Regulators and intermediate pressure for deep dives

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Test chamber, available 500m

Introduction

- Intermediate pressure IP
  Hydrostatic pressure HP
  Total pressure IP + HP

  The correct intermediate pressure (IP) value is the basis for the proper operation of the regulator, solenoid and manual valves.

  The problem may be the change of intermediate pressure in some types of regulators during deep and extremely deep dives.

Piston and „wet“ membrane regulators

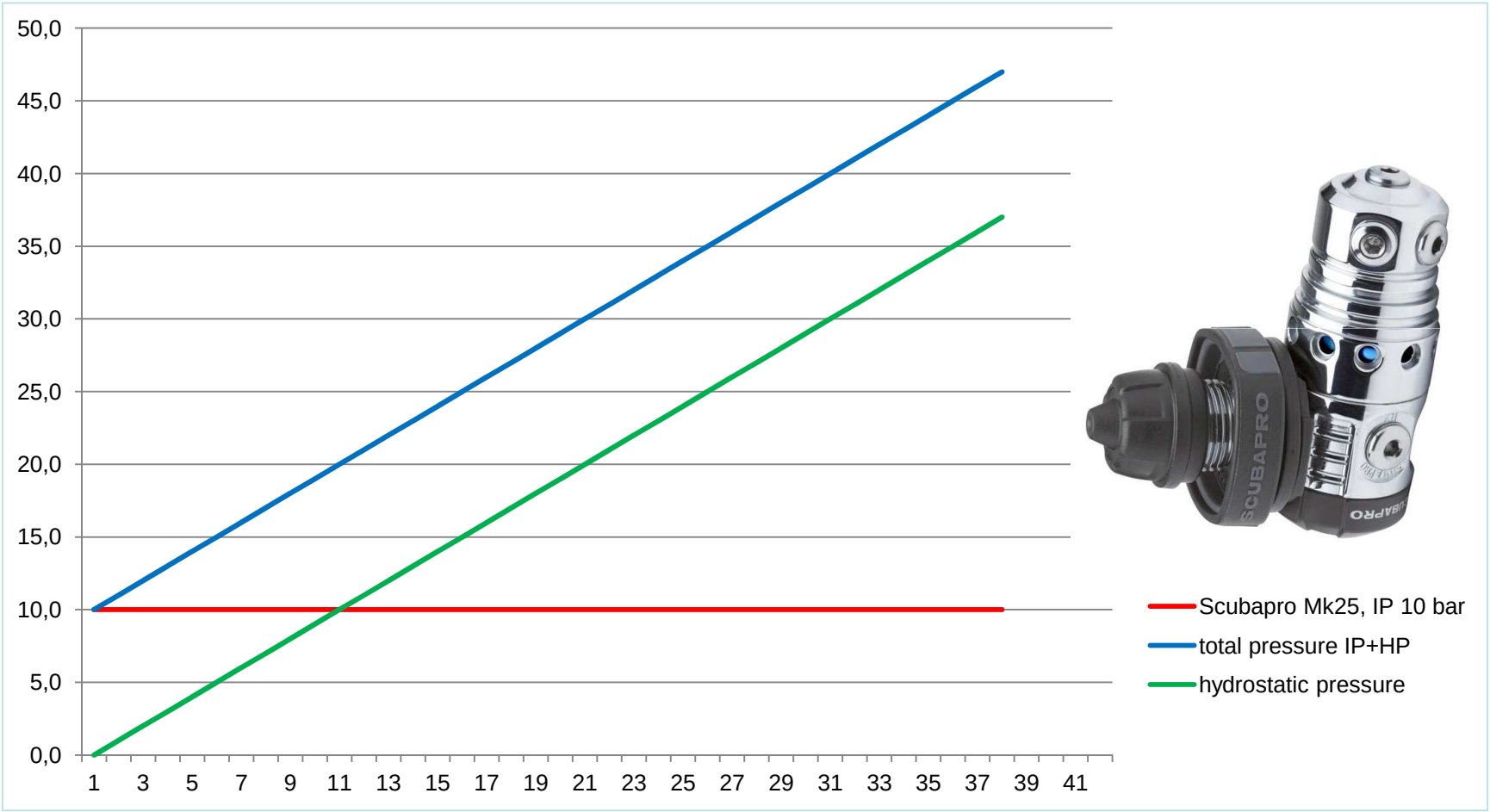
- Water pressure acts directly on the working piston or working diaphragm.

  The total pressure in the intermediate pressure area increases directly in proportion to the hydrostatic pressure, ie the set IP remains the same.

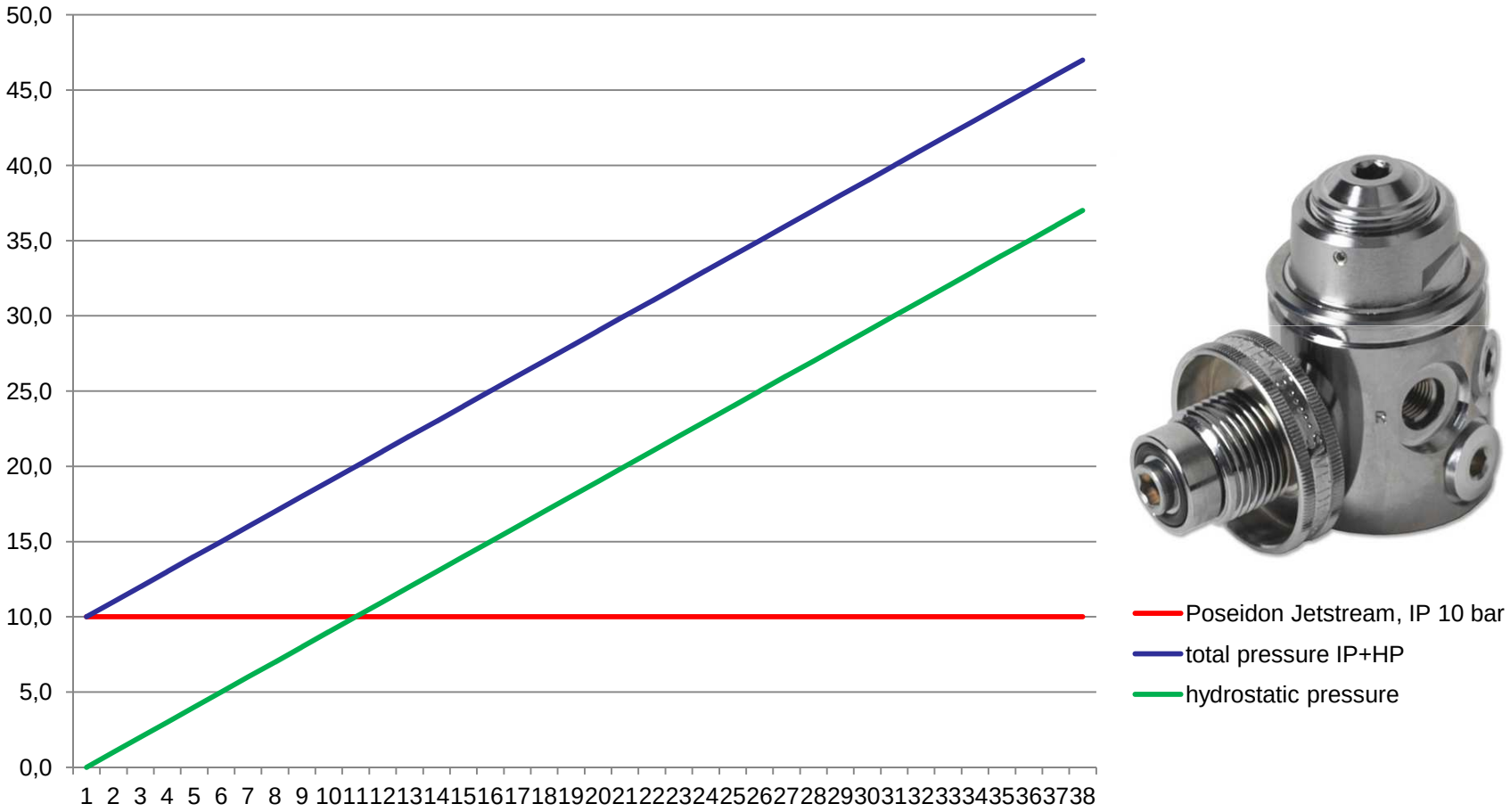
  Simple principle and construction, no changes in intermediate pressure values during the dive or at great depths.

