

# National System of Garage Ventilation's Engineering Guide

In designing a fume removal system, it is extremely important to determine the following:

1. Type of apparatus to be exhausted (i.e. gasoline, propane, diesel, etc.)
2. Maximum horsepower of apparatus
3. Condition of apparatus (i.e. tune-up/idle, pump testing, full-load dyno, etc.)
4. Exhaust tailpipe size, shape, & location
5. Type of system desired (i.e. underfloor or overhead)

After securing the above information, it is helpful to fill out the National System of Garage Ventilation Specification Planner. This planner is designed to assist in designing the at-the-source exhaust removal system. When determining where the system will be located, consideration must be made as to ease of use for the mechanic. **USER FRIENDLY MEANS MORE EFFECTIVE, CONSISTENT USE.**

National's tailpipe adapters are designed to be larger than the apparatus tailpipes to allow ambient air to be introduced into the system. The ambient air mixes with the exhaust fume for cooling and dilution to eliminate the possibility of direct exhaust being emitted from the exhaust blower.

The following is a selection guide for CFM, flexible tube diameter, & recommended tube type based on horsepower and conditions. Underfloor and overhead ductwork must be graduated to create a balanced system while maintaining a velocity between 2,500 & 4,500 fpm.

**NOTE: The below table is for Normally Aspirated vehicles.**

Engine	Horsepower	Idle	Tube Ø	Tube Type	Dynmometer	Tube Ø	Tube Type
Gasoline	< 150	150 cfm	3"	RW, NK	350 cfm	4"	XT, NS, BB
Gasoline	300<hp>150	300 cfm	4"	RW, NK	600 cfm	6"	XT, NS, BB
Gasoline	> 300	500 cfm	5"	XT, NS	1000 cfm	8"	BB, HT
Diesel	< 150	300	4"	RW, NK	600 cfm	6"	XT, NS, BB
Diesel	300<hp>150	600	6"	XT, NS, BB	1200 cfm	8"	HT
Diesel	> 300	1000	8"	XT, NS, BB	<b>Consult factory</b>		

**NOTE: CONSULT FACTORY FOR EXTENDED FULL LOAD DYNOMOMETER**

The flexible tubing is also determined by the type of system being utilized (overhead, underfloor, hose reel, etc.). Each system specification in this National System of Garage Ventilation product catalog lists which flexible tubing is recommended for that particular system.

Once you have determined the diameter and type of flexible tubing, you need to determine what type of system best fits your needs. National Systems has two basic types of at-the-source exhaust removal systems; overhead and underfloor.

### **UNDERFLOOR**

Underfloor systems are an excellent choice for new facilities, since the entire system is built into the floor. Existing facilities can also modify their floors for installation of an underfloor system. Underfloor systems are virtually maintenance free once they are installed. There are three types of underfloor systems; cast aluminum self-close (RY), constructed self-close 1/4" plate lit (CGY, CSY, or SSY), and the cast aluminum plug-in (PY or TS-30). The RY, CGY, CSY, and SSY underfloor inlets are designed to store the flexible tubing assembly under the floor. The PY and TS-30 inlets are designed to store the flexible tubing assembly in another location (i.e. wall bracket).

The RY inlet consists of a cast aluminum body, cast aluminum lid, shear pin, galvanized saddle, and galvanized adjusting sleeve. The RY inlet can accommodate either 3" or 4" diameter flexible tube assemblies. The RY inlet also comes in a dual configuration.

The CGY inlet consists of an angle-iron frame, 1/4" plate lid, galvanized steel body, galvanized steel saddle, and galvanized steel adjusting sleeve. The CGY inlet can accommodate 4", 5", or 6" diameter flexible tube assemblies. The CSY inlet is constructed the same as the CGY with the exception that the saddle, body and adjusting sleeve are stainless steel. The SSY inlet is constructed the same as the CSY with the exception that the angle-iron frame and 1/4" plate lid are stainless steel. The CGY, CSY, or SSY inlet also comes in a dual configuration.

