Managing an Oxygen Contingency
Part 2

If you recall in the last issue of the Beacon we spent a bulk of the time trying to provoke the thought process in dealing with oxygen contingencies. We discussed different considerations that the flight crew is faced with and offered some very basic solutions within our current scope.

The main motivation of these articles is to stimulate the thought process concerning how to cope with these issues NOW so there is some starting frame work available if you find yourself in a similar situation. Dealing with an oxygen contingency is a very complex problem ranging from the fuel/oxygen dilemma, to environmental issues (passenger warmth), equipment failures (passenger Masks), to health concerns (decompression sickness) As you gather more information you will develop useful tools to assist in the decision making process.

To summarize the last LEC Times issue, we outlined some technical issues that the flight crew is faced with in any oxygen situation and our two main operational concerns boiled down to how much fuel (time/duration) and how much oxygen (time/duration) the pilot has onboard the aircraft. As you can see there is a link, a common denominator if you will, between these two resources and that commonality is time. Time will allow the pilot to trade one resource for another and the way that this can be done will be by varying the altitude of the aircraft.

When you think about it……it makes sense. We are dealing with two diametrically opposing consumption rates as we change altitude. The higher you climb the aircraft the better the specific range (the more fuel we gain) and conversely the less oxygen duration knowing that the higher the cabin altitude, the more oxygen is required for crew and passengers.

Here is the current logic. After a decompression a descent is made to 10,000' feet where oxygen is not required. The pilot will determine if there is adequate fuel at 10,000'feet to continue to the alternate airport and land safely. If he/she is able to do so then for all practical purposes the basic emergency is over as you have an adequate supply of fuel and of course oxygen is not required. However, if you do not have enough fuel to continue at 10,000' now you need to consider two scenarios, climb the aircraft to an altitude where the increased specific range will allow a safe landing at the alternate airport or begin preparation to ditch, the latter being the least favorable option. We will consider only the first option, climbing to a higher altitude.

As mentioned earlier, the option to climb higher and exchange fuel for oxygen is available if you have planned to do so. The obstacle now is……. The only indication available to read the oxygen quantity is a pressure gauge. Some type of matrix will need to be constructed to allow us to convert our pressure into time.

As mentioned in an earlier issue some of those variables include mask type, number of occupants, system quantity, altitude, temperature etc. Technology is available that can give us this information. Lets examine two different formats.

This first design is in a series of charts at the different Cardinal altitudes (FL150, FL200, and FL250). The chart below is easy to read. Simply find the current oxygen bottle pressure on the left and follow that row to the number of crew that are using the system and where those lines intersect indicates time (duration) remaining. This chart is based on oxygen flow rates at that altitude, it does not consider higher flow rates that you would see if you experienced a decompression, followed by a descent to 10,000' feet and then a climb back up to that particular flight level. This additional oxygen is added on the bottom of this chart for preplanning purposes. Interpolation is necessary not only between pressure increments, but between altitudes as well.

FLIGHT LEVEL

150

Boeing 757 **N0000**

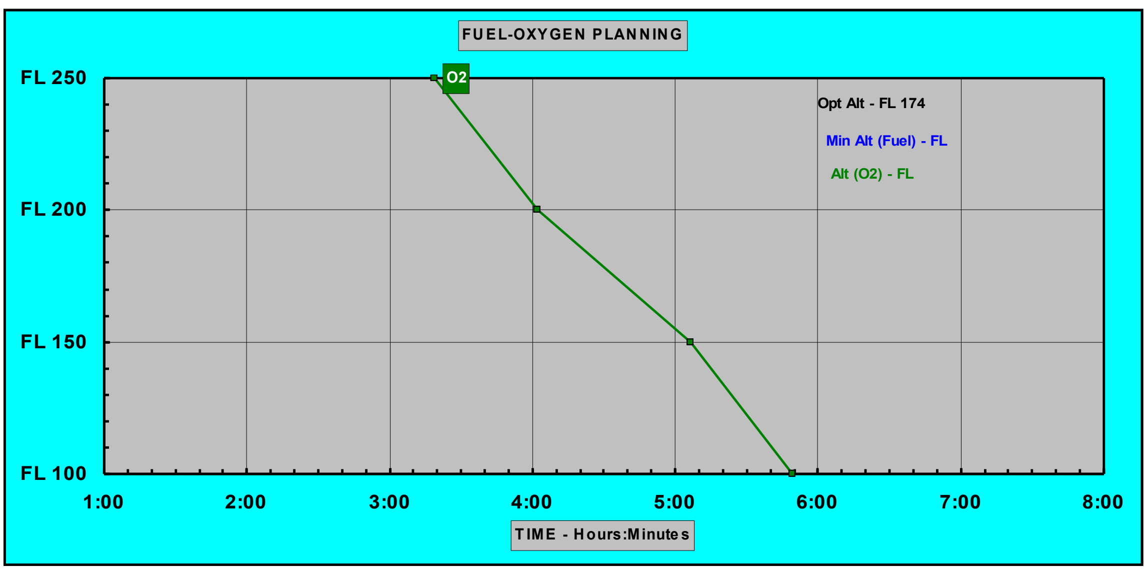
S/N 123 **115 Cu. Ft. Bottle**

NTPD	LITERS	CREW SYSTEM			
1800	3169	6:08	4:33	3:37	3:00
1600	2817	5:28	4:03	3:13	2:40
1400	2465	4:47	3:32	2:49	2:20
1200	2113	4:06	3:02	2:25	2:00
1000	1761	3:25	2:32	2:01	1:40
800	1408	2:44	2:01	1:36	1:20
600	1056	2:03	1:31	1:12	1:00
400	704	1:22	1:01	:48	:40
200	352	:41	:30	:24	:20
CREW		**1**	**2**	**3**	**4**
	REDUCTION FOR ON-BOARD DESCENT AND RESIDUAL				
		445	539	664	789

