

SMARTFLUIDPOWER & VIS HYDRAULICS



JOINT WEBINAR SERIES



4:00 - 4:45 PM CET (LINGUA ITALIANA)



24.03 | DALLA GEOMETRIA ALLA PRESTAZIONE:
MODELLAZIONE PARAMETRICA DI UNA
VALVOLA OLEODINAMICA

07.04 | DAL DISEGNO ALLA VALIDAZIONE: SIMULARE E
ANALIZZARE UN SISTEMA OLEODINAMICO
COMPLETO

21.04 | DALL'UFFICIO TECNICO AL BANCO PROVA:
SIMULAZIONE APPLICATA ALL'INTERNO
DELL'AZIENDA

05.05 | DALLA SIMULAZIONE ALL'OTTIMIZZAZIONE:
MASSIMIZZARE PRESTAZIONI ED EFFICIENZA
ENERGETICA

19.05 | DALL'IDEA ALLA PRATICA: INTRODURRE LA
SIMULAZIONE NEI PROCESSI AZIENDALI



21 APRILE 2026



**DALL'UFFICIO TECNICO AL BANCO
PROVA: SIMULAZIONE APPLICATA
ALL'INTERNO DELL'AZIENDA**



Giovanni Cillo



Marco Rizzoli



Massimo Borghi



Barbara Zardin



Adamo Venturelli



Vittorio Pecorari



Carlo Molon



VIS
HYDRAULICS



SALÍ
Hydraulic Motors

salamj
FLUID POWER SYSTEMS



SLANZI
CREATIVE HYDRAULIC SOLUTIONS

FIT Fluid



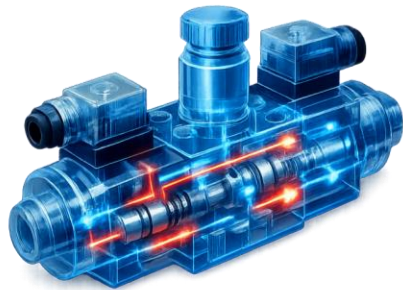
PIUSI



Prevedere il comportamento del sistema/componente



Modello virtuale



Testare virtualmente diversi design

Riprogettare e ottimizzare rapidamente a posteriori

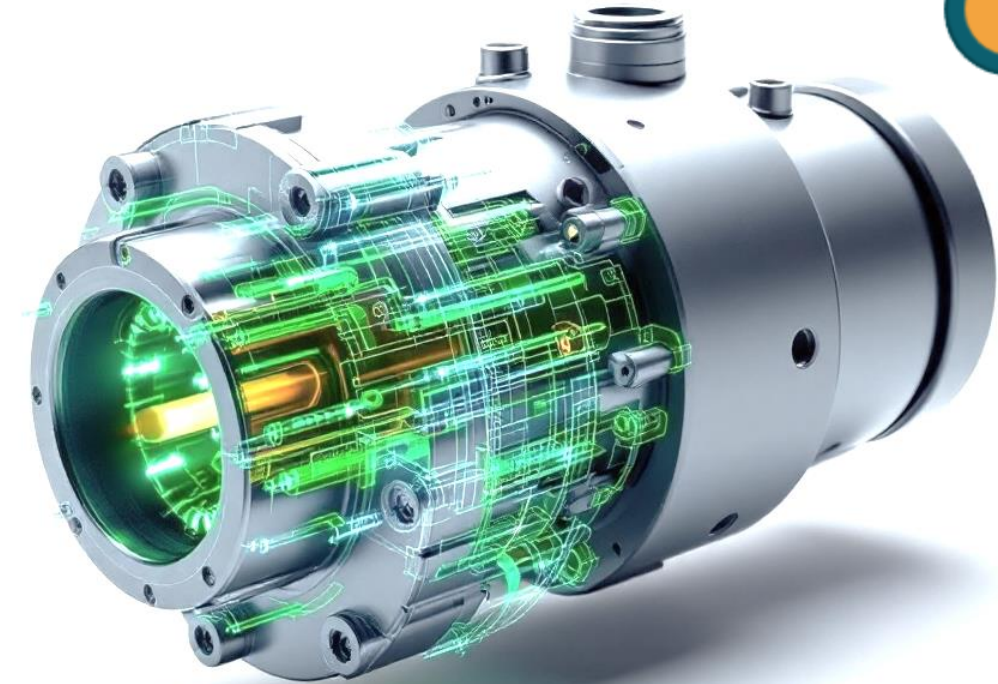
Ridurre il n° di prototipi reali e di test sperimentali



Tagliare tempi e costi



Ridurre il time-to-market



Linguaggio Modelica sviluppato per sistemi multi-dominio

Piattaforma open source per la co-simulazione

Modellazione a blocchi rapida e intuitiva

Servizi personalizzati dedicati all'integrazione nei processi aziendali

Team specializzato nel fluid power



OM

OpenModelica

- Ambiente open source di simulazione dinamica di sistemi multi-dominio
- Co-simulazione attraverso lo standard FMI



Dynamic

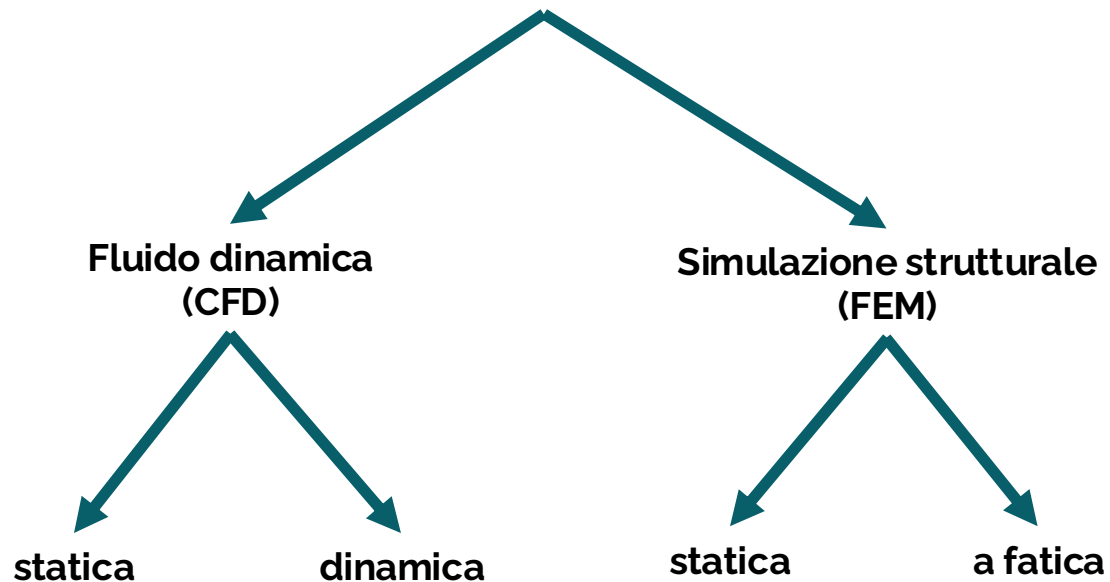
SmartFluidPower Library

- Libreria specifica per il settore fluid power in linguaggio Modelica
- Modellazione a blocchi dei componenti da simulare

Ci sono diversi tipi di simulazione di un sistema o componente, diversi approcci che si possono scegliere in base agli obiettivi della simulazione

