

Guide to Permitting Air Curtain Destructors in Colorado

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Introduction- During 2004, the Colorado Air Quality Control Commission (Commission) approved requirements for permitting of air curtain destructors (ACDs) for the disposal of fuels generated as a result of projects to reduce the risk of wildfire. These devices can, with appropriate permit conditions, safely be used to dispose of certain materials without endangering public health or causing or contributing to a violation of the National Ambient Air Quality Standards (NAAQS) and will reduce emissions compared to traditional pile burning. The devices can be used year-round and provide more windows of opportunity for disposal than pile burning.

Regulation Highlights- Colorado Air Quality Control Commission Regulation 9, Open Burning, Prescribed Fire, and Permitting (Regulation 9) sets forth the specific requirements for obtaining a permit for an Air Curtain Destructor (ACD). Permitting requirements for ACDs are addressed in Section IV.B.4.. The complete regulation can be downloaded at <http://www.cdphe.state.co.us/ap/smoke/DocumentsLinked/Regulation9.pdf>. Below are some highlights from the ACD section of Reg. 9:

- Division can permit air curtain destructors (ACDs) for the disposal of yard waste, wood waste, clean lumber, or any mixture thereof generated as a result of projects to reduce the risk of wildfire.
- Division will consider whether there are any practical non-burning alternatives to disposal.
- Within 60 days of beginning operation permittee must demonstrate the ACD meets the emission limits in the regulation. This demonstration is done using EPA Method 9, Visual Determination of the Opacity of Emissions from Stationary Sources. See the section on Opacity Testing and Smoke School, below.
- The device (ACD) shall not be co-located with another ACD or any other facility which is required to have an air quality permit or any commercial or industrial facility. This means an ACD cannot be located on site with another source requiring a permit, such as a landfill or another ACD.¹
- There are specific requirements to ensure devices are operated efficiently. Reduction in air pollutant emissions is demonstrated with properly operated and well-maintained ACDs when compared to pile burns. Therefore the regulation states a number of requirements to ensure optimal operation parameters:
 - The ACD will be erected and operated according to the manufacturer's recommendations.
 - Trenches will be clean of other biomass, dry and maintained with straight sides
- Throughput² of woody debris shall not exceed manufacturer's recommendation or 20 tons per hour, whichever is less.
- Units can be operated during daylight hours and no more than 13 hours per day. Daylight hours were used by the Division to model potential air quality impacts.

¹ This does not mean there can only be one ACD in a US Forest, BLM District, CSFS District, etc. If an administrative unit would like to operate more than one ACD at a time, contact Louis McBride, Division. The Division will determine based on site-specific criteria how far apart the units will need to be located.

² Throughput is the amount of fuel (woody debris) that will be fed into and burned in a device. This is generally measured as tons of fuel burned per hour. Through-put depends on many factors, such as ACD unit size, nature and type of fuel, its moisture content, prescribed opacity limits, operator skills, elevation of location, etc.

- To remain classified as a minor source, the device cannot emit more than 99 tons of any criteria pollutant in a calendar year. The Division is not aware of any fuels reduction projects to reduce the risk of wildfire that would emit more than 99 tons of air pollutants.
- Units located for 14 days or more in the same place must be set back from occupied structures at least 300 feet. Units that will be in a location for less than 14 days must be at least 150 feet from occupied structures. These requirements were established as a result of air quality modeling.
- Maintain sufficient records of the operations to meet the Division’s reporting requirements. Each year a summary of the amount of fuel treated on a daily basis and air pollutants emitted must be submitted to the Division

Emission Factors- EPA has not established emission factors for air curtain destructors. Division staff compiled reasonable emission factors from various sources to evaluate potential impacts of emissions from ACDs. The Air Quality Control Commission reviewed these emission factors before adopting the permitting requirements for ACDs in Regulation 9. See Appendix A for the emission factors used by the Division. All permittees will use the emission factors established by the Division when reporting the annual activity for ACD permits issued under Section IV.B.4. of Regulation 9. If a permittee wants to use alternative emission factors for a permit application, contact the Division’s Stationary Sources Program staff concerning the stationary source permitting requirements.

Obtaining a Permit for an Air Curtain Destructor- Fuel reduction projects will be issued a **General Open Burning Permit** and the device (ACD) will be issued an **Air Curtain Destructor Permit**. The permit application forms for the Open Burning Permit and the ACD Permit can be downloaded from the Division’s website at

<http://www.cdphe.state.co.us/ap/coenfor.html#Open%20Burning>.

