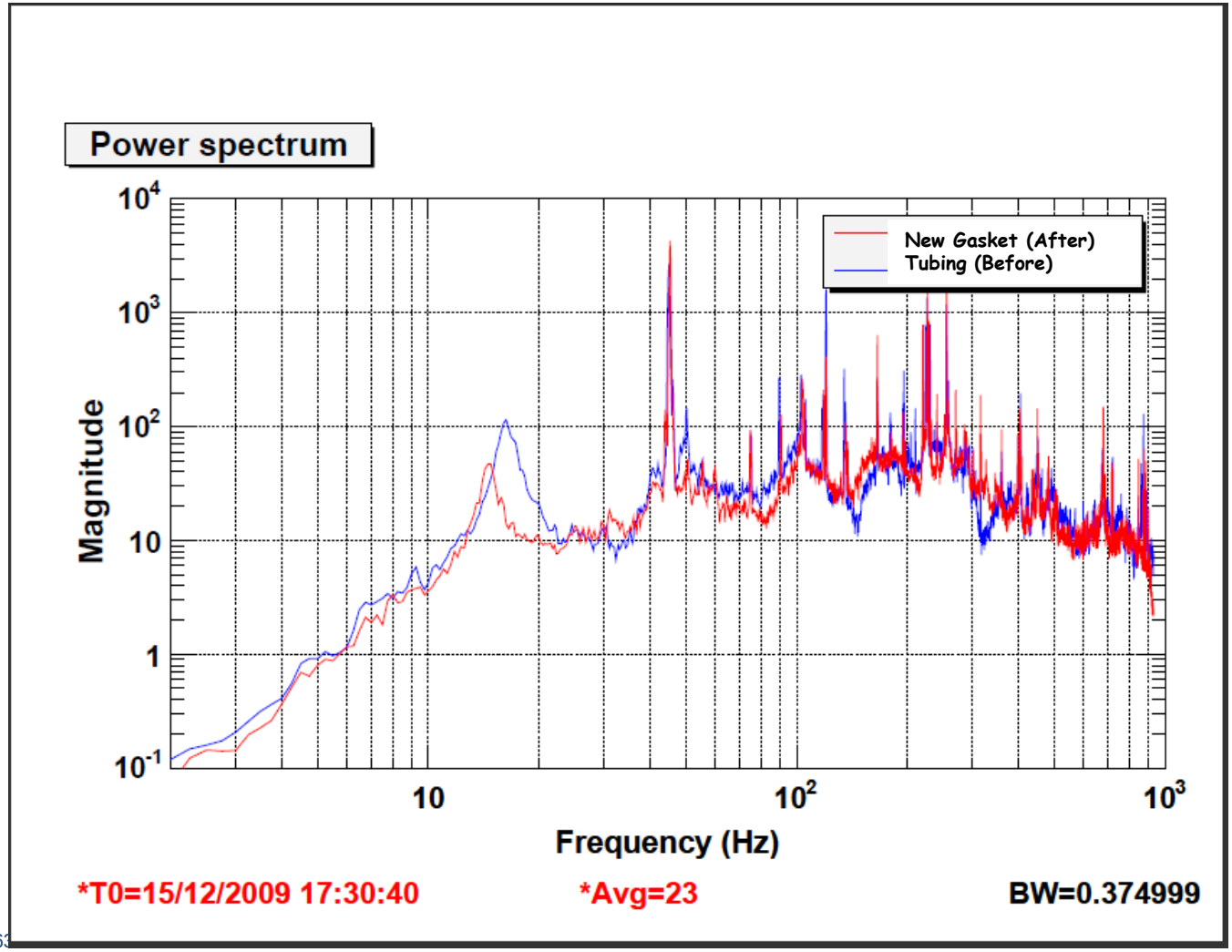
New Gasket vs Tubing – Measurement Methodology

Two sets of before-and-after measurements were made. The before measurements were made when the tubing was still in place, and the after measurements were made after the new gasket was installed. One set of measurements used the DTT Fourier Analysis tool, and the other set used a Stanford Research SR785 Spectrum Analyzer.

