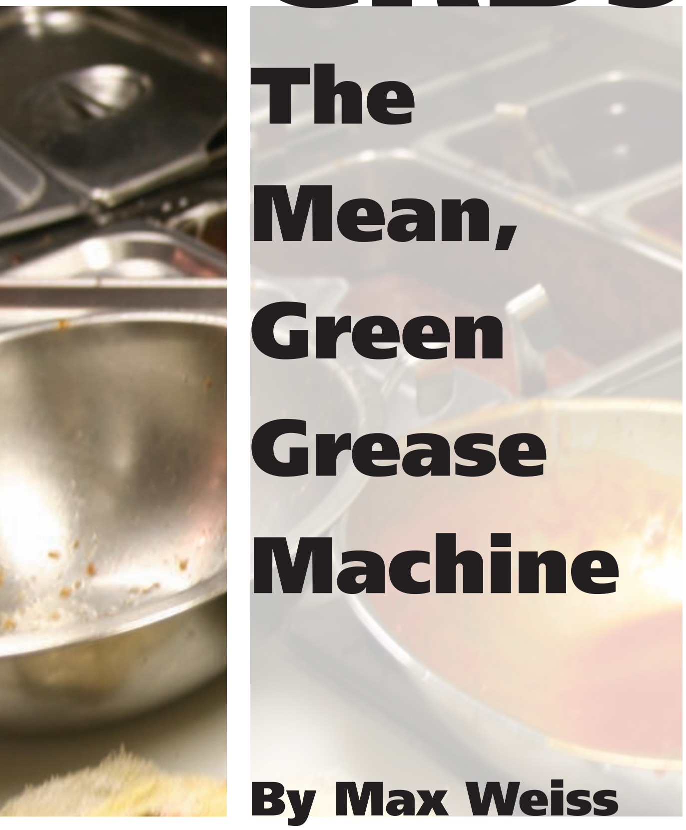
GRDs

The Mean, Green Grease Machine

By Max Weiss



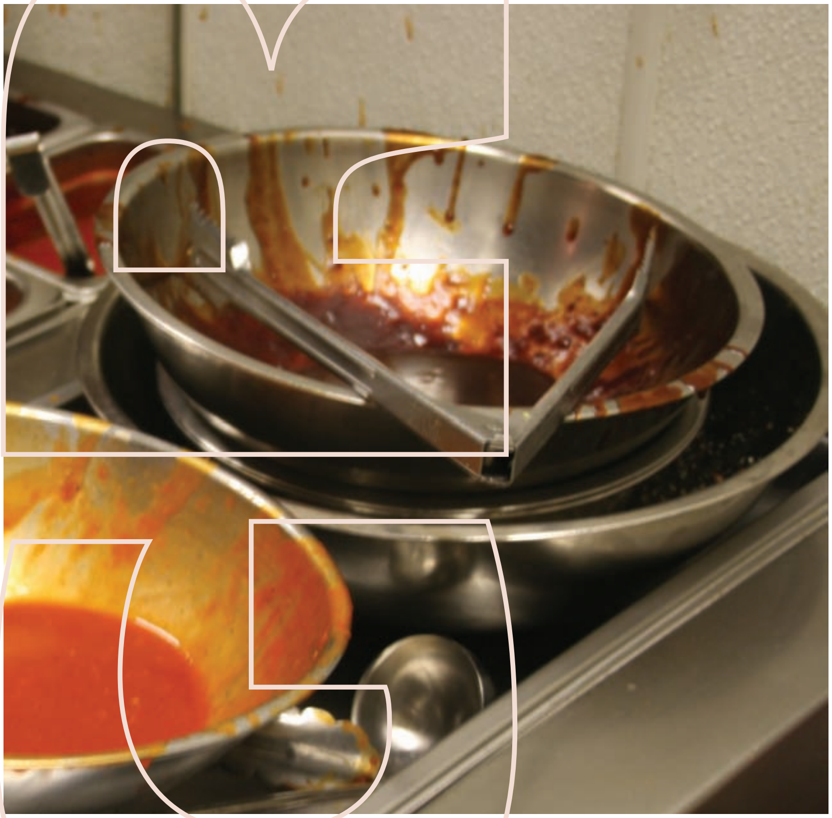


Photo by David Ropinski

Today, the country is experiencing historically high demand for alternate sources of transportation fuel and a green movement, previously known as conservation. There also is increasing concern by pretreatment authorities over poor maintenance of grease interceptors. Grease removal devices (GRDs, see Figure 1), sometimes referred to as automatic grease removal devices, are uniquely capable of efficiently meeting each of these interrelated issues.