The PY and TS-30 inlets consist of a cast aluminum body, cast aluminum lid, galvanized saddle, and galvanized adjusting sleeve. The PY inlet accepts either 5" or 6" diameter flexible tube. The TS-30 inlet accepts either 3" or 4" diameter flexible tube.

### **OVERHEAD**

Overhead systems are the best choice for an existing facility. National Systems offers five basic types; F-Systems, hose reels, Tele-Flex, boom arms & EVE systems.

The F-System is designed to store the flexible tube assembly as close to the ceiling as possible. The system consists of 3" to 8" diameter flexible tube, tailpipe adapter, lifting elbow, blastgate, clamps, & a pull-up assembly w/ pulleys. A spring return balancer or winch assembly can be substituted for the standard pull-up.

Hose Reels are designed to store the flexible tube on a reel drum. We offer two types of reels; spring operated and motorized. The reels can accommodate 3" to 8" diameter flexible tube. The reels can be used with (RW, XT-65, NS, BB or HT) flexible tube. The reels can store up to 42'-0" of 4", 34'-0" of 5", 28'-0" of 6", or 25'-0" of 8" diameter flexible tube.

Tele-flex units are designed for gasoline vehicles. The tele-flex inlets are an economical solution when a wall is not accessible. The flexible tube tele-scopes within itself to give the mechanic a total of 17'-0" reach when fully extended and 6'-6" in the stored position. We offer two sizes TF-543 and TF654.

The Boom Arms are designed to give the mechanic the ability to move the arm out of the way of obstructions and cover a much wider work area. National's boom arms can be accessorized to fit with hose reels, F-systems, or weld arms and comes in sizes from 5'-0" to 20'-0".

The EVE emergency vehicle exhaust system is designed to automatically release from the emergency vehicle. The system controls the blower and release from the apparatus. It consists of a pneumatic adapter, safety-disconnect, manual inflate valve, safety boot, lifting elbow, manual deflate valve, balancer, track, trolley regulator valve, and auto-start system.

After you have determined what type of system you require and the general location of the drops, it is time to size the blower. First you need to know the total cfm requirements of the system. You can do this by adding up the cfm needed for each inlet. Next you need to determine the total static pressure in the system. Total static pressure is determined by first locating the furthest drop from the blower and calculating the static pressure in that drop. See chart below for general static pressure calculations. Once you have calculated the static pressure for the furthest drop you then have to calculate the static pressure in the ductwork back to the blower. Be aware that you must add the cfm to the duct when you pass each inlet back to the blower. Once you have determined the total static pressure for the system you can use the performance charts in this catalog to determine what blower will meet your needs.

National offers two styles of blowers; direct drive and belt drive. The PB and AF blowers are designed for low cfm, high static applications. The belt drive blowers are designed a variety of cfm and static pressure. We also offer in-line belt driven blowers. All of National's blower wheels are non-overloading.

**TUBE TYPE**

CFM	3" NK	4" NK	5" NK	6" NK	3" flex	4" flex	5" flex	6" flex	8" flex
150	.349	-	-	-	.105	-	-	-	-
300	-	.299	-	-	-	.089	-	-	-
500	-	-	.255	.099	-	-	.077	.029	-
600	-	-	.349	.139	-	-	.105	.042	-
750	-	-	-	.215	-	-	-	.065	.015
1000	-	-	-	-	-	-	-	-	.025
1200	-	-	-	-	-	-	-	-	.037

**STATIC PRESSURE LOSS PER FOOT OF FLEXIBLE TUBE**

**Rigid Spiral Ductwork**

CFM	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"
150	.068	-	-	-	-	-	-	-	-	-
300	-	.059	-	-	-	-	-	-	-	-
450	-	-	.041	.017	-	-	-	-	-	-
600	-	-	.071	.028	-	-	-	-	-	-
750	-	-	-	.042	-	-	-	-	-	-
1000	-	-	-	-	.016	-	-	-	-	-
1200	-	-	-	-	.025	-	-	-	-	-
1500	-	-	-	-	.037	.012	-	-	-	-
2100	-	-	-	-	-	.023	.008	-	-	-
2400	-	-	-	-	-	.028	.012	-	-	-
2700	-	-	-	-	-	-	.014	.006	-	-
3000	-	-	-	-	-	-	.016	.007	-	-
3500	-	-	-	-	-	-	.024	.010	.005	-
4000	-	-	-	-	-	-	-	.014	.006	-
4500	-	-	-	-	-	-	-	.017	.008	.004
5000	-	-	-	-	-	-	-	-	.011	.006
5500	-	-	-	-	-	-	-	-	.013	.007
6000	-	-	-	-	-	-	-	-	-	.008
CFM	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"