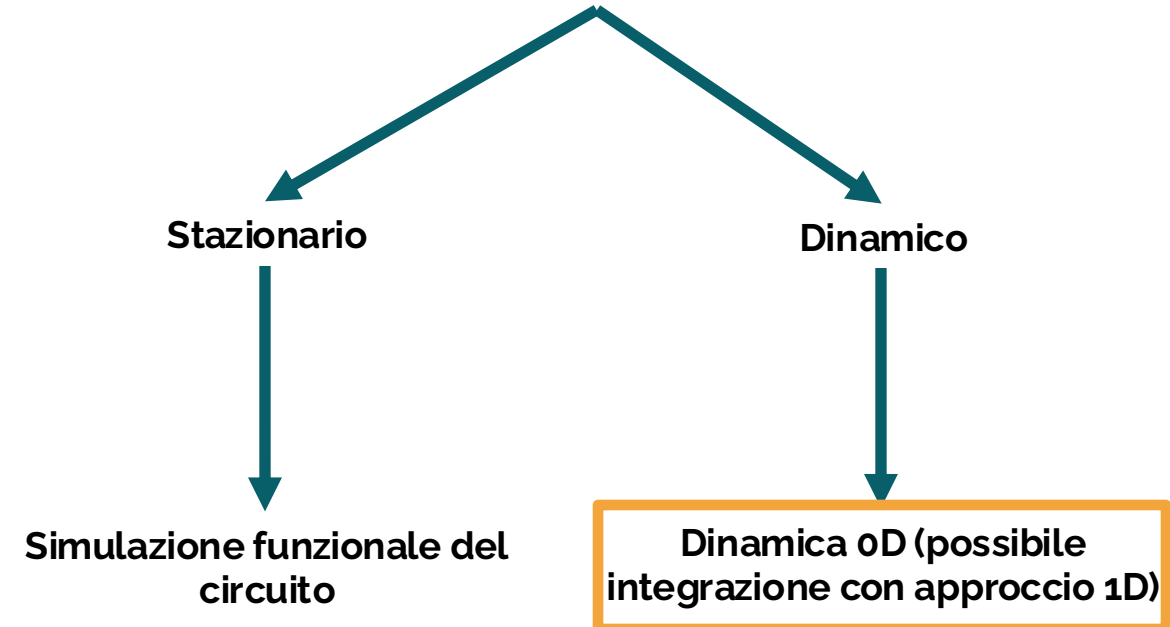
Simulazione a parametri distribuiti

*i fenomeni sono considerati in
1D/2D/3D*

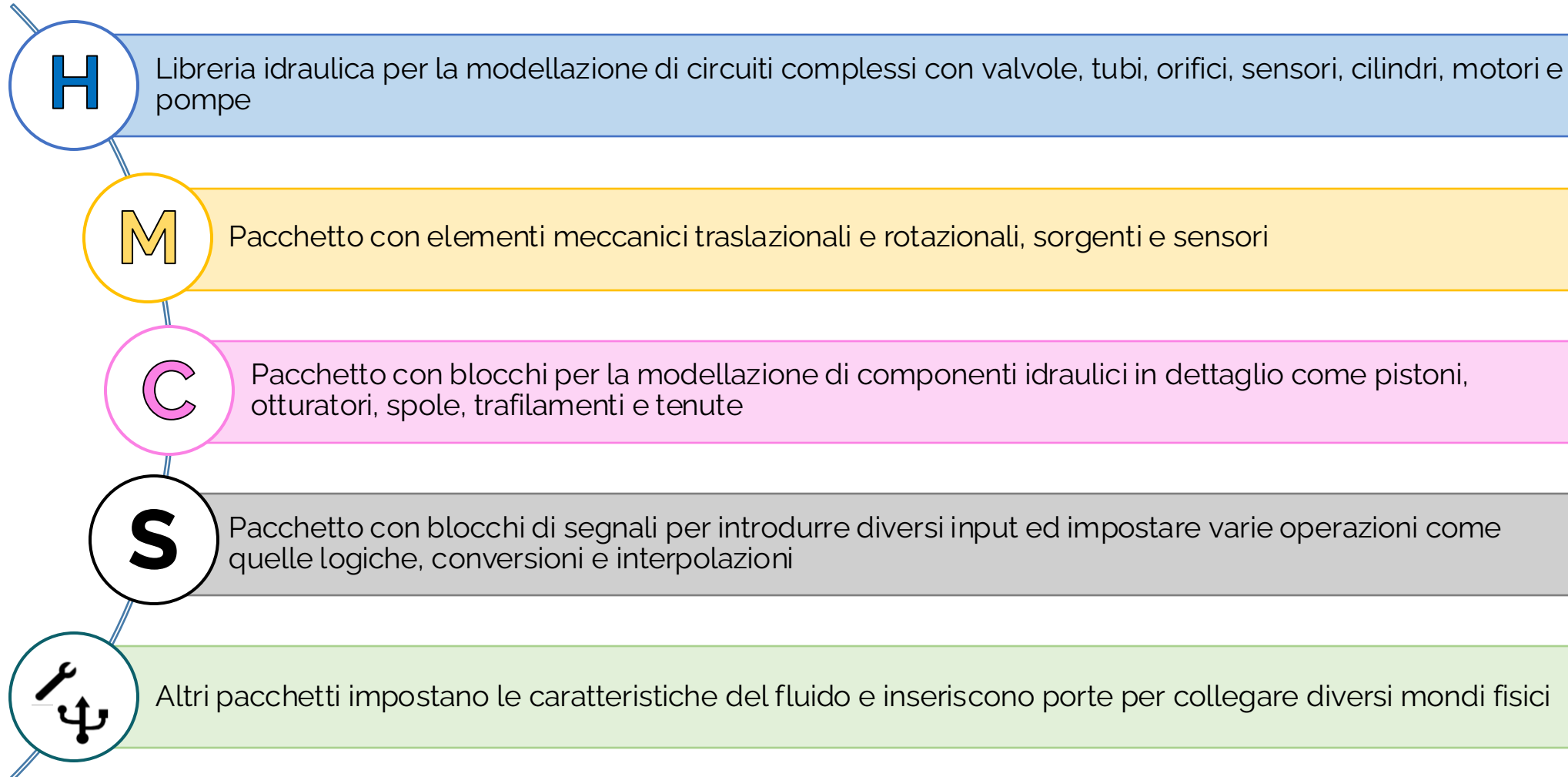


Simulazione a parametri concentrati

*comportamento dei fenomeni rispetto al
tempo, ignorando quello relativi allo spazio*



Sviluppata con lo scopo di facilitare la simulazione dei sistemi fluid power



Sviluppo

- Librerie
- Modelli
- Interfacce personalizzate

Consulenza

- Analisi CFD
- Analisi FEM
- Strumenti di progettazione

Corsi di formazione

Supporto



Progettazione

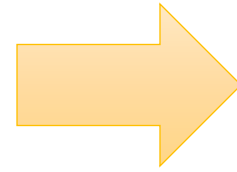
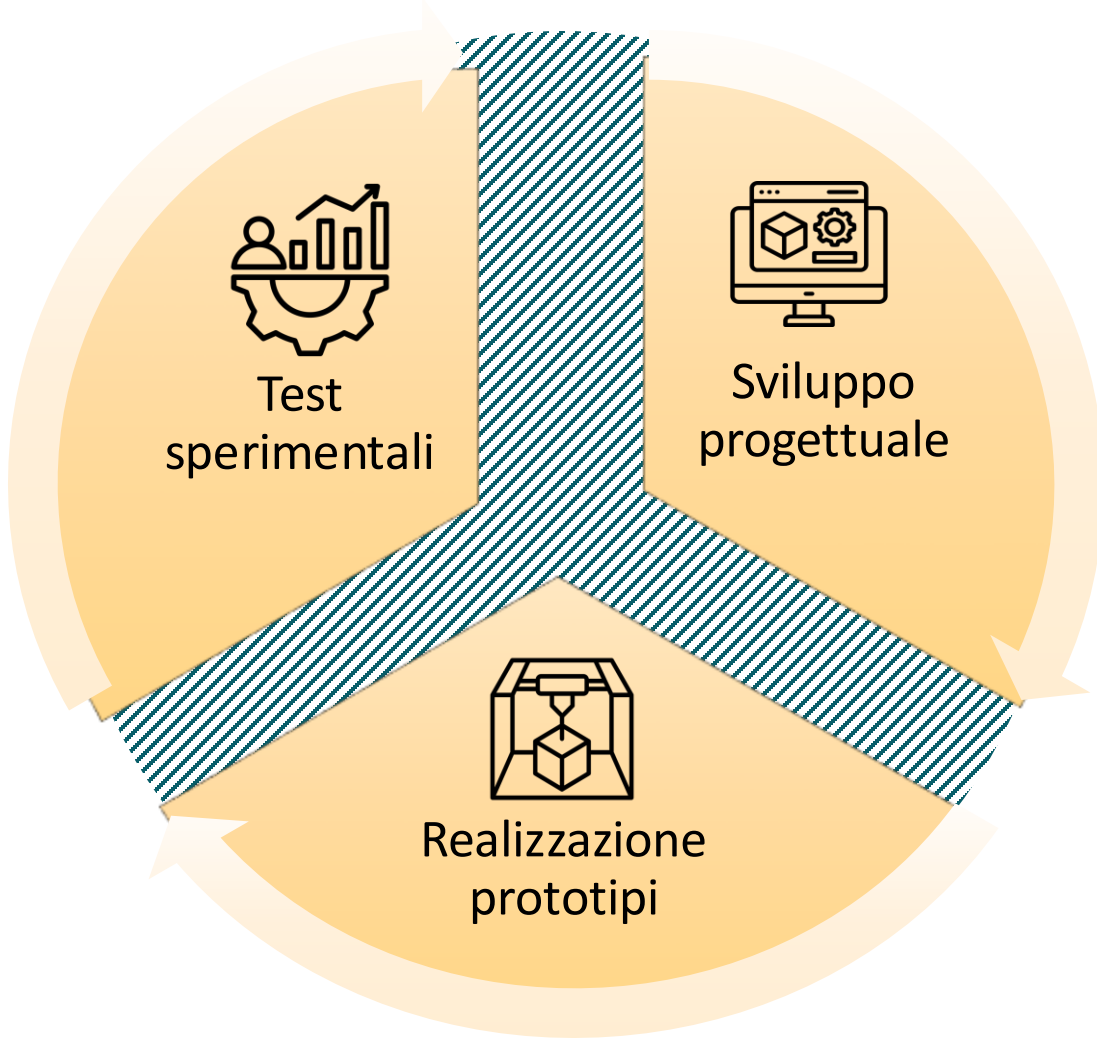