  Reliable operation, no problems.

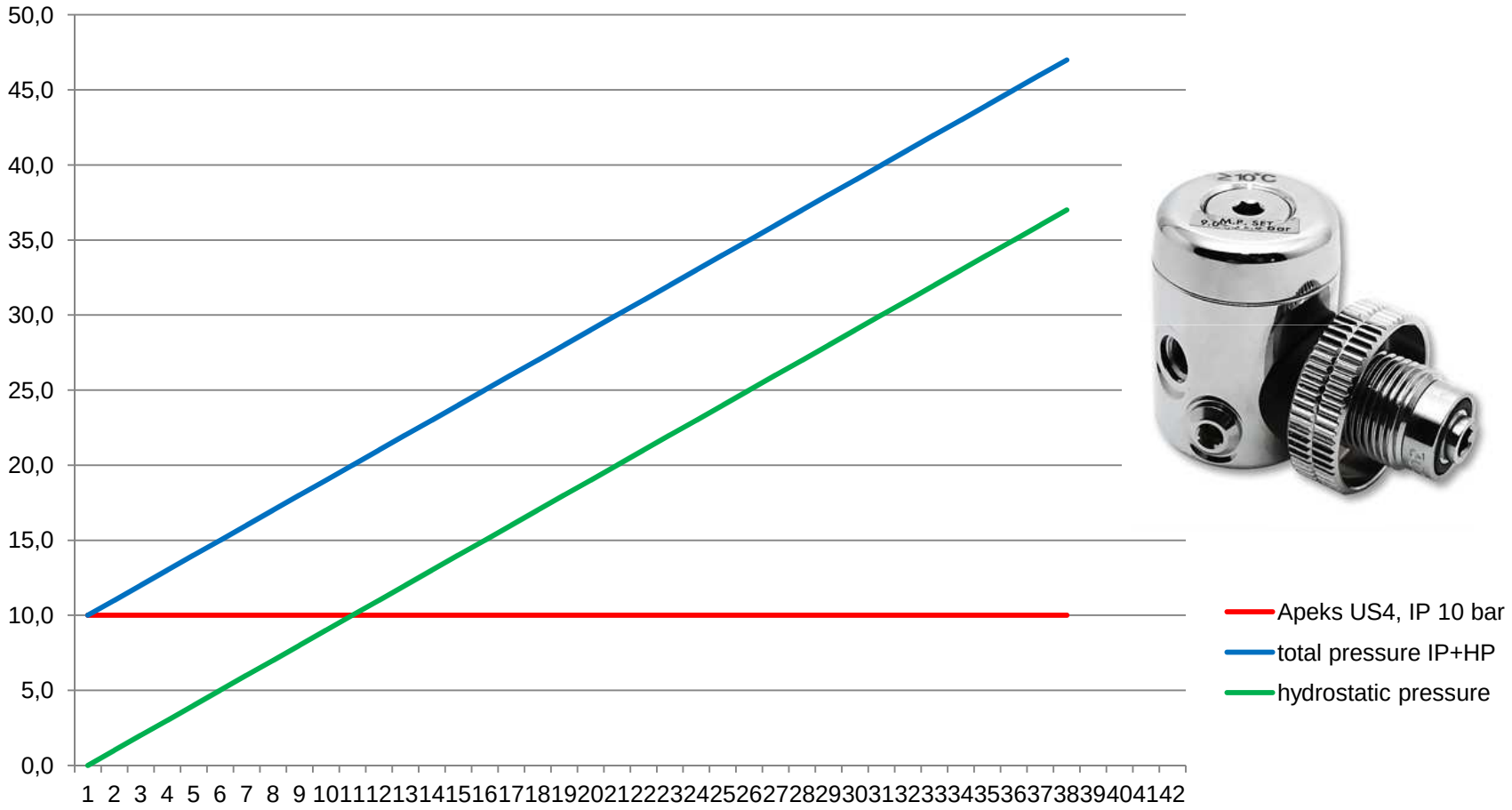
Piston regulators, Scubapro Mk25



„Wet“ membrane regulators, Poseidon Jetstream

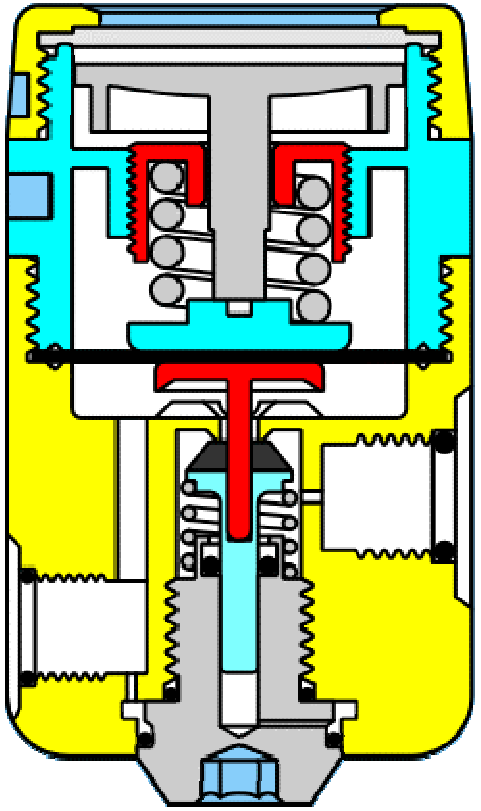


„Wet“ membrane regulators, Apeks US4



Dry Sealed membrane regulators

Example:
Apeks DS4



Dry Sealed membrane regulators

- The water pressure acts on the cover membrane. It is transmitted to the diaphragm by a plastic transmitter. The transmitter chamber is dry, waterproof.

  The intermediate pressure (IP) increases to a depth of about 200m.

  At depths below 200m, the intermediate pressure starts to drop, and can drop to zero at depths below 300m.

