Gas Matching

There are 3 different scenarios that will be covered

- Both divers having the same tank sizes and pressure
- Both divers having the same size cylinder but different pressures
- Divers having different size cylinders and /or different pressures

NB The discussion will cover the basic principles of gas matching on a simple dive – no consideration is given to decompression, travel gas or different gas mixtures.

DEFINITIONS

Total gas = Total volume of gas in the cylinders either in litres (L) or pressure (BAR) (TG)

Penetration gas = The amount of gas allocated to reach the maximum penetration point (PG)

Exit gas = The amount of gas allocated to return from the maximum penetration (EG)

Reserve gas = The amount of gas allocated for the dive buddy should they lose their gas (RG)

Turn pressure = The reading on our pressure that determines when we turn the dive (TP)

Rules for gas matching

#1 RG Must be the same or greater than PG
#2 EG Must be the same or more then the PG

GAS MATCHING

The purpose of gas matching is to make sure that you or your dive buddy don't penetrate further than they can safely return on the available gas when the divers have different size tanks or different pressure fills

Poorly planned penetration dives without gas matching will result in using gas reserves that are set aside for emergencies.

The planning has to be such that you allow for the worse case scenario – i.e. a gas loss at the maximum distance from the start of the dive.

Its worth noting that the closer you get to the maximum penetration point the larger the amount of the reserve gas you may need as you are getting progressively further from the start, and conversely as you return the gas reserves required reduce because you are closer to the exit.
So the critical points on the dive are either side of the maximum penetration point.

A simple way to understand this is to visualize that your reserve gas is in your buddies tank and their reserve gas is in yours

RULE OF THIRDS

The idea behind the rule of thirds is to divide the tank gas volume up into 3 parts – each part is set aside for different phases of the dive

1) Entry 2) Return 3) Reserve -represented here by a cylinder filled to 210 BAR

In order to better understand how this works we'll draw in the gas segments and call it the 'Blue' diver's gas

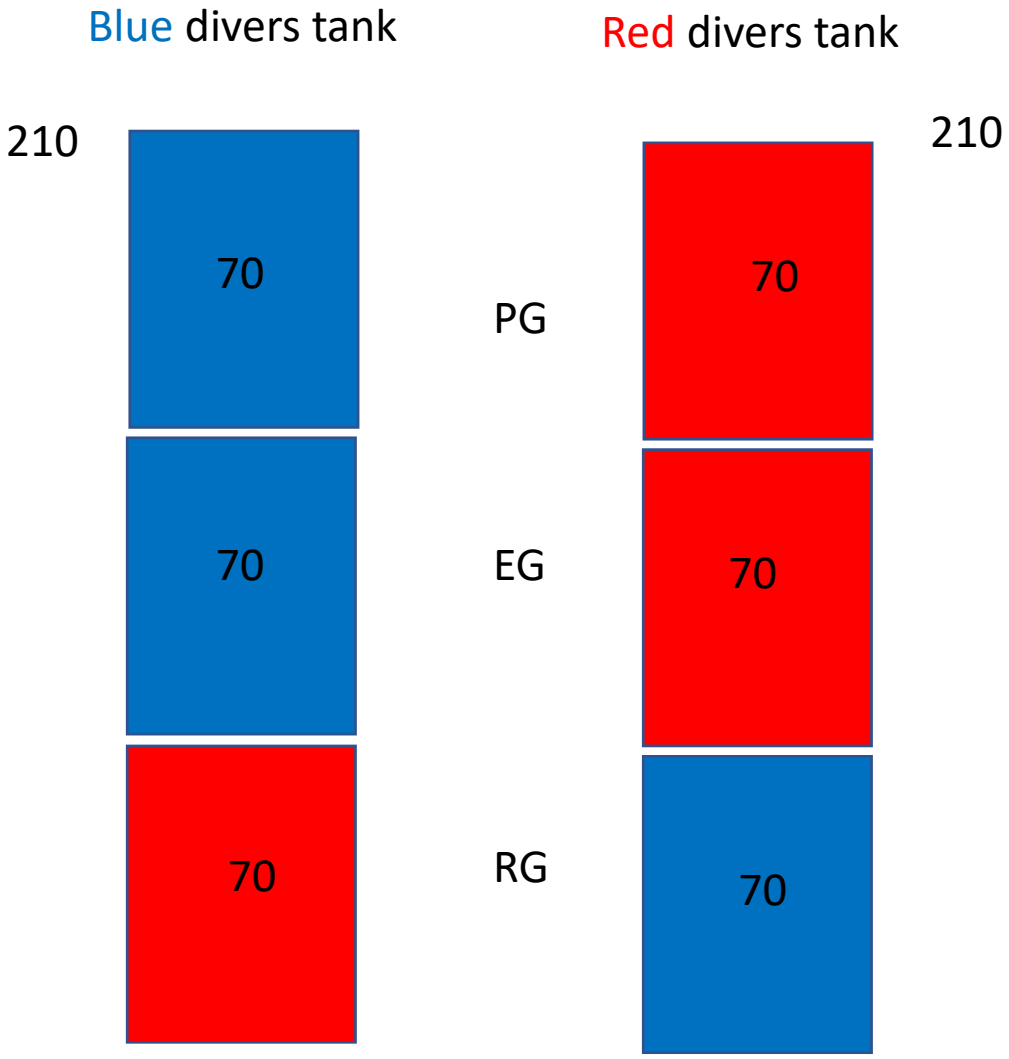
Bear in mind that 1/3 of the gas is set aside for your dive buddy the 'Red ' diver. This gas is not yours its your buddies – you're just storing it for them in your tank