Once a device has obtained an **Air Curtain Destructor Permit**, the ACD permit expires in one year (Several permits issued prior to September 2005 expire December 31, 2005). If the **General Open Burning Permit** that the ACD permit was issued with expires before the **Air Curtain Destructor Permit**, another **General Open Burning Permit** must be obtained for any additional projects that the ACD would be used for. Both permits must be current to operate the ACD.

By accepting a permit for an ACD through this process the owner/operator is agreeing to operate in a manner consistent with the requirements of Regulation 9. Regulation 3, Section IV.B.4. exempts devices, permitted in accordance with the other requirements in the section, from the APEN (Air Pollutant Emission Notice) requirements in Colorado Air Quality Commission Regulation 3, Stationary Source Permitting and Air Pollutant Emission Notice Requirements (Regulation 3). By meeting the requirements set forth in Regulation 9, Section IV.B., an ACD is a minor source and a Division modeling analysis demonstrated compliance with National Ambient Air Quality Standards (NAAQS). There is no charge for the **General Open Burning Permit** or the **Air Curtain Destructor Permit**. The regulation allows for a permit to be issued without engineering review and an air quality modeling analysis, as long as the permittee accepts the permitting conditions included in the regulation.

Area Source vs. Stationary Source Permits- Pile burning is considered an area source. Area sources are not subject to annual emission limits. Disposal of fuel in a properly operated air curtain destructor (ACD) creates less pollution than disposal by pile burning. For this reason the Division and the Commissioners support the use of ACDs as a mechanism to reduce emissions of open burning of wildland fuels. EPA classifies ACDs as stationary sources. As such, any stationary source must meet the permitting requirements set forth in the State’s regulations that implement the mandated federal and state permitting programs. Depending on the type of pollutants and the amount of pollutants emitted annually, a stationary source will be classified as a minor source or a major source. If classified as a major source, the type of source and the type and amount of pollutants emitted will determine the permitting requirements. To encourage the use of ACDs to dispose of wildland fuels, Regulation 9 allows for an exemption of the APEN (Air Pollutant Emission Notice) and associated fee, as well as a streamlined, no cost permitting process for those devices emitting less than 100 tons of each of the criteria pollutants. The Division is not aware of any projects to reduce the risk of wildfire that would generate more than 100 tons of any of the criteria pollutants in one year.

How Much Fuel Can Be Burned- See **Appendix A** for calculations and default densities for typical Colorado fuels, but general calculations are:

- Each year approximately 33,000 tons of fuel (woody debris) can be burned in one ACD. Each device requires a permit and must meet the permitting requirements to maintain a valid permit.
- Describing the same amount of fuel differently, each year almost 28 million ft³ of piled fuel (ponderosa) can be burned in a permitted ACD.
- 33,000 tons of fuel or 27,852,000 ft³ is equivalent to burning a windrow of ponderosa 16 ft wide x 8 ft high x 58 ft long each hour, 13 hours per day, 5 days per week all year. Burning a pile, 18 ft high x 29 ft diameter, each hour would also be equivalent.

Opacity Testing and Smoke School- Within 60 days of beginning operation and once a year thereafter, an opacity observation must be completed and the results submitted to the Division for the ACD device. This test will document that the device is meeting (or not meeting) the opacity requirements of the permit. Regulation 9 requires the device operate with an average opacity of less than 10%, except during the startup period. Once the Division receives and approves an opacity test report for a device (tracked by serial number), the report is valid for any permittee requesting an ACD permit for that specific device for one year. Permitted devices are subject to inspection (including opacity observations) at any time by Division personnel or their agents. Division inspection does not fulfill the operator’s requirement to complete an opacity test each year.

A person with a current opacity determination certification must complete the annual testing. Operators of the ACDs should consider attendance of at least one smoke school, even if the certification is not maintained. Since day-to-day operations must meet the opacity requirements, the operators will need to evaluate operations and startup.

