

<b>Description</b>	<p>Oil/water separators are multi-chambered devices designed to remove hydrocarbons from stormwater runoff as it moves through the device. Three variations are presented in this manual:</p> <p>Spill control (SC) separators are the least expensive and complex of the three. The device is a simple underground vault or manhole with a “T” outlet designed to trap small spills.</p> <p>American Petroleum Institute (API) separators are long vaults with baffles designed to remove sediment and hydrocarbon loadings from urban runoff. Large API separators may include sophisticated mechanical equipment for removing oil from the surface and settled solids from the bottom. Note: Many studies conducted on the east coast refer to this multi-chambered (generally three chambers) design with baffles as a “water quality inlet.”</p> <p>Coalescing plate (CP) separators include a series of parallel inclined plates to encourage separation of materials of different densities. The plates are typically made of fiberglass or polypropylene and are closely spaced to improve the hydraulic conditions in the separator and promote oil removal.</p>								
<b>Applications</b>	<p>Oil/Water separators have limited application in stormwater treatment because their treatment mechanisms are not well suited to the characteristics of stormwater runoff (i.e., highly variable flow with high discharge rates, turbulent flow regime, low oil concentration, high suspended solids concentration). In addition, separators can require intensive maintenance, further restricting their desirability as a stormwater treatment BMP. The primary use of oil/water separators will be in cases where oil spills are a concern. Their inclusion in these guidelines is merely to provide as wide a range as possible of stormwater BMPs. While the use of oil/water separators may be appropriate for high traffic areas such as multi-family dwellings and apartment complexes, the decision to use an oil/ water separator should be made on a case-by-case basis.</p> <p>If an oil/water separator is to be used for treatment, it should be located off-line from the primary conveyance/detention system. The contributing drainage area should be completely impervious and as small as necessary to contain the sources of oil. Under no circumstances should any portion of the contributing drainage area contain disturbed pervious areas that can be sources of sediment.</p>								
<b>Limitations</b>	<table><tr><td data-bbox="467 1646 836 1684">Drainage area – 1 ac.</td><td data-bbox="943 1646 1153 1684">Max slope – 15%</td></tr><tr><td data-bbox="467 1684 836 1722">Minimum bedrock depth – 8 ft</td><td data-bbox="943 1684 1266 1722">Minimum water table – 8 ft</td></tr><tr><td data-bbox="467 1722 836 1759">NRCS soil type – A, B, C</td><td data-bbox="943 1722 1153 1759">Freeze/thaw – fair</td></tr><tr><td data-bbox="467 1759 836 1785">Drainage/flood control – no</td><td></td></tr></table>	Drainage area – 1 ac.	Max slope – 15%	Minimum bedrock depth – 8 ft	Minimum water table – 8 ft	NRCS soil type – A, B, C	Freeze/thaw – fair	Drainage/flood control – no	
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**Targeted  
Pollutants**

Sediment – 15%  
Phosphorus – 5%  
Trace metals  
Hydrocarbons

**Design  
Parameters**

The following design parameters apply to all three separator types:

- Separators should precede all other stormwater treatment.
- Appropriate removal covers should be provided that allow access for observation and maintenance.
- Stormwater from building rooftops and other impervious surfaces are not likely to be contaminated by oil and should not be discharged to the separator.
- Any pump mechanism should be installed downstream of the separator to prevent oil emulsification.

Additional requirements for API and CPS separators:

- Separators should be sized for the water quality design storm (one-third of 2-year event). Larger storms should not be allowed to enter the separator; the use of an isolation/diversion structure is recommended.
- Separators should have a forebay to collect floatables and the larger settleable solids. Its surface area should not be less than 20 square feet per 10,000 square feet of the area draining to the separator.

The following are additional requirements for CPS separators:

- Plates should not be less than 3/4 inch apart.
- The angle of the plates should be from 45 to 60 degrees from the horizontal.
- Absorbent pillows may be used in separators. For API and CPS-type separators they should be placed in an afterbay. With the SC separator, absorbent materials should be placed in the manhole/vault. Used absorbent pillows will need to be properly disposed of.