Dry Sealed membrane regulators, depth 0 – 200m, IP increase

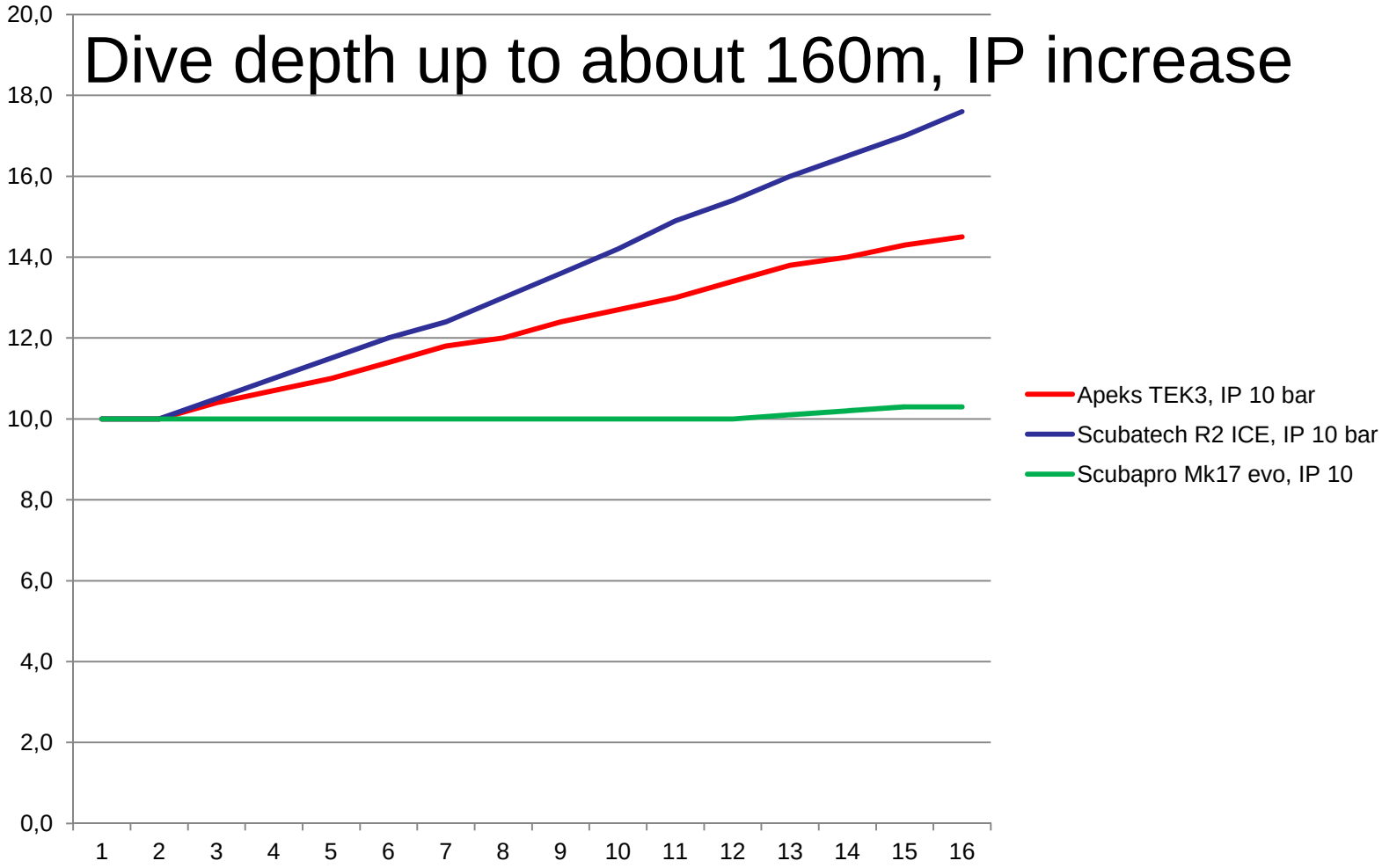
- Examples of IP increase at depths up to 200m:

  Apeks TEK3, depth 170m, intermediate pressure increases by 4.8 bar (from 10 bar to 14.8 bar).
  Scubatech R2 ICE, depth 160m, intermediate pressure increases by 7.5 bar (from 10 bar to 17.5 bar).

  Scubapro Mk17 evo, depth 160m, intermediate pressure only increases from 10 bar to 10.3 bar.

- Note: applies to regulators I have tested, other products may behave differently

Dry Sealed membrane regulators, depth 0 – 200m, IP increase



Dry Sealed membrane regulators, depth 0 – 200m, IP increase

- What follows from the increase in intermediate pressure:

  Most divers do not have to notice it, the regulators to a depth of about 200m work reliably.

  Some CCR rebreathers may have a problem - oxygen solenoids may have a limited input pressure (eg. Snaptight - 8 bar). In this case, use a different type of regulator, or another solenoid.

Dry Sealed regulators, depth 200 – 350m, drop of intermediate pressure

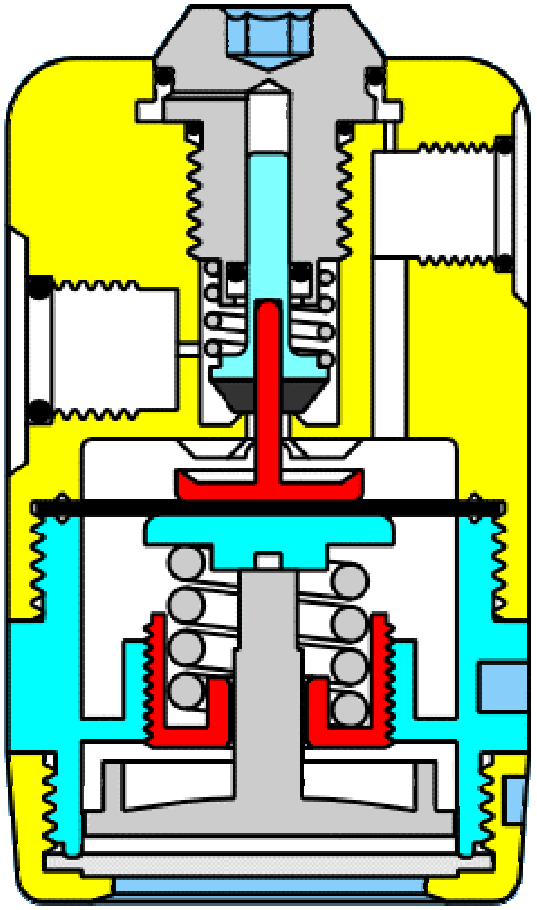
- At a depth of approx. 180 - 200 m, the transfer of hydrostatic pressure to the working diaphragm stops functioning properly, the plastic transmitter stops and starts to deform.

  At depths below 200m, medium-pressure starts to drop significantly, and at depths below 300m, it can drop to values close to zero.

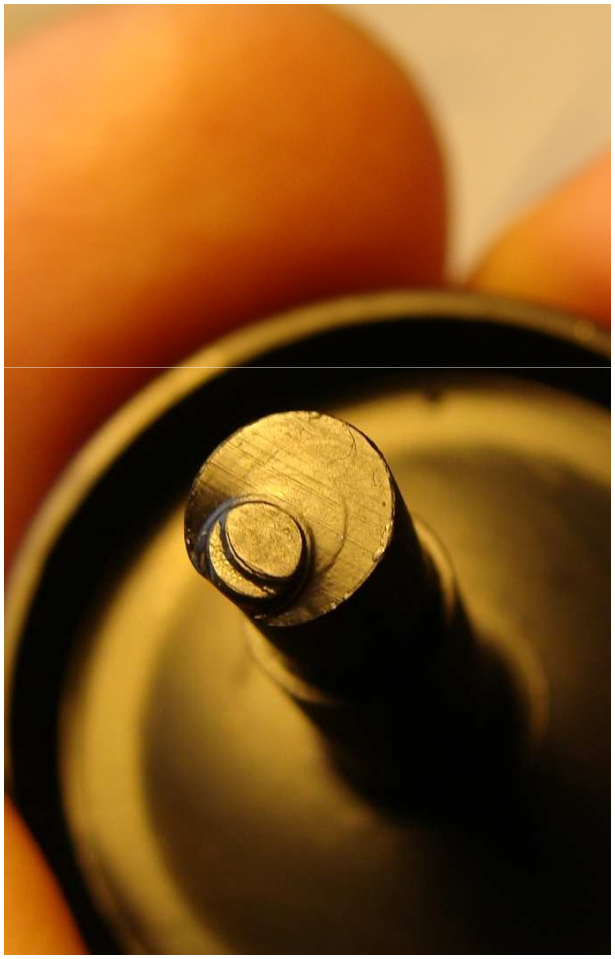
  The regulator gradually stops supplying gas.

