UDS OVERVIEW

A Utility Distribution System is a stainless steel enclosure consisting of a horizontal raceway and vertical end riser(s) containing electrical bussing and plumbing manifolds with connections for multiple kitchen appliances. It is built in two versions: Wall mounted or Island. The electrical distribution is one of two types: Copper busbar, or a Circuit breaker panel (Wireway).

Electrical Distribution

The Electrical distribution can be 1 of 2 types, Busbar or Wireway. A busbar are solid copper bars mounted on insulating blocks. The insulating blocks separate the bars from each other and other metal components of the LTDS such as the chase. In a 3 phase system there is one copper bar per phase, one bar for the neutral, and one bar for safety ground. The branch breakers are mounted along the raceway and tapped off the busbars for power then wired to the receptacle for each of the equipment.

A wireway is a circuit breaker panel containing all branch breakers mounted in the riser. The branch breakers are plugged in the breaker panel for power and wired to the receptacle for the equipment.

In both bussing types a main breaker with 120V shunt trip is mounted on the riser and wired to the bussing. The breaker is mounted with a reset handle or with a weather proof cover for low amperage.

Basic Electrical Theory

The UDS electrical is sized by the equipment that will be connected to it. We start by sizing each breaker for each piece of equipment. We need to know the following electrical information per equipment: Voltage! Amperage! Wattage! As long as we have the watts and volts the amperage can be derived.

Equations:

$$\text{Single Phase Kilowatts} = \frac{\text{Volts x Amps x Power Factor}}{1000}$$

$$\text{Three Phase Kilowatts} = \frac{\text{Volts x Amps x Power Factor x 1.732}}{1000}.$$

Since we normally don't know the power factor of each equipment we will assume it is 1. For example Market Forge steamer is rated at 480 **VAC/3ph** at 24KW and the given amperage is **32 amps** (note this is per Phase). Using the Three Phase Kilowatts formula (No. 2 above) the calculation is as follows:

$$\text{Three Phase Kilowatts} = \frac{480 \times 32 \times \text{Ix } 1.732}{1000}$$

Three Phase Kilowatts = 26.60 KW

As you can see the calculated value is very close to the one specified by the manufacture. If we use the manufacture values and solve for the PF (Power Factor) it comes out to be 0.90.

Sizing The Main Breaker And Service

To size the main breaker and service for the UDS we need to know the Kilowatts of every piece of equipment connected. Usually the UDS is a 3 phase system so we need to know what amperage will be required to supply to the UDS. By using formula 2 and solving for the amperage this value can be found, for example: The total KW is 18.01KW, and the voltage is

208 V/3ph = 18.01KW x 1000
3 ph Amps or Amps per phase = 208 x 1.732
3 ph Amps or Amps per phase = 50 A

So the service and its wiring needs to handle a minimum of 50 amps; however, we also need to add in a safety factor of 25% for future loads and equipment startup currents.

Continuing our example 25% of 18.01KW is 4.5KW for a total of 22.51KW, which calculates to be 62.49 amps. We now specify the service size to be in increments of 5 greater than the required load and in this case 70 amps.
There are three KW and their corresponding Amperage values we need to know, they are:

- **Connected Load -** The total of every piece of equipment all turned on.
- **Future Load -** The connected load plus 25% plus any DCO's that could be powered in the future.
- **System Capacity** - The total of connected load and future load.

From the system capacity value we can determine the main breaker and service size required. The main breaker is sized equal to or to the next available breaker size. The main breakers are usually in increments of 10, for example 50, 60, 70, etc. In our example the Main breaker needs to be 70 Amps and the service size has to be equal or greater. One thing to keep in mind is a circuit breaker is purposely the weak link in the electrical chain. We want the breaker to open before the equipment, wiring, or receptacle, melt; each of these devices need to be equal or greater than the amperage of the breaker protecting them.

This would be from a direct short to (safety) ground. A 120V/1ph circuit contains 3 wires Hot, Neutral (the return), and (safety) ground. Electricity needs a closed loop, in other words, a complete circuit to operate. A break in the circuit (circle) stops current flow, referred as an Open Circuit. Every circuit needs a load to drive or to use power. If there is no load then the circuit is said to be a Short Circuit which will open the breaker. In a 12OVAC/ 1ph/ 60Hz circuit current flows through the hot wire and back through the Neutral and then reverses direction hence AC (Alternating Current). AC alternates directions 60 times per second, at 60 Hz. The Safety Ground does not carry any current unless the equipment short circuits. The purpose of GFI is to trip the breakers quicker than they would normally trip on there own.