**Sizing Procedure**

Oil droplets exist in water in a wide distribution of sizes. The separator, therefore, is sized to remove all droplets of particular size and greater that will ensure that sufficient oil is removed to achieve the effluent standard.

API separators are usually sized to remove oil droplets 150 micron in size and larger. Smaller droplets rise so slowly as to require a relatively large vault. CPS separators are commonly sized to remove 60 or 90 micron and larger oil droplets.

There are no data on the size distribution of dispersed oil in stormwater from commercial or industrial land uses with the exception of petroleum projects storage terminals. These data indicate that, by volume, about 80% of the droplets are greater than 90 micron. Less than 30% are greater than 150 microns. For these guidelines, both the API and CPS separator are sized to remove 60 microns and larger droplets at a temperature of 10 °C giving a rise rate of 0.033 feet per minute (10 millimeters). The requirement for treatment of 60 micron and larger sized droplets may preclude the use of API separators.

### API-Separator Sizing

API separators are sized using these general guidelines:

- Horizontal velocity: 3 feet per minute or 15 times the rise rate whichever is smaller (rise rate of 0.033 feet per minute is recommended)
- Depth of 3 to 8 feet
- Depth to width ratio of 0.3 to 0.5
- Width of 6 to 16 feet
- Baffle height to depth ratios of 0.85 for top baffles and 0.15 for bottom baffles

The separator is first sized for depth using the equation:

$$\text{Depth} = (Q/2V_h)^{.5}$$

Where,

Q = design flow (cfm)

V<sub>h</sub> = design horizontal velocity ft/min = 0.50 (15 times 0.033)

Calculate the width using the above ratios (i.e., 0.3 to 0.5 depth-to-width ratio).

Then calculate length using the equation:

$$\text{Length} = \text{depth/rise rate} * V_h = [(Q/2V_h)^{.5}/0.033] * 0.50$$

### CPS-Separator Sizing

Calculate the projected (horizontal) surface area of plates required using the following equation:

$$A_p = Q/\text{rise rate}$$

where,

A<sub>p</sub> = projected surface area of the plate (ft<sup>2</sup>); note that the actual surface area, A<sub>s</sub> = A<sub>p</sub> \*

cosine(H)

H = angle of the plates with the horizontal in degrees, usually varies from 45-60 degrees

Q = design flow (cfm)

Rise rate = recommend using 0.033 ft/min

Manufacturers of plate packs provide standard size packages that are rated at a particular flow (usually gallons per minute). However, as the manufacturer's flow rating is for conditions different than used above, the engineer should compare the plate surface area with the above calculation. Do not confuse projected plate area with actual plate area.

The width, depth, and length of the plate pack and the chamber in which the plate pack is placed is completely flexible and is a function of the plate sizes provided by the particular pack manufacturer and standard size vaults that are available for small sites.

