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Technical Reference

CBW® Tunnel Washer Water Flow and Chemical Injection

Read the separate safety manual before installing, operating, or servicing

PELLERIN MILNOR CORPORATION POST OFFICE BOX 400, KENNER, LOUISIANA 70063-0400, U.S.A.

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MATCBWPFAE/18103A

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LIMITED STANDARD WARRANTY

We warrant to the original purchaser that MILNOR machines including electronic hardware/software (hereafter referred to as "equipment"), will be free from defects in material and workmanship for a period of one year from the date of shipment (unless the time period is specifically extended for certain parts pursuant to a specific MILNOR published extended warranty) from our factory with no operating hour limitation. This warranty is contingent upon the equipment being installed, operated and serviced as specified in the operating manual supplied with the equipment, and operated under normal conditions by competent operators.

Providing we receive written notification of a warranted defect within 30 days of its discovery, we will at our option repair or replace the defective part or parts, FOB our factory. We retain the right to require inspection of the parts claimed defective in our factory prior to repairing or replacing same. We will not be responsible, or in any way liable, for unauthorized repairs or service to our equipment, and this warranty shall be void if the equipment is tampered with, modified, or abused, used for purposes not intended in the design and construction of the machine, or is repaired or altered in any way without MILNOR's written consent.

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BIUUUD19 (Published) Book specs- Dates: 20081231 / 20081231 / 20081231 Lang: ENG01 Applic: UUU

How to Get the Necessary Repair Components

This document uses Simplified Technical English.
Learn more at http://www.asd-ste100.org.

You can get components to repair your machine from the approved supplier where you got this machine. Your supplier will usually have the necessary components in stock. You can also get components from the Milnor® factory.

Tell the supplier the machine model and serial number and this data for each necessary component:

- The component number from this manual
- The component name if known
- The necessary quantity
- The necessary transportation requirements
- If the component is an electrical component, give the schematic number if known.
- If the component is a motor or an electrical control, give the nameplate data from the used component.

To write to the Milnor factory:

Pellerin Milnor Corporation
Post Office Box 400
Kenner, LA 70063-0400
UNITED STATES

Telephone: 504-467-2787
Fax: 504-469-9777
Email: parts@milnor.com

— End of BIUUUD19 —

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AutoSpot™	GreenTurn™	Milnor®	PulseFlow®
CBW®	GreenFlex™	MilMetrix®	PurePulse®
Drynet™	Hydro-cushion™	MilTouch™	Ram Command™
E-P Express®	Linear Costa Master™	MilTouch-EX™	RecircONE®
E-P OneTouch®	Linear Costo™	Miltrac™	RinSave®
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Dealer Bulletin

PELLERIN MILNOR CORPORATION
P.O. Box 400, Kenner, LA 70063

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Dealers
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DEALER BULLETIN # B22DB02001 All
Update A
Revised April 27, 2012

Subject: Update to B22DB02001 Stainless Steel Is Corrosion Resistant NOT Corrosion Proof

The attached referent bulletin introduced the key concepts to prevent corrosion issues by maintaining a Healthy Tunnel Washing Profile. In this update to the Bulletin, we are bringing forward additional best practice ideas that have been derived during the years since the issuance of that original bulletin.

1) Sour Selection - We want to clarify that neither the original bulletin nor this update prohibits the use of any sours. It is just that some sours need more attention than others. We cited potential issues when improperly using certain sours especially when intermixed in any way with chlorine bleach. If corrosion occurs then it is necessary to correct the cause. Please again refer to the original bulletin regarding Healthy Tunnel Profile. This is extremely important as many states and municipalities restrict the types of sours, especially phosphoric acid, that may be discharged.
   Using one of the more aggressive sours requires paying STRICT attention to the proper profile along with additional steps listed in this update bulletin.

2) Sour must be injected below the water line.

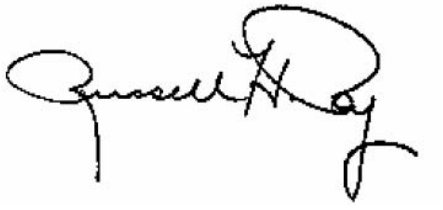
3) Venting - The absolute best practice is to segregate the vents of the bleach zone and sour modules. Powered ventilators add another layer of security to prevent vapor interaction between bleach and sours. This is explained in document BIPCUI02 “Connecting Ancilliary Equipment and Services,” which is part of the installation manual for the CBW® tunnel washer.

4) Chlorine in the wash liquor must be completely neutralized prior to the rinse zone modules.

5) If you see corrosion, fix it. Don’t let it go unattended. We pointed this out in the original bulletin and suggested some methods of remediating corrosion on stainless steel.

Sincerely,

PELLERIN MILNOR CORPORATION



Russell H. Poy Vice President – Product Development

Dealer Bulletin

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All Dealers

Dealer Bulletin B22DB02001
September 9, 2002

Subject: Stainless Steel Is Corrosion Resistant NOT Corrosion Proof!

A few of our CBW washer customers have recently asked our advice concerning corrosion appearing at the discharge end of the tunnel and on certain parts of presses or extractors. Although our expertise is in machinery design and manufacture rather than chemicals and metallurgy, we did investigate the situation and, in conjunction with an expert in corrosion, have come up with some suggestions for preventative measures to render the system as corrosion resistant as possible.

It's important to be vigilant in maintaining a "Healthy Tunnel Washing Profile" described below. Many chemical products used improperly or misused can cause problems. Coupled with a Tunnel Washer that is operated improperly, there are arrays of problems that can manifest and compound. A Healthy Tunnel Washing Profile includes:

1. Proper supply water quality.
2. Industry standard quantity and method of injecting chemicals.
3. Proper water flow in each zone – Refer to "Quick Guide for Setting Counterflow in Milnor CBW Washers" (Attachment A).
4. Proper Levels in each module – Refer to "Quick Guide For Setting Weir Plates & Level Switches On Milnor CBW Washers" (Attachment B).
5. Proper temperature in each zone.
6. Proper pH.
7. No intermixing of sours and bleaches.

