# LAUNDRY PLANNING GUIDE

WASHER-EXTRACTORS | TUMBLER DRYERS | OZONE SYSTEMS

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EDRO Corporation designs and manufactures Industrial Strength DynaWash® washer-extractors, DynOzone - DynaWash® Ozone System, the M-SERIES tumbler dryers for U.S. Navy shipboard and submarine laundries, and the C-SERIES tumbler dryers for all types of On-Premise and Commercial & Industrial Laundries.

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You are reading this Laundry Planning Guide because you are interested in getting all you can out of your laundry in the most efficient manner. This guide will help you with general data calculations for elements in a laundry, sizing the right equipment for your application, and helping you match EDRO machines to your operation.

## Water Data

Specific data on water:

- About 60% of water used in a typical laundry formula is hot (if conventional water system used)
- 1 cubic foot of water = 62.425 lb
- 1 cubic foot of water = 7.48 gallons
  gallon(s) x 0.1336 = cubic feet gallon(s) x 231 = cubic inches
- 1 pound (lb) of water x 0.016 = cubic foot
- 1 pound (lb) of water x 0.12 = gallons
- 1 gallon = 8.33 lb. @ 62 degrees Fahrenheit (°F)
- Boiling water = 212 Fahrenheit (°F) = 100 Celsius (°C)
- Freezing water = 32 Fahrenheit (°F) = 0 Celsius (°C)
- To convert to °F; multiply °C by 9, divide by 5, and add 32
- To convert to °C; subtract °F by 32, multiply by 5, and divide by 9

## pH Data

Above 7.0 = Alkaline
Equal to 7.0 = Neutral
Below 7.0 = Acid

## Cubic Content

Cubic content measures the physical size of cylinder (or basket). It is the best way to compare rated capacity of competitive machines. The higher the cubic content, the more laundry the machine's cylinder can hold. It is calculated as follows:

(PI) $R^2$ (radius of cylinder) x depth of cylinder / 1,728 = cubic content of cylinder

The accepted capacity for washer-extractors is between 5 lb and 7 lb per cubic foot. Accepted capacity for dryers is between 2.5 and 3.5 lb. per cubic foot.

## Volume

Volume refers to the available area within the basket or cylinder of the washer. Here are some relationships between cubic content, gallons and liters.

1.0 cubic foot = 7.48 gallons = 28.27 liters
0.134 cubic foot = 1.0 gallons = 3.78 liters

## Data Charts

### Water Consumption

| Water Level | CSL60 | CSL110 | CSL175 | CSL225 | CSL350 | CSL450 |
|---|---|---|---|---|---|---|
| Low (15%) | 8 gallons | 10 gallons | 14 gallons | 24 gallons | 32 gallons | 60 gallons |
| Medium (50%) | 19 | 24 | 33 | 60 | 79 | 120 |
| High (100%) | 35 | 50 | 65 | 120 | 160 | 250 |
| | | | | | | |
| **Water Level** | **DW100** | **DW150** | **DW200** | **DW300** | **DW400** | |
| Low (15%) | 16 gallons | 19 gallons | 21 gallons | 29 gallons | 35 gallons | |
| Medium (50%) | 38 | 53 | 54 | 75 | 83 | |
| High (100%) | 80 | 104 | 113 | 155 | 165 | |
| | | | | | | |
| **Water Level** | **ESL200** | **ESL400** | | | | |
| Low (15%) | 26 gallons | 48 gallons | | | | |
| Medium (50%) | 64 | 112 | | | | |
| High (100%) | 124 | 205 | | | | |
| | | | | | | |
| **Water Level** | **NX40** | **NX60** | **NX100** | **NX140** | | |
| Low (15%) | 4 gallons | 8 gallons | 9 gallons | 12 gallons | | |
| Medium (50%) | 13 | 19 | 24 | 35 | | |
| High (100%) | 23 | 35 | 50 | 65 | | |