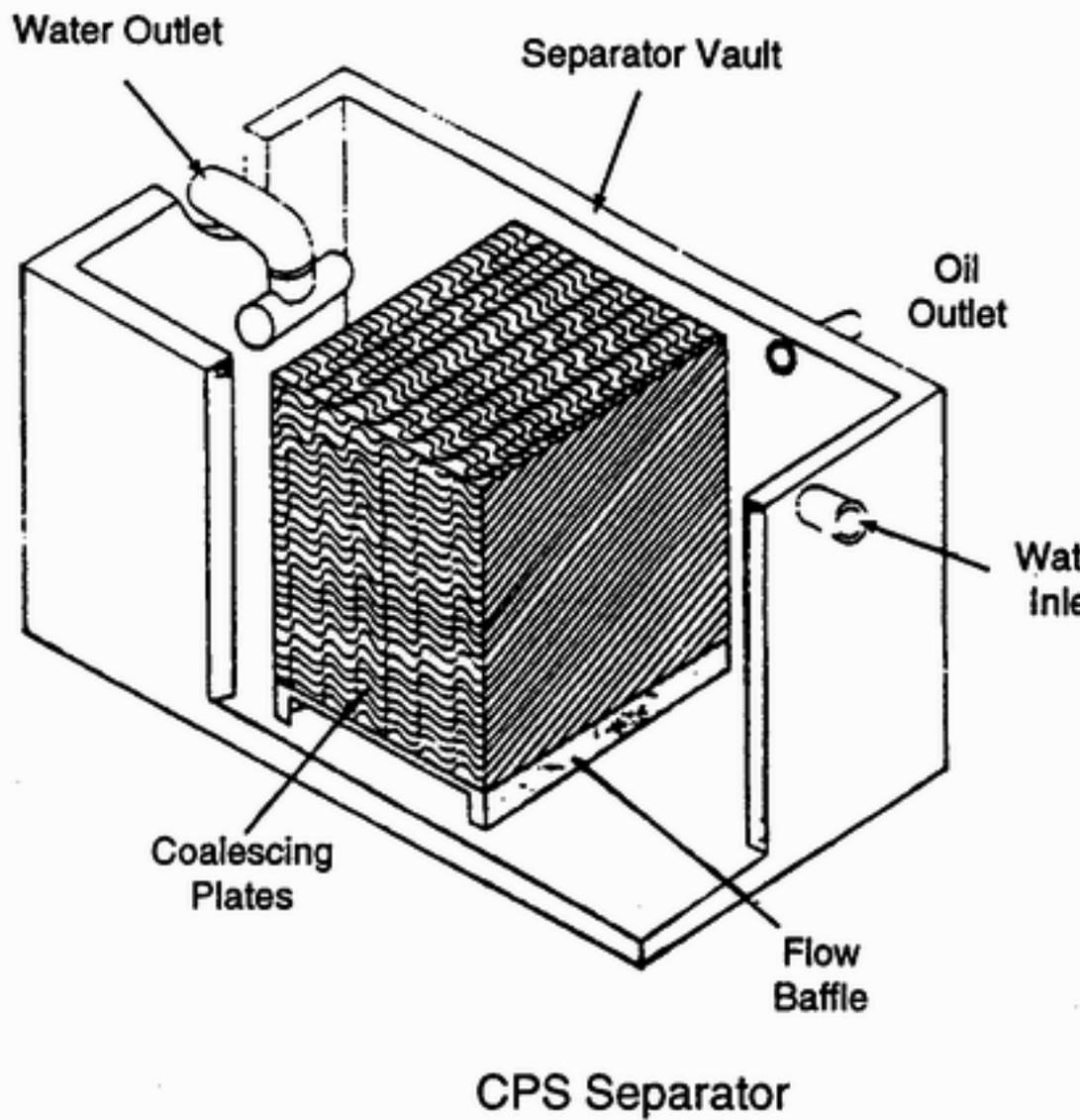
Refer to the King County Surface Water Management Manual for additional design and sizing details.