Chemical products commonly found in the laundry industry when utilized in **established** dosages and proper tunnel operating parameters under the auspices of an experienced tunnel chemical specialist will produce satisfactory results and no consequential detrimental effects.

It is not the steel!

Improper laundering process conditions can destroy the corrosion resistance of stainless steel. Stainless steel provides resistance to corrosion because of its capacity to be passivated. In simple terms, most scientists explain that a protective oxide film acts as a barrier between the metal and its environment (Handbook of Stainless Steels, Peckner and Bernstein, 1977).

Pitting and stress corrosion cracking can occur when the conditions of the wash liquor break down the passive layer of the steel. These conditions are well known, some of which are: high concentrations of chlorine bleach, improper (low) pH, iron-laden process water, corrosive supply water, and reactions of sours and bleach.

Milnor has manufactured washer-extractors and tunnel washers with the same stainless steel specification since our founding. Every batch of steel we use is certified and documented by the steel mill. We tested samples of the stainless after reports of corrosion. Every instance has proven the steel to be well within the AISI 304 specification.

Corrosion is a complex, multifaceted problem. When some or all of the following factors come into play together, corrosion has occurred.

- **Carboy strength bleach and sours are now routinely directly injected into machines.**

  Even though the chemicals may be injected below the water line, localized chemical reactions may cause corrosive conditions. **Injections must be flushed with water.** Make sure fittings connecting chemical supply lines are not leaking.

- **Excessive quantities of chlorine bleach are being used.**

  The industry has published standards in Riggs and Sherrill, Textile Laundering Technology. We have seen machines programmed with much greater quantities of bleach instead of extending the bleach zone and/or transfer rate to achieve contact time for special fabrics. (Refer “Rust Never Sleeps”, Samuel Garofalo, TRSA, February 2002).

  Exacerbating the issue, some tunnels have been programmed with “first dosing” for bleach. We have seen CBW washers programmed to inject 300% of the maintenance hypochlorite dose when changing from a light soil to heavier soil classification. We do not recommend programming Hypochlorite injections with First Dosing “compatibility”.

- **Acid sours react with Hypochlorite to form corrosive compounds.**

  Acid sours reacting with Hypochlorite form chlorine gas and hydrochloric acid – resulting in corrosive conditions to stainless steel and a potential danger to personnel. This bleach carryover into the sour module(s) can be the result of:

  1. Too much bleach – too much programmed or too small a batch size for the programmed dosage.
  2. Flow rate too low in the rinse zone.
  3. Improper antichlor.
  4. Blocked flow splitter and/or lifters. Normal maintenance is required to keep the screens clean and free flowing. With hard water supply, calcium carbonate will deposit in the wedge wire, blocking the screen.

5. Low water pressure. The counterflow may be interrupted to such a degree to allow chemistry to be present in downstream modules.
6. Using a dual bath (half time for counterflow rinse and half time for standing bath finishing) last module with Hypochlorite bleaching in the adjacent module.

A Caution About Hydrofluosilicic Acid

Comparatively, Hydrofluosilicic (HFS) acid is ***much more*** aggressive to stainless steel than other common laundry sours such as phosphoric, citric, formic and acetic acid. The presence of Hypochlorite increases its corrosive potential. Moreover, HFS is specifically called out in the Handbook of Stainless Steel as aggressive in vapor form.

While HFS acid is successfully used with proper conditions, we have seen a number of instances of misuse of this chemical. Tunnels differ from washer extractors because finishing modules are a "standing bath". Washer extractors flush with fresh water after every use of acid sours.

Thus, it's even more important to have proper washing conditions when using this sour.

- **Sours in vapor form are highly concentrated and thus more corrosive.**

  Formic, HFS and acetic acid have high vapor pressures compared with phosphoric and citric acid, readily forming corrosive vapors.

	Vapor Pressure (mm Hg @20 C)
Formic	44.8
HFS (@25 C)	24.0
Acetic	14.0
Phosphoric	2.2
Citric	Nil

- **Corrosive supply water (low pH and measurable presence of iron) in the presence of certain types of piping and chemistry results in conditions conducive to corrosion of stainless steel.**

  Water with the characteristics of high concentrations of dissolved oxygen, carbon dioxide and low pH is aggressive to carbon steel and galvanized carbon steel piping. Corrosion of this piping releases significant amounts of iron to the process wash liquor.

  Low pH water may also contribute to corrosion by depressing the wash water pH to levels sufficiently low to accelerate the decomposition of sodium Hypochlorite.

We urge you to:

1. Make sure water flow, level settings, and temperatures are proper. Insure proper and constant maintenance of flow splitters and lifters. Keep the wedge wire screens clean. Refer to “Technical Reference Water Flow and Chemical Injection” Milnor Manual Number MATCBWTRAE.

2. Ensure your chemicals are dosed correctly. Ask your chemist to verify that your bleach and sour concentrations are within industry standard limits.

3. If you have evidence of corrosion near the discharge end of the CBW washer, then speak with your chemist immediately. Get back to a “Healthy Tunnel Washing Profile”.

4. Remove corrosion products and re-passivate the steel. Corrosion left untreated in the presence of continuing abnormal process conditions can result in failure and/or staining of laundry. If the observed corrosion is severe enough, after cleaning, you will need to re-passivate the material to prevent future corrosion.

   DeRustit, www.derustit.com and Chemetall Oakite, www.oakite.com offer products for cleaning and passivating stainless steel. Do not skip the passivation step or the stainless will be more susceptible to corrosion than before.

Our goal herein is to prevent the potential for corrosion. And if it does occur help you resolve it. Please contact us with any questions.