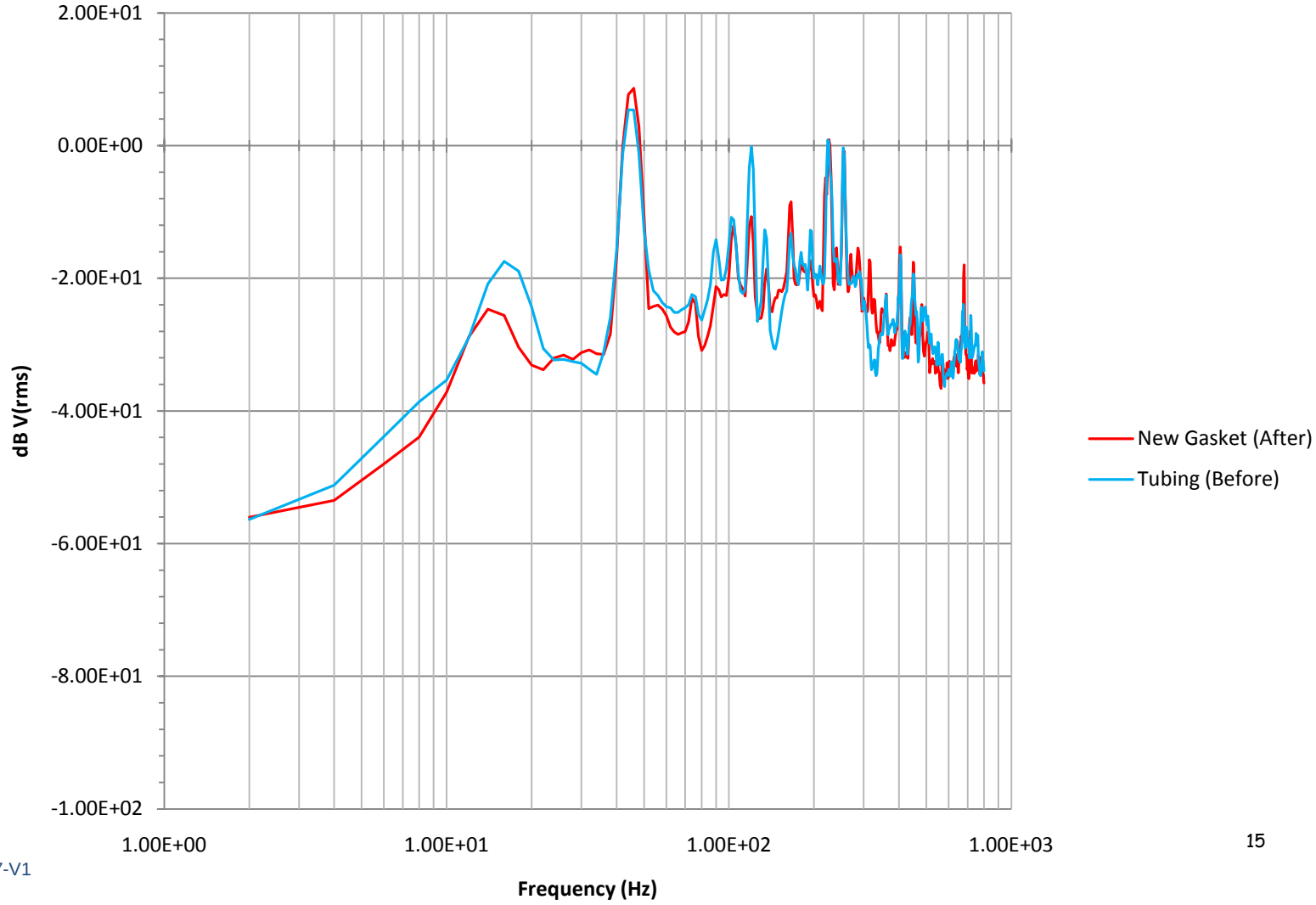
Certain hardware was common to both measurements. A Wilcoxon Model 731-207 accelerometer was the sensing device. This accelerometer was firmly attached to a mount that had been epoxied to the top of Rack 6. The accelerometer interface cable was connected to an open input channel (channel 15) on one of the Isotron Model 2793 Amplifier Modules located in Rack 5. The accelerometer was covered during measurements.