- Smoke School- One option is to have a person or persons attend “smoke school” to become certified to perform visual determinations of the opacity of emissions. At least one company is offering smoke school in the spring and fall in Denver (2 sessions) and Grand Junction. Sessions are also offered in Pueblo and Cheyenne. Certification is valid for 6 months. It takes 2 to 3 days the first time and probably only 1 day on subsequent certifications. The cost is approximately \$375 for first-time attendees or \$250 for attendance of the field portion only (smoke certification or re-certification). Attendance of the one-day classroom training is recommended for first-time attendees. *The Division does not endorse any of these companies; these are companies Division staff is aware of.* For more information contact:
 - Eastern Technical Associates, Raleigh, NC, (919) 878-3188. APCD has a contract with ETA to train all of the state inspectors. See their website for a schedule and class description: <http://www.eta-is-opacity.com/>
 - Opacitek, Salt Lake, UT, (435) 257-2889
 - Carl Koontz, (615) 889-9494
- Opacity Testing Firms- Several private firms are certified to perform opacity testing. Contact the individual firms for their current fees. You may also contact some of the larger stationary sources (big factories, power plants, cement plants, asphalt plants, etc.) in your area. They may have certified personnel that would be willing to perform the needed test for your device, most likely for a fee. There are also companies that conduct stack testing (smoke stack monitoring). As part of the stack test, opacity readings will be taken, therefore stack-testing firms may also be certified to perform opacity testing and be willing to provide opacity testing. Attached are two lists (smoke testing and opacity testing) of firms the Division is aware of. *This is not an endorsement of any of the firms.*
- County Health Department Inspectors- Many county health or environmental health departments, have staff certified to perform opacity testing. Some of the counties will provide testing for a fee. This is generally the same agency that you will contact to notify of a pending prescribed fire. The current list of local county contacts can be downloaded at <http://www.cdphe.state.co.us/ap/smoke/>, click on the **County Contacts** link.

Relocation of an ACD- In the event the device is relocated, the Division must be notified of the new location. This is not a requirement to notify the Division each time a new trench is built (in the case of trench style ACDs) or the fire box (self-contained style) is moved due to ash buildup. A Relocation Notice must be received by the Division at least ten (10) days prior to relocating an ACD to another Section (1 mile square section of the United States Public Land Survey) or more than four miles within a county or relocated to a different county than permitted. Download the Relocation Notice from the Division’s general open burning website <http://www.cdphe.state.co.us/ap/coenfor.html#Open%20Burning>.

Reporting Requirements- Annually a summary report for each device with an **Air Curtain Destructor Permit** must be submitted to the Division. The Division will use these reports to determine compliance with the conditions of the permit. See Appendix A for information on how to estimate throughput. To meet the annual reporting records and to document the device is operated according to the permit conditions, owner/operator of the device must maintain

sufficient records to document the hours of operation and approximate hourly throughput in tons of fuel per hour or the volume of fuel burned in an hour or day. A sample record log and a tracking worksheet are available on the ACD webpage:

<http://www.cdphe.state.co.us/ap/coenfor.html#Open%20Burning>

Colorado Companies Who Sell and Lease ACDs- Division staff have been contacted by two Colorado firms that have ACDs available. This is provided for information purposes only. *The Division does not endorse these companies or their equipment.*

Blue Sky Environmental, Inc.
Brian Harvey, President
POB 982
Granby, CO 80446
(970) 531-3283
bhgrand@yahoo.com

Dodd Diesel
Lance Armstrong
767 Valley Court
Grand Junction, CO 81505
970-243-3422
www.ddiequip.com

General Information Concerning ACDs- For general information concerning the principles of operation and links to current literature and research on ACDs see the Air Burners, LLC website. *The Division does not endorse this company or their equipment.*

<http://www.airburners.com/>

Division Contact Information-

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Appendix A

To remain classified as a minor source (and eligible for the streamlined ACD permitting process), units must emit under 100 tons of each of the criteria pollutants (carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particulate matter) per year. The annual pollutant emissions will depend on the emission factors, the annual fuel throughput, and type of fuel. The following tables can be used to evaluate how much fuel can be burned in an ACD unit in Colorado and remain below the 100-ton emission limit.

Table I		
Emission Factors used by APCD for Modeling		
Pollutant	Pounds of pollutant/ton of fuel consumed	Source
PM_{2.5}	6	25% reduction from WRAP/FEJF pile emission factor
PM₁₀	6	25% reduction from WRAP/FEJF pile emission factor- This includes the PM _{2.5} emissions. This means that 100% of the emissions are below 2.5 microns in diameter
VOC	0.272	AP-42 Boiler (ozone precursor)
NO_x	4	AP-42 Trench
CO	5.35	Average of AP-42 Boiler and Fountain Engineering
SO₂	0.1	AP-42 Trench Burner

Since the particulate matter emission factors (PM_{2.5} and PM₁₀) are greater than the other pollutants, particulate matter is the limiting pollutant. Since the PM₁₀ emissions include the PM_{2.5} emissions, the emission factors indicate 100% of the emissions are 2.5 micron diameter or less in size. The amount of fuel that is burned each year must produce less than 100 tons of particulate matter. In these examples, PM₁₀ emissions will be calculated.

$$99_{\text{tons PM10}} = (X_{\text{tons of fuel}} * 6_{\text{lb PM10/ton of fuel}}) / 2000_{\text{lb/ton}}$$

$$X_{\text{tons of fuel}} = (99_{\text{tons PM10}} * 2000_{\text{lb/ton}}) / 6_{\text{lb PM10/ton of fuel}}$$

$$33,000_{\text{tons of fuel}} \text{ produces } 99_{\text{tons PM10}}$$

Therefore, Colorado regulations allow 33,000 tons of woody debris per year to be burned in an air curtain destructor. This is the weight of pure wood without air. The gross volume of wood must take into account the wood type and how tightly packed a pile is. Gross volume calculations are also based on the shape of a pile.