NOMENCLATURE

What is a grease removal device? According to ASME A112.14.4: *Grease Removal Devices*, a GRD is "a plumbing appliance that is installed in the sanitary drainage system in order to intercept free-floating fats, oils, and grease from wastewater discharges. Such equipment operates on a time- or event-controlled basis and has the ability to remove the entire range of commonly available free-floating fats, oils, and grease automatically without intervention from the user except for maintenance. The removed material is essentially water-free, which allows for recycling of the removed product."

As with many other devices in the grease attenuation arena, precision and uniformity of nomenclature are lacking regarding GRDs. Not unlike the grease trap/interceptor problem, this lack of uniformity often leads to inadequate installations. Depending on the document referencing a grease removal device, the term could mean virtually anything intended to separate grease from water. The term frequently is used in a general sense in local ordinances and some statutes.

A GRD is a hydromechanical grease interceptor (HGI). Unlike a gravity grease interceptor or a conventional hydromechanical interceptor, a GRD must have automatic means to remove the grease. To be certified as a GRD, the device first must pass the separation and retention efficiency requirements of an HGI (ASME A112.14.3: *Grease Interceptors*) and then must pass the test requirements of ASME A112.14.4.

Nothing would prevent a GRD extraction mechanism from being attached to a gravity grease interceptor; however, testing to the standards with such an arrangement likely would prove unworkable. Therefore, the device specifically defined in the ASME A112.14.4 standard is the topic of this article.

GREASE INTERCEPTORS DEFINED

Uniform Plumbing Code (2006), Section 210.0: Hydromechanical Grease Interceptor—A plumbing appurtenance or appliance that is installed in a sanitary drainage system to intercept nonpetroleum fats, oils, and grease (FOG) from a wastewater discharge and is identified by flow rate and separation and retention efficiency. The design incorporates air entrainment, hydromechanical separation, interior baffling, and/or barriers in combination or separately, and one of the following:

- External flow control, with air intake (vent), directly connected
- External flow control, without air intake (vent), directly connected
- Without external flow control, directly connected
- Without external flow control, indirectly connected

Uniform Plumbing Code (2006), Section 209.0: Grease Removal Device (GRD)—Any grease interceptor that automatically, mechanically removes nonpetroleum FOG from the interceptor, the control of which may be either automatic or manually initiated.

ASME A112.14.4: *Grease Removal Devices*—A GRD is a plumbing appliance that is installed in the sanitary drainage system in order to intercept free-floating FOG from wastewater discharges. Such equipment operates on a time- or event-controlled basis and has the ability to remove the entire range of commonly available free-floating FOG automatically without intervention from the user except for maintenance. The removed material is essentially water-free, which allows for recycling of the removed product.

Uniform Plumbing Code (2006), Section 209.0: Gravity Grease Interceptor—A plumbing appurtenance or appliance that is installed in a sanitary drainage system to intercept nonpetroleum FOG from a wastewater discharge and is identified by volume, 30-minute retention time, baffle(s), a minimum total volume of 300 gallons, and gravity separation. (These interceptors comply with the requirements of Chapter 10 or are designed by a registered professional engineer.) Gravity grease interceptors generally are installed outside.

Figure 1 Grease removal device

Source: Jay R. Smith Manufacturing Co.

HISTORY

Various forms of automatic units have been patented over the years. The earliest models date to 1936 and were based on HGIs as they are today.

Though the GRD device long preceded a consensus standard, it currently is prescribed by ASME A112.14.4, an ANSI consensus standard, and is referenced in the 2006 editions of the Uniform Plumbing Code and International Plumbing Code.

Most early designs relied on gravity draw-off schemes activated by vertical displacement. These sometimes were assisted by surface weirs or discharge valves and water to raise the static water level, causing floating grease to flow out through a conduit to a receiving container.

The petroleum industry utilized the concept of mechanically removing collected oil from water earliest and most extensively. The design incorporates a band, belt, or rope rotating around an upper and lower pulley arrangement, with the lower pulley submerged in the vessel. The rising belt carries the oil up to a wiper or compression mechanism, discharging the oil to a receiving container. This design persists to this day because of its simplicity and the low water content in the extracted oil.

PRINCIPLES OF OPERATION AND PERFORMANCE TESTING

Initial separation and retention of fats, oils, and grease (FOG) from influent wastewater from food service establishment wastewater discharge is the same as a conventional HGI and must be at a minimum efficiency of 90 percent as tested in accordance with either PDI-G101: *Testing and Rating Procedure for Hydromechanical Grease Interceptors* or ASME A112.14.3. Separation is by application of the hydromechanical forces of counterflow, diversion, and entrained air to assist separation. This causes the less dense material to rise in the vessel more rapidly than by gravity alone. The separated FOG is retained, usually by various baffle arrangements, in a quantity of at least 2 pounds for each gallon per minute (gpm) rated flow (i.e., 50 gpm requires 100 pounds of retention). Most designs retain significantly more than the minimum required by the protocols. All designs are tested for separation and retention requirements with the extraction function disabled.