**STATIC PRESSURE LOSS PER FOOT (2,500 TO 4,500 FPM)**

**NOTE: FOR ELBOWS MULTIPLY THE DIAMETER X 1.5 TO GET STRAIGHT PIPE LENGTH**

## WELDING

National also has welding fume removal systems. There are three basic types of systems; weld arms, bench/canopy hoods, and the W-type (pull-up) system.

We have three styles of weld arms; externally supported, internally supported and PVC arms.

The externally supported weld arm comes in four sizes; WA03 (3'-0" reach), WA05 (5'-0" reach), WA0710 (7'-0" – 10'-0' reach), WA01215 (12'-0" – 15'-0" reach). The WA03 and WA05 arms each have a table or wall mount support, and the WA0710 and WA01215 arms can have either a wall or ceiling bracket. Each weld arm can accommodate 3", 4", 5", 6", or 8" diameter RW flexible tube. Each arm comes standard with a stainless steel fume receptor.

The internally supported weld arm comes in two standard sizes; NWA010 (10'-0" reach) and NWA014 (14'-0" reach). Both arms can have either a wall mount or ceiling mount bracket. Each arm can accommodate 6" or 8" diameter RW flexible tube. Each arm comes standard with a powder coated hood.

The bench-welding and canopy hoods come in numerous sizes depending on the applications being used. They are constructed of 16 gauge galvanized steel with an option for stainless steel.

The W-system is similar to the F-system as noted above. The W-system comes with a weld hood (either stainless steel, galvanized or aluminum), pull-up set and RW flexible tube. Balancer or winch can be substituted for the rope and pulley assembly.

In sizing a continuously used weld arm or a W-system, National recommends that for a distance of 10" – 15" from the weld rod tip to the hood, the rate of exhaust should be 600 cfm minimum. The duct velocity in a welding fume removal system should be 2,500 to 4,500 fpm and a face velocity at the receptor of 1,500 fpm. For some applications where steel, such as galvanized with a toxic fume emitted is being welded, 850 cfm should be used with the same velocities.

In sizing a bench welding hood, the first step is to determine the size of the work table. Once you have determined the location of the bench welding hood the length of the hood will be equal to the width of the table. In calculating the airflow for the bench welding hoods use the formula:  $Q = V(5(X \cdot X) + A)$ .

Q = air flow, cfm

V = capture velocity, fpm, at distance x (50 fpm for welding applications)

X = distance from hood face to farthest point of contaminant release, ft

A = area of hood opening, square feet

## **DUST COLLECTION**

National Systems offers a Thor-Kleen cyclone collector. Our collectors can exhaust from 311 to 8000 cfm. We offer numerous optional accessories.

In sizing a dust collection system you first must determine the number of pick-up points. Many pieces of equipment have a port to attach a removal system. Typically drops require a minimum of 300 cfm. After having this information you have the total cfm required for the system. We recommend that at least one floor sweep be added to the system. The floor sweep should be rated for 600 cfm. Now that the total cfm is secured you then need to calculate the static pressure in system. The external static pressure is calculated the same the at-the-source fume removal systems. Then you must add the internal static pressure in the cyclone. The typical rule of thumb is approximately 1 1/2" to 2".

## **SENSORS**

National System of Garage Ventilation offers a variety of sensors. Our sensors monitor carbon monoxide, nitrous dioxide, and carbon dioxide. They detect an area of 5000 square feet. We offer stand alone sensors as well as sensors tied to a common controller. We do have a dual gas detector that monitor's carbon monoxide and nitrous dioxide.

