Cell Construction

This document provides detail for the steps involved in constructing state-of-the-art sound-dampened dyno control rooms, engine cells, and chassis bays.

First, review your requirements. If you only occasionally leak test rebuilt industrial engines, and your shop is in an isolated area, rolling the dynamometer outside might be all the “cell” you need. Likewise, a trailerable chassis dyno used only to visit motorcycle events can live without a testing bay. In most cases though, a quiet and well ventilated indoor test room is almost a necessity. Internal combustion engines generate plenty of noise, fumes, and heat.

Just how quiet and how well ventilated an area you need/build will determine its suitability, construction methods, and ultimate costs. Conventional 2" x 4" wood frame, fiberglass insulation, and 1/2" drywall construction is not too effective at controlling noise – but it is inexpensive. The listing below shows some relative STC (Sound Transmission Class) values for various wall and ceiling alternatives.

- 2"x4" wood studs @ 16"oc, fiberglass, one 1/2" drywall each side = 34 STC – loud
- 2"x4" wood studs @ 16"oc, fiberglass, one 5/8" drywall each side = 38 STC
- 2"x4" steel studs @ 24"oc, fiberglass, one 5/8" drywall each side = 43 STC
- Pre-engineered sound room kit walls and ceilings (finished metal faces) = 50 STC
- Staggered 2"x4" wood studs @ 24"oc, fiberglass, two 5/8" drywall each side = 53 STC
- Staggered 2"x4" steel studs @ 24"oc, fiberglass, two 5/8" drywall each side = 57 STC
- Staggered 2"x4" steel studs @ 24"oc, fiberglass, three 5/8" drywall each side = 59 STC
- 8" concrete CMU block, hollow cores, painted each side = 48 STC
- 8" concrete Soundblox™, hollow cores, painted each side = 53 STC
- 8" concrete Soundblox™, sand-filled cores, painted each side = 56 STC
- 8" concrete Soundblox™, masonry-filled cores, painted each side = 60 STC
- 12" concrete Soundblox™, sand-filled cores, painted each side = 60 STC
- 12" concrete Soundblox™, masonry-filled cores, painted each side = 64 STC – quiet

> *Note: STC numbers (higher will be quieter) represent the average sound blocking over a range of frequencies. An increase in STC of 3 is noticeable. An increase in STC of 10 cuts noise in half.*

Staggered-stud or double-wall Sheetrock™ construction is a very effective way to block sound. Use multiple laminations of 5/8" drywall, on each side, to further cut noise (see figure at left). A

sound-dampening membrane or mastic (i.e. Green Glue™) should isolate each lamination of drywall (or plywood for decks) so that the assembled sandwich attains the desired STC values.

A downside to concrete is noise reverberating off its hard flat surfaces. Inside, the cell becomes an echo chamber, and may be unpleasant for technicians to work in. A very effective solution is to use Soundblox™ (or an equivalent) for the cell's longest wall. These blocks are cast with two narrow slits in one face, which lead into internal dampening cavities. These cavities are also fitted with fiber-faced metal sound baffles (see figure below). Sound blocks literally turn a room into a "glass-pack muffler."

> *FYI: Six of the new cells at DYNOmite Dyno utilize Soundblox™ walls – you can easily hear a difference compared to our plain block cells.*

Painting concrete blocks (both sides) materially improves their sound-blocking properties. No matter what materials are used, walls and ceilings should be finished in a light color to aid visibility.

Concrete and steel construction offers the additional benefit of inflammability. If the upper face of a multilayer drywall ceiling must support loads, then poured concrete or a double lamination of ¾" fire-treated tongue-and-groove plywood decking can be used.

Specialty construction methods and materials, like using resilient channels between each layer of drywall or "soundproof drywall" (expensive) also exist. However, although these proven solutions boast impressive STC numbers, much of their rating is earned at higher frequencies. The thundering noise of a big bike engine on a dyno is comparatively low in frequency – where nothing blocks the sound like high-mass walls and ceilings (e.g. solid-filled concrete block or six laminations of 5/8" drywall)!

