The Poor-Man's Warpless Pressure Case

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The sensitivity exhibited by vertical seismometers to air buoyancy variations arising from atmospheric pressure fluctuations has required such instruments to be surrounded by a pressure case in order to keep atmosphere-induced noise to a low level. It was realized early on that the microscopic flexing of the bottoms of such pressure cases must not be allowed to influence the stable mechanical connection between the instrument and the earth beneath.

Three solutions to the case-flexure problem seem to be in common use:

In relatively permanent installations the instrument can rest directly on a plate solidly bonded to the top of a massive concrete pier with a bottomless pressure cover sealed over it.

For more portability a very stiff bottom plate may be used to support the seismometer, again with a pressure cover sealed over it. This plate must be extremely stiff in order to resist any tendency to flex as the atmospheric pressure changes. Granite plates, several inches thick have most often been employed in the pressure isolation systems used for the FBV instruments.

In 1991 in cooperation with ASL, Erhard Wielandt helped complete the "Warpless" seismometer base plate design, which was more compact and much lighter than a granite slab. Instead of resisting flexing by brute strength, it was allowed to flex under pressure changes, but was designed to not significantly transmit the resulting motion to the seismometer which rested on it. http://bnordgren.org/seismo/WarplessBase.pdf This beautiful but complex design has frequently been used in high-quality vertical seismometer installations and is being incorporated into the mounting for the vertical component of the Metrozet M2166-VBB STS-1 replacement.

Having tired of carrying granite slabs and heavy pressure cases, Dave Nelson was looking for a smaller, lighter weight, alternative design which would use the general principle of Wielandt's base, but which could be built by amateurs. First incorporated in the smaller Napa sensor, this case design has proven itself capable of reducing atmospheric pressure effects to an insignificant level.

The figure below shows how it responds to a greatly exaggerated illustration of pressure-induced distortion. In this design the seismometer is attached to or rests on a relatively thick metal (Aluminum) plate which contains blind holes into which are threaded the three adjustable support legs. The sealed pressure case may be relatively thin, though it must still be thick enough in proportion to its size to adequately attenuate outside pressure variation. On each leg, a pair of thick washers made from soft rubber, such as silicone, provide the mechanical isolation from forces resulting from the case's flexing. The top washer, clamped between the metal base plate and the case ensures the pressure

seal, while another similar washer is clamped against the underside of the pressure case by a serrated, flanged nut. This only needs gentle tightening in order to provide an excellent seal, and it has proven adequate to resist long term air leakage in an evacuated case trial. The friction of the nuts against the rubber washers is adequate to prevent their rotating when the legs are turned in the process of leveling the instrument. Generous clearance holes in the case prevent any metal-to-metal contact between it and the legs.

As the case flexes the rubber washers absorb any small motions, preventing them from significantly distorting the internal mounting plate or the adjustment legs.