The Safety Ground is connected to the metal case of the equipment and when the hot wire touches the case then the current will flow through the case and back to the breaker box. In and only in the breaker box the Neutral and Safety ground are physically connected together. This creates a short circuit and will allow current to flow through the equipment breaker through the Safety Ground back to the panel where it is connected to Neutral. This is a no load condition which will allow the current to instantaneously increase to its maximum capacity. The only thing stopping this condition is the breaker; it will open upon exceeding its current rating.

Circuit Breaker
Circuit breakers are thermo devices, which means the current flowing through them heats up the bimetallic metals internal to the breaker and once they exceed their designed rating the internal contacts open and lock open. This heating up takes time which could allow the current to be "live", short circuit condition, to the equipment case for a few seconds. The purpose of GFI is to decrease this time to 100 milliseconds or 0.1 seconds.

Busbar bussing
The busbar is where the power from the main breaker connects to and the branch breakers are tapped off for power. The width and thickness of the bar is dictated by the amperage they must carry. For example from 20 to 100 amps the bars are 1 inch wide by 1/8" inch thick. The thickness goes to 4" greater than 100 and so on. Each phase requires a copper bar, the neutral requires a bar, and the safety ground also requires a bar. Since the safety ground does not carry any current under normal conditions it is smaller in size, ¼" x ¼" for 20 to 100 amps service. The busbar must be able to handle the total current, because we want the main breaker to open way before the copper bar melts; therefore, the larger the bar the better the results.

The copper bars are mounted in insulating blocks which hole the bars at 1" spaced separation from each other and the metal enclosure. The insulating blocks are required to be spaced no greater than 18" apart. Two bolts are bolted on each side of the blocks on the bar to prevent the bar from moving from side to side. A front insulating cover is placed over the front of the bars to keep them from falling out.

Main Breaker
The main breaker is where the field electrician connects the service. He would connect to the top of the breaker terminals, so 1 wire per phase. The neutral service connects to a insulated neutral block normally mounted next to the main breaker. The safety ground is connected to the chase. The safety ground is connected to neutral in the breaker panel feeding the UDS. Wire is continued from the main breaker and the neutral block and connected to its respective phase copper busbar. In a wireway the bussing is in the circuit breaker panel (Square D Load Center) and the wires are connected to the terminals at the top of the bussing.

In both bussing types the main breaker is mounted with a reset handle to the outside of the riser. Turning the handle will turn the main breaker either off or on. The only exception is when the main breaker is small in size 40 amps or less where the reset handle will not mount on the breaker. In this case the breaker switch will be accessible to the outside of the riser with a weatherproof cover.

All main breakers will contain a shunt trip device for fire system shut down. The shunt trip will normally be 120V AC. This will be dedicated power from the fire system switch. In a fire condition the switch will connect 120 VAC/1ph to the shut trip device to open the main breaker removing power to the UDS and its equipment.

Branch breaker(s)
The branch breakers are sized to the equipment. The increments are 10, *15,* 20, *25,* 30, *35,* 40, **45,** *50,* 60, 70, 80, 90, and 100. The next available breaker size should be chosen for the equipment. Any amperage less than 10 amps will get a 10 amp breaker. Equipment that requires 13.9 amps will get a 15 amp breaker, and so on.

On a busbar system the wires are tapped off of the busbar to the branch breaker and from the branch breaker to the equipment receptacle. All single pole breakers are divided between the 3 phases to keep the system balanced.

The physically construction of a busbar UFI branch breaker contains the following items:

- Branch breaker with a shunt trip added.
- A current transformer (donut)

The shunt trip on the branch breaker will physically trip electrically. I have chosen the shunt trip to be 120VAC/1ph although they can be 12VAC/DC, 24VACIDC, or other voltages. The current transformer is a circle with the Hot wires from the equipment breaker pass through. The current flowing in the wire creates a magnetic field which induces in the current transformer. When this current reaches its setting its relay contact closes sending 120V AC power to the shunt trip of the equipment breaker. The current transformer induction is much quicker than the breaker tripping by itself.

A wireway breaker with GFI circuitry built internally to the breaker can be ordered; however, they are limited to 1 and 2 pole breakers and also available in limited ratings. All 3 pole breakers will use a shunt trip, which takes up an additional 1 pole space in the panel, and a current transformer for GFI.