In order to measure using the DTT, the output of the Isotron channel was connected through a 10-1 voltage divider (1kΩ /100Ω) to L1:PEM-LVEA-TEST1, a test channel found at DAQIC-4, port 14. This test channel has 10x gain, and needed the voltage divider in-circuit to prevent clipping. In order to measure using the SR785, the output of the Isotron channel was connected directly to Channel 1, Port A of the spectrum analyzer. The analyzer was set to use an FFT Power Spectrum 1 measurement with RMS averaging on.

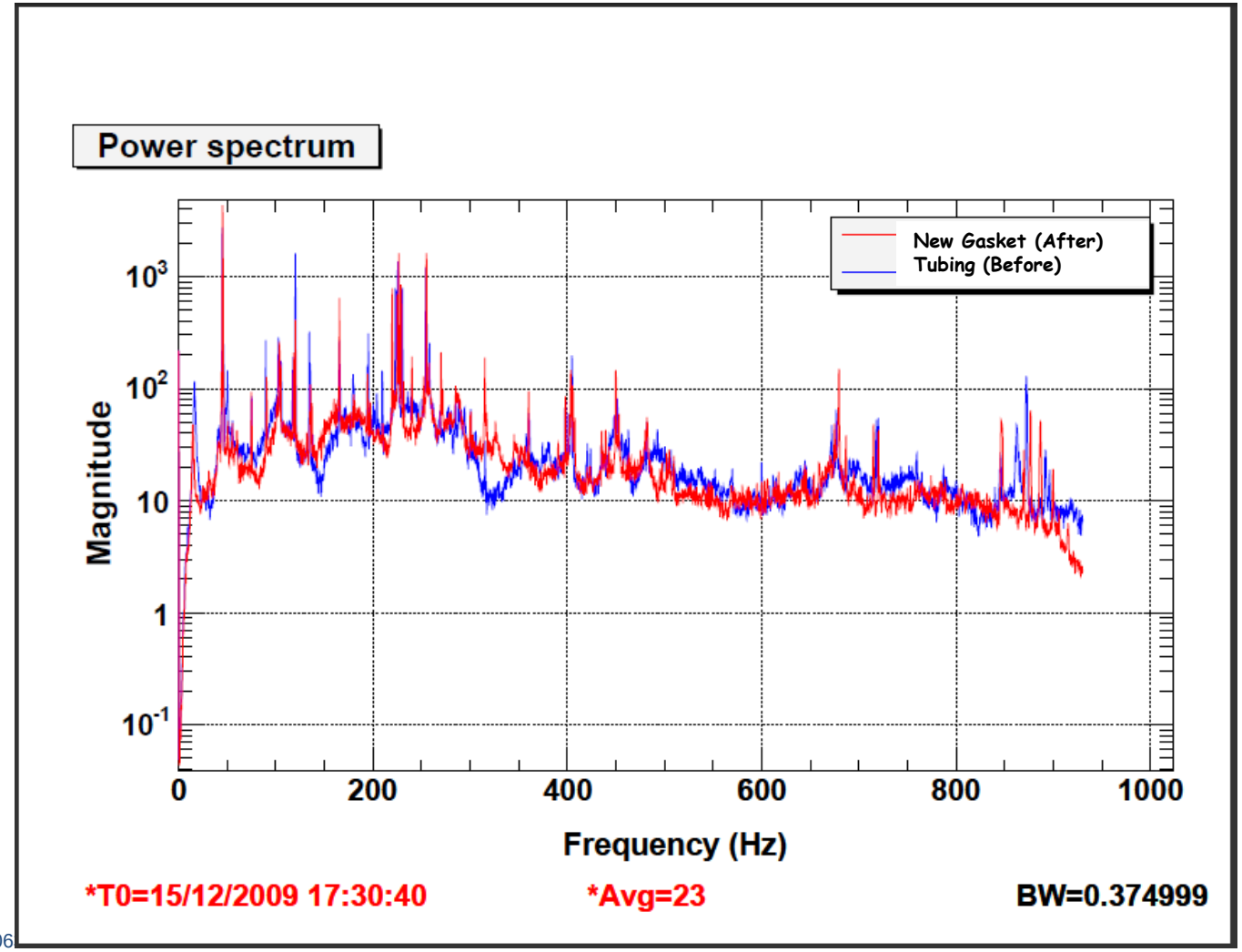