The amount of fuel that can be burned in an ACD will vary depending on the size of the ACD unit, the diameter of the fuel, and the method of loading the unit. Use **Table II** to determine how many hours an ACD can be operated in a year based on various hourly throughputs of woody debris. The regulation allows units to operate up to 13 hours a day or a maximum of 4745 hours in a year. Therefore, at the 4 and 7 tons of fuel/hour rate the maximum number of hours of operation, not the pollutant emissions, are the limiting factor. For all other throughputs, the tons of particulate matter being emitted are the limiting factor for annual operations. It is possible that a particular device will operate at differing throughputs at various times. The throughput may vary based on the fuels that are being loaded, the method of

loading, or other factors. ACD units will come with the manufacturer’s recommended maximum throughput. In general, units are unlikely to be operated at the maximum throughput.

Hourly Throughput (tons of fuel/hour)	Emission Factor for PM₁₀ (lb / ton)	Tons PM₁₀ Emitted (per hour)	Max hours of operation in year	Days per year (assume 10 hour days)	Tons of PM₁₀ Emitted Annually
4	6	0.012	4,745*	365*	57
7	6	0.021	4,714**	362**	98.8
12	6	0.036	2,750	275	99
15	6	0.045	2,200	220	99
20	6	0.06	1,650	165	99

† **Throughput** is the amount of woody debris that is burned in a device, usually in one hour. Throughput depends on many factors, such as size of the ACD device, nature and type of fuel, its moisture content, prescribed opacity limits, operator skill, elevation of location, etc.

Tons PM₁₀ emitted per hour (for 4_{tons/hour}):

$$4_{\text{tons of fuel/hour}} * 6_{\text{lb PM}_{10}/\text{ton of fuel}} = 24_{\text{lb PM}_{10}/\text{hour}} / 2000_{\text{lb/ton}} = 0.012_{\text{tons/hour}}$$

Maximum Hours of Operation Calculation for 4_{tons/hour}:

$$99_{\text{tons PM}_{10} \text{ allowed each year}} / 0.012_{\text{tons pm}_{10}/\text{hour}} = 8,250_{\text{max hours of operation}}$$

* The maximum hours of operation allowed in the regulation is 4,745 per year. At a throughput of 4 tons/hr, the maximum number of hours allowed limits the fuel consumed, not the amount of fuel. Therefore operations at 4 tons/hr could be operated up to **13 hours per day** (maximum allowed in regulation) and 365 days per year without exceeding 99 tons of particulate matter (57 tons annual throughput).

** Operations at 7 tons/hr operated 13 hours per day and 365 days per year (4,745 hours per year) would emit 99.6 tons of particulate matter. Operations this close to the 100-ton limit would be scrutinized closely. Operations at 7 tons/hr could be operated 13 hours per day and **362** days per year without exceeding the 99 tons of particulate matter (98.8 tons annual throughput).

Since it is impractical, if not impossible, to weigh the fuel that will be disposed of in an ACD; the throughput (tons per hour) must be estimated. Fuel type, how compacted the piled fuels are, diameter of the fuels, and the shape of the piled fuels will affect the estimate of the throughput. Use the following tables and references to estimate the weight of the fuels that are disposed in the ACD.