### Average Cycle Water

| CSL60 | CSL110 | CSL175 | CSL225 | CSL350 | CSL450 |
|---|---|---|---|---|---|
| 115 gallons | 210 gallons | 330 gallons | 425 gallons | 665 gallons | 855 gallons |
| | | | | | |
| **DW100** | **DW150** | **DW200** | **DW300** | **DW400** | |
| 190 gallons | 285 gallons | 380 gallons | 570 gallons | 760 gallons | |
| | | | | | |
| **ESL200** | **ESL400** | | | | |
| 420 gallons | 830 gallons | | | | |
| | | | | | |
| **NX40** | **NX60** | **NX100** | **NX140** | | |
| 76 gallons | 115 gallons | 190 gallons | 265 gallons | | |

## Water Hardness

More tallow soap is required for washing in hard water than in soft water. A water softener may be required if grains/gallon of hardness exceed 3 grains per gallon of water.

| Grains per gallon | Parts per million | Description |
|---|---|---|
| Less than 1 | Less than 17.1 | Soft |
| 1 to 3.5 | 17.1 to 60 | Slightly hard |
| 3.5 to 7.0 | 60 to 120 | Moderately hard |
| 7.0 to 10.5 | 120 to 180 | Hard |
| 10.5 and over | 180 and over | Like a stone |
| **Note - One grain per gallon = 17.1 parts per million** | | |

## Water Softener

**How To Size:**

Determine grain hardness (3 grains acceptable without softening).
Determine total gallons of water to be used per hour.
Multiply grains hardness x total gallons x hours of operation between regeneration (back washing).

*Example:*

20 grains x 1000 gallons x 24 hours = 480,000 grain softener

Check the flow rate of softener, and make sure it is adequate.

## Gas Water Heaters

**How To Size:**

To determine the quantity of hot water requirements per hour:

Figure about 2.5 gallons per pound washed.
Figure about 60% of the water to be hot.
Determine temperature of incoming water. Subtract this from the desired hot water level to arrive at the degree of rise.

Formula: gallons hot/hr x 8.3 (lb./gal) x degree rise / 0.6 = BTU/hr

*Example:*

100 gal/hr x 8.3 (lb./gal) x 100 F rise / 0.6 = 138,333 BTU/hr

If heating with steam, divide by 33,500 BTU/BHP. Storage capacity should equal from 1/2 to 1 hour's demand.

## Gas Data

A BTU (British Thermal Unit) is the amount of heat required to raise one pound (lb) of water approximately one degree Fahrenheit (°F):

one Therm (TH) = 100,000 BTU
one cubic foot = 1,000 BTU (approx)
one MCF (1,000 cubic feet) = 10 Therms (approx)
one cubic foot of Butane gas = 3,200 BTU
one gallon No. 2 diesel fuel oil = 139,500 BTU (approx)
one gallon No. 6 fuel oil = 149,000 BTU (approx)
one kilowatt (kW) = 3,415 BTU
one gallon propane = 92,000 BTU

**Gas Cost:**

The cost of gas is usually stated in the price per therm or price per M or MCF (1,000 cubic feet). In computing costs, the actual total to the end user should be used, and divided by the number of therms used to find the cost per therm. Various rate structures are used by local gas suppliers. These include " straight line" rates, and "block" rates in which the rate varies for various quantities. Additional charges such as "demand charge", "commodity charge", or "service charge" may also be part of the gas cost. Any charge the customer may pay to receive gas, including sales tax where applicable, should be included in the total gas cost from which the actual cost per therm is derived.

## Electricity Data

1 kW/hr = 3413 BTU or 0.03413 Therm
1 Therm = 29.99 kW/hr
Kilowatt-hours, kW/hr = Horsepower X 0.7457

For estimated planning purposes, the cost of electrical power can be estimated to be $0.0996 per kW/hr. Contact your local power company for up-to-date costings.