Penetration gas 1/3 = 70 BAR

Exit gas 1/3 =70 BAR

Reserve gas for the red diver 1/3 = 70 BAR

So now we'll use our first scenario – gas matching for equal tanks and equal pressures

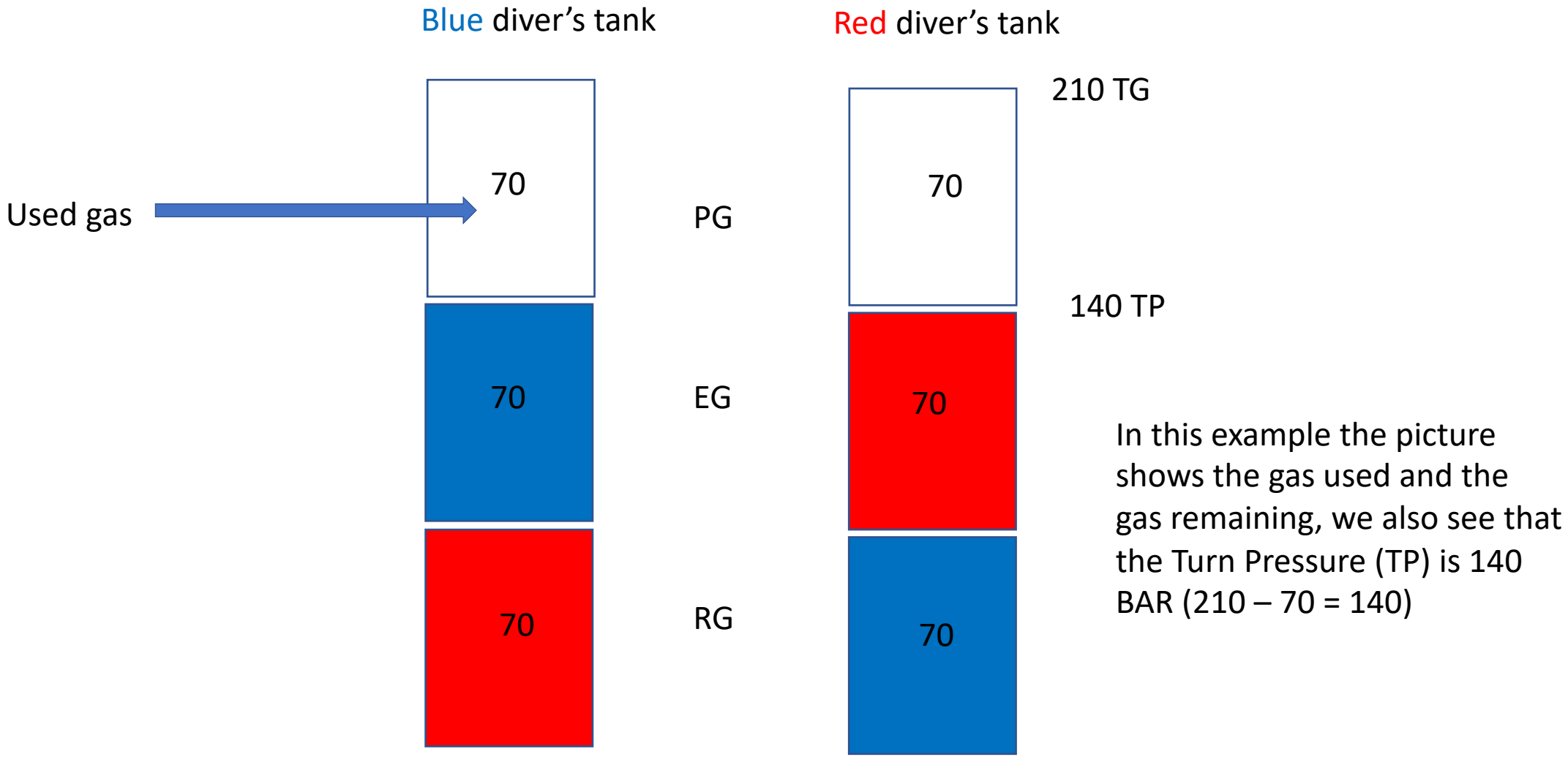


This is a straight-forward exercise. Both divers have 70 Bar to penetrate and 70 to exit allowing 70 Bar for reserve