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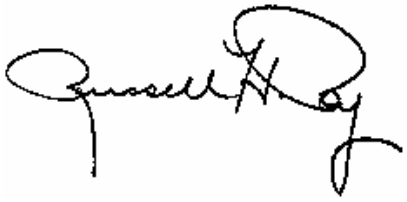


Russell H. Poy
Vice President
Engineering

RHP/kf

Attachment A

Quick Guide for Setting Counter Flow Rates in Milnor Tunnels

To set the Flow Rate into the Rinse Zone, use the following formula:

$$\text{Flow Rate In GPM} = \frac{\text{Lbs Per Hour} * \text{Desired Gal/Lb}}{60}$$

$$\text{Lbs Per Hour} = \text{Soil Weight} * \text{Soil Factor} * \text{Transfers/Hr}$$

$$\text{Transfers Per Hour} = \frac{60 * \#\text{ of Modules}}{\text{CBW Washer Process Time}}$$

Figure 1 illustrates the "flow balance" of a Milnor tunnel. The Milnor CBW washer uses counterflow washing and rinsing. Generally, a CBW washer is configured to have four or five zones, each have an appropriate number of modules for its function and production rate: Wet out And Flush, Wash (may be comprised of two or more zones depending on goods and production rate), Bleach, Rinse, Finishing.

Water counter flows from the Rinse Zone through the Bleach and Wash zones as shown. As a starting point, a typical configuration is shown, based on 1 Gallon per Pound of Goods (Many light soil classifications can be processed with much less than 1 Gal/Lb. Bar mops and other heavy soil goods may use in the range of 1.2 to 1.4 Gal/Lb). Water used in each zone is shown in Gallons per Pound of Goods, Cotton and Polycotton.

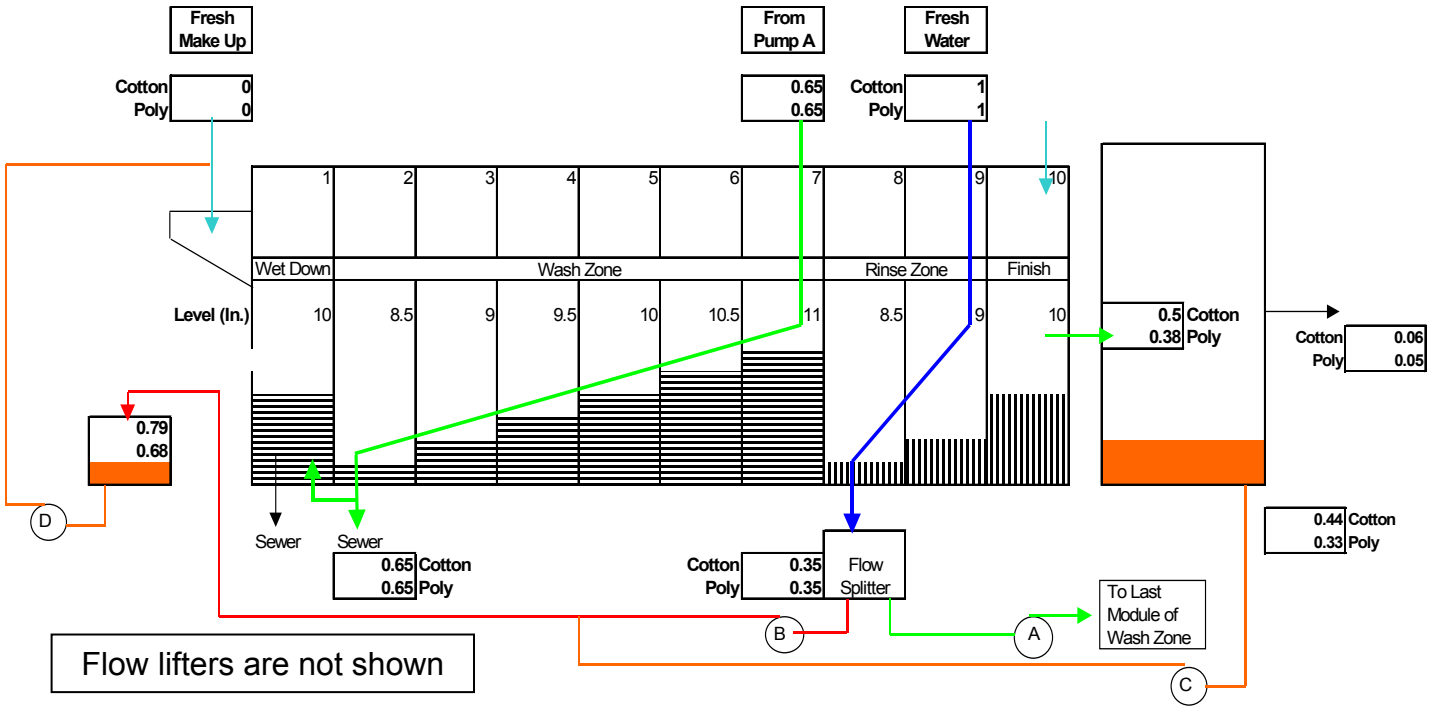


Figure 1

Attachment B

Quick Guide for Setting Weir Plates and Level Switches on MILNOR CBW Washers

1. Make sure the bottom of the float tube is positioned as shown in Figure 2. Water will be just at the bottom of the drum and also at the bottom of the float tube. This is set at the factory and generally does not need to be readjusted.