Amps (3 phase) $\frac{\text{kw X 1,000}}{\text{Volts X 1.732}}$ (1 phase) $\frac{\text{kW X1,000}}{\text{Volts}}$

## Air Compressors

**How To Size:**

Add up CFM requirements on all air driven equipment.
Add an additional 25% to CFM.
Tank size should be 3 to 5 times the CFM output in gallons of storage.

*Example:*
Required 20 CFM + 25% = 25 CFM
Tank should be 75 - 125 gallon size.

## Boiler Data

**How To Size:**

Find the BHP rating on each piece of equipment in the operation that requires steam. If pounds of steam consumption is known (in place of BHP), divide by 34.5 to get BHP.

To all BHP requirements, add 10% of the total for heat loss/radiation and divide by 0.7 (this allows for efficiency factor and keeps you from operating the boiler at full capacity, which is both costly and harmful to the boiler).

**Horsepower:**

one BHP = the work of converting 34.5 lb of water per hour from and at 212°F to steam at 0 lb gauge pressure.

one BHP = 33,500 BTU/hr
one BHP = 34.5 lb/steam
one BHP = 9.803 kilowatts

**Horsepower Chart:**

This technical data is based on the following criteria:

Cycle time = 45 minutes
Incoming water temperature = 60°F
Desired hot water temperature = 160°F
Amount of hot water = 60% of water in total cycle

| Model | Boiler HP | Model | Boiler HP |
|---|---|---|---|
| CSL60 | 1.6 | DW300 | 10.8 |
| CSL110 | 2.9 | DW400 | 13.1 |
| CSL175 | 7.0 | ESL200 | 9.5 |
| CSL225 | 9.5 | ESL400 | 14 |
| CSL350 | 11 | NX40 | 1.2 |
| CSL450 | 15 | NX60 | 1.6 |
| DW100 | 3.4 | NX100 | 2.8 |
| DW150 | 6.7 | NX140 | 4.5 |
| DW200 | 9.2 | | |

BHP required calculated on a per unit basis.

## Drain Troughs

**How To Size:**

Determine the total number of gallons to be dumped at one time by all present and future machines. Use high level rinse figures to get this total.

Divide total gallons by 7.48 gallons/cubic foot to get the total cubic feet required.

*Example:*

300 gallons / 7.48 = 40 cubic feet of trough area

The trough depth should usually be 12 inches, and the width 14 inches. In the example above, assume a 12 inch deep and 14 inches wide trough:

14” x 12” = 168 sq in

168/144 (one sq ft) = 1.166 sq. feet (trough area)

40 (cubic feet required) / 1.166 = 34.3 feet (length of trough)

Drain trough should slope 1/4” per linear foot to the outlet drain. On long troughs, this can be decreased to 1/8” per linear foot to keep the depth from becoming too great.

## Water Extraction

The extract function reduces moisture retention in the laundering process. The process begins with textile saturation. Free water will not accumulate in the cylinder until the textiles have absorbed enough water to become saturated.

**Saturation Examples:**

***Cotton***
– Approximately 0.3 gallons per pound (lb) of cotton or 2.5 lb of water per pound

***100% Polyester***
– Approximately 0.1 gallon per pound (lb) of polyester or 0.8 lb of water per pound

Therefore, a 350 lb load of cotton will hold approx. 105 gallons (876 lb) of water when saturated. A 350 lb load of 100% polyester will hold approx. 35 gallons (280 lb).

The amount of water needed for saturation must be added to the amount of free water in the washing cylinders when the water consumption of laundering formulas is calculated. The extract function reduces the water content of textiles to 25% to 70% moisture retention depending on the fabric laundered and equipment used.

Moisture retention describes the ratio of retained moisture weight to clean dry textile weight. Clean dry weight is normally calculated by using the weight after full drying to “bone dry state”.

One pound of cotton textile holds 2.5 lb of water (0.3 gallons) or 250% of the dry weight.

- The extract function decreases retained moisture to a level of 50%, a removal of two pounds of water per pound of fabric.

