

Performance of CTS S.p.A. cylinders

CTS S.p.A. Type 4 cylinders have been certified according to European Pressure Equipment Directive 2014/68/EU (thus CE marking) and European Pressure Directive T-2010/35/EU (thus π marking).

In both cases, in order to receive the certification, the cylinders had to pass all tests required by the UNI EN 12245 standard.

Among the tests, the most significant in terms of the safety of products are:

- Burst test - the burst pressure must be more than 3 times the working pressure.
- Cyclic test - in order to certify the cylinder with the Non-Limited Life certification, the cylinder must withstand 12,000 cycles at test pressure (1.5 times the working pressure).
- Salt water immersion test - the cylinder has to pass the burst test and the cyclic test after having been immersed in salt water for 90 days.
- Fire resistance - the cylinder, loaded with air at the working pressure, must not burst for at least 120 seconds when placed on direct flames.
- Physical defect test - defects, according to the dimensions specified by the regulation, are applied to two cylinders. One is then subjected to a burst test at more than 2 times the working pressure, while the other is subjected to 5,000 cycles at working pressure.
- Hydrostatic test - it is a test performed on all cylinders: each one must be pressurized with water to 1.5 times the working pressure, which has to be maintained for at least 30 seconds.

Other tests include: drop test, cyclic test at extreme temperatures, permeability tests, high speed impact test (e.g. bullet), etc.

CTS S.p.A., in order to guarantee the safety and reliability of its cylinders, also regularly performs a further series of tests not prescribed by the regulations:

- Fast-filling cyclic test with air- test performed during the design phase and then on a sample of the manufactured cylinders (the test consist in filling the cylinder with air from 0 bar to 330 bar in less than 60 seconds).

- Burst test after cyclic test - test performed during the design phase and then on a sample of the manufactured cylinders (cylinder subjected to a cyclic test and then, after approximately 12,500 cycles, to a burst test, according to the standard regulatory criteria).
- High pressure leak test - test performed on all cylinders (cylinder filled with air to working pressure and subsequent verification of its impermeability by immersion in soapy water).
- Low pressure leak test - test performed on all cylinders (cylinder filled with air to a 5 bar pressure and subsequent verification of its impermeability by immersion in soapy water).

The tests prescribed by the regulations and by CTS S.p.A. internal quality system guarantee the best product performance. Example data from some of the performed tests is shown in the following charts:

Examples of burst pressure reached after cyclic test			
Serial No.	Model	Cyclic results	Burst pressure [bar]
T000203	2.0 litres 300 bar	Over 12,000 cycles at 450 bar	1017
1014335	2.0 litres 300 bar	Over 12,000 cycles at 450 bar	1155
1012066	3.0 litres 300 bar	Over 12,000 cycles at 450 bar	1128
T000445	6.8 litres 300 bar	Over 12,000 cycles at 450 bar	1100
T000441	7.2 litres 300 bar	Over 12,000 cycles at 450 bar	985
T000449	9.0 litres 300 bar	Over 12,000 cycles at 450 bar	1177

Fast-fill examples						
Cylinder model	Pressure range	Loading time [seconds]	No. of cycles	Results		
				Visual inspection	Air seal	Burst pressure [bar]
2.0 LT 300 bar	0-20 bar to 330 bar	35 ÷ 40	2,000	No defect	Ok	1,150 ÷ 1,250
3.0 LT 300 bar	0-20 bar to 330 bar	35 ÷ 40	2,000	No defect	Ok	1,150 ÷ 1,250
6.0 LT 300 bar	0-20 bar to 330 bar	47 ÷ 52	2,000	No defect	Ok	980 ÷ 1,100
6.8 LT 300 bar	0-20 bar to 330 bar	47 ÷ 52	2,000	No defect	Ok	980 ÷ 1,100
7.2 LT 300 bar	0-20 bar to 330 bar	47 ÷ 52	2,000	No defect	Ok	980 ÷ 1,100
9.0 LT 300 bar	0-20 bar to 330 bar	52 ÷ 57	2,000	No defect	Ok	1,000 ÷ 1,130