Both Tanks filled to 210 BAR

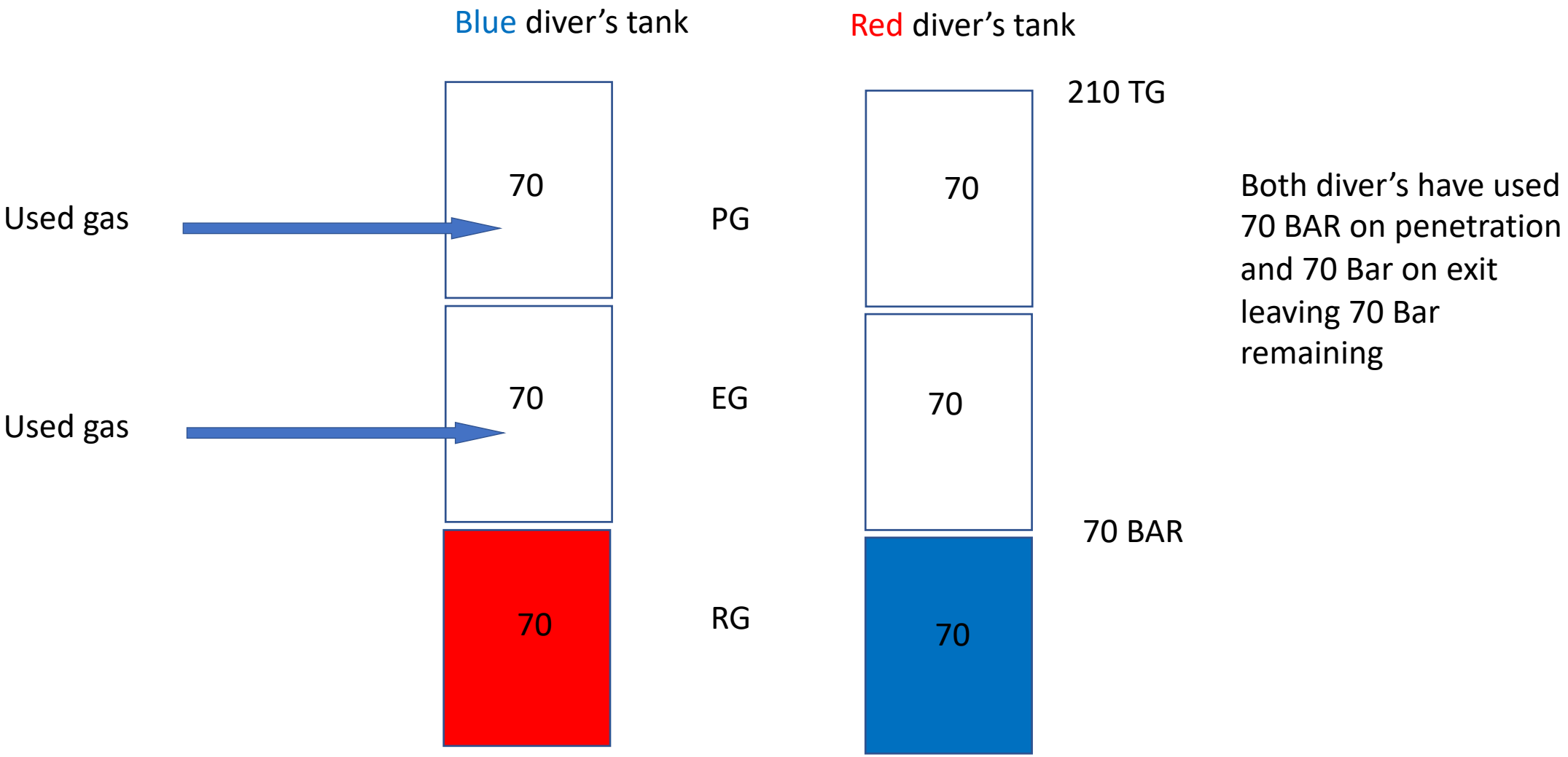
No rules are broken
PG = EG
PG = RG

Once the dive commences, we need to determine Turn Pressure to make sure we have sufficient gas to safely exit



In this example the picture shows the gas used and the gas remaining, we also see that the Turn Pressure (TP) is 140 BAR (210 – 70 = 140)

Now after successfully completing the dive we have used our gas to enter and return and still have the other divers reserve gas in our tanks