- Since 50/50 polyester/cotton retains only 1.7 lb of water per pound of fabric, only 1.2 lb would be removed to reach the same 50% moisture retention. However, polyester/cotton textiles come out drier for the same extraction effort.

Extraction is performed in the washer-extractor; the pre-programmed PLC moves the washer into high-speed rotation after the laundering cycle.

With conventional washer-extractors, the load has to be removed from the washer and extracted separately. Extraction is carried out using either centrifugal or hydraulic extraction. With centrifugal extraction, the centrifugal force (G-Force) spins the water out of the fabric at high speed.

There are two types of hydraulic extraction.

In the first type, the water is squeezed from the fabrics by utilizing fluid pressure exerted against a flexible diaphragm that houses the textiles.

In the second type, the fabrics are placed between a piston and a bulkhead. The piston is forced towards the bulkhead, squeezing the water from the textiles.

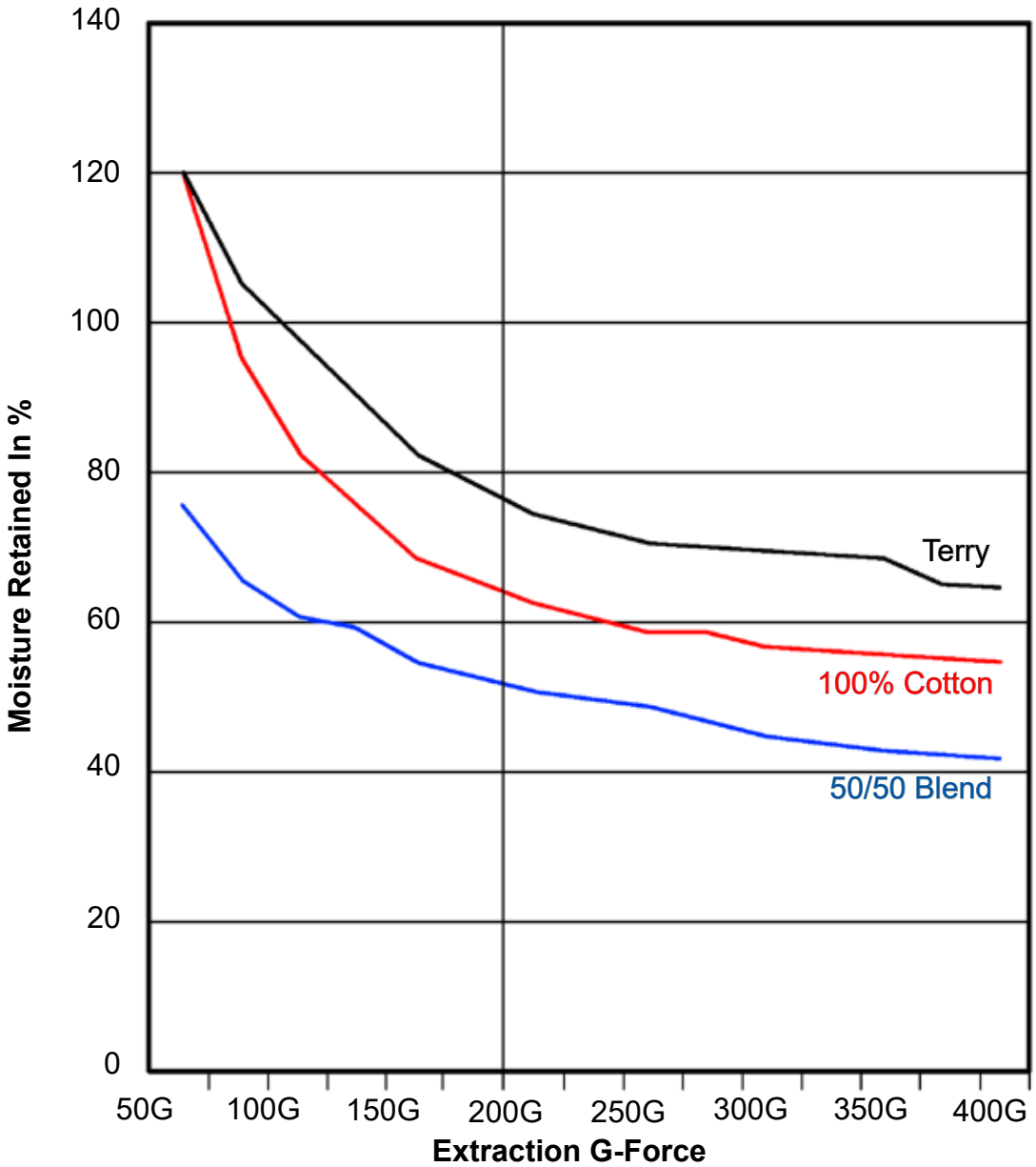
In tunnel washing equipment, moisture is usually extracted by using a hydraulic press, but centrifugal extraction is an efficient choice for certain classifications of textiles if batch cycle times allow.