Dry Sealed regulators, depth 200 - 350m, drop of intermediate pressure

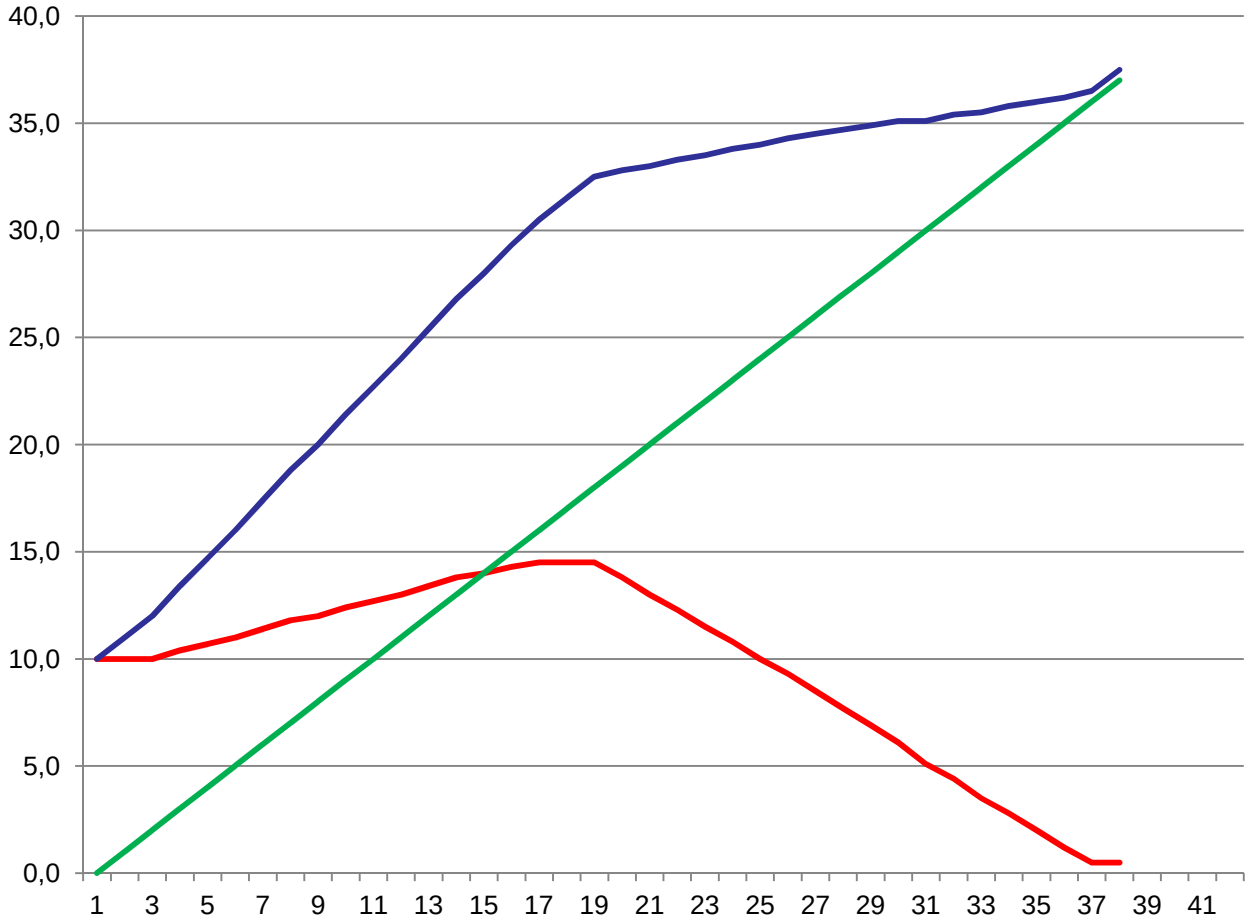
Pressure transmitter



Dry Sealed, transmitter deformation



Apeks TEK3, IP 10 bar, 200-350m, drop of intermediate pressure

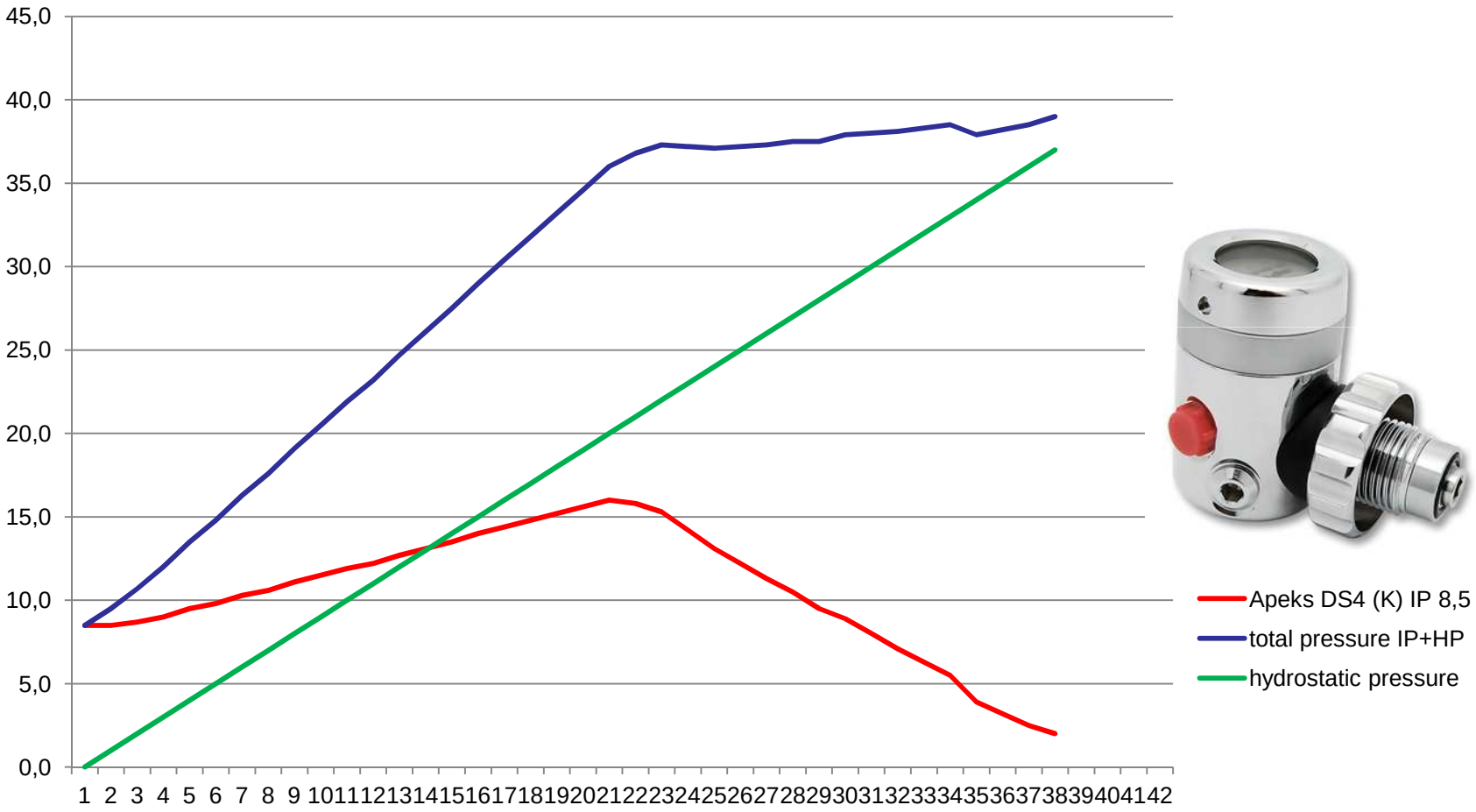


Apeks TEK3 DS, IP 10 bar

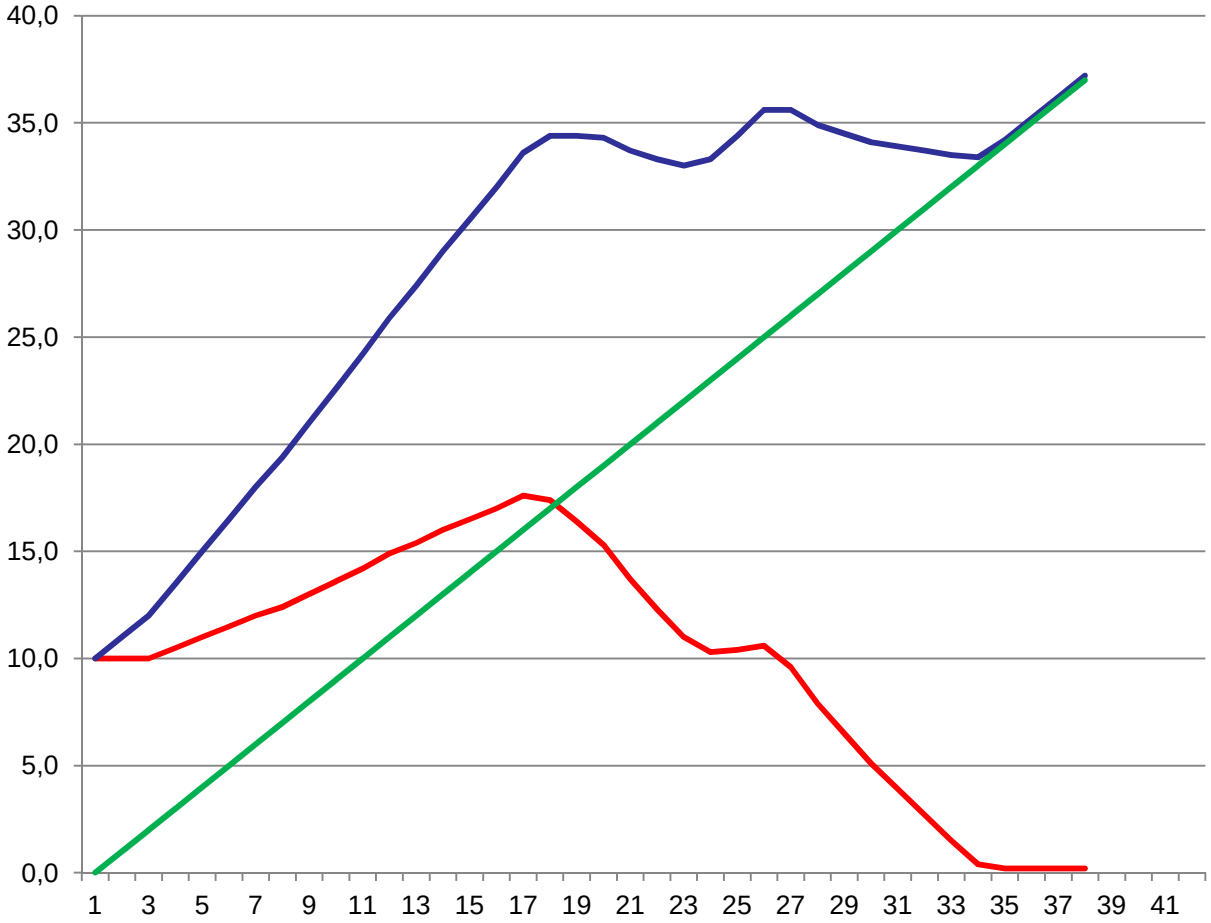
total pressure IP+HP

hydrostatic pressure

Apeks DS4, IP 8,5 bar, 200-350m, drop of intermediate pressure



Scubatech R2 ICE, 200-350m, drop of intermediate pressure