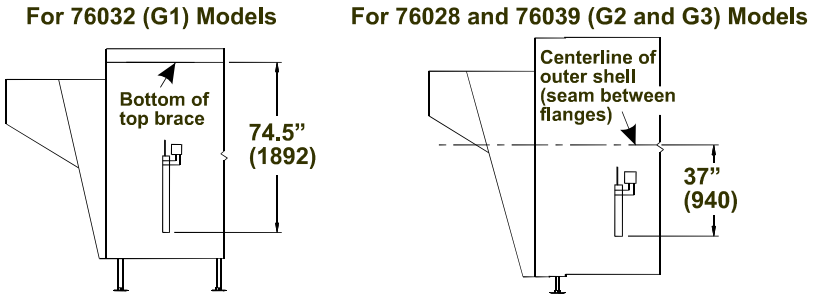


Figure 2

2. Level switches are used to insure proper water level for successful transfer in the CBW washer. Whenever a tunnel goes into "hold" for a prolonged period, water is pumped over the weir. The low level switch has to be set so that it can accurately sense level even with the undulation of water due to drum rotation. **It's essential to precisely follow these instructions in order to prevent potential jamming.**

   Set Output Time, "Maximum Time in Hold" to 3 minutes (applicable to Mentor and Serial Miltron Software Date Code 0000D.)

   On modules equipped with drains and fast fill valves, the level switch is also used for opening and closing the fast fill valve. Also in this case please refer to the special case described in the "Weir Plate section, Item 4".

3. Here's the simple way to set the level switches:
   a) Remove the clips from the rod and insert the rod through the level switch lever.
   b) Let the float sit on the bottom of the float tube. If the machine is full of water, push the rod to the bottom of the float tube.
   c) Hold down the level switch actuator, marking the rod at the top of the level switch actuator. See Figure 3A. Cut the rod.
   d) Place the float rod clips as illustrated below in Figure 3B or 3C, whichever applies.

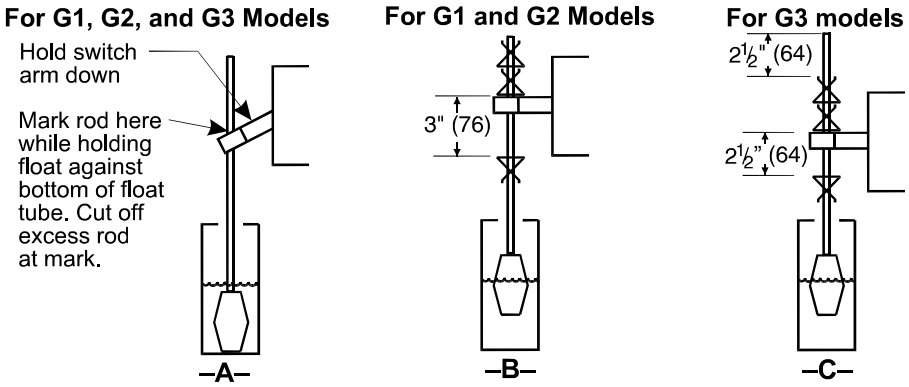


Figure 3

4. Here's how to set weir plates:

   a) The weir plate, not the level switch, sets the level in a module.

   b) Module 1 is normally set at a 10" (254) level. However, if Module 2 has a "Flow Not" valve, set Module 1 at the 8½" (216) weir setting and Module 2 at 9" (229), etc.

   c) Start at the front of the next zone (i.e. first module of the zone) at an 8½" (216) weir setting. Each subsequent module will have a weir plate setting ½" (013) higher than the previous module. Example: Module 2 is set at 8½" (216), Module 3 will be set at 9" (229), Module 4 set at 9½" (241) (considering that these modules flow to each other).

      A flow lifter is employed when a zone exceeds 4 to 5 modules. In this case, the module flowing to a flow lifter defines the beginning of a "sub" zone – thus a 8½" (216) weir setting.

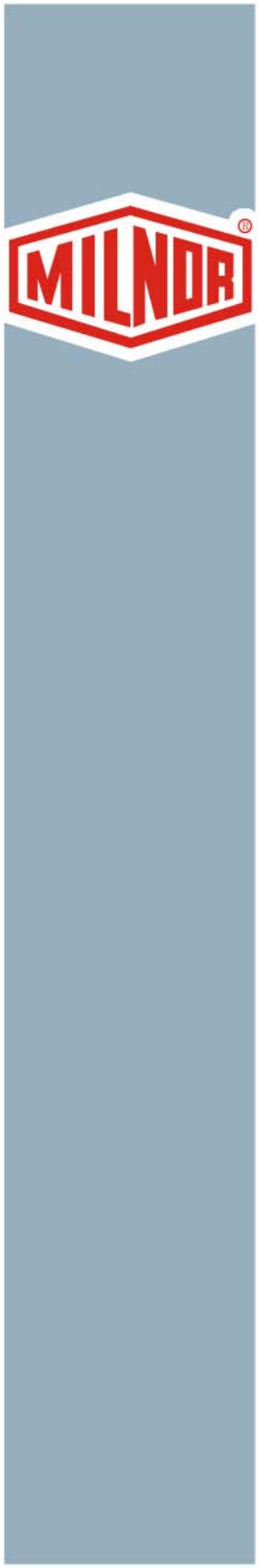
      See Figure 1 in "Quick Guide for Setting Counter Flow Rates in Milnor Tunnels."

   d) If a module is equipped with a drain and fast fill valve, start the zone at a 9½" (214) weir setting. Otherwise, the level switch may not sense high level and therefore leave the fast fill valve on.

   e) Set the standing bath finishing module(s) at a 10" (254) weir setting.

   f) When flowing water through a CBW washer, there must be level over the weir in order to flow. As flow rates increase, the resultant level in each module goes higher. In some cases, the resultant level may be as much as 3" (076) higher than the weir setting in a given module. On G2 and G3 CBW washers, the divider plate, between modules, is at the 14" (356) water level. If the weir plate in a module is set at 12" (305) and the flow through the zone is set such that the level in the module is 3" (76) higher than the weir plate, then obviously water would be able to flow over the divider in the module. This is counterproductive to washing and should always be avoided.

   g) This issue is most likely to surface in the last module of the rinse zone where water flow is highest and water level is traditionally set high. The result is sometimes water splashing or flowing over the divider into the last module where sour, softener (and sometimes starch) is applied. The result is a dilution of this bath, which sometimes requires increased chemical dosing. If the weir setting is reduced in the rinse zone, this problem will simply disappear.