New Gasket vs Tubing – DTT Measurement



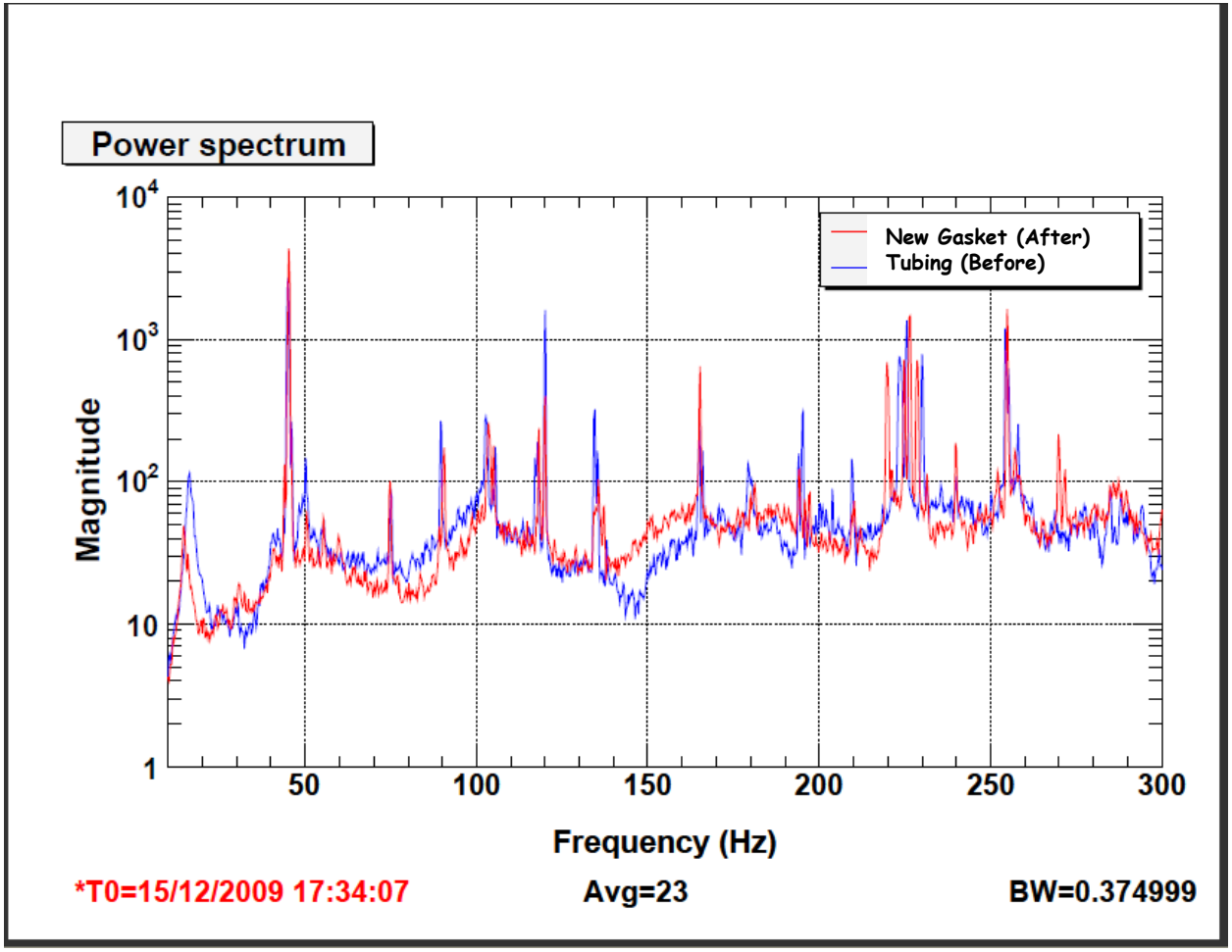
New Gasket vs Tubing – SR785 Measurement



New Gasket vs Tubing – (DTT Log-Linear, Full Band)



New Gasket vs Tubing – (DTT Log-Linear, Detail Around 230Hz)



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New Gasket – Conclusions

While the objective of having a more permanent solution to fan isolation has been met, the two sets of measurements agree as they show that the new gasket presents a minor difference in the source power spectrum, but that coupling is not greatly improved with this design.