Wireway bussing
The branch breakers are sized to the equipment. The increments are 10, 15, 20, 25, 30, *35,* 40, 45, 50*,* 60, 70, 80, 90, and 100. The next available breaker size should be chosen for the equipment. Any amperage less than 10 amps will get a 10 amp breaker. Equipment that requires 13.9 amps will get a 15 amp breaker, and so on.

In a wireway system the breakers are plugged into the circuit breaker panel. The balancing is already accomplished by its construction by the phase connection alternating in the breaker panel.

Cable Bus (proposed adding to listing, competitors spec.)
This is just large insulated cable (wire) with its insulation removed at various spots along its length to tap off for the branch breakers. We do not build this type of bussing, because it is limited to 100 amps, it is more labor intensive, and would not be as flexible as a busbar system. The only reason to consider adding this to the Ut listing would be to meet a spec.; however, we normally spec. busbar to meet this specification.

Receptacle connections
All equipment up to 60 amps will have a receptacle, greater than 60 amps will be direct wired to the bussing. The only exception is to go to Pin & Sleeve type Receptacles. The receptacles will be mounted with weatherproof covers in the one of the following locations:
- The bottom of the raceway (normally on a Island style UDS).
- The front side of the raceway (normally on a wall style UDS).
- On an electrical plate beside its breaker. (rarely done).

Straight blade
Straight blade receptacles are normally used in home construction, their connecting blades are straight. Straight blade receptacles are rated up to a maximum of 60 Amps. The receptacles have to be rated equal to or greater than the branch breaker protecting the equipment.

Twist Lock
The blades for the twist lock are arched with one of the blades having an L shaped arched blade. The L shaped blade is the safety ground. Twist Lock receptacles are rated up to a maximum of 60 Amps. The receptacles have to be rated equal to or greater than the branch breaker protecting the equipment.

Pin & Sleeve
Pin & Sleeve receptacles are rated up to a maximum of 100 Amps. The receptacles have to be rated equal to or greater than the branch breaker protecting the equipment. This type of receptacle is bulky and rarely used.

Direct Connection
The only other option for larger than 60 amps is to direct connect the equipment to the bussing, this would only be capable on a busbar system.

Cord & Plugs
All cords and plugs are supplied to equipment that is not supplied with its own from the manufacture. The plugs supplied with the equipment are normally straight blade. The appropriate receptacle is supplied for this situation. The cords are assembled to the plugs in 6 foot lengths, longer or shorter lengths can specified.

Plumbing Distribution

The plumbing in the UDS can be hot and cold water, gas, steam supply and return, and compressed air. These lines are just manifold with the supply being connected from service lines.

Water, hot and cold

The water manifolds and drops are copper with soldered joints. A drop is a Tee in the manifold reducing it down to the required size with a ball valve connected on the end. For example a 3/4" manifold with a 1/2" drop will contain a 3/4" **x** 3/4" **x** 1/2" Tee and a 1/2" ball valve. The manifolds are insulated with pipe insulation approximately 1" thick. The standard size manifolds are either 3/4" or 1", 1/2" manifold can be built, however, the price is the same for either 1/2" or 3/4". The more volume required the larger the size manifold required. The UDS specifications usually state the required size. A rule of thumb is to size the manifold by the largest size drop, also a large number of drops would require a larger size manifold.

Gas

The gas manifolds usually range from 1-1/4", 1-1/2", 2", *2-1/2",* and 3". The size is dictated by the required total BTU of the UDS and the length of The manifold (UDS). Any run greater than lOft and 975,000 BTU's at 5" of w.c. pressure (water column) will require to be "looped service." Looped service is when the gas supply is connected to both ends of the manifold. The reason to use looped service is to keep from starving the equipment at the far end of the UDS on a non-looped manifold. The following table is a rule of thumb that is currently used for sizing:

BTU/HR (in thousands) per length of raceway - at 5" w. c.						
Pipe Size in Inches	10 ft	15 ft	20 ft	30 ft	40 ft	50 ft
Single Service (One End)						
1-1/2"	975	790	675	550	N/A	N/A
Looped Service (Both Ends)						
1-1/4"	1200	960	840	700	590	540
1-1/2"	1950	1580	1350	1100	930	850
2"	4100	3400	2900	2350	1980	1800

Main service size from meter is dependent on building piping system and pressure. Main service looped to feed both ends when more than 3 appliances in 10 ft. Pressure drop varies according to number of appliances and quick-disconnects, normal pressure drop is 0.3" to 0.5" w.c.