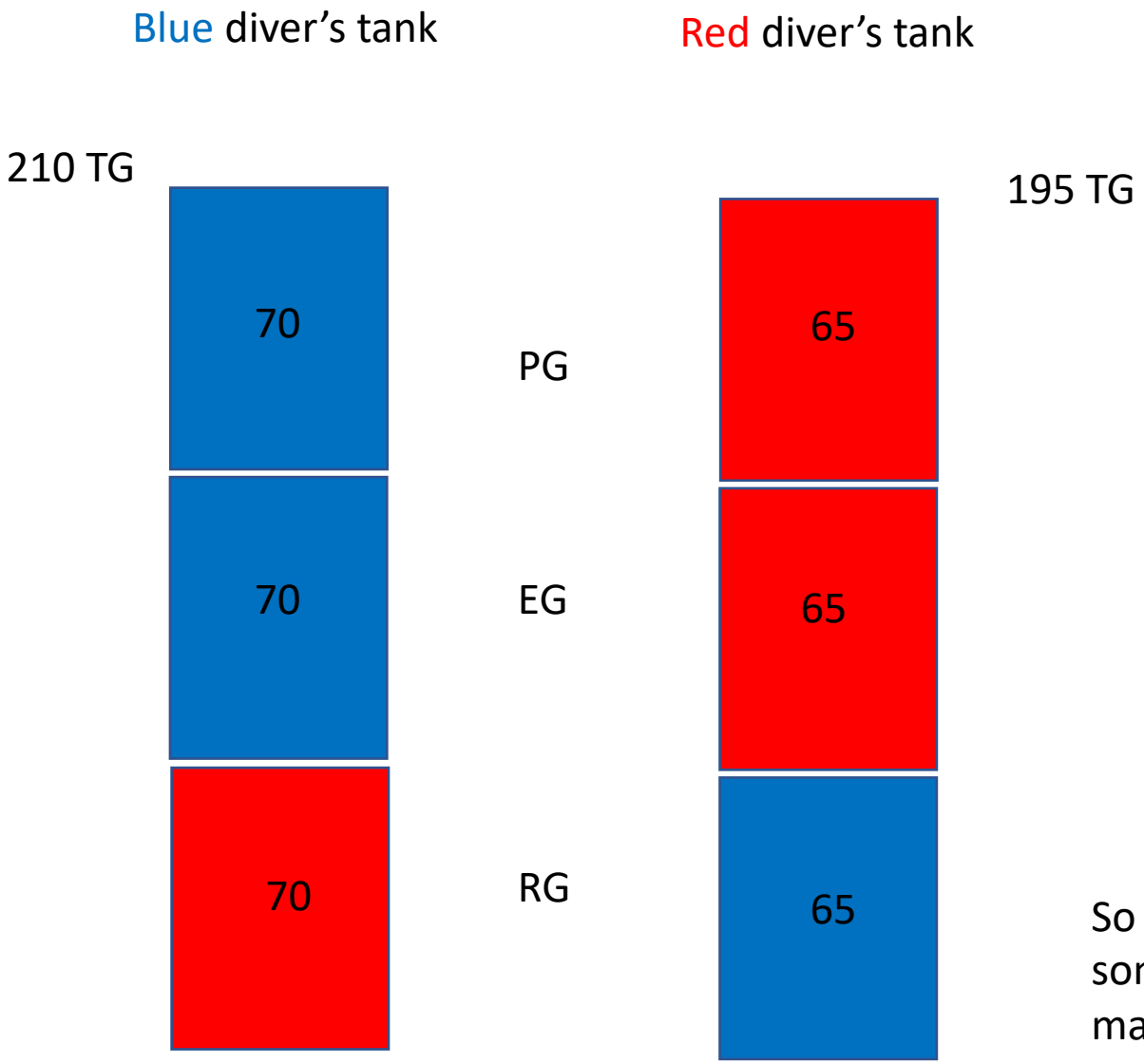


Both diver's have used 70 BAR on penetration and 70 Bar on exit leaving 70 Bar remaining

Now we'll look at scenario 2- both divers have equals size tanks but different pressures

Here we see the tanks divided up as before but this time there's a problem- rule #1 is broken, The blue diver's RG is (in the red diver's tank) less than their PG

The red diver has plenty of RG in the blue diver's tank and their PG and EG are the same so no rules are broken