Prototipazione



Servizi di test

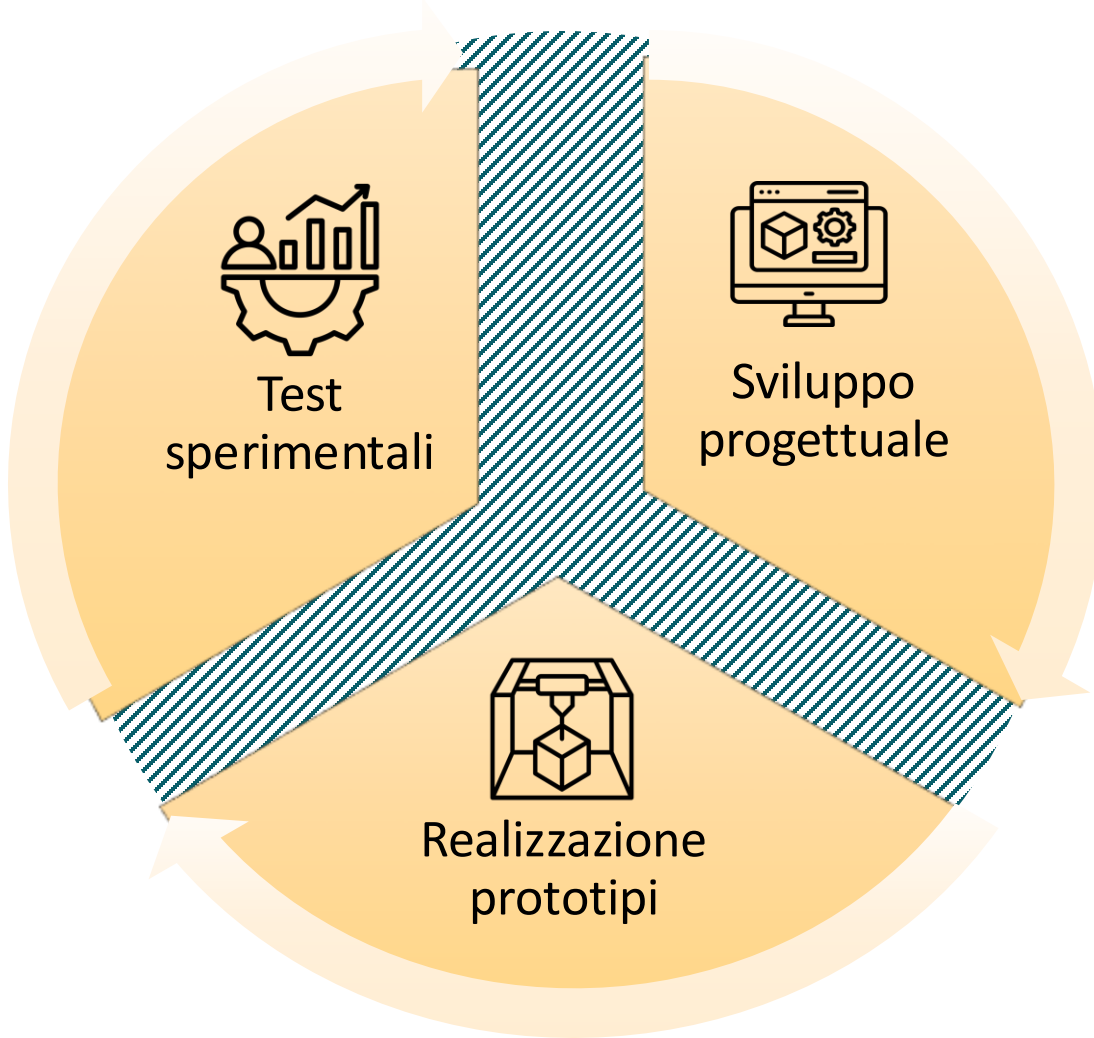
Come lavorano oggi molte aziende



metodo **trial&error**:

- sprechi di risorse
- lunghi tempi di completamento
- scarsa visibilità sul comportamento dinamico reale
- incertezza sull'ottimizzazione delle prestazioni

Cosa manca



Continuità tra i reparti



Modelli riutilizzabili

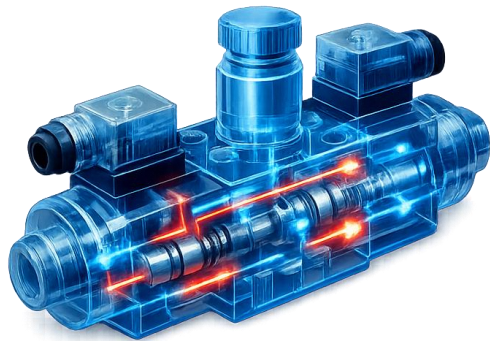


Integrazione nel flusso

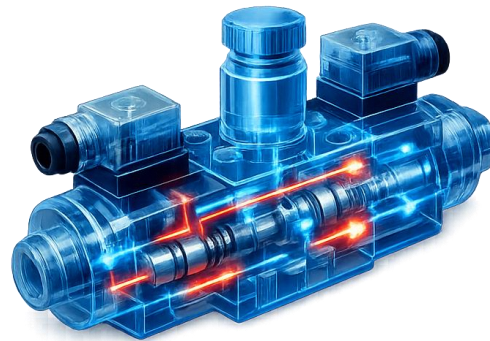


Un unico modello, più utilizzi

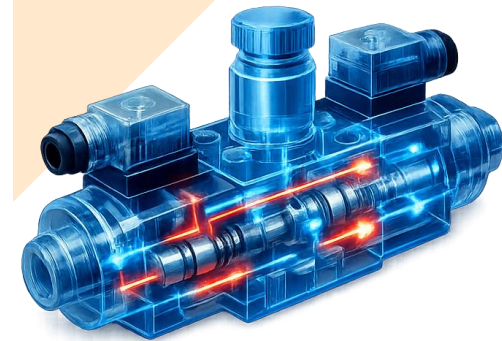
Sviluppo
progettuale



Realizzazione
prototipi



Test
sperimentali



Come prosegue il webinar



Ufficio tecnico

Prototipi
Ri-progettazione
Sistema



Banco prova

Integrazione con test
Simulazione delle prove



Supporto decisionale

Verifiche funzionali e
prestazionali



Estensione al cliente

Collaborazione tecnica
Stessa libreria
Altro software (FMU)
Nessun software



Il caso guida

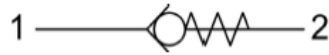
CVC0.S08 VALVE SERIES

SAE08 Cartridge - 420 bar

Direct acting - Poppet type



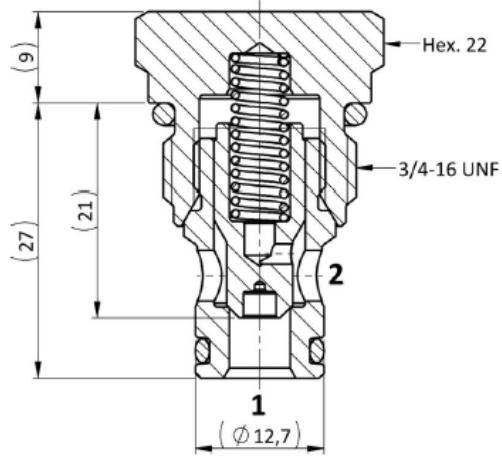
HYDRAULIC SYMBOL



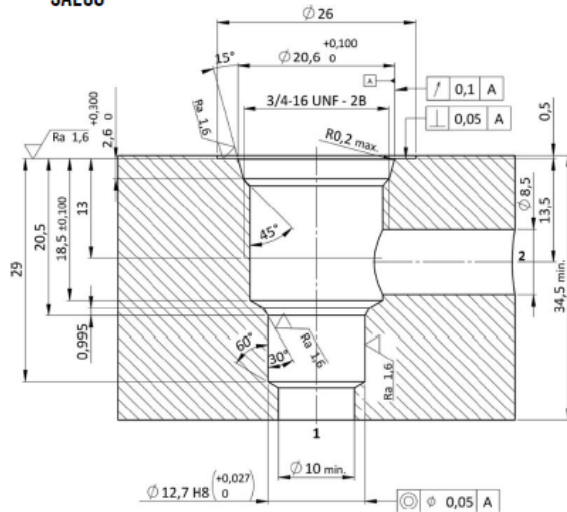
DESCRIPTION

A screw-in, cartridge style, direct acting, poppet type check valve. Main use is as a blocking or load-holding device. The CVC0.S08 allows flow passage from port 1 to 2: the cartridge has a fully guided check which is spring-biased closed until sufficient pressure is applied at port 1 to open to 2. The flow is blocked in the opposite direction (2 to 1).

CROSS SECTION



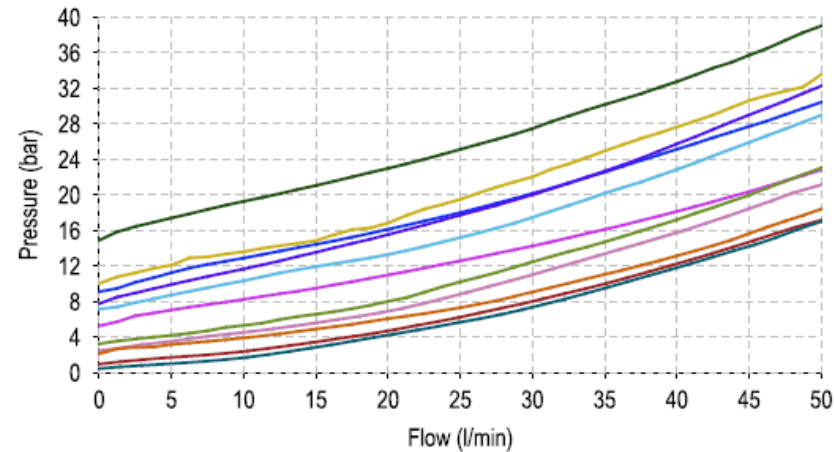
CAVITY SAE08



TECHNICAL DATA

MAXIMUM OPERATING PRESSURE	420 bar
MAXIMUM FLOW	50 l/min
CRACKING PRESSURE	see table below
MAXIMUM INTERNAL LEAKAGE	0,10 cm ³ / min @ 10 bar 0,10 cm ³ / min @ 420 bar
EXTERNAL COMPONENT TREATMENT	Zn/Fe - standard (96h) Zn/Ni (720h) (Upon customer request)
O-RING TEMPERATURE RANGE	-30° C to 110° C (standard sealing NBR - BUNA - N) -35° C to 140° C (HNBR - Upon customer request) -23° C to 225° C (FKM - Upon customer request)
OIL TEMPERATURE RANGE	-30° C to 110° C
FLUIDS	Mineral - based or synthetics with lubricating properties
VISCOSITIES	7,4 to 420 cSt
FILTRATION	20/18/15 ISO 4406 (maximum filtration admitted)
ORIENTATION	No restrictions
INSTALLATION TORQUE	40-45 Nm Hex.22
TECH. SPEC. FOR CHARACTERIZATION	see page 700
OIL TESTING CONDITIONS	ISO VG 46 cSt
SEAL KIT CODE	SK.030 (standard sealing NBR-BUNA-N)
WEIGHT	0,060 kg