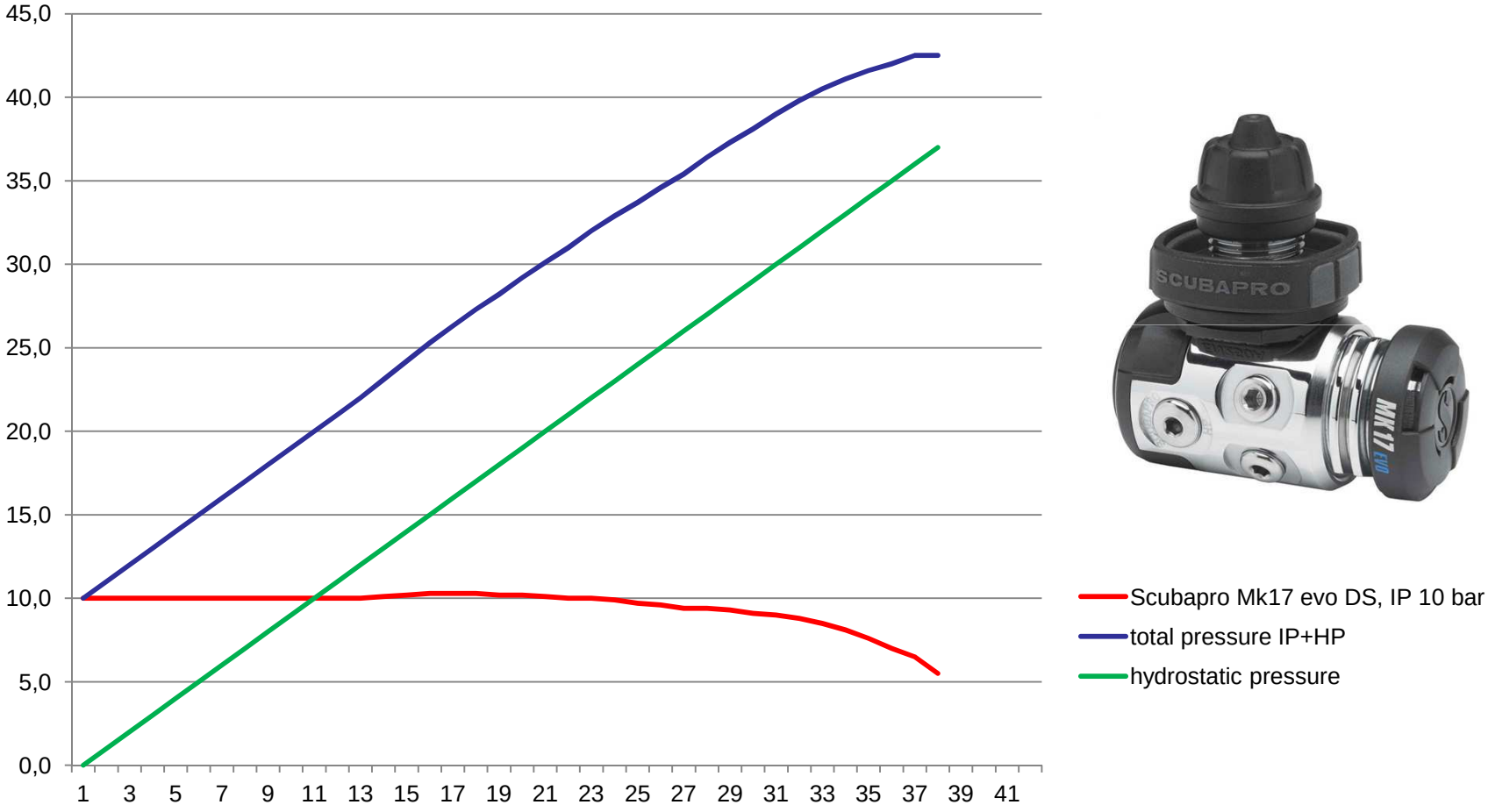


Scubatech R2 ICE DS, IP 10 bar

total pressure IP+HP

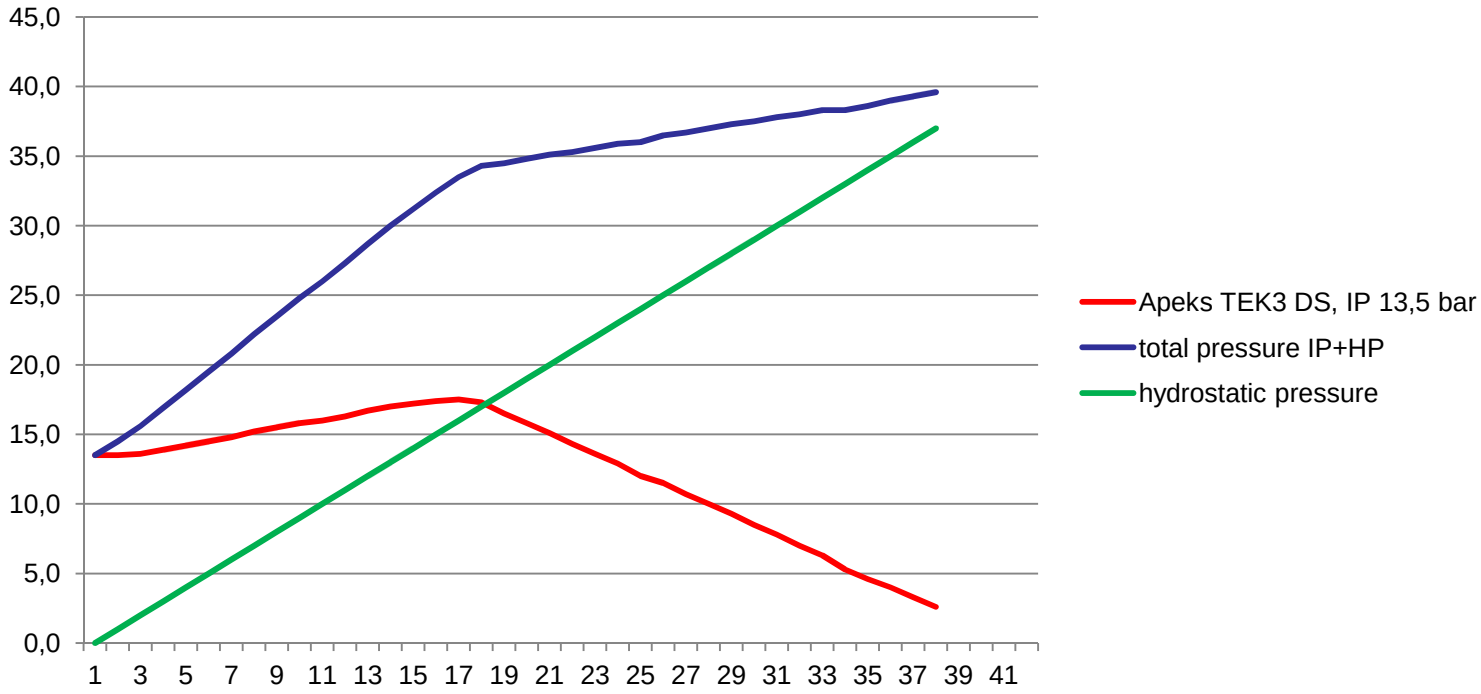
hydrostatic pressure

Scubapro Mk17 evo, 200-350m, drop of intermediate pressure



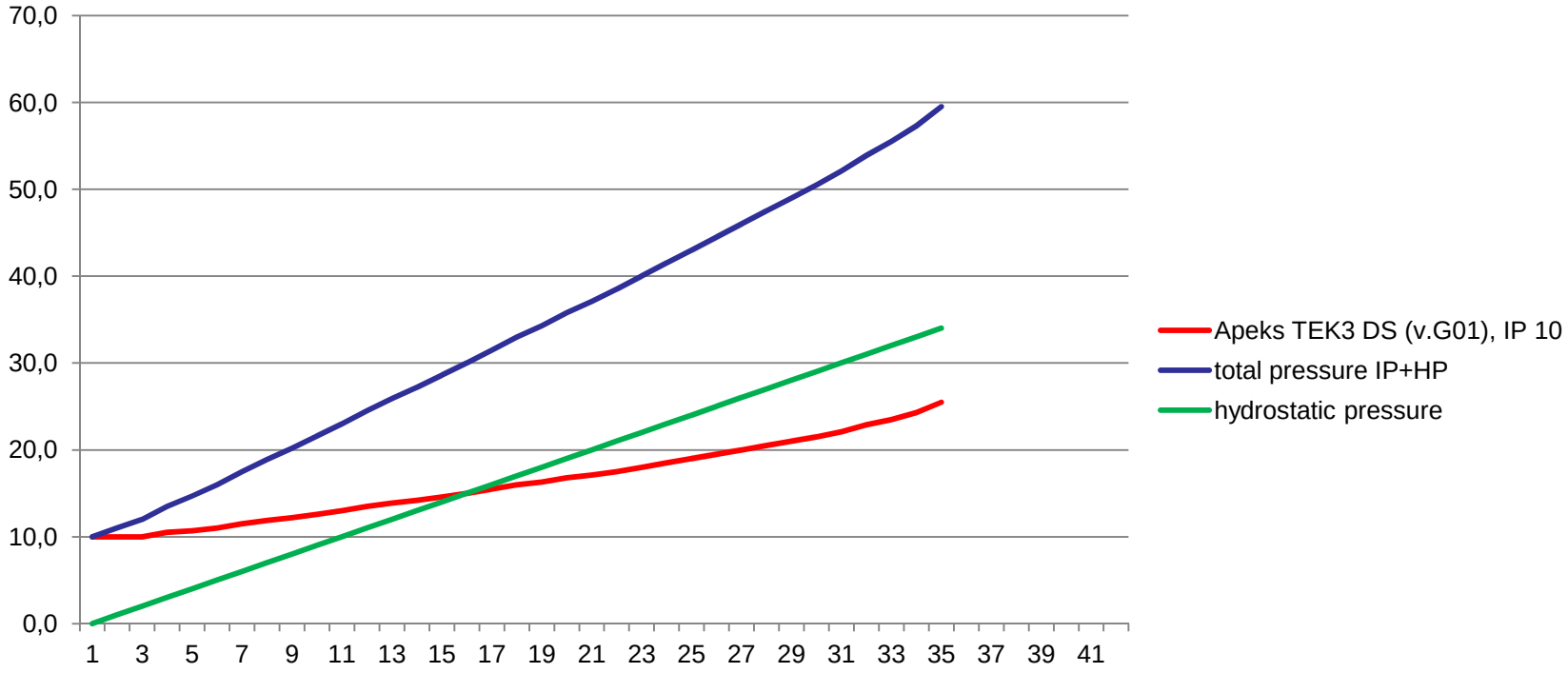
So what to do with Dry Sealed regulators for extreme depths?

- Increase intermediate pressure? It does not solve the problem, it only moves it to greater depths. In addition, there is a risk of destruction of the plastic transmitter.



So what to do with Dry Sealed regulators for extreme depths?

- Adjusting the pressure transmitter? Intermediate pressure is no longer dropping, on the contrary it is growing too high.



So what to do with Dry Sealed regulators for extreme depths?

I think that Dry Sealed membrane regulators are not suitable for these extreme depths.

Recommendation: Use only certified regulators of the appropriate type and design for these extreme dives that do not drop below the intermediate pressure.