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Document—

How Milnor® PulseFlow® Technology Works

PELLERIN MILNOR CORPORATION POST OFFICE BOX 400, KENNER, LOUISIANA 70063 - 0400, U.S.A.

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How Milnor® PulseFlow® Technology Works

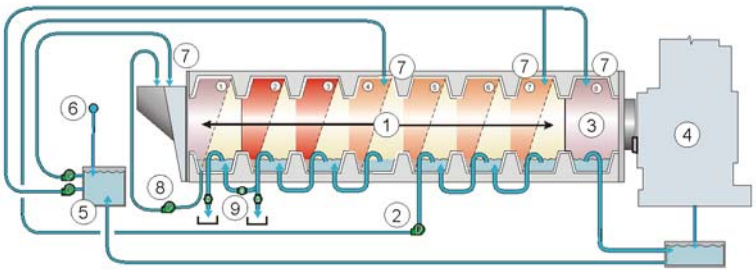
The basis of the conventional Milnor CBW® tunnel washer's cleaning effectiveness is counterflow combined with the lift-and-drop action of the top-transfer design. As goods progress through the wash cycle, the goods encounter modules with different roles to play in the wash process: flush, break, and carryover at the load end; rinsing and finishing at the discharge end. Because fresh water is injected into the rinse zone and counterflows to the load end, the goods encounter ever-cleaner baths as the dilution effect eliminates the soil from the goods.

Milnor tunnel washers have always achieved superior wash quality with low fresh water consumption. PulseFlow technology (Patent Pending) takes production throughput and water savings to a new level.

All modules in the PulseFlow tunnel, save for the finishing module(s), are now used for both washing and rinsing. Counterflow is reserved for the rinse portion of the time the goods spend in each successive module. Clean reuse water, with sufficient fresh water to make up the water absorbed by the goods, is used for rinsing, but in only the quantities required by the soil level of the goods. Typical water consumption is 0.36 to 0.54 gallons per pound (2.5 to 4.5 liters per kilo) for light to medium soil, and 0.54 to 0.66 (4.5 to 5.5 liters per kilo) for medium to heavy soil.

Figure 1: Typical Milnor, PulseFlow CBW® Tunnel Washer

Schematic Side View



Legend

1. Dual use modules and PulseFlow zone
2. Flow lifter pump
3. Finish zone
4. Extraction device
5. PulseFlow tank
6. Fresh water in
7. Metered water inlets
8. High velocity recirc pump for Module 1 flush
9. Flow/flownot valves

1. The Characteristics that Define PulseFlow Technology

1.1. Dual use modules for highly efficient soil release and removal—There are no dedicated wash or rinse modules. These are now dual use (Figure 1, item 1). Only finishing modules (item 3) are not dual use. Washing and rinsing within a module occur in two steps:

Step 1: The first part of the transfer rate (time between transfers) is a standing bath for washing. In standing bath mode, chemical equilibrium is achieved in 30 to 40 seconds (three to four wash cylinder reversals). At chemical equilibrium, the soil release effects of chemical energy (alkali pressure) and mechanical action in this bath are complete. The suspended soil is then efficiently removed (rinsed away) by high velocity counterflow in the next step.

Step 2: The remaining part of the transfer rate (three to four reversals) is reserved for PulseFlow, the high velocity counterflow used for rinsing. PulseFlow water is comprised of water retrieved by the press or extractor (Figure 1, item 4) and fresh water (item 6). The PulseFlow flow rates are based typically on 30 seconds of flow and on the following soil classification-specific ratios:

Light soil—0.36 to 0.42 gallons per pound (2.5 to 3 liters per kilo) of linen

Medium soil—0.42 to 0.54 gallons per pound (3 to 4.5 liters per kilo) of linen

Heavy soil—0.54 to 0.66 gallons per pound (4.5 to 5.5 liters per kilo) of linen

The resulting flow rates provide maximum rinsing within the weir capacity, which is generally 100 gallons per minute (379 liters per minute) for 110 lb (50 kg) and 150 lb (68 kg) capacity tunnels and 150 gallons per minute (568 liters per minute) for 250 lb (115 kg) capacity tunnels.

1.2. **Metered, Volumetrically Controlled Water**—The PulseFlow tank serves as a stabilization tank to eliminate inconsistencies in the water flow which can frequently occur as a consequence of fluctuations in incoming water pressure. Additionally, variable speed pumps, combined with highly accurate, electronic flow meters and a volumetric control scheme ensure precise injection volume for the given function: wet-out in module 1, fresh water make-up, and PulseFlow rinsing. The Mentor controller monitors the output of each pump and continually adjusts these pumps so that under normal conditions, the programmed volume is delivered at the same time that the specified PulseFlow time ends. However, if conditions such as lint buildup or an abrupt change from heavy to light soil goods affect the water flow, controller adjusts the PulseFlow time to compensate, guaranteeing the precise water volume.

1.3. **Flexible zoning**—A zone, in tunnel washing terminology, is a contiguous group of modules dedicated to some common purpose or function. Typically, water is injected at the discharge end of the group and flows against the flow of goods (counterflows) to the load end where it exits to the sewer through the first module's weir box. The discharge end water inlet is fed by water pumped from the PulseFlow tank. When a zone reaches 6 modules or more in length, a flow-boosting pump (Figure 1, item 2) is employed to achieve the hydraulic pressure needed for high velocity counterflow. Thus flow is continuous from end to end within the zone.

Alternatively, the tunnel can be divided into two or three PulseFlow zones to meet any special temperature or disinfect time requirements. Normally, this can be accomplished with no increase in water usage.