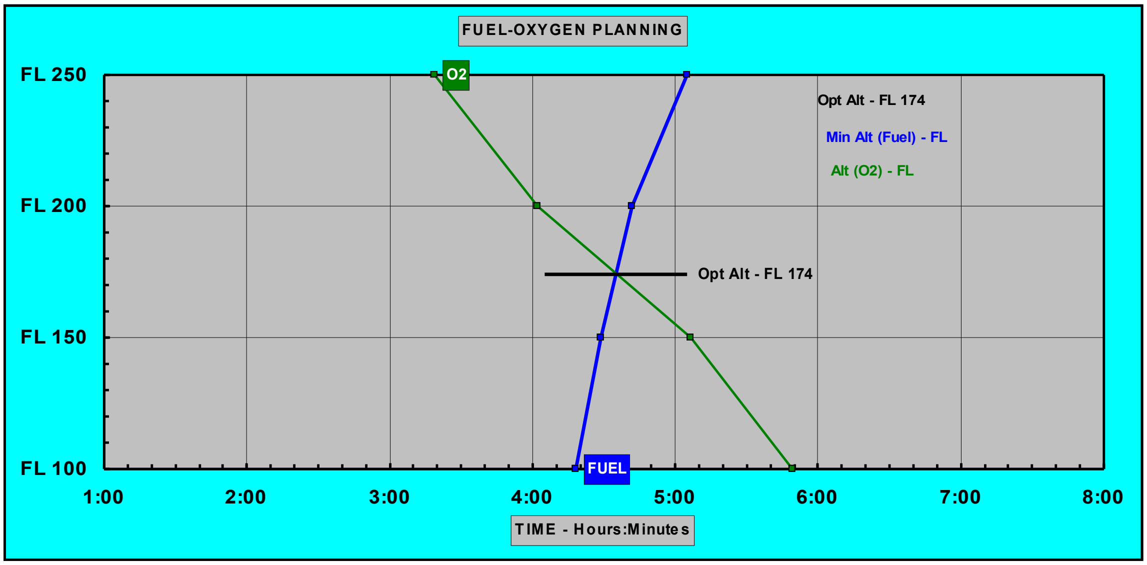
Fig.1

This next design is software and the display options can vary as to what is available on the flight deck. The computerized version is more accurate, quicker to use, and incorporates the fuel duration as well. The software creates a time line for both the fuel and oxygen and the pictorial display is more effective in observing the effects of altitude vs. the fuel and oxygen resources.

In **fig 2** this is the oxygen time line for a particular aircraft at the various altitudes. Once the variables for a particular oxygen system are loaded into the computer, the only input required is the number of crew using the system and the system pressure (psi). As you can see, the higher you climb in altitude the less time (duration) you have available, remembering the higher you fly, the more oxygen is required (higher flow rates/higher consumption)



In **fig 3**, a fuel time line has been added and now you can visually see the affects of both these resources as the altitude varies.



With having both fuel and oxygen conveyed in time, you as the pilot can adjust these resources through altitude. By now you can see the importance of having the proper tools to deal with any oxygen contingency. Our industry deals with worst case scenarios and the only reason they become the worse case scenario is because there is not sufficient information to manage the situation.

This technology has not yet reached our cockpits, but the logic employed is important to understand in order to cope with this type of situation. Oxygen is an area of our industry that has been lagging in technology but is slowly catching up.

Let me leave this issue with a situation that will help exercise some grey matter. Statistics show that an engine failure may result in an uncontained rotor burst which can pierce the pressure vessel causing a decompression. Often when this happens part of a cowling or other aircraft structure hanging out in the air stream will cause induced drag and as a result…….fuel consumption is increased. It is important to be able to recognize this situation early into the emergency and compensate as quickly as possible to counter the effect it could have on your flight. You as the Pilot should know how to determine if your aircraft is flying the way it should and know where to look and how to verify if you in fact have induced drag. Don't always count on vibration as an indication that there is a structural problem. This is a fuel contingency that could very quickly become an oxygen contingency if you do not have enough fuel at 10,000' feet.

Fuel and oxygen management is essential to every flight. Looking at as many scenarios as you can helps in the education process and ultimately will make your flight a safer one, whether it is in the pre-departure phase or during the actual flight itself.

In the next issue of the LEC Times, we will examine the limits of the resources (fuel and oxygen) and the flexibility gained from having a comprehensive fuel/oxygen plan available. By then you will see the importance of having this flexibility to immediately manage the various types of oxygen contingencies. Fly safe and fly smart in the mean time.