PERFORMANCE DETAILS



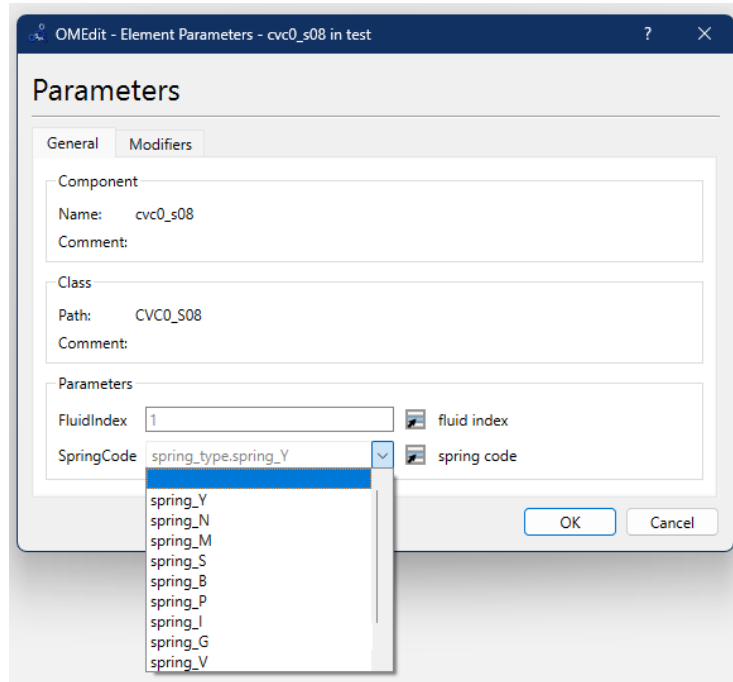
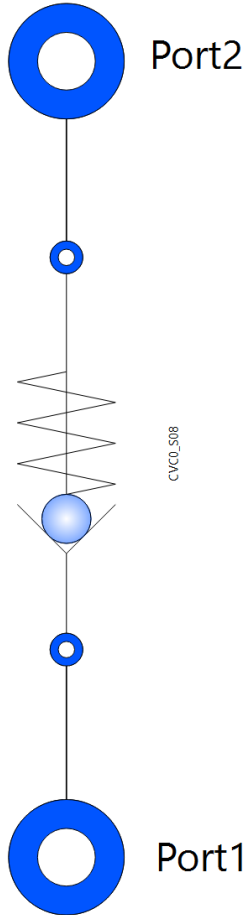
NOTE
The performance chart illustrates flow handling capacity for significant spring bias options. p/Q curves are recorded at T_{Oil} = 40°C and 46 cSt.

LEGEND

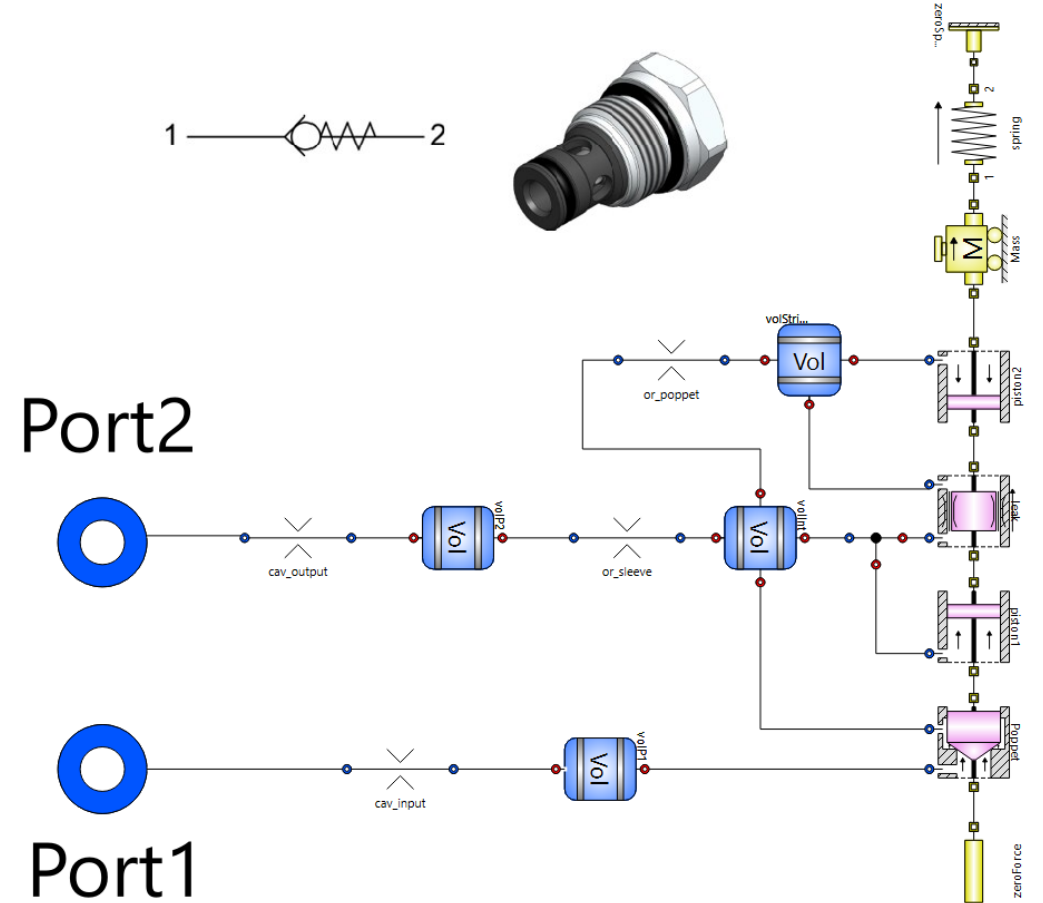
- Spring Y
- Spring N
- Spring M
- Spring S
- Spring B
- Spring P
- Spring I
- Spring G
- Spring V
- Spring R
- Spring W