1.4. **Rapid Wetout With Minimal Fresh Water**—A high velocity recirculation pump (Figure 1, item 8) floods the load chute and sprays the goods with water from Module 1 at high velocity when each new batch starts to enter the tunnel. Goods are fully wetted out and essentially flushed after one or two reversals. The water that enters Module 1 from the PulseFlow tank is only the amount needed to replace that initially absorbed by the goods. As compared to a conventional tunnel washer, this saves 20 to 30 gallons (76 to 114 liters) of fresh water and it permits Module 1 to serve as a true wash module because it need no longer be dedicated exclusively to wetout/flush.

2. The Essential Benefits of PulseFlow Technology

2.1. **Rinsing Power**—PulseFlow rinsing efficiency results from the:

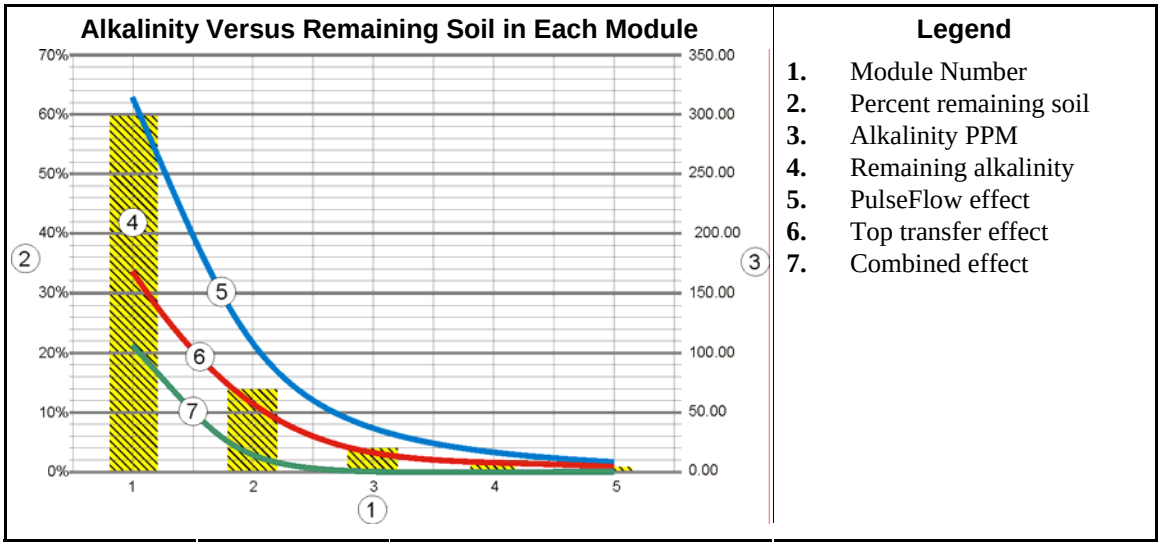
pulse flow effect—the rapid removal of suspended soil by high velocity counterflow

top transfer effect—the draining action that leaves behind about half of the free water when the perforated transfer scoop lifts the goods out of one bath and moves them to the cleaner bath in the next module.

Top transfer is equivalent to a drain and fill in a washer-extractor. Only top transfer machines with perforated transfer scoops can leverage the PulseFlow effect to rinse with extremely low water consumption and without a costly, external filter reuse system.

This combination of high velocity PulseFlow rinsing and top transfer movement of the goods through the tunnel results in unmatched rinsing power and provides the highest dilution factor to rinse the suspended soil. Figure 2 below illustrates this graphically.

Figure 2: Mathematical Performance Model—5 Module Milnor PulseFlow CBW Tunnel Washer



2.2. More Throughput—Because of the efficiency of its dual use modules, the production rate, and hence, the transfer rate of the eight module PulseFlow tunnel shown in Figure 3 is equivalent to that of the 10 module conventional tunnel also shown. If these are 68 Kg capacity machines, both machines have the capability to process 68 kilograms (150 pounds) of hotel/hospital room linen (see Table 1) every 1.83 minutes (their transfer rate). To look at it another way, a 10 module PulseFlow tunnel can process the same amount of hotel/hospital room linen every 1.46 minutes. This yields a 25% increase in throughput over the 10 module conventional tunnel.

3. Comparison of Conventional, and PulseFlow Water Usage

This comparison uses the tunnel schematic views shown in Figure 3, which have comparable production rates. The rounded boxes in these views give water flow values in liters per kilogram of goods (L/kg), except for the boxes labeled QM_, which give flow rates in liters per minute and (gallons per minute). Both tunnels depict processing light/medium soil cotton goods.

3.1. Conventional Water Usage—Refer to Figure 3, “Conventional, 10-Module Tunnel.” The total flow into the dedicated rinse zone is 8.0 L/kg, comprised of 5.71 L/kg fresh and 2.29 L/kg extracted. This water flows from the rinse zone and is split for reuse of 5.6 L/kg into the dedicated wash zone and the remaining 2.4 L/kg contributes to wet-down in module 1.