### Maintenance

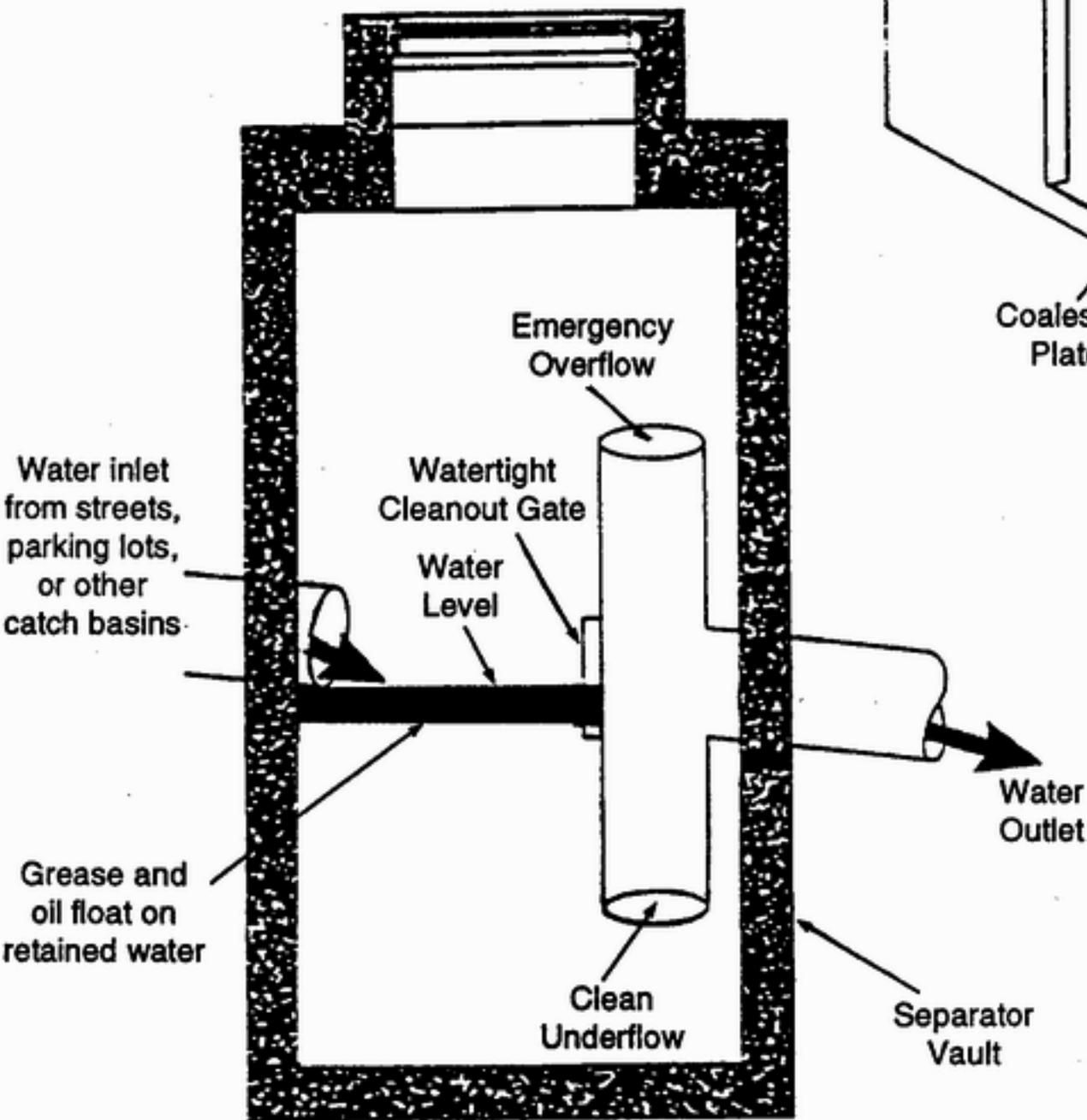
- Oil/water separators should be cleaned frequently to keep accumulated oil

from escaping during storms. As a rule of thumb, they should always be cleaned by mid-October to remove material that has accumulated during the dry season, and again after a significant storm.