Normally the manifold size is stated in the UDS specification and should only need to be check to check if it is adequate.

Gas valve reset and power interruption device.

All gas service requires a gas valve to shutoff supply in a fire condition. Normally a 120 VAC electric gas valve is used and built into the manifold in the UDS. If the manifold is looped there are 2 gas valves, one on each end in the risers. When AC power is lost to the building the AC gas valves will immediately close (they are powered and maintained open). A power interrupting device will allow the gas valves to reopen automatically if the power is restored in certain amount of time. This time can vary and is usually 10 to 15 seconds. After the delay time the gas valve will have to be manually opened by pressing an electric reset button. The reason for this control is due to the pilot light on the gas equipment will extinguish and would allow raw gas to flood the room if not shut off. The gas would not be reset until they are ready to re-light all equipment pilot lights.

The gas valve can be DC (direct current) and use optional battery power to maintain the gas valve open in an AC power outage condition. The valve would only be held open the charge on the battery. This is usually only a few hours, 7 to 8. Another way to maintain gas supply in a power outage condition is to use a mechanical gas valve; this will only close by a cable connected to the fire system and pull station.

The standard is to use 120 VAC gas valve, because, when AC power is lost the exhaust fan(s) are also AC and will shut down. They are not allowed to cook without exhaust fans.

Steam Supply

Steam supply line can be sized using the table below. Steam is usually low pressure around 5 PSI and use 2" or 2-1/2". A 3" supply line is very large and makes the plumbing construction difficult; it should only be used for necessary supply demands.

SATURATED STEAM CAPACITIES -OD TUBE Capacities in lb/h

		Tube Size (O.D X 0.065 inch wall)								
Pressure PSI	**Velocity ft/sec**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1-1/2"**	**2"**	**2-1/2"**	**3"**
	50	-	-	5	20	35	90	170	270	395
5	80	-	5	10	30	60	145	270	430	635
	120	-	5	15	45	85	215	405	650	950
	50	-	5	10	25	45	110	210	335	490
10	80	-	5	15	35	70	180	330	535	785
	120	-	10	20	55	110	270	500	800	1175
	50	-	5	10	30	60	155	285	460	675
20	80	-	10	20	50	100	245	460	735	1080
	120	5	10	25	75	150	370	685	1105	1620
	50	-	5	15	40	80	195	365	58ff	855
30	80	5	10	30	65	125	310	580	935	1370
	120	5	15	35	95	190	465	870	1400	2050
	50	-	10	15	50	95	235	440	705	1035
40	80	5	10	25	75	150	375	700	1125	1655
	120	5	20	40	115	230	565	1050	1690	2480
	50	-	10	20	55	110	275	515	825	1210
50	80	5	15	30	90	180	440	820	1320	1935
	120	5	20	50	135	265	660	1235	1980	2905
	50	-	10	25	65	125	315	590	945	1385
60	80	5	15	35	105	205	505	940	1510	2215
	120	5	25	55	155	305	755	1411	2265	3325
	50	5	15	30	80	160	395	735	1180	1730
80	80	5	20	45	130	255	630	1175	1890	2770
	120	5	30	70	195	380	950	1764	2835	4155
	50	5	15	35	95	190	470	880	1415	2075
100	80	5	25	55	155	305	755	1410	2265	3320
	120	10	35	85	230	455	1135	2115	3395	4975
	50	5	20	40	115	220	550	1030	1650	2420
120	80	5	30	65	180	355	885	1645	2640	3875
	120	10	40	95	270	535	1325	2465	3965	5810

Condensate return

The steam supply line connects to a sideways "U" shaped piping containing:

- Strainer
- Thermostatic Steam Trap
- Unions
- Ball Valves

The Thermostatic Steam Trap drains the water from the steam condensing in the supply line to the return line to maintain steam only in the line and not water.

Air

An Air manifold can be installed in the plumbing section of the UDS. It would be pipe and drops capable of withstanding the pressure. We have not built a UDS in the past that contained an air manifold.

Stainless Steel Chase

The body of the UDS by our ETL listing is constructed with 16 gauge stainless steel. The chase consists of Risers, Raceway, Pedestals, and Access Doors.

Raceway

The raceway is enclosure mounted horizontally between the risers and if required by length supported in the middle with a pedestal. The raceway is divided into 2 sections electrical and plumbing. They are isolated (water tight) from each other. On a Island style the electrical is on one side which contains the following for a busbar system, busbar, receptacles, wire, and branch breakers; and which contains the following for a wireway system, receptacles, and wire. The receptacles are mounted with weatherproof covers on the bottom of the electrical side raceway.