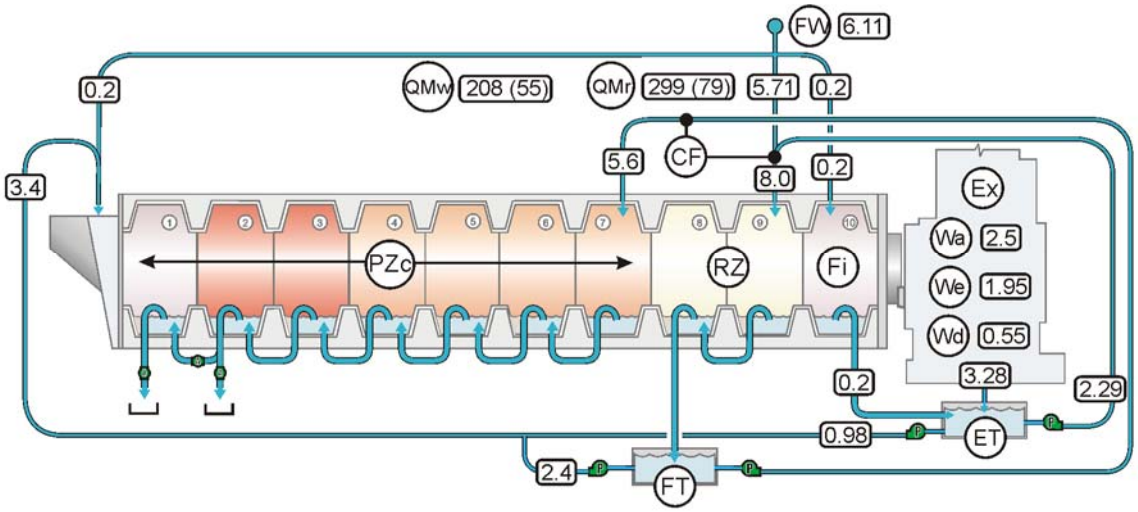
The process zone has a continuous counterflow of 208 liters per minute (55 gallons per minute). **Total fresh water consumption, including trickle flow is 6.11 L/kg.**

3.2. PulseFlow Water Usage—Refer to Figure 3, “PulseFlow, 8-Module Tunnel.” PulseFlow technology eliminates the rinse zone—conventional modules 8 and 9. Wash chemistry dynamics have proven that the wash chemistry has completed its work in 30 to 40 seconds. After that, the released soil should be removed. Continuous counterflow is not necessary to accomplish this. The flow rate of 278 liters per minute (76 gallons per minute) for the PulseFlow zone is only for a duration of 30 seconds, with no water wasted. The recirculation system in module 1 that assures reliable wetout and flushing reduces the added water requirement to just that initially absorbed by the goods—2.5 L/kg in this example. The 3.4 L/kg shown for module 1 of the conventional tunnel unnecessarily exceeds this requirement.

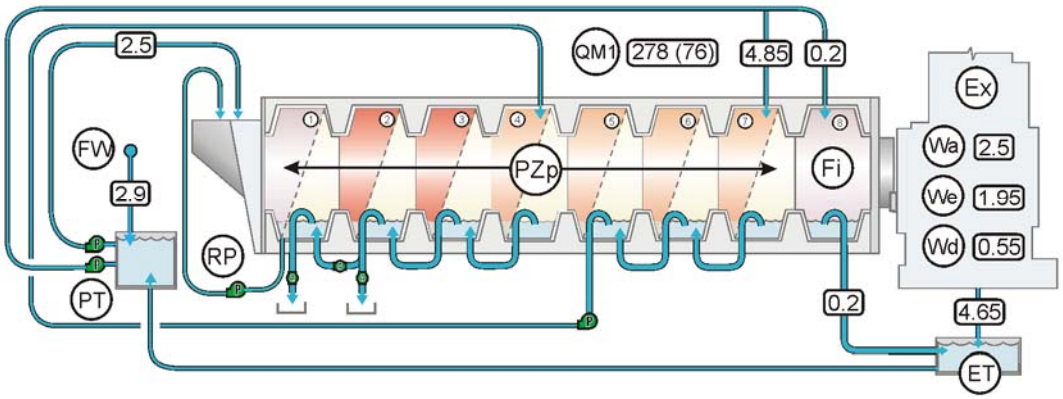
These water saving features greatly reduce the overall fresh water requirement. **In this example, the demand is reduced from 6.11 L/Kg to 2.9 L/Kg.**

Figure 3: Water Flow in Conventional, Versus PulseFlow Tunnel—100% Cotton Goods in Both

Conventional, 10-Module Tunnel



PulseFlow, 8-Module Tunnel



Legend

CF. Continuous flow
ET. Extraction water tank
Ex. Extraction
Fi. Finish module
FT. Flow splitter tank
FW. Fresh water (liters per kilogram)
PT. PulseFlow tank
PZc. Process Zone, conventional tunnel—dedicated modules
PZp. Process zone, PulseFlow tunnel—dual use modules
QMw. Quantity (liters (gallons)) per minute, wash zone
QMr. Quantity (liters (gallons)) per minute, rinse zone
QM1. Quantity (liters (gallons)) per minute during flow in PF zone 1. Example shown: 278 liters (76 gallons) per minute x 0.5 minute = 139 liters (38 gallons).
RP. Recirculation pump for Module 1 flush
RZ. Rinse zone—eliminated in PulseFlow tunnels by dual use modules
Wa. Absorbed water transferred to the extraction device (liters per kilogram)
We. Water extracted from the goods by the extraction device (liters per kilogram)
Wd. Water remaining in the goods sent to the dryer (liters per kilogram)

4. Comparison of Conventional, and PulseFlow Formula Times

Formula times in a PulseFlow tunnel are shorter than in a conventional tunnel. The dual use modules in a PulseFlow tunnel perform the same functions as that of both the wash modules **and** the rinse modules in a conventional tunnel. By the time that goods enter the finish module, they have undergone equal or better processing in a PulseFlow tunnel than that of a conventional tunnel with the same number of wash modules as dual use modules in the PulseFlow machine.

Conventional top transfer tunnels of six modules or less have one rinse module. Those with seven modules or more have two rinse modules. Hence, the ratio of rinse to wash modules changes with different size conventional tunnels. The ratio of rinse to wash functions in a PulseFlow tunnel is not influenced by tunnel size. It is possible to give formula times in a PulseFlow tunnel, as a percentage of conventional formula time, regardless of tunnel length. Based on current field data, this is 81%. Because PulseFlow technology is relatively new, Milnor may adjust this recommended percentage somewhat in the future.

Table 1 provides a list of formula times for conventional, top transfer tunnels and corresponding times for PulseFlow tunnels, along with the transfer rates for a range of PulseFlow tunnel sizes.