Table III				
Annual Volume of Piled Fuel for Various Fuel Types				
Fuel Type	Wood Density¹ lb/ft ³ (from CONSUME)	Net Volume per Ton of Wood (ft ³ /ton of fuel)	Gross Fuel Volume per Ton of Fuel² (assumed 10% packing ratio)	Annual Limit: Gross Volume of Piled Fuel³ (ft ³)
Aspen	21.9	91.3	913 ft ³ /ton	30,129,000
Ponderosa	23.7	84.4	844 ft ³ /ton	27,852,000
Douglas fir	28.1	71.2	712 ft ³ /ton	23,496,000
<p>Example Calculations for Aspen:</p> <p>Net Volume per Ton of Wood ft³ /ton of aspen = $2000 \text{ lb} / 21.9 \text{ lb/ft}^3 = 91.3 \text{ ft}^3$ of aspen wood weighs one ton</p> <p>Gross Fuel Volume per Ton of Fuel= $91.3 \text{ ft}^3 / 0.10 = 913 \text{ ft}^3$ outer dimensions of piled aspen , weighs 1 ton</p> <p>Annual Gross Volume of Piled Fuel= $99 \text{ tons PM}_{10}/\text{year} * 2000 \text{ lb/ton} = 198,000 \text{ lbs PM}_{10}/\text{year}$ $198,000 \text{ lbs PM}_{10}/\text{year} / 6 \text{ lbs/ton of fuel} = 33,000 \text{ tons of fuel max per year}$ $33,000 \text{ tons of fuel} * 913 \text{ ft}^3/\text{ton of fuel} = 30,129,000 \text{ ft}^3$ of aspen will produce 99 tons of PM₁₀</p>				
<p>¹ Fuel densities used in CONSUME for fuel compacted into a solid.</p> <p>² Packing ratio of 10% is one of the values for piles offered in CONSUME, this would be typical of small diameter fuels that WUI projects would generate. Piles consisting of large diameter fuels and/or highly compacted piles may have packing ratios as high as 25%. With a higher packing ratio, the gross volume of a pile of aspen would be less ($365 \text{ ft}^3/\text{ton}$ for a 25% packing ratio).</p> <p>³ Based on a limit of 99 tons of particulate matter per year</p>				

The gross fuel volume in the above table does not indicate the shape of a pile of fuel. A pile of fuel 913 ft³ in volume would be the amount of fuel that would fill a cube approximately 9.7ft on each side. Piled in a paraboloid shape (shape code 2 in reference), as an example, this is approximately 17 feet in diameter and 8 feet tall. This volume of fuel would also be a windrow (shape code 3) of approximately 12 ft wide by 6 ft high by 16 ft long³.

Another way of estimating how much fuel can be burned in the ACD unit in one year is by looking at how much fuel can be burned in one hour at various hourly throughputs. This may be an easier method to visualize, but the operator will need to keep track of approximate hourly throughputs for each of the hours of operation throughout the year.

³ **Hardy, Colin C. 1996.** Guidelines for Estimating Volume, Biomass, and Smoke Production for Piled Slash. General Technical Report, PNW-GTR-364. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Station.

Table IV
Estimated Dimensions of Piled Fuel Based on Hourly Throughput¹

Hourly Throughput & Fuel Type	Hourly Net Volume of Fuel (ft ³)	Hourly Gross Volume of Fuel Based on Common Pile Shapes ²	
		Shape 2 Parabaloid (w x h in ft)	Shape 3 Windrow (w x h x l in ft)
4 tons of fuel/hr			
Aspen	3,652	24.1 x 16	16 x 8 x 36.3
Ponderosa	3,376	23.2 x 16	16 x 8 x 33.6
Fir	2,848	21.3 x 16	16 x 8 x 28.3
7 tons of fuel/hr			
Aspen	6,391	30 x 18	16 x 8 x 63.6
Ponderosa	5,908	28.9 x 18	16 x 8 x 58.8
Fir	4,984	26.5 x 18	16 x 8 x 49.6
12 tons of fuel/hr			
Aspen	10,956	37.3 x 20	16 x 8 x 109
Ponderosa	10,128	36 x 20	16 x 8 x 100.7
Fir	8,544	32.9 x 20	16 x 8 x 85

Calculations for Aspen @ 4 tons of fuel/hr:

Hourly Net Volume= 4 tons of fuel/hr * 913 ft³ /ton = 3,652 ft³ of aspen

Shape code 2 equation:

$V = \pi h w^2 / 8$ or see Table 1 in reference

$w = \sqrt{(V * 8) / (h * \pi)}$

$w = \sqrt{(3,652 * 8) / (16 * 3.14)}$

$w = \sqrt{(29,216 / 50.26)}$

$w = \sqrt{(581.2)}$

$w = 24.1 \text{ ft}$

Shape code 3 equation:

$V = \pi w l h / 4$ or see Figure 5 nomagram in reference

$l = (V * 4) / (\pi * w * h)$

$l = (3,652 * 4) / (3.14 * 16 * 8)$

$l = 14,608 / 402$

$l = 36.3 \text{ ft}$

¹ Three throughput rates and two common pile shapes are presented in this table as examples. See Colin Hardy’s publication (listed below) to calculate the volume of other sizes and shapes of piled material. The numbers in the above table can also be adjusted proportionately to obtain allowable pile dimensions for other throughputs.

² **Hardy, Colin C. 1996.** Guidelines for Estimating Volume, Biomass, and Smoke Production for Piled Slash. General Technical Report, PNW-GTR-364. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Station.