Dry Sealed, depth 200 – 350 m

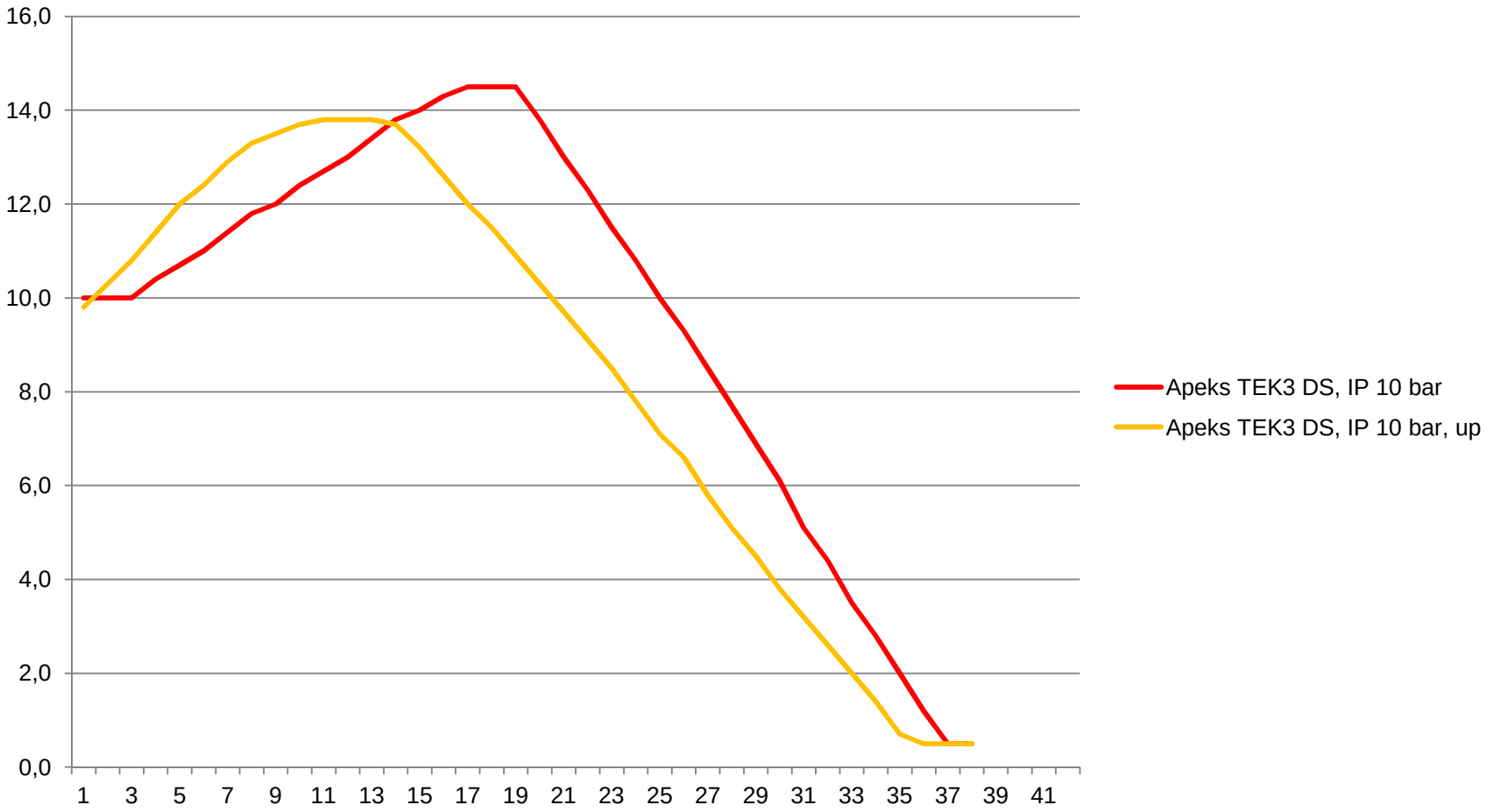
- One more problem with extreme dives:

  Extreme depths cause irreversible deformation of the plastic transmitter due to high stresses.

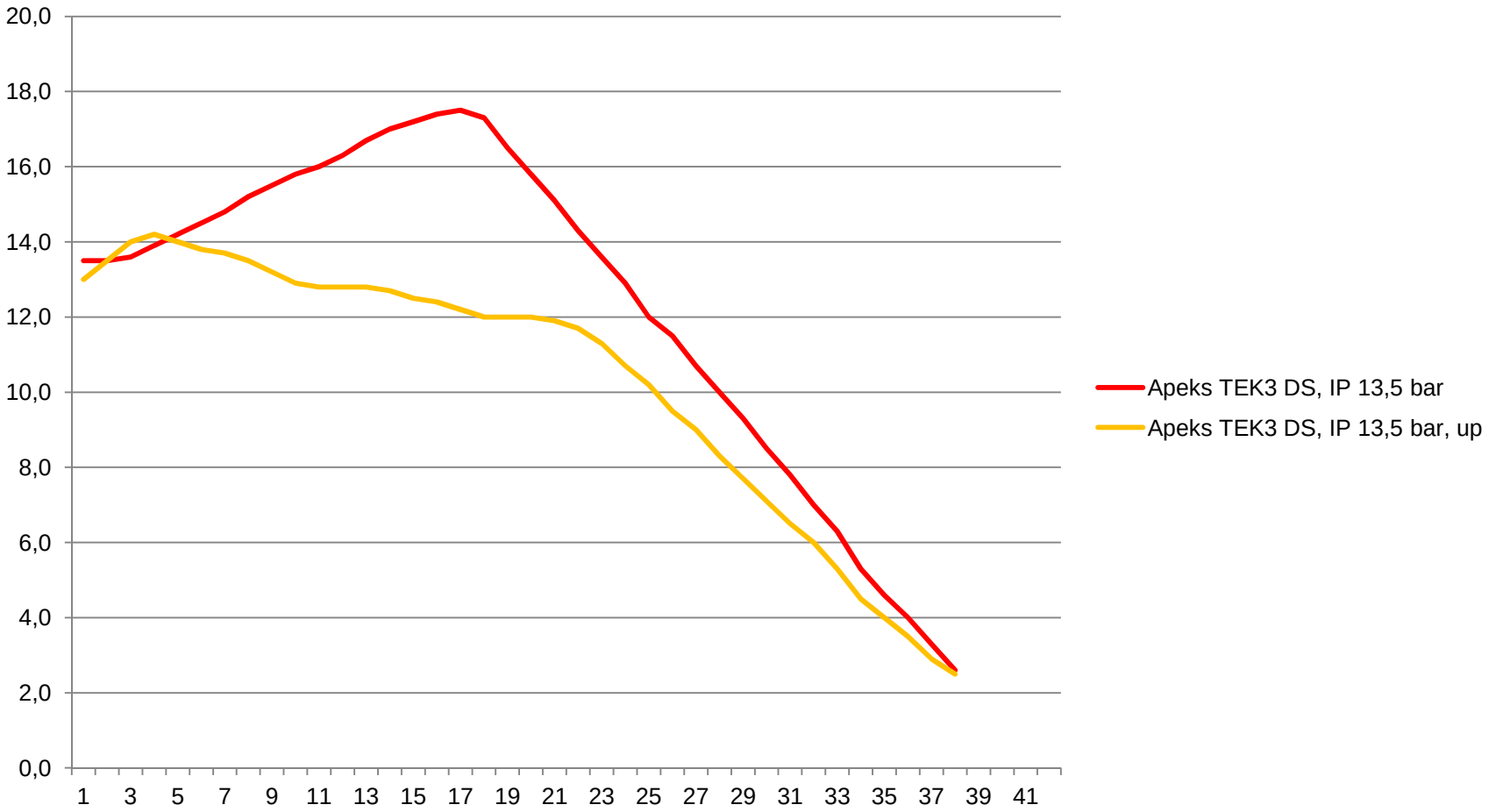
  The IP progress during ascent is different from the descent phase.

  The IP progress of the second and other dives to these extreme depths is different from the first dive.