The pluming side contains all pluming manifolds and their drops are routed out the bottom of the plumbing side.

Risers

The end risers contain the mains. The main plumbing connections each contain a ball valve; water (hot and cold), gas, steam. The main breaker, DCO's, light switch, and fan switch are usually mounted on the riser. A riser is usually mounted at each end of the raceway; one is dedicated to the electrical and the other to the plumbing. Loop gas line is also routed through the electrical riser so we have to make the electrical water tight. This means running liquid tight conduit and building special stainless steel boxes to contain every electrical component.

The standard size risers width is either 24" or 30" and the thickness is normally 12". These sizes can vary depending on the specifications and what will be mounted on and in the riser. If we have to turn the riser perpendicular to the raceway, the top is sloped to prevent hood notching. The riser's standard height is 6'-6" which is the bottom of the hood when hung from the ceiling. The risers can be made to extend behind the hood if needed. It has been suggested to increase the height to 6'-8" to allow a better seal to be made between the riser and the hood. The risers come with leveling bolts to level the UDS (standard).

Access doors

We provide access doors on the risers on one side and along the raceway. This provides field access for installing and also in construction. The doors on the risers are made to lift out to give access when cooking equipment is in front of the riser. This is convenient on a wireway to provide access to the circuit breaker panel for branch breaker access.

Pedestals

Pedestals are used when the raceway length exceeds 12 feet. It is mounted below the raceway for support. The pedestal is equipped with leveling bolts standard to level the UDS. A 2 "diameter post can be use as a pedestal; however it is not as ascetically appealing and does shift slightly.

Electrical plates

The electrical plates have changes over the years and this year is no exception. The standard electrical plate is used to mount the branch breaker for a busbar system along the peaked top on the raceway. The dimensions are 7-1/2" x 10". Various plates are have been cut to mount DCO's, light switches, and Fan switches.

Fabricated boxes

All of out water tight boxes for the electrical components are fabricated in-house. The only exception is pre-wire packages and circuit breaker panels.

Labels

Every equipment connection electrical and plumbing are color coded, labeled by item number, and description of the cooking equipment. They are plastic engraved labels from Hermes.

Options

Control panels, AM2, TAC-3000, and AQUA-FOG, mounted in the risers.
All of our Aquamatic control panels are ETL listed to be mounted in the UDS. The manifolds are mounted in the riser and the electrical is enclosed in a water tight box and usually with a hinged door just like the one used for the control panel. They are treated just like an independent panel that would be mounted on the wall. The electrical power for the panels must be independent from the UDS. The water wash manifolds are normally connected to the hot water supply that the UDS uses.

DCO's (Dual Convenience Outlet(s))
This is a outlet with its own breaker mounted on a electrical plate usually one is mounted on each riser end. The standard outlet we use is a GFI protected device. It is powered from the UDS electrical bussing. When the UDS shunt trip breaker opens this device loses power.

Light switch
This is powered from the UDS with terminal blocks on its electrical plate for field wiring to the hood lights. When the UDS shunt trip breaker opens this device loses power.

Fan switch
This is powered from the UDS with terminal blocks on its electrical plate for field wiring to the hood lights. When the UDS shunt trip breaker opens this device loses power. This option is used normally if the fan control is supplied by others. If this switch will connect to one of our pre-wires then its power must be independent from the UDS to allow the exhaust in fire condition.

Indicator lights
This option mounts a green light connected (and powered by) each branch breaker to indicate if the receptacle is powered. Under normal conditions the light is illuminated and extinguishes when the breaker opens. This option is most of the time specified with a wireway since the branch breakers are concealed in the risers.

Fill Faucets
A stainless steel enclosure is built on the raceway and water connections are made faucet mounted on the enclosure. This is seen with kettles and normally mounted between two kettles.

Bumper guards
This is plastic guards to prevent mobile equipment from scraping against the UDS.

Requirements for quoting a UDS

Equipment cut sheets
A UDS is built around what will be connected to it. Every cooking equipment connections dictate the connection size and required service for the UDS. This is a must know information to quote and also generate a drawing for a UDS.

UDS job specifications
The specification states the options that are required on the UDS and usually list the equipment to be connected to the UDS. The shape (Chase length, width, height) of the chase is spelled out in specs. The main service feed sizes for Electrical and Plumbing are usually also spelled out. This is used to compare equipment service requirement to verify the service is adequate.