Modern GRD designs employ various extraction methods such as weirs with drain off; weirs with pump; rotating drums made of oliophilic material such as stainless steel or polymerics with wipers to remove adhering FOG; rotating discs operating similarly to the drum style; pulley-belt designs as described above; and on large commercial applications, dissolved air and skimmers.

Most designs use submerged heaters to ensure that the captured FOG is in liquid form to maximize removal efficiency. The removal function (i.e., the transfer of captured FOG to a container) is activated by timer, load retention measuring device (sensor), or manually on a schedule or as perceived necessary.

Testing of the extraction function and certification of performance is pursuant to the protocol prescribed in ASME A112.14.4. Generally speaking, the unit must extract at a rate such that the retained grease does not exceed the unit's rated capacity, and the extracted grease must contain no more than 5 percent water.

SIZING

As with other HGIs, the peak discharge velocity from any facility must be accurately calculated to ensure that no flow velocity exceeds the device's rating. Excessive velocity will cause scouring and pass-through, thereby defeating the purpose of installation.

Figure 2 Hydromechanical interceptor sizing using fixture capacity

The calculation of fixture capacity is as follows:

$$\frac{\text{Length} \times \text{Width} \times \text{Depth}}{231} = \frac{\text{Gallons} \times 0.75 \text{ fill factor}}{\text{Drain period (1 or 2)}}$$

Add hydrant capacity (gpm supply). Add rated appliances such as dishwasher or water wash hood at manufacturer ratings.

Example

Fixture Compartment Size (inches)	Compartments	Load (gallons)	Recommended Interceptor Size	
			One-minute period	Two-minute period
24 × 24 × 12	2	44.9	50	25

Figure 3 Hydromechanical interceptor sizing using pipe size

Pipe Diameter (inches)	At ¼-inch Slope/Foot[1]	Full Pipe Flow, Nominal (gpm)[2]	Interceptor Size, One-minute Drain, Nominal (gpm)	Interceptor Size, Two-minute Drain, Nominal (gpm)
2	0.250	19.44	20	10
3	0.250	58.67	75	35
4	0.250	125.77	150	75
5	0.250	229.75	250	125
6	0.250	375.47	500	250

[1] Inches drop per foot of run

[2] Based on Mannings Formula with friction factor N = 0.012; Cast Iron Soil Pipe and Fittings Handbook, Chapter 8: "Flow Theory and Capacity," Cast Iron Soil Pipe Institute

Sizing calculations must contain verifiable dimensions and mathematical methods. Mathematical averaging devices such as drainage fixture units and arbitrary size statements by administrative bodies are not acceptable methods of sizing if the device is to be installed and operated in accordance with the certification of performance of PDI-G101 or ASME A112.14.3.

The following two methods of determining peak flow expressed in gallons per minute produce empirical results that are reproducible by anyone applying the same methods.

1. Measure the volume of all connected fixtures capable of holding water and convert to gallons, adding manufacturer rated flows such as from exhaust hoods and warewashers as illustrated in Figure 2. Volume is expressed in gallons. Volumetric flow rate is expressed in gallons per minute.

   Then add faucet flows. The total is the amount capable of flowing from the facility's connected fixtures. Divide that amount by two if the flow is controlled by flow control to two-minute drain duration. It is very important to distinguish between flow controls and flow restrictors. Whichever device is used by the manufacturer to establish flow duration, the manufacturer's installation requirements must be followed precisely. Flow control devices are not interchangeable between interceptor manufacturers; the device is integral to the interceptor. The gpm obtained simply is matched to the proper interceptor according to its rated flow. Note: While calculation at one minute is the arithmetic norm, all testing and certifications are conducted at two-minute flows; conversion for jurisdictional differences is elementary.

2. In a case where the fixtures to be connected are not known, such as new construction or remodel, measure the diameter and total slope of the pipe to be connected to the interceptor. Then either calculate the maximum gpm that pipe will carry at full flow, or refer to a engineering manual flow table, such as one published by the Cast Iron Soil Pipe Institute. (See Figure 3.) That number is the maximum flow the facility can produce with that pipe configuration. Divide the number by two if the flow is controlled to two-minute drain duration. Once again, the gpm obtained is simply matched to the proper interceptor according to its rated flow.