Due livelli

Modello semplificato

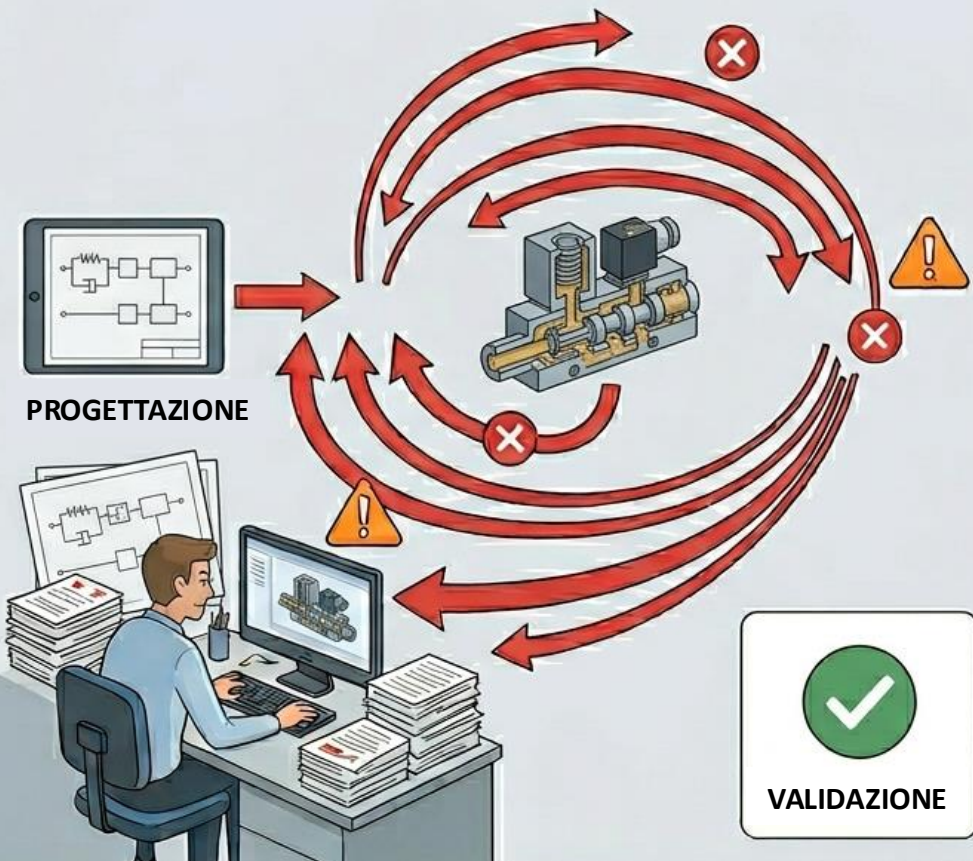


Modello dettagliato

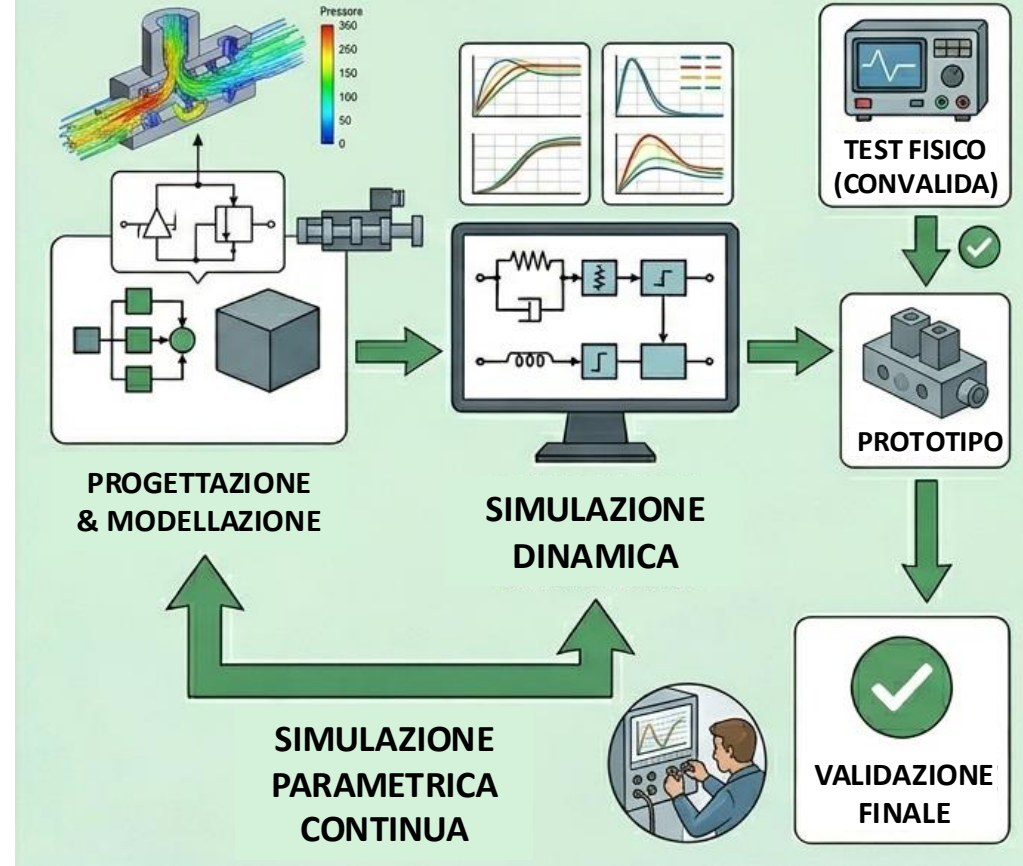


Prima e dopo

SENZA SIMULAZIONE INTEGRATA



CON LA SIMULAZIONE



Attività

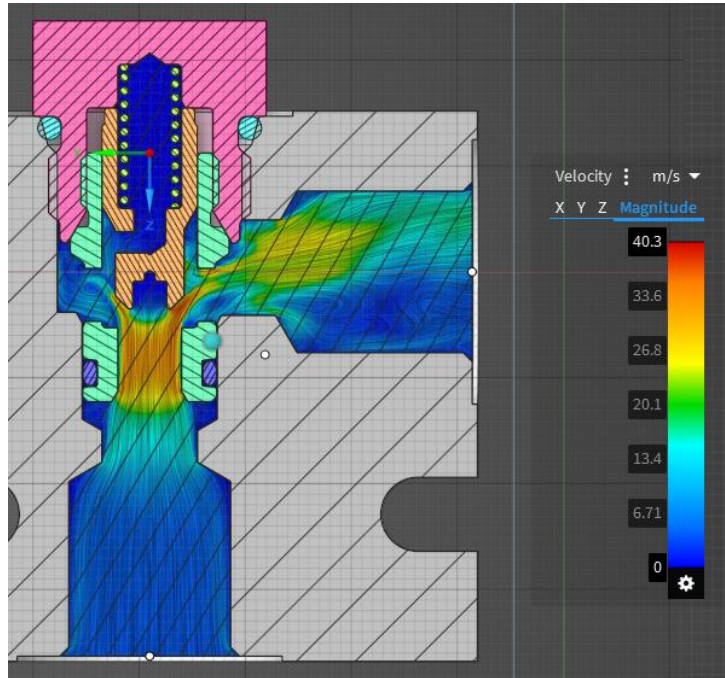
Prototipi

Ri-progettazione

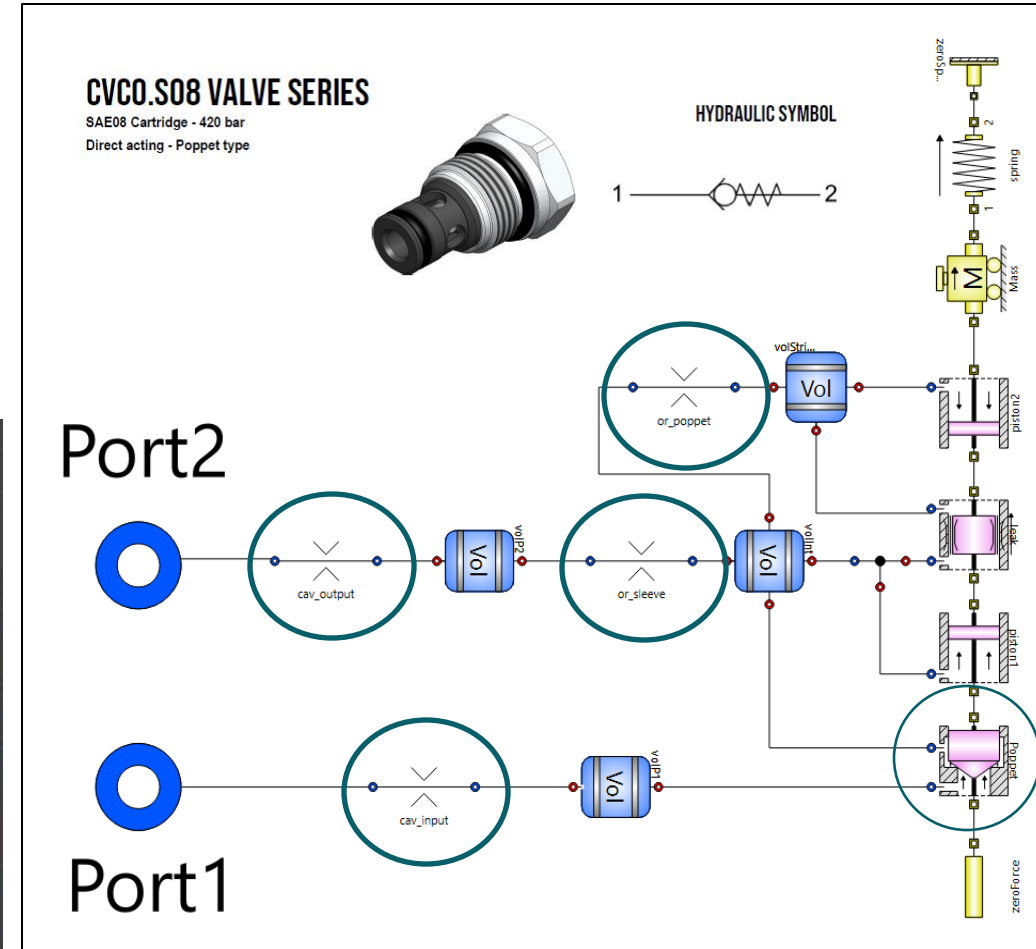
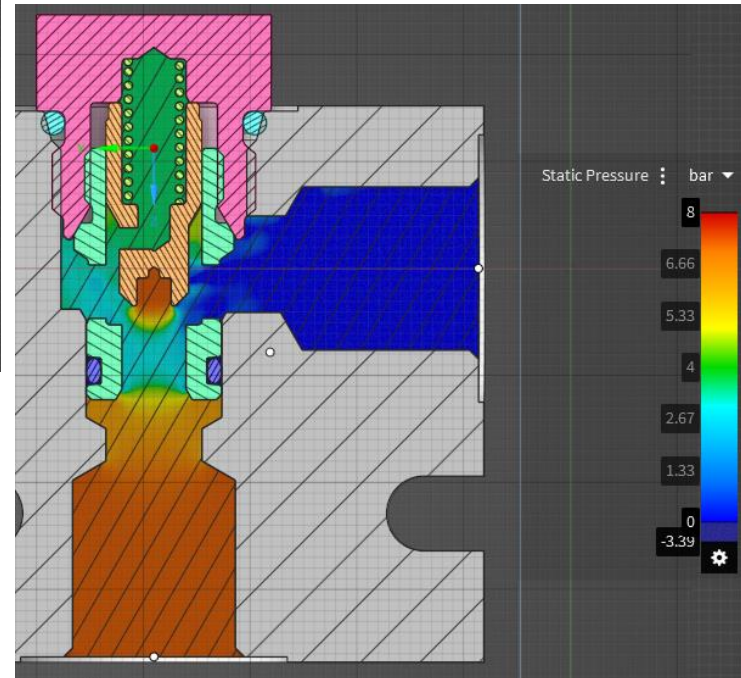
Sistema