There are advantages and disadvantages to each extraction method. Water removal using the extract function is more cost effective than dryers, ironers, presses, etc.

Extraction from textiles is enhanced by increasing water temperature and the incorporation of fiber lubricants (e.g., fabric softeners) in the sour bath. The warmer the fabric extracted, the better the moisture removal.

## Moisture Retention

Shown below is a Moisture Retention Chart that demonstrates moisture retention in % when subjected to differing extraction G-Forces. Note that once G-Force exceeds 200G there is a diminishing return on the moisture removed from textiles compared to moisture removal from 50G to 200G.




Moisture retention measures the water extracted from the load. The more water removed from the load, the less drying time required. Too much water removal, however, can damage fabrics. A certain amount of water retention is required for finishing procedures. To calculate moisture retention, use the following formula:

Weight after extraction - dry weight / dry weight = Moisture Retention (%)

## G-Force

G-Force is a relative measurement used to compare a washer's extraction capabilities (spin cycle). Comparatively, higher RPM's relate to higher G-Force when the cylinder size is similar. However, larger diameter cylinders can spin slower, yet attain a higher G-Force than smaller diameter cylinders. Here's the formula to calculate G-Force:

$RPM^2$ x diameter (inches) / 70,500 = "G" Force

**G-Force Chart**

| Model | High Spin (RPM) | G-Force |
|---|---|---|
| CSL60 | 810 | 297 |
| CSL110 | 750 | 310 |
| CSL175 | 700 | 315 |
| CSL225 | 650 | 293 |
| CSL350 | 625 | 324 |
| CSL450 | 650 | 378 |
| DW100 | 625 | 232 |
| DW150 | 590 | 237 |
| DW200 | 650 | 288 |
| DW300 | 625 | 299 |
| DW400 | 600 | 306 |
| DW100PT | 625 | 232 |
| DW150PT | 590 | 237 |
| DW200PT | 580 | 229 |
| DW300PT | 550 | 232 |
| DW400PT | 540 | 248 |
| ESL200 | 650 | 276 |
| ESL400 | 580 | 286 |
| NX40 | 700 | 209 |
| NX60 | 700 | 222 |
| NX100 | 625 | 200 |
| NX140 | 575 | 197 |

NX, ESL, CSL and DW models feature inverter with single motor drive. Extract speeds are field programmable in (1) RPM increments via the DynaTrol HMi touch screen control.

## Tumbler Dryers

**How To Size:**

Dryer should be of larger capacity than corresponding washer-extractor. Estimate between 1.4 and 1.5 times washer-extractor capacity. (i.e.: a 50 lb. washer requires approximately a 75 lb. dryer).