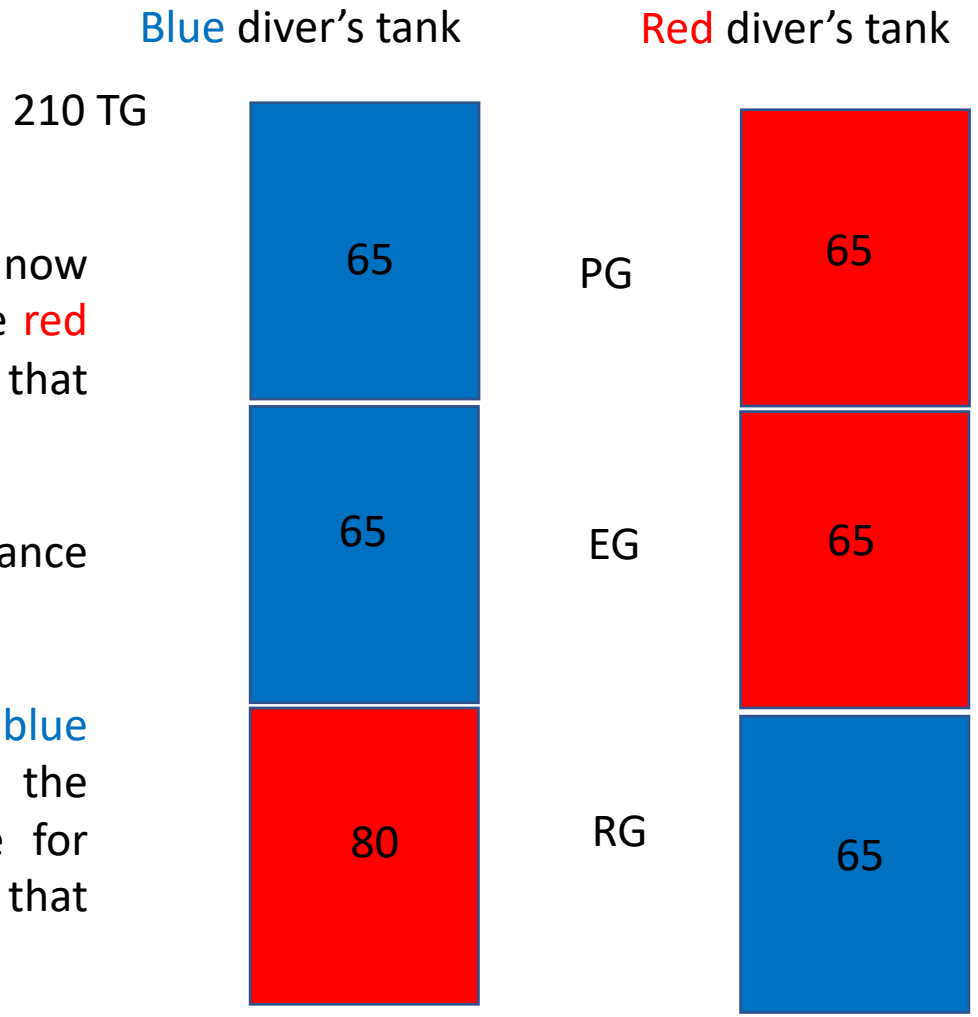
So to allow for this some adjustment are made….

The blue diver uses the same volume of PG as the red diver (1/3 = 65)

The blue diver's PG is now the same amount as the red diver's PG and it follows that the EG is also the same

The RG of 80 is the balance of 210 - 65 - 65 = 80

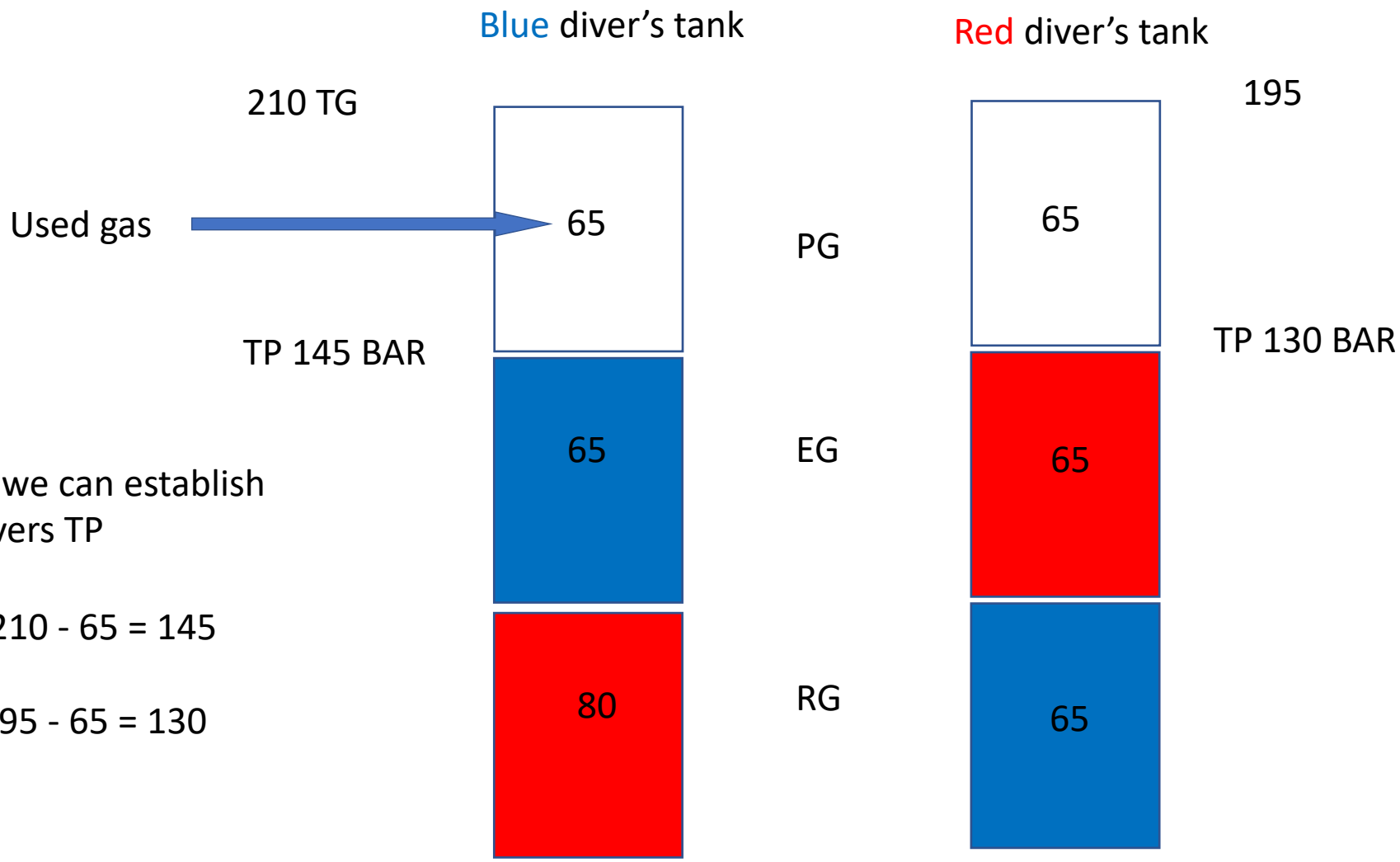
This will prevent the blue diver going beyond the reserves (65) set aside for them by the red diver so that PG = RG