Prototipi – caso guida

Distribuzione di velocità

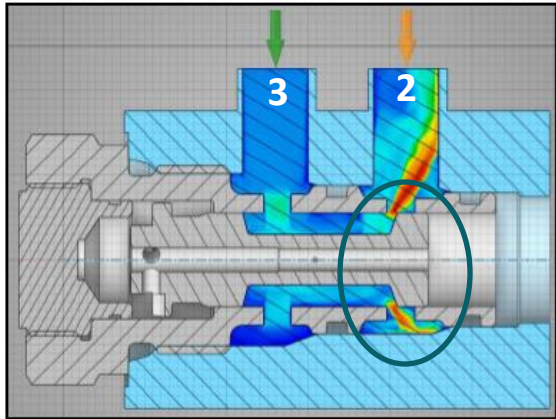


Distribuzione di pressione

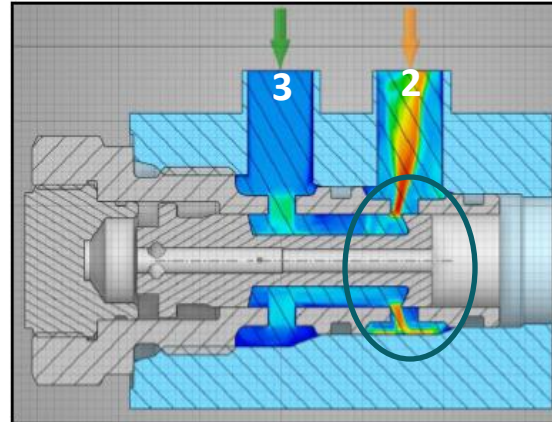


Prototipi – SVP0.S10

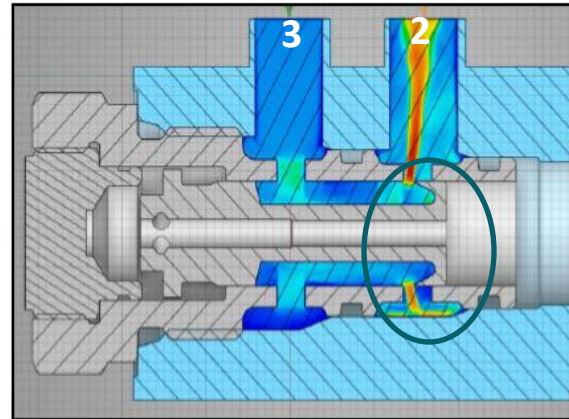
Geometria 1



Geometria 2

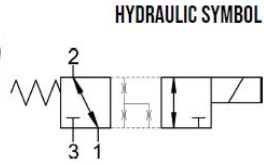


Geometria 3

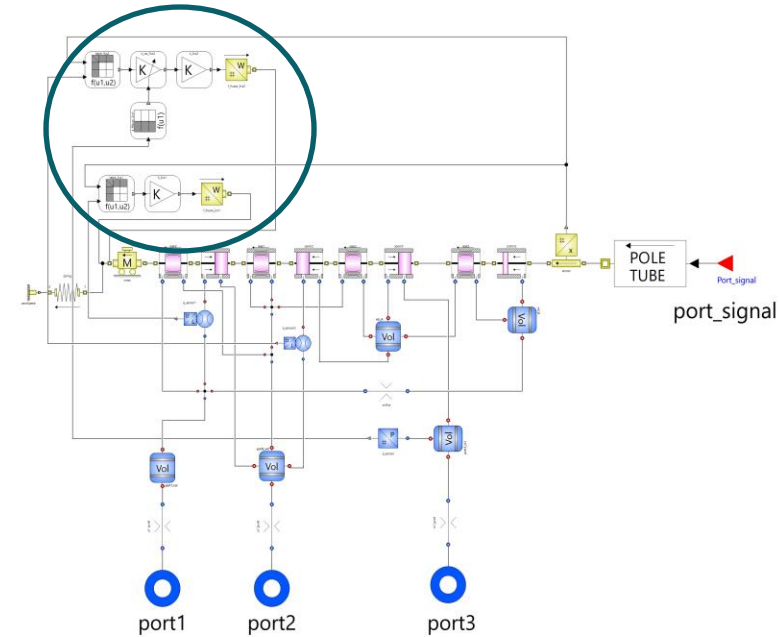
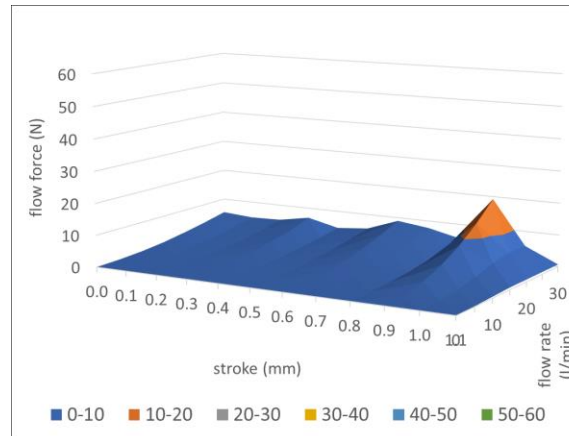
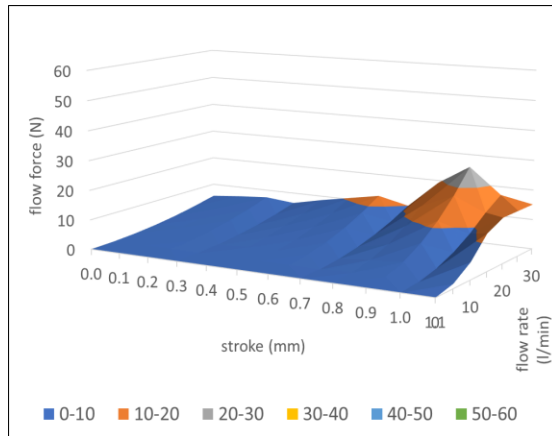
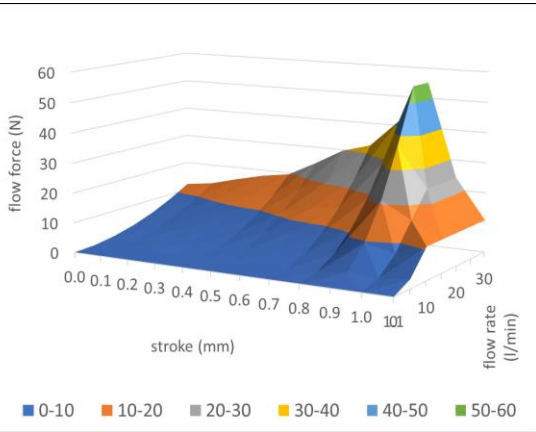


SVP0.S10 VALVE SERIES

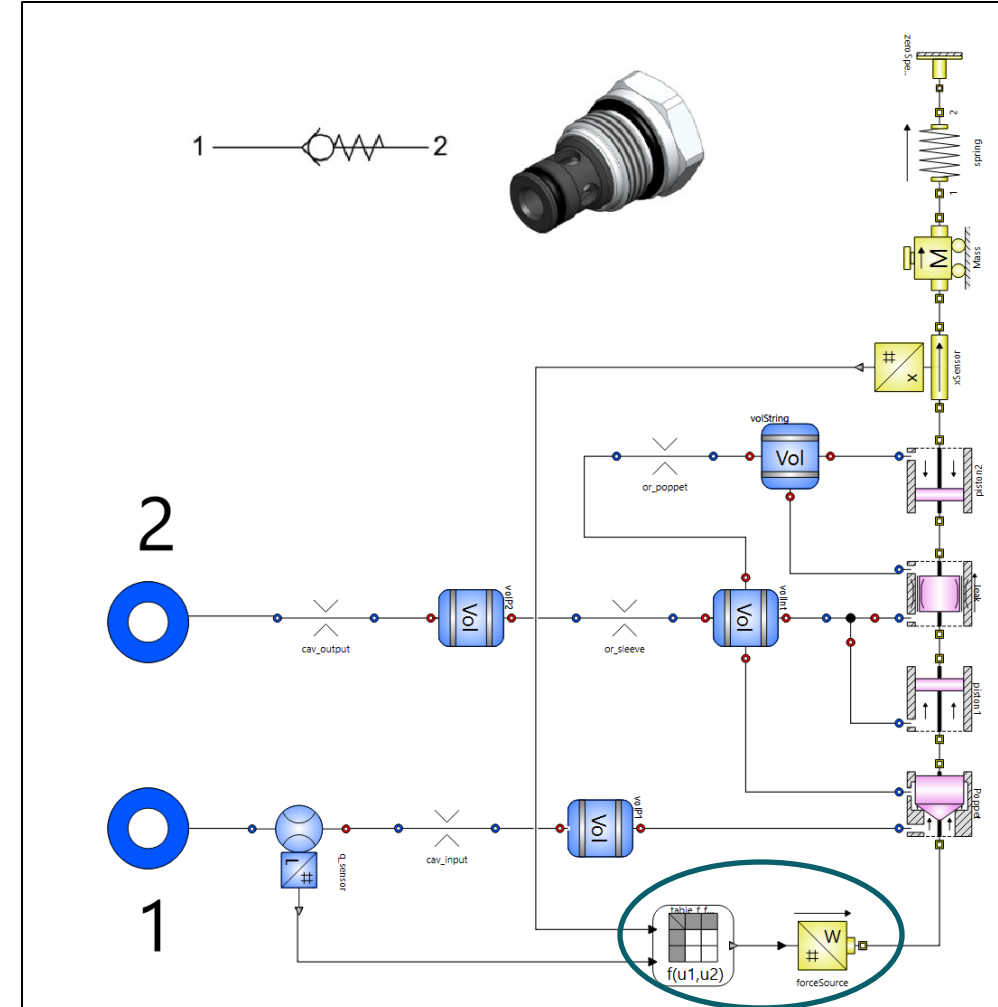
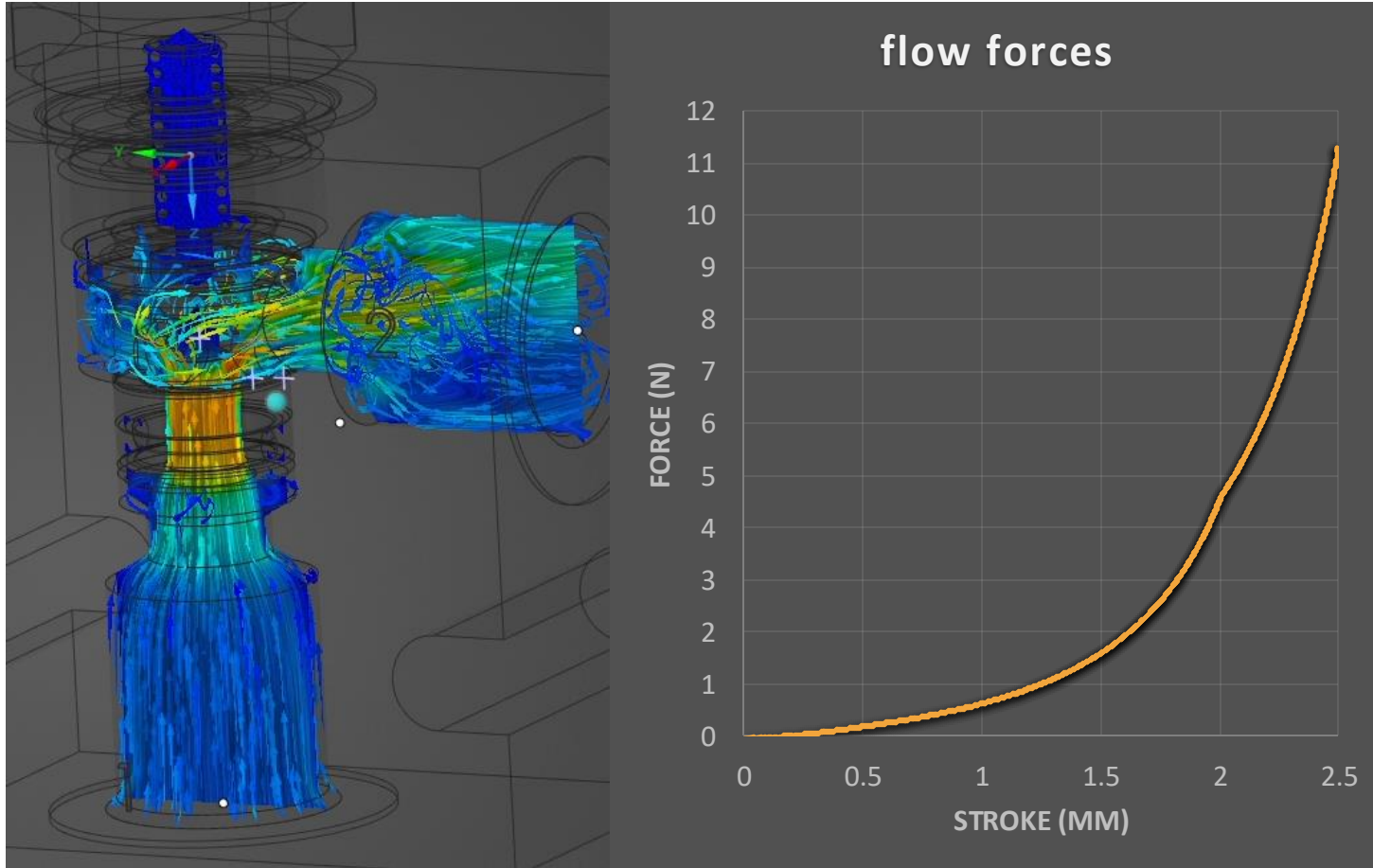
SAE Cartridge - 250 bar
Directional valve - 3/2 Spool type
Scheme 200