Notice 1: Guidelines only—These published formula times are general guidelines that do not consider local conditions. Nor are they adjsusted to correspond to whole counts (whole wash cylinder reversals) as will occur when a formula is entered in the CBW Controller. They are intended only to permit rough calculations early in the design process. Consult the Milnor Laundry Engineering department or your Milnor dealer as the design evolves.

Table 1: Formula Durations for PulseFlow Tunnels, Based On TRSA Recommended Wash Times

Goods Classification	Processing Time		Transfer Rates—PulseFlow Tunnels							
	Conventional *	PulseFlow (81%)	5 Mod	6 Mod	7 Mod	8 Mod	9 Mod	10 Mod	11 Mod	12 Mod
Vinyl floor mats	14 minutes	11.3 minutes	2.26	1.88	1.61	1.41	1.26	1.13	1.03	0.94
Hotel sheets	16 minutes	13 minutes	2.6	2.17	1.86	1.63	1.44	1.3	1.18	1.08
Hotel/hospital room linen	18 minutes	14.6 minutes	2.92	2.4	2.09	1.83	1.62	1.46	1.33	1.22
General hospital linen	21 minutes	17 minutes	3.4	2.8	2.43	2.13	1.89	1.7	1.55	1.42
Adult pads/diapers	24 minutes	19.4 minutes	3.88	3.23	2.77	2.43	2.16	1.94	1.76	1.62
Colored table linen	24 minutes	19.4 minutes	3.88	3.23	2.77	2.43	2.16	1.94	1.76	1.62
Industrial uniforms	28 minutes	22.7 minutes	4.54	3.78	3.24	2.84	2.52	2.27	2.06	1.89
White table linen	30 minutes	24.3 minutes	4.86	4.05	3.47	3.04	2.7	2.43	2.21	2.03
Bar mops	34 minutes	27.5 minutes	5.5	4.58	3.93	3.44	3.06	2.75	2.5	2.29
Industrial wipers	36 minutes	29.2 minutes	5.84	4.87	4.17	3.65	3.24	2.92	2.65	2.43

* Source: Textile Laundering Technology 2005 ed. Alexandria, VA: Textile Rental Services Association of America, 2005. Print.

Tip: The transfer rate must not exceed the capability of the extraction device.

5. Titration Example—8-Module, PulseFlow CBW Tunnel Washer

This information gives the result of titrations performed by an independent consultant on an installed PulseFlow CBW tunnel washer. The pertinent field conditions are as follows:

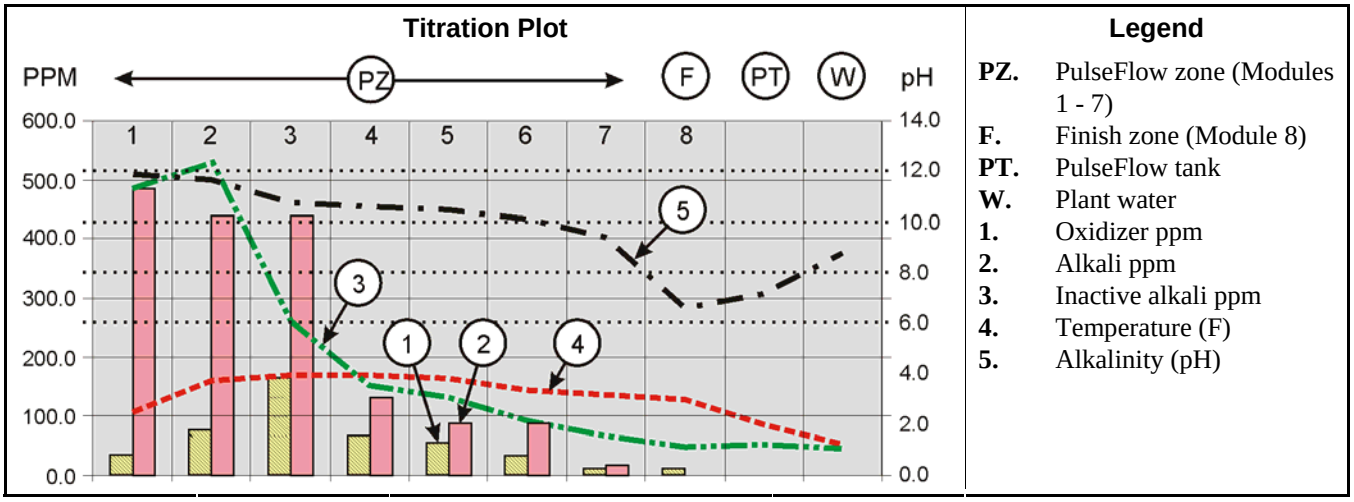
8 Modules: 7 dual use (PulseFlow) modules plus one finish module.
76039 CBW: 150 Lb (68 Kg) capacitiy, sectional
135 Lb (61 Kg) actual batch size
Poly-cotton sheets formula

1.68 minute, 9-count transfer rate
85 gallons per minute (322 liters per minute) PulseFlow rate

Table 2: Chemestry—Numeric Values

Where->		<----------PulseFlow Zone---------->							Fin.	Pulse Flow Tank	Plant Water
Parameter	Units	Mod 1	2	3	4	5	6	7	8		
		Alk, Deterg		Bleach			Carryover		Sour		
Inactive Alkali	Drops	110	120	60	35	30	21	15	11	12	10
	PPM	184	528	264	154	132	92.4	66	48.4	52.8	44
Temperature	Deg F	111	160	170	170	165	146	136	128	87	52
Alkalinity	pH	11.9	11.6	10.8	10.6	10.5	10.1	9.4	6.6	7.2	8.8
Oxidizer	PPM	33	77	165	66	55	33	11	11		0
Alkali	Drops	484	440	220	132	88	44	17.6	0	0	0
	PPM	11	10	5	3	2	1	0.4	0		0

Figure 4: Chemestry—Graphic Representation



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