Blue diver now has adequate RG
Red diver has more RG than required

RULE #1 PG =EG
RULE # 2 PG = RG

The dive will turn by the first diver who reaches their TP



So now we can establish both divers TP

Blue is 210 - 65 = 145

Red is 195 - 65 = 130

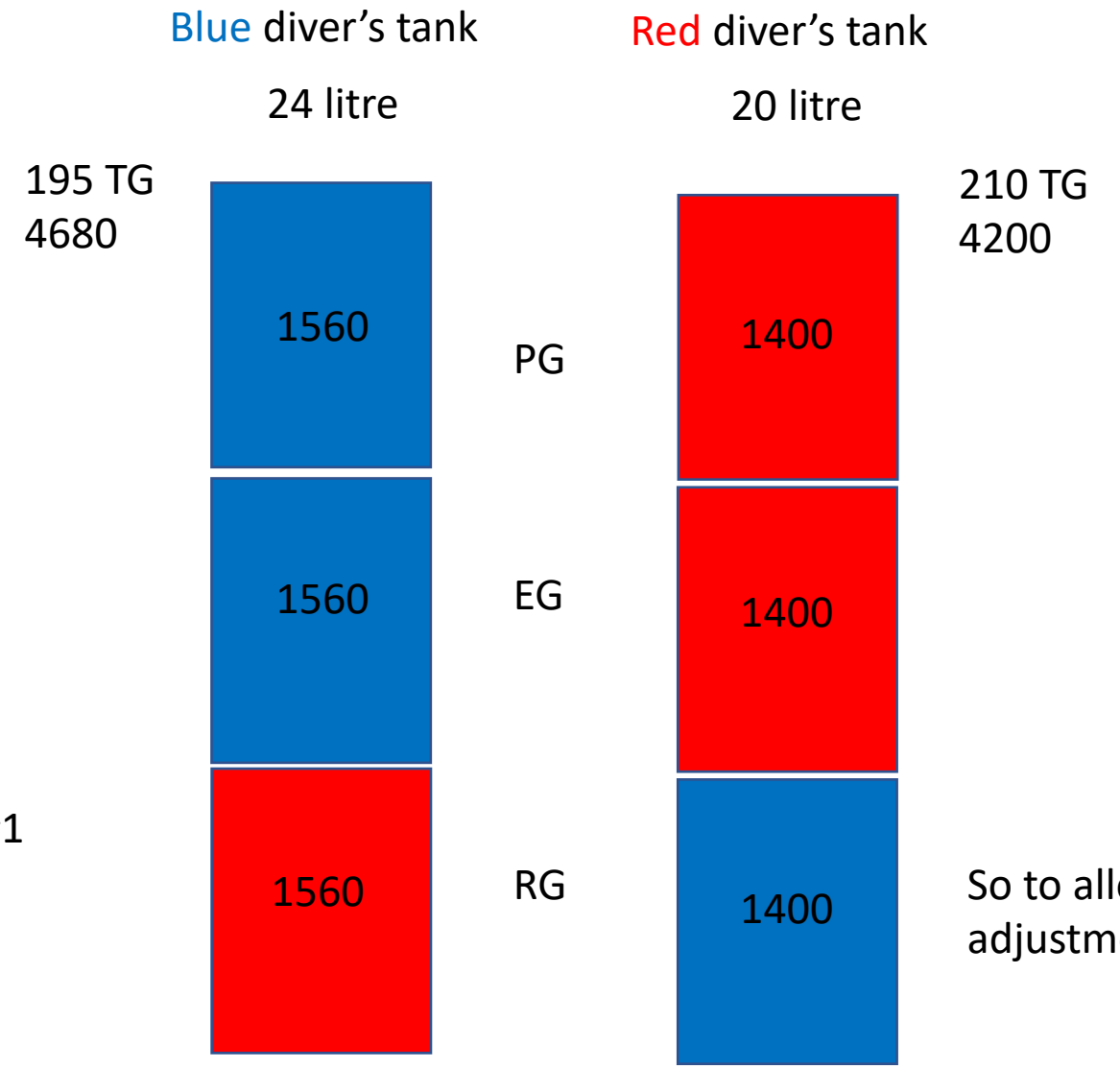
Our last example is to use **different size cylinders**. We'll make the blue diver's tank twin 12 litre at 195 BAR and the red diver's tank twin 10 litre filled to 210 BAR

In order to make this calculation we must first convert the pressure into volume

Blue diver
24 x 195 = 4680 litres
Divide into thirds = 1560 litres

Red diver
20 x 210 =4200 litres
Divide into thirds = 1400 litres

We can see looking at the diagrams that rule #1 (RG Must be the same or greater than PG) is broken for the blue diver but not the red diver



So to allow for this some adjustment are made….