HYDRAULIC SYMBOL



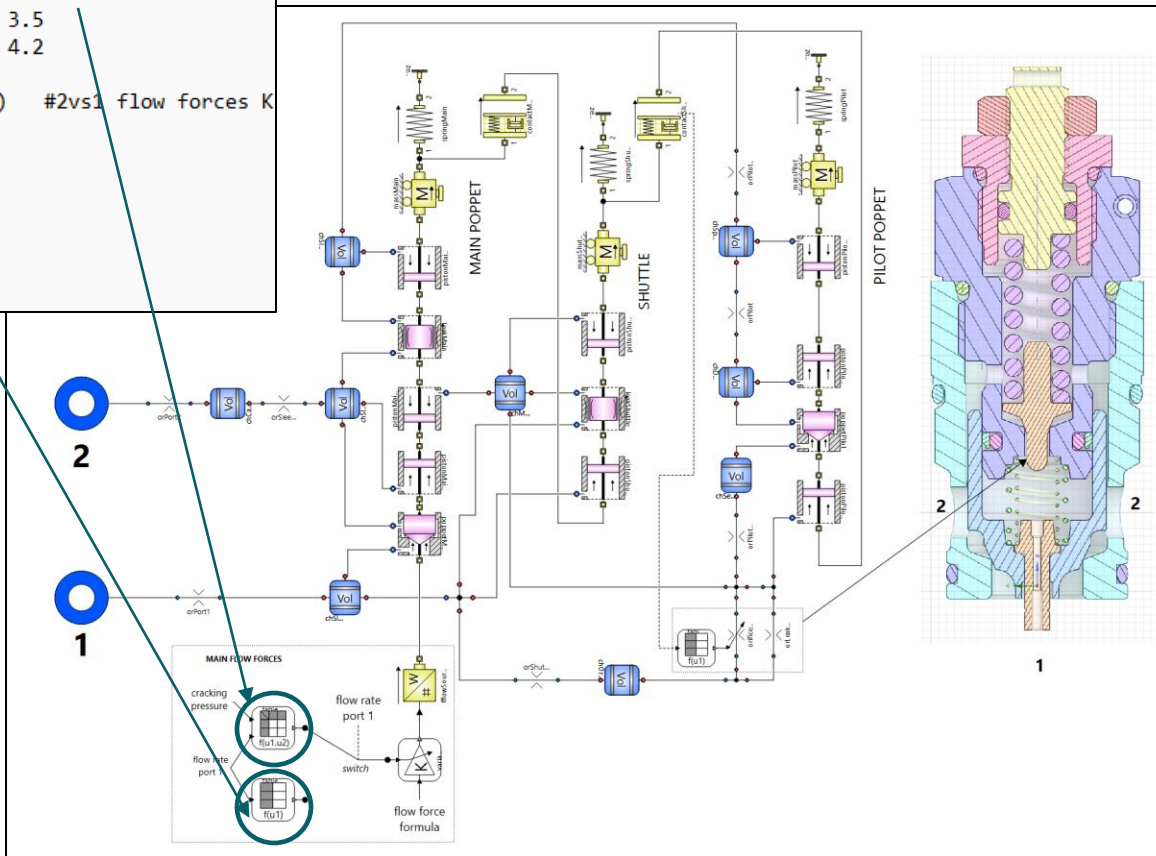
Ri-progettazione – caso guida



Ri-progettazione – RVP0.M26

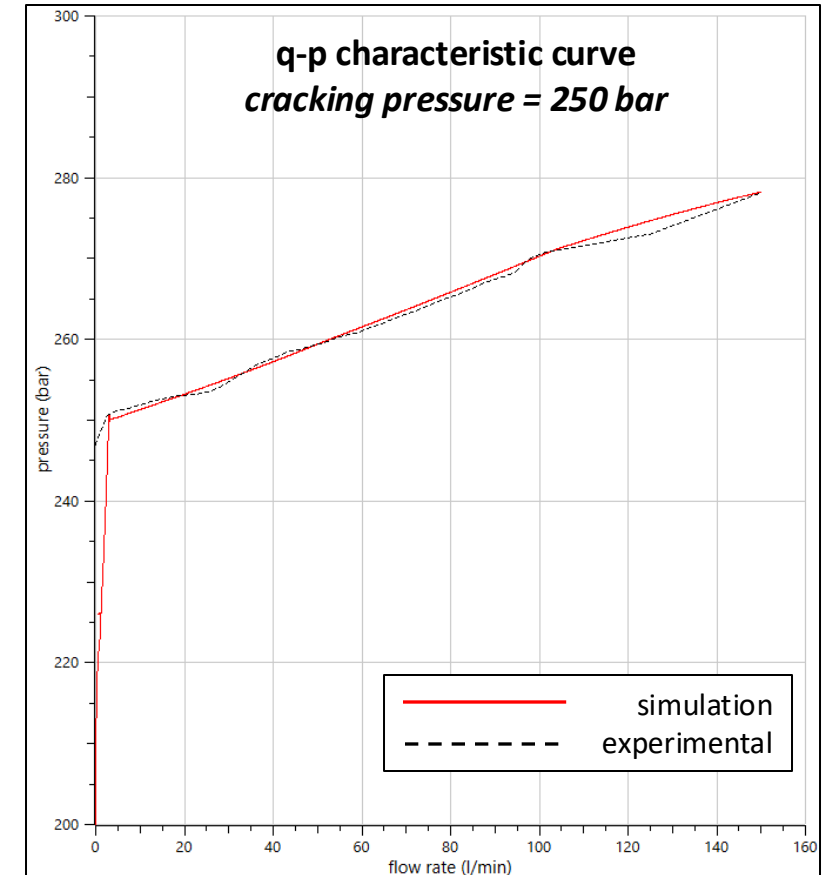
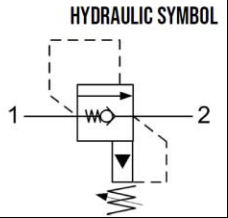
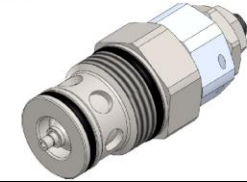
```
#1
double tabCoeff1vs2(6,4) #1vs2 flow forces K
0      50      100     150
15     -0.4    -0.8    -0.45
117    0      -0.3    -0.4
210    2.3     2       1.3
302    4       4       3.5
369    5.6     5.6     4.2

double tabCoeff2vs1(7,2) #2vs1 flow forces K
0      0
20     -1
30     -1
60     0.6
90     0.7
120    1.0
150    1.1
```