APPLICATION

GRDs should be installed as close as possible to the last contributing fixture, air-injecting flow control at the highest invert elevation following the last connected fixture, and no more than 10 feet total unbroken inlet head. Interceptors should be installed where they can be easily serviced and, in the case of a GRD, where the FOG-receiving vessel is easily observed and accessed for emptying.

Solids interceptors, if required by the manufacturer, should be installed at each solids-generating fixture or immediately following the last connected fixture. Placing solids interceptors in remote machinery spaces or with high inlet head elevations is not advised.

Food waste grinders must not be connected to HGIs or GRDs.

OPERATION AND MAINTENANCE

GRDs are no different than HGIs when considering daily operation in the kitchen environment, with one major exception: At the end of a shift or day, it is not necessary to remove the lid and extract the captured FOG from that period's operation. The GRD will have automatically, by timer, content monitor, or manual initiation, transferred the captured FOG to a container for clean, easy emptying into a proper disposal container.

Just as with an HGI or gravity grease interceptor, training on and implementation of best management practices for the control of drain-borne solids and FOG are the best maintenance tools in the kitchen. Frequent attention (more than once a shift) to the solids interceptor will help ensure that the contents aren't solubilized and passed into the interceptor or allowed to generate noxious odors from decomposition.

Thorough periodic system inspection and cleaning are necessary to ensure dependable operation. Each facility will have differing service interval requirements depending on the nature of the operation.

FOG DISPOSAL

There are nearly as many misconceptions surrounding the disposal of FOG as there are regarding interceptors. Important to understanding FOG is knowing the difference between yellow grease and brown grease.

Yellow grease, basically, is grease that has not been in contact with water. Yellow grease comes mainly from fryers and cook-line pour off. Recycling opportunities for yellow grease are numerous, including human contact products, pet food, and biofuels. Feeding to animals in the human food chain is now prohibited because of connections to BSE (mad cow disease). Many pet food manufacturers are following suit. The dominant post-use of yellow grease is now the production of biofuels such as biodiesel.

Brown grease disposal historically involved many of the products above until advancement in scientific knowledge made it clear that human, livestock, and pet consumption and contact are very risky. Reputable renderers will not accept waste grease containing brown grease. Besides containing varying quantities of unknown substances, brown grease, having been in contact with water and cleaning chemicals, does not have a predictable molecular structure. Without going into great detail about lipid molecules, suffice it to say that the ratio of glycerine to fatty acids in brown grease varies widely. These facts have made brown grease very difficult to dispose of, and tipping fees for disposal are still quite high in some areas.

A couple of recent reforming processes (one hydrothermal based, the other plasma based) take waste carbon compounds and turn them into various forms of fuel, refinery feedstock, and electrical energy. Both of these processes are effective at converting FOG. Although both processes were invented in the United States, adoption of the processes in this country has been slow due to comparatively low petroleum prices, recent history notwithstanding. Some pioneering U.S. installations are underway and further, more rapid development should follow.

SYNERGY OF GRDs

GRDs, more than any other type of grease interceptor, are receiving increased attention by regulating authorities and food service establishment operators because of reduced maintenance requirements (e.g., training), resulting in less FOG escaping to the collection system and treatment works.

Two convening factors make a GRD interceptor the new, mean, green grease machine. One is the energy opportunity described above. Second is the chemical evolution of FOG itself.

Today's FOG is comprised of more modified vegetable oils—such as zero trans-fatty acid varieties—than animal and dairy fats of the past. The traditional FOG composition is susceptible to hydrolysis, the process by which water breaks down the FOG molecular structure, releasing glycerin and fatty acids. However, new, modified vegetable oils react more quickly to contact with water and begin dropping glycerin almost immediately.

Glycerin, once separated from the FOG molecule, has a specific gravity greater than water, so it won't float and isn't retained by the interceptor. It escapes to the collection system, providing carbon for bacteria. pH drops at deposition sites and interceptor bottoms, accelerating corrosion.

The fatty acids remaining in the interceptor have a lower pH than the unmodified molecule, accelerating halo corrosion at the static water line in interceptors. The divorced fatty acids of modified oils have a greater affinity for places where oxygen is available, such as iron oxide in collection systems and lift station pumps where fatty acid deposits are chemically bonded rather than simply mechanically attached.

Because of the changing molecular structure of FOG, the need, from a pollution prevention perspective, to quickly remove separated FOG from the interceptor is greater than ever before. The rewards of continuous FOG removal are greater pollution prevention, reduction of the need for special receiving and processing equipment for FOG disposal at wastewater treatment plants, and a product more suitable for new energy opportunities. The GRD type of interceptor fills the bill on both counts. PSD

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