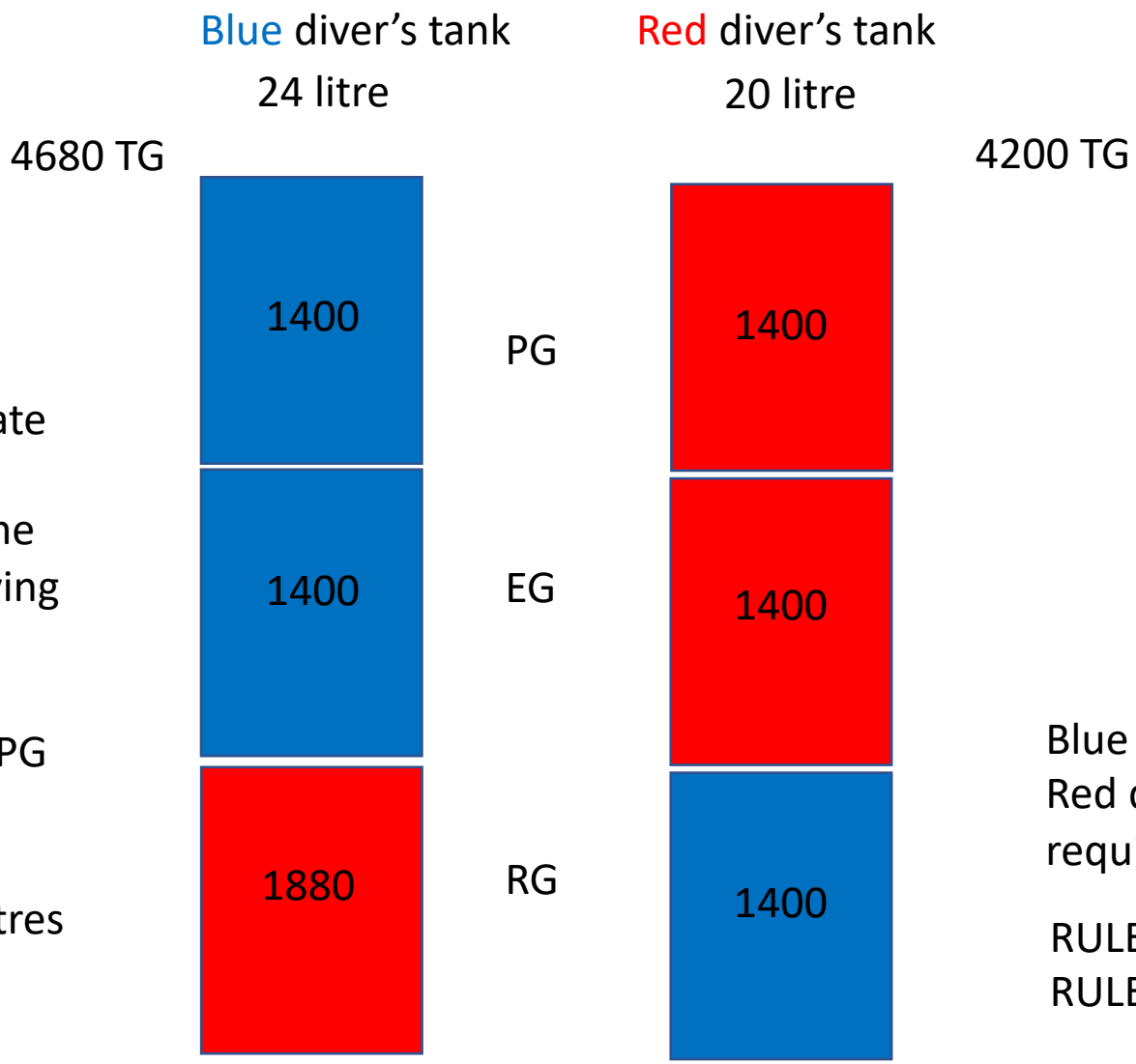
The calculations are based on whoever has the least amount of gas

Here the Red diver has the least amount so we divide their tank by thirds 4200/3 = 1400

The blue diver can only penetrate to the point that they use 1400 litres because that is the volume of RG that the red diver is carrying for them.