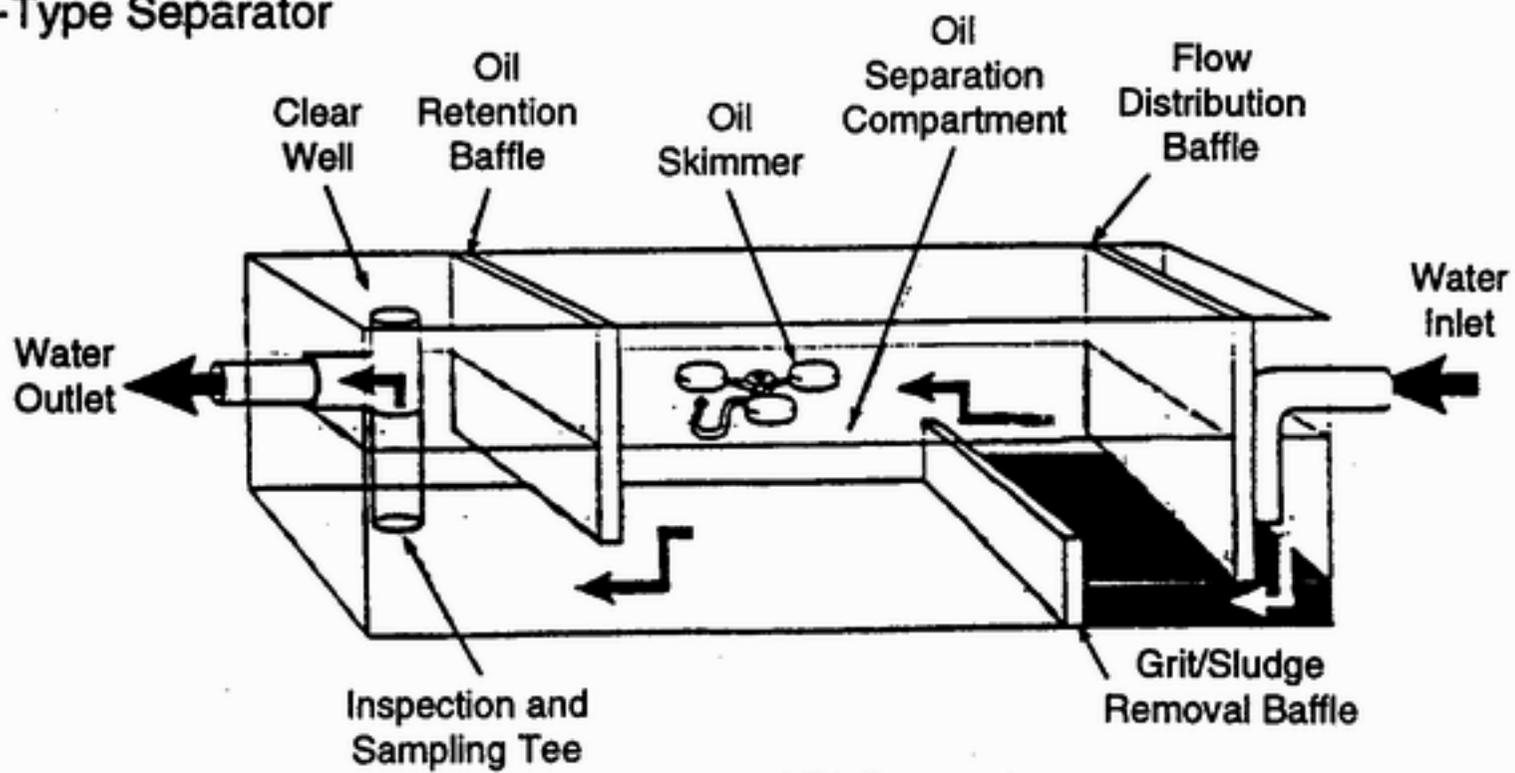
- The owner should inspect the facility weekly.
- Oil absorbent pads are to be replaced as needed but should always be replaced in the fall prior to the wet season and in the spring.
- The effluent shutoff valve is to be closed during cleaning operations.
- Waste oil and residuals should be disposed in accordance with current local government health department requirements.
- Any standing water removed during the maintenance operation should be disposed to a sanitary sewer at a discharge location approved by the local government.
- Any standing water removed should be replaced with clean water to prevent oil carry-over through the outlet weir or orifice.



CPS Separator



SC-Type Separator



API Separator