Average loads per hour:

- Gas fired = 2
- Steam heated = 1.5
- Electric heated = 1

In general, the 1.2 - 1.4 capacity rule applies to washer-extractors with high extract speeds (G-Force greater than 200G). If low or medium speed (80G - 180G) are used, a dryer to washer ratio should be 2:1. Thus, a 50 lb washer would require a 100 lb dryer. If part of the volume of laundry is to be ironed, dryer capacity can be reduced.

The time for drying a load can be estimated with this formula:

$$\text{Drying time (hrs)} = \frac{\text{(Load weight, lb)} \times \text{(\% water retention)} \times \text{(2,500 BTU/lb)}}{\text{(BTU per hour rating of dryer)}}$$

Under ideal conditions, it takes approximately 1,200 BTU to evaporate 1 lb of water. Since a dryer is not 100% efficient, use 2,500 BTU/lb to make up for any inefficiencies.

It is usually best to enclose the dryers to separate the make up air supply. This is especially true if the laundry will have air conditioning or some other environmental control.

Dryer enclosures provide two significant benefits:

The dryers will not use conditioned air from the room for make-up air. This will reduce operating expenses, since the dryer is not taking cooler room air and heating it to 160 to 180 degrees.

Heat emission is reduced by up to 80%. A good rule of thumb is that a dryer will emit 2% of its rated BTU's through each exposed face. Thus, if a dryer is unexposed, there are 5 faces radiating heat into the room (the front, sides, rear and top). The total emission is then 10% of the rated BTU! By enclosing the same dryer, heat emission is reduced to only 2%.

Noise from the mechanical components of the dryer is also reduced by the enclosure. There are occasions when enclosing the dryers is not suitable, so use good judgement for each situation. When enclosing dryers, always provide enough space for service at the rear of the equipment. Most importantly, always provide a properly sized make up air source. A good rule of thumb for makeup air is 1 square inch of clear opening for each 800 BTU of heat. Check local codes for exact requirements. If a louver or screen is to be used, the opening should be at least doubled, since the device will restrict at least half of the opening.

## Washer-Extractors

**How To Size:**

**Motels / Hotels and Resorts**

One bed per room in economy hotel
8 lb / day x rooms x 7 days x occupancy % / 40 hrs = lb / hr

Two beds per room in economy hotel
14 lb / day x rooms x 7 days x occupancy % / 40 hrs = lb / hr

One bed per room in luxury hotel or resort
11 lb / day x rooms x 7 days x occupancy % / 50 hrs = lb / hr

Two beds per room in luxury hotel or resort
20 lb / day x rooms x 7 days x occupancy % / 50 hrs = lb / hr

With larger facilities, increase poundage because of pool, spa, fitness, banquet and/or dining facilities used by both guests and non-guests.

Assume laundry to process 1.5 loads per hr traditional; 2 loads per hr with ozone.

**Nursing Homes**

50 lb / bed / week x number of beds / 37.5hr = lb / hr.

This includes patient clothing in the average home. If a higher number of incontinent patients, increase the per bed per week poundage to 60lb.

Assume laundry to process 1.3 loads per hour traditional; 1.5 loads per hr with ozone.

**Hospitals**

15 lb / day x number of beds x 7 days / 37.5hr = lb / hr. For the division of work, assume 60% flat work (ie: sheets), 40% fluff / dry.

Assume laundry to process 1.3 loads per hour traditional; 1.5 loads per hr with ozone.

**Correctional Facilities**

6 lb / day x number of inmates x 7 days / 50 hrs = lb / hr.

Assume laundry to process 1.3 loads per hour traditional; 1.5 loads per hr with ozone.

**Shirt Laundry / Dry Cleaning Plant**

1/2 lb x number of shirts / day x 6 days / 40 hrs = lb / hr.

Assume washer to process 1.2 - 1.5 loads per hr traditional; 2 loads per hr with ozone.