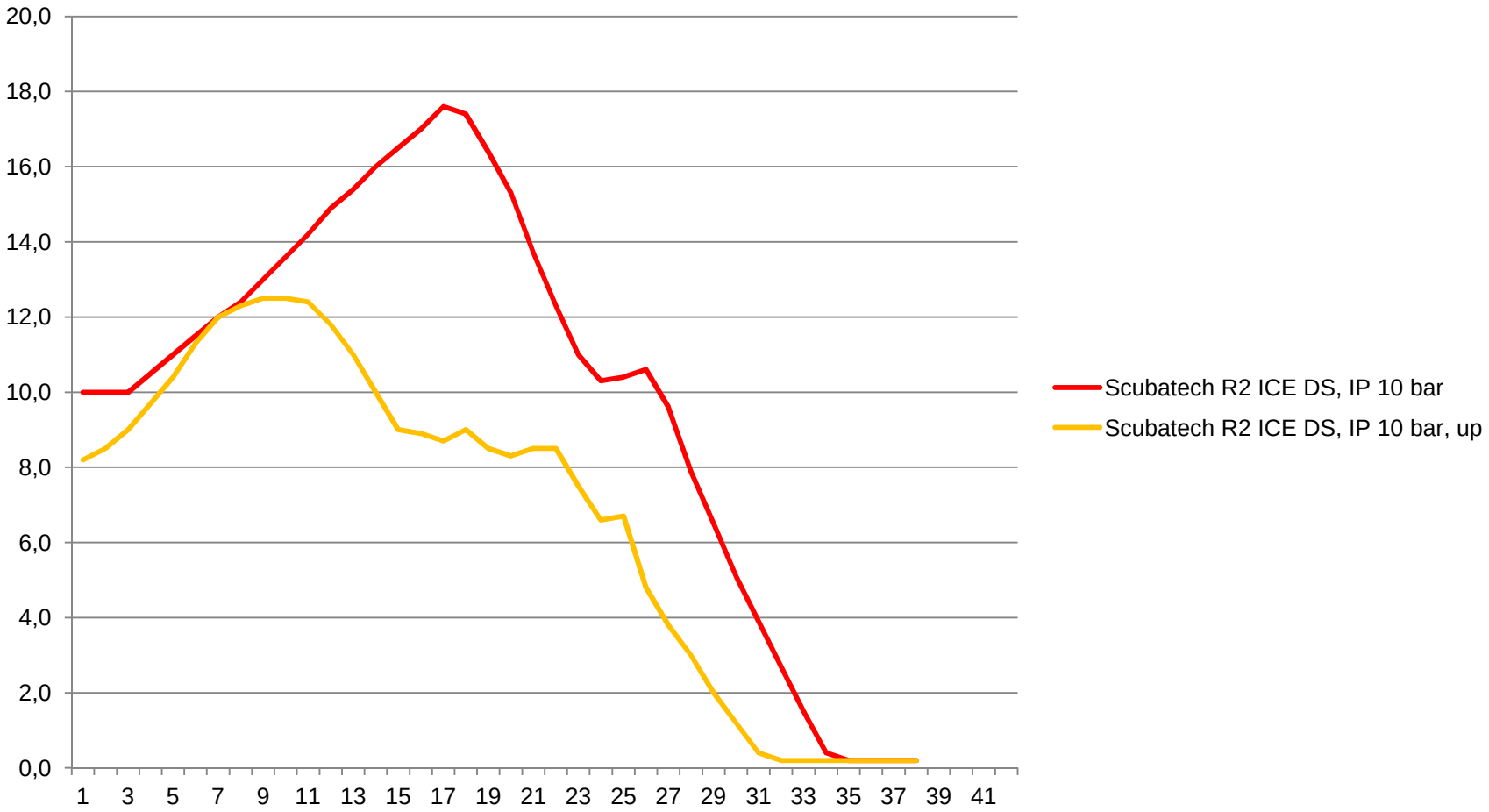
Apeks TEK3, IP 10 bar



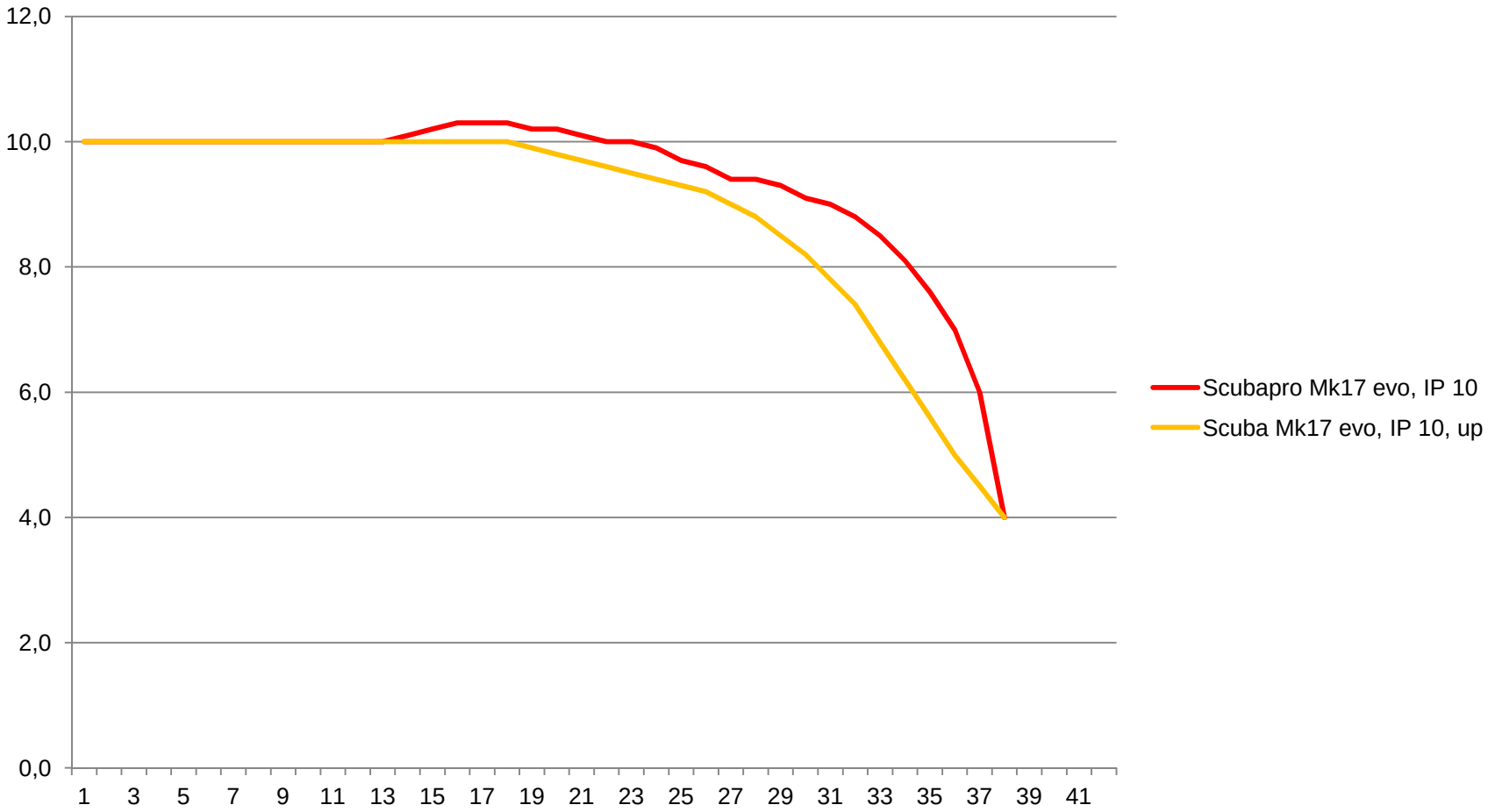
Apeks TEK3, IP 14 bar



Scubatech R2 ICE



Scubapro Mk17 evo



Conclusion

- Do not dive deeper than 200m.
  Watch the permissible intermediate pressure into the solenoid.

  So most divers can dive in peace.

  And those few divers going deeper?
  Use only suitable and proven equipment for extreme depths.

- Thanks for your attention.

- Technical assistance provided by:
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