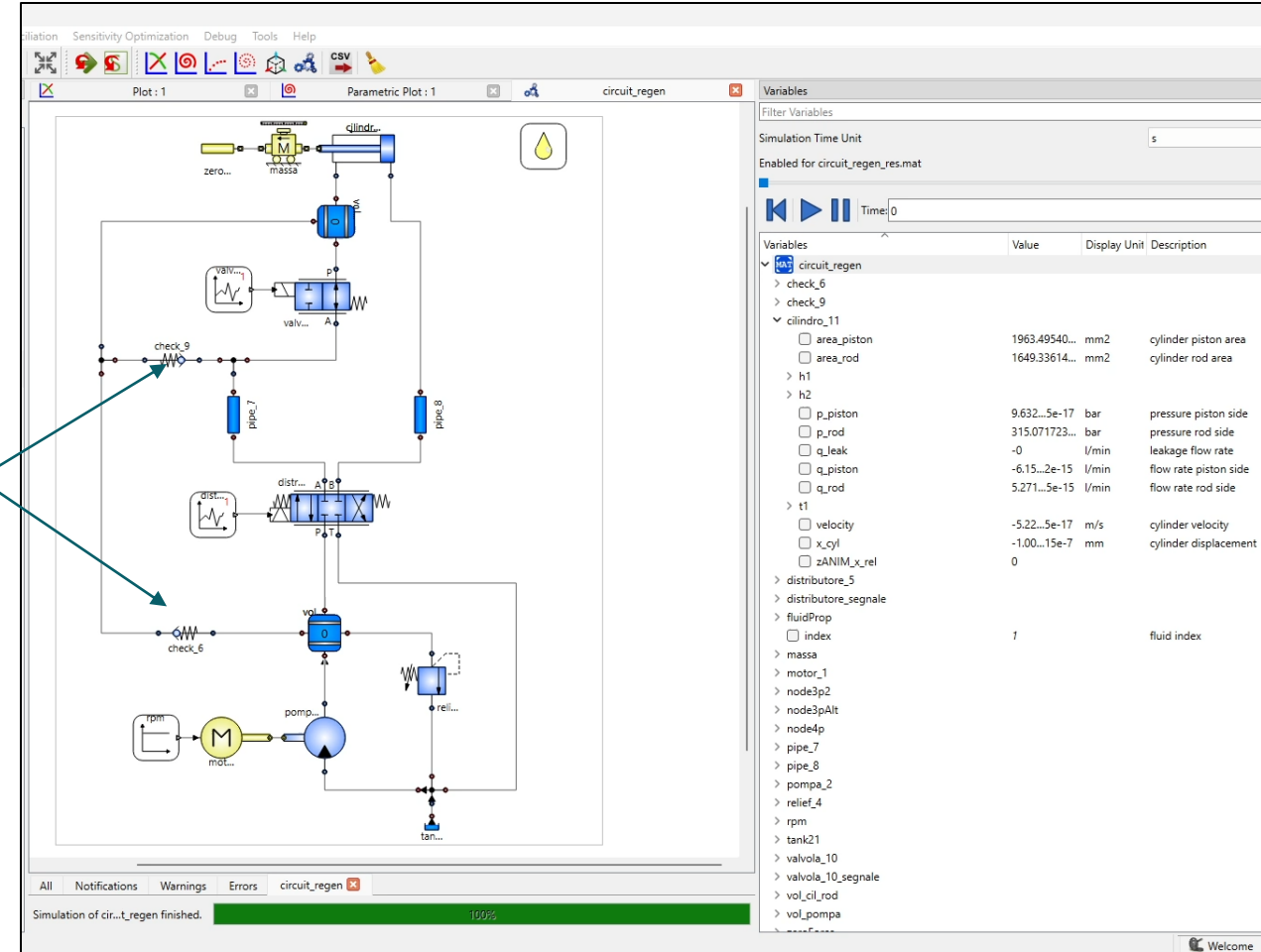
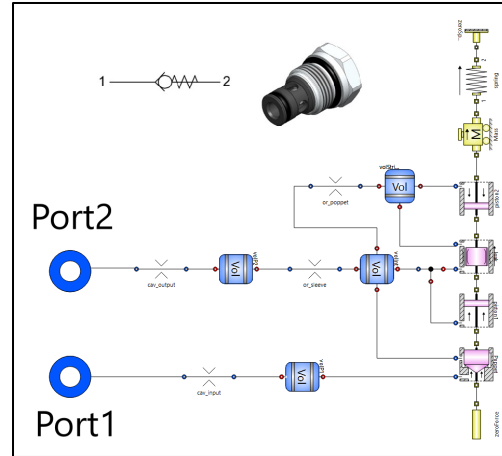
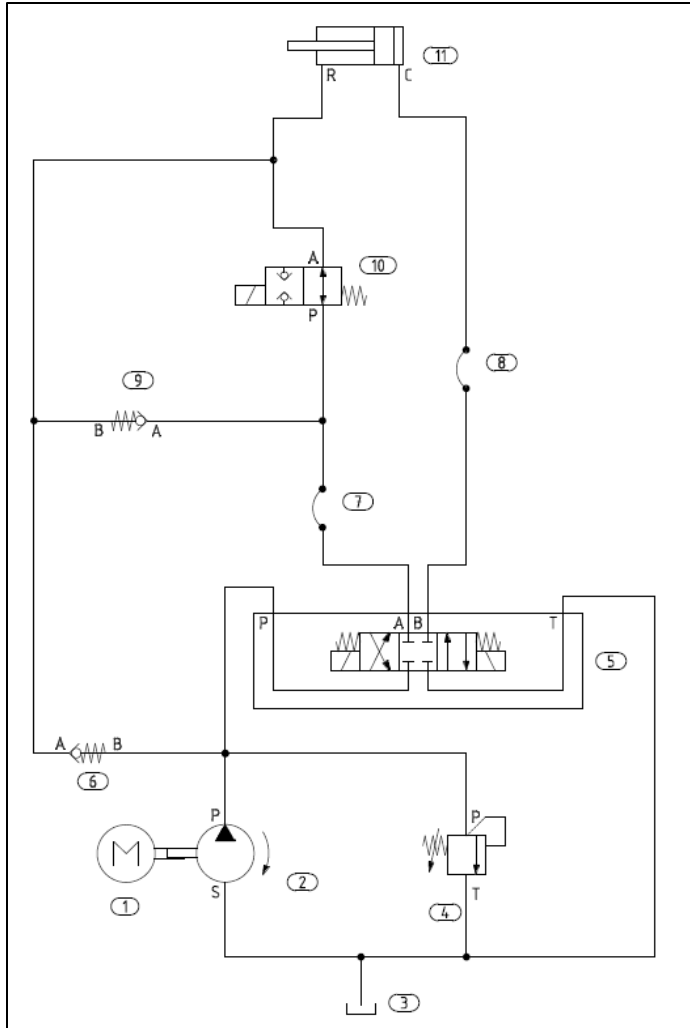


RVP0.M26 VALVE SERIES

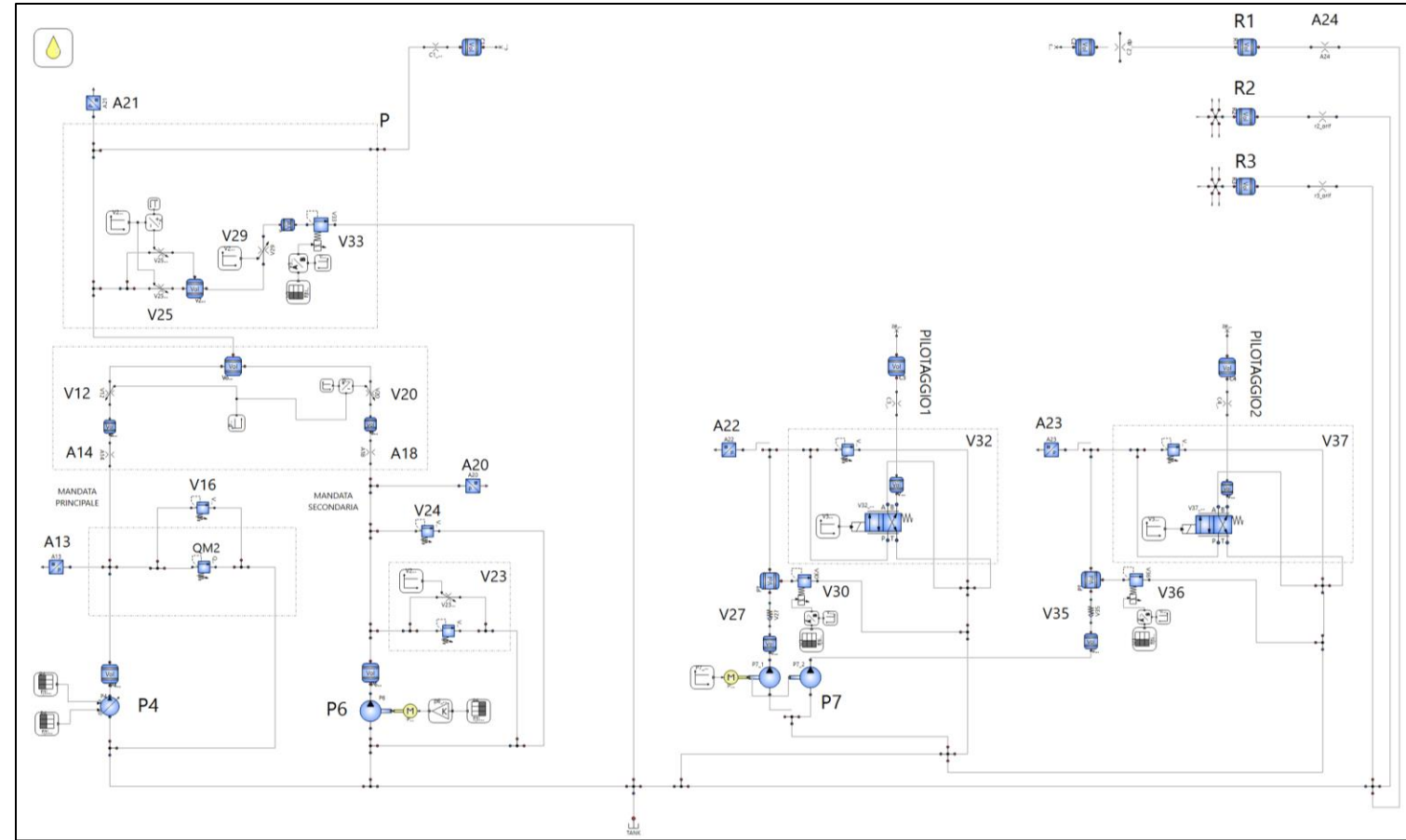
