



# The Two Minute Solutionizer

## Selecting Refrigerated Dryers-Part 1

Why select a dryer in the first place?

Let us consider a compressor, which has a capacity of 47.2 l/s (100-cfm). Ambient temperature is 20 °C & the relative humidity is 60%. Through a DS dryer the resulting moisture passed down stream is 0.138 l/hr should the temperate drop below 3°C. Compared to 1.5 l/hr or **36 litres of water per day** without the dryer.

Would you be surprised to find out that many refrigerated dryers don't consistently produce the desired end results of providing air free of water liquid to production? This is not because the equipment is not capable, but because it is probably misapplied. There are critical issues necessary to get the dryer to work.

Two of the most important issues are temperature in and velocity out (Velocity is a function of capacity and pressure). The beginning of proper selection is evaluating not only the theoretical conditions, but also the impact, which will create the highest inlet flow and temperature and the lowest inlet pressure. Combined, this will create the heaviest latent heat load and the highest differential pressure. If you have air cooled after coolers upstream, you must consider the CTD (cold temperature differential or approach temperature) at the highest temperature and relative humidity. As the relative humidity increases, the air-cooled heat exchanger reduces in efficiency and increases in CTD. Ingersoll-Rand rates CTDs on air-cooled machines' after coolers @ 40% RH. At 80% RH the CTD almost doubles. Our competitors will rarely declare the RH% their coolers are rated at. Unless you are working in the desert or Alaska, a 32°C-inlet temperature can produce an inlet condition of 50°C to the dryer. This will require twice the refrigeration and condensing capacity (not necessarily twice the air flow capacity) of a 35°C inlet temperature dryer.

This will shock you. Coolers get dirty! This will cause the CTD to rise. How dirty are you going to let the cooler/s and condenser on the dryer get? You have to decide in advance and then monitor the CTD's to assure that the dryer will continue to produce the desired results. Plan for it! If the compressor uses a hydrocarbon (mineral oil) or synthetic hydrocarbon coolant such as a PAO (there are other compressor manufacturers), it will foul the airside of the after cooler and the dryer. Find out what the manufacturer's fouling factor is and how it may impact your planned fouling. For water-cooled compressors the heat exchangers can get fouled with dissolved solids, biological material, or phosphate treatment. Again, check the fouling factor and monitor the after cooler CTD, the inlet temperature to the dryer, and condenser efficiency on the dryer to assure that the dryer will continue to provide the desired end results. If you don't like the end results for the dryer after a thorough evaluation, you have the choice of applying a low CTD slave cooler upstream of the dryer to cope with the conditions you may be faced with. This can also correct an unfortunate situation in an existent system. If you don't have a source for water cooling, you can apply a closed loop water chiller for the same purpose.

Pressure drop across the dryer will vary dependant on the type and size of the dryer relative to the velocity or capacity at inlet pressure. Where under sizing the dryer will demonstrate lower capital cost the cost on operation and possible impact of product quality will result in customer dissatisfaction. See example below. If you are using conventional coalescing filtration, you will probably have 0.14 bar of differential with the element wet and clean. It is important to select the dryer on the approach pressure after the inlet filter. This pressure is the compressors LPS or cut in pressure. Selection basis off load pressure would result in poor selection.

You have a moral obligation to point out how you have sized your dryer and the impact on productivity and quality basis the selection that is made by your competitor.

Sizing example:

Compressor rated capacity 460-cfm (ML75)

Inlet pressure to dryer is 7-barg, Ambient is 25°C. CTD is 10 or 15°C.

→ Select 5.01 - OUTPUT		TS 140	TS 110	TS 140	TS 140
<b>COMPRESSED AIR DRYER MODEL</b>					
Maximum air flow	cfm FAD 60°F	487	459.6	409	466.4
Air working pressure	barg	7	7	7	7
Air temperature at dryer inlet	°C	35	35	40	40
Air temperature at evap. inlet	°C	19.6	22.2	22.6	24.4
Air temperature at evap. outlet	°C	3	7	3	6
Air temperature at dryer outlet	°C	25.1	25.7	29.7	30.3
Air pressure drop*	kPa	30.17	42.97	21.65	28.1
Condenser cooling fluid		AIR	AIR	AIR	AIR
Condenser cooling fluid temp.	°C	25	25	25	25
Fridge compress. absorb. power	kW	1.49	1.23	1.49	1.51
Required condenser capacity*	kW	7.01	6.16	7.06	7.61
Suction air vapour content	gr/Nm <sup>3</sup>	15.56	15.56	15.56	15.56
Vapour content at dryer inlet	gr/Nm <sup>3</sup>	5.61	5.61	7.38	7.38
Vapour content at dryer outlet	gr/Nm <sup>3</sup>	0.75	1	0.75	0.93
Total condensed moisture	gr/h	3805	3411	4357	4835
*: referred to maximum air flow					
CHANGE ALL INPUT DATA		Anoth. altern.		Return to start	
				EXIT	

You can see from the selection program that the TS140 is the correct dryer to provide a 3°C dew point. If the inlet conditions were the same and the max capacity was around 460-cfm the smaller TS110 will deliver a 7°C dew point, which may effect productivity and product quality.

In the case of the higher CTD the TS180 would provide a 3°C PDP basis peak capacity. Using the TS140 with a 40°C inlet you can achieve a 3°C PDP but only at a reduced capacity. Basis peak capacity and 40°C inlet you will achieve a 6°C PDP.

You will notice that the pressure drop increases as the flow across the dryer increases. This drop is significantly higher if the dryer is borderline for rated flow.

“ Attention to details and looking at the worst case operating scenario’s will pay big premiums, when it comes to long term performance.” A future two-minute solutionizer will determine the impact of events on air treatment (clean-up) performance and dryer velocity.