## Typical Dry Weights Of Selected Items

| Item | Weight lbs | Item | Weight lbs |
|---|---|---|---|
| Apron (waitress) | 0.36 | Gown (patients) | 0.64 |
| Apron (bibbed) | 0.45 | Gown (surgical) | 0.9 |
| Apron (waist) | 0.36 | Jacket (waiter) | 1.4 |
| Apron (shop) | 0.69 | Mop Head | 1.5 |
| Bath Mat (Terry) | 0.59 | Napkin (20” X 20”) | 0.11 |
| Bath Mat (heavy) | 1.35 | Pants (cotton) | 1.27 |
| Blanket (84” X110”) | 4.2 | Pillow Case | 0.32 |
| Bedspread ( 84” X 118”) | 4.7 | Sheet (King size) | 2.25 |
| Bed Pad (60 “ X 76”) | 2.75 | Sheet (Queen size) | 1.9 |
| Chef’s Cap | 0.07 | Sheet (double) | 1.75 |
| Lab Coat | 1.23 | Sheet (twin) | 1.48 |
| Coat, Utility | 2.5 | Shirt (cotton) | 0.65 |
| Coverall (lightweight) | 2.2 | Smock (Poly/cotton blend) | 1.11 |
| Coverall (flame retardant) | 2.84 | Smock (100% cotton) | 3.25 |
| Coverall freezer) | 5.0 | Tablecloth (54” X 54”) | 0.7 |
| Diapers (baby) | 0.6 - 0.12 | Tablecloth (54” X 96”) | 1.35 |
| Draw Sheet (63” X 99”) | 1.17 | Tablecloth (45” X 45”) | 0.53 |
| Dress (uniform) | 0.91 | Tablecloth (64” X 64”) | 0.98 |
| Dust Mop (36”) | 1.5 | Tablecloth (54” X 120”) | 3.0 |
| Fire Station Duty Shirt | 1.0 | Hand Towel (17” X 26”) | 0.18 |
| Fire Station Duty Pants | 1.5 | Bath Towel (24” X 44”) | 0.49 |
| Fire Station Workout Sweatshirt | 1.3 | Turnout Gear  Pants | 5.0 |
| Fire Station Workout Sweat Pants | 0.8 | Turnout Nomex Hood | 0.2 |
| Gloves | 0.5 - 0.75 | Turnout Gear Coat | 6.0 |
| Gloves (cotton) | 0.5 | Turnout Gear Gloves (leather) | 0.8 |
| Gloves (canvas) | 0.75 | Wash Cloth (12” X 12”) | 0.06 |

## Facility Check List

An 18-point check list to consider when laying out your new laundry.

**1** - Space available: _____ x _____

Ceiling height: _____

Door height: _____

Door width: _____

**2** - Floor type: _____

Concrete thickness: _____

**3** - Concrete Pad needed: Yes ☐ No ☐

**4** - Floor condition: _____

**5** - Floor Location: _____

Above ground: _____

Basement or ground level: _____

**6** - Loading dock: Yes ☐ No ☐

Steps: Yes ☐ No ☐

**7** - Rigging required: Yes ☐ No ☐

Length of run to location: _____

**8** - Electrical Service:

Voltage: _____

Phase: _____

Available Amps: _____

**9** - Location of power: _____

Need to run new line?: Yes ☐ No ☐

**10** - Gas service: _____

Natural: _____

Propane: _____

**11** - BTU / cu.ft.: _____

Work needed: Yes ☐ No ☐

**12** - Water: Size of line: _____

Hot water capacity: _____

gal/hour: _____

Hardness/grain: _____

**13** - Drain: Size: _____

Gravity?: _____

Sump pump?: _____

**14** - Distance from washers to drain: _____

Height of drain: _____

**15** - Steam available?: Yes ☐ No ☐

Pressure?: _____

**16** - Ventilation for dryers:

Numbers of vents: _____

Size of vents: _____

**17** - Through roof?: Yes ☐ No ☐

Work needed: Yes ☐ No ☐

**18** - Thickness of wall/ceiling for vent to go through: _____

Make-up air available? _____

## Contact EDRO

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