The size of a cell impacts its total sound transmission, ventilation requirements, and construction costs. Keeping room, and window, sizes down reduces all three. Just make certain you allow enough elbow room to comfortably work on your engines and equipment. Typical minimum sizes might be:

- Automotive Engine Cell = 8' wide x 12' deep x 8' high
- Small Engine Cell = 8' wide x 8' deep x 8' high
- Automotive (in-ground) Chassis Bay = 14' wide x 12' deep x 8' high
- Motorcycle/ATV (ramp) Bay = 10' wide x 20' deep x 8' high
- Snowmobile Bay = 10' wide x 12' deep x 8' high

Ventilation is one of the more expensive components of cell construction – but avoid any urge to skimp on it. It is possible for powerful race engines to radiate over 1,000,000 BTUs/hr of heat off their exposed block surfaces, exhaust, and cooling systems. To keep the cell near ambient temperatures, and to purge 100% of the exhaust and crankcase fumes from the test chamber, you will want plenty of high velocity air. This necessitates a high-Hp blower and large duct work – especially for a large truck or race car chassis dyno bay. Plan for about 10 air changes a minute.

CFM calculations work out to a minimum of 5,000 for a small engine cell – or something more like this 33,000 CFM unit that serves one of the 17' high bays at DYNOmite Dyno (see image below). Our individual cells are each ventilated via their dedicated pairs of motorized exhaust and intake louvered ducts – connected to 10 Hp and 7½ Hp roof-mounted blowers, respectively. Variable frequency drives allow DYNO-MAX to regulate air velocity (for less volume during idling and cool-down periods) and also the test cell pressure (to adjust out the minor* day-to-day changes in barometric pressure).
**Only about +-0.2" Hg pressure compensation is practical though, before structural failure of the test cell doors, ceilings, etc. can occur.*

Each duct should be at least 10' long and internally lined with 1" to 2" thick acoustical weave, for effective outdoor environment noise control. Low-restriction sound baffles may be installed in the duct runs for still more attenuation. Wrapping the outside of the sheet- metal work (or enclosing it within its own walled area) will reduce noise infiltration into your surrounding facility.

Doors and windows are other critical items (and expenses) needed to build a test cell enclosure. Doors must be extra large, to allow rolling engines or vehicles in, and require a couple of unique features to make them suitable for test cells. Sound control doors with 50+ STC ratings are available. Metal doors and frames are preferred due to their superior fire rating and because their hollow cores allow them to be filled with high-mass vinyl and gypsum (for low-frequency sound control). Special cam-lift hinges, sweeps, and magnetic seals take care of some common sound leakage spots.

Windows frames should also be filled with mortar or gypsum and the glass should be insulated (double pane) type, with a minimum ½" air-gap. Laminated safety glass is the preferred glazing. Its 0.030" PVB inner liner adds still more sound blocking – along with resistance to shattering. Best is an opposing pair of insulated glass panels installed on each side of a single metal window frame. This provides two ½" air gaps plus a larger (2+") one in-between pairs.

DYNOmite Dyno's showroom observation area uses the above four-pane design. Double-glazed PyroStop™ (gel-filled fire-rated glass) is separated by a full 12" air space (itself lined in acoustical foam) with the dyno cell side getting its own double-pane panel of laminated safety glass. This combination yields over a 55 STC rating. Race engines running full-throttle on the dyno, just several feet away, sound like only an exciting hum to observers.

> *Tip: Consider adding mirrors or video cameras to help you monitor blind spots in the cell. Using today's low priced video cameras and large LCD monitors, some cells are forgoing windows all together.*

Acoustical suspended ceilings (with 1-½" thick lay-in tiles) and wall panels (foam, blankets, etc.) may be used to help absorb reverberation inside the room. Understand that these products do very little to block noise from escaping the cell, tiles should be added as a secondary ceiling – good for installing lights, hiding overhead wiring, etc. Absorption surfaces serve to make it quieter working inside the cell, next to a running engine – important if the cell's walls or ceilings are hard concrete (without any Soundblox).

If all this sounds like too much construction detail to worry about, or if you lease space that makes fixed construction impractical, consider a modular sound room. Prefab turn-key installations and do-it-yourself kits are available. For free advice, on building from scratch or buying a modular cell, contact DYNOmite Dyno's tech team.