Both divers now have 1400 of PG and EG

So 4680 – 1400- 1400 = 1880 litres is the remaining volume



Blue diver now has adequate RG
Red diver has more RG than required

RULE #1 PG =EG
RULE # 2 PG = RG

Convert the volumes back to pressure -

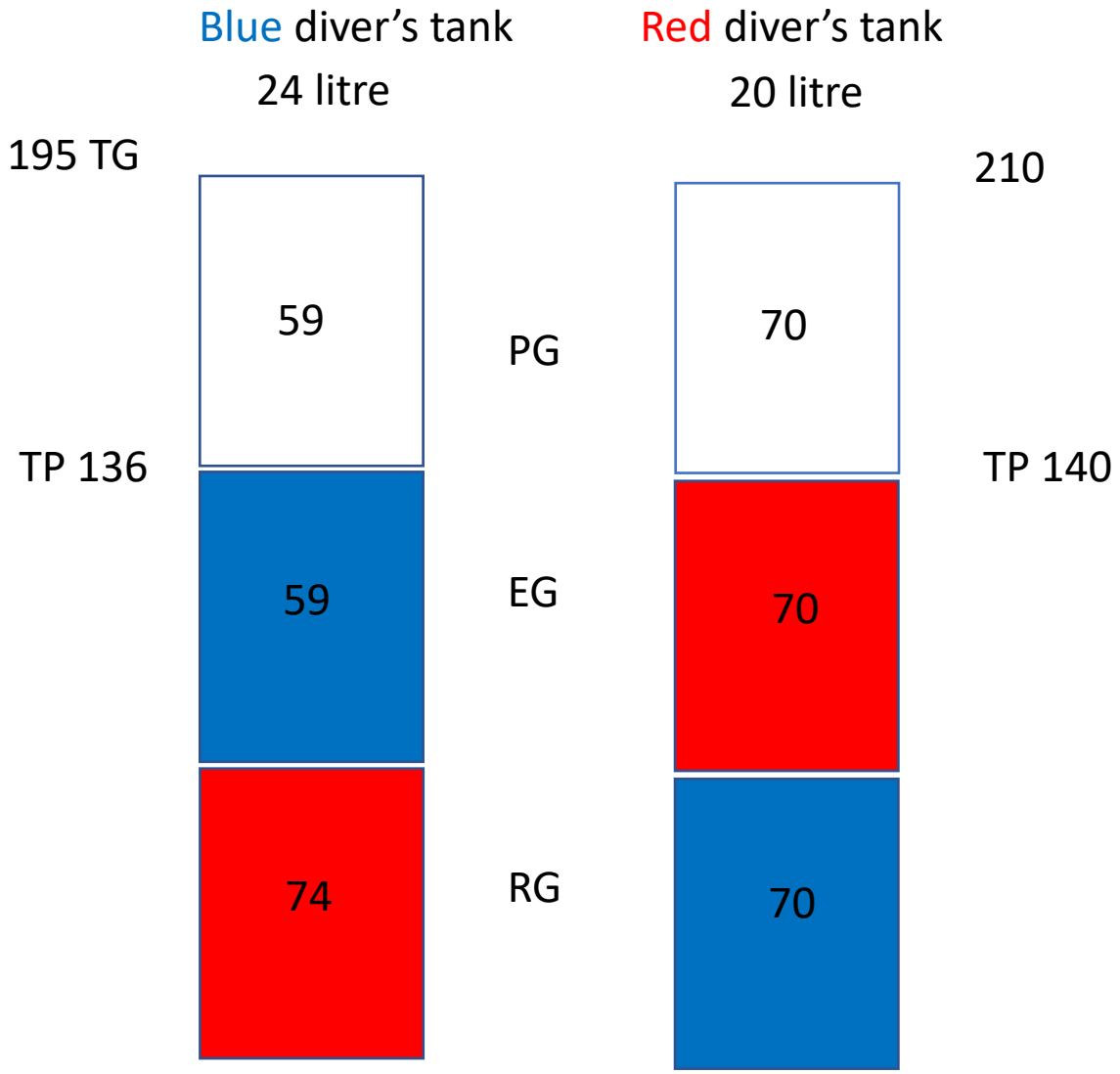
Once we have calculated the PG EG and RG we then convert them back to pressure to give us our turn point

Blue diver
4680/24 = 195 BAR
1400/24 = 59 BAR

Red diver
4200 /20 = 210 BAR
1400/20 = 70 BAR

Take the TG of each diver and subtract the PG to find the TP

Blue 195 – 59 = 136
Red 210 - 70 = 140



SUMMARY:

The person with the smallest volume of gas is the controlling diver

For equal size tanks Pressure or volume can be used for calculations

For unequal size tanks convert pressure to volume first to do calculations

The distance covered in a penetration dive is limited to how much reserve gas is carried

When using cylinders of differing sizes be aware that the pressure readings on respective tanks may appear to be close, however the volumes are not

This presentation covers the introductory principles of gas matching. Below are some further considerations:

Decompression obligations and the required gas volumes add a significant level of complexity.

SAC /RMV need to be taken into account if there's a large difference between divers consumption rate, as does large differences in tank volumes. An extra cylinder may be required to enable a practical penetration dive.

RMV will sky-rocket in an emergency scenario – a third reserve is the bare minimum, consider adding a dive factor to the calculations

When using sidemount breath down cylinders evenly so as to allow suitable reserves. This will allow you to exit with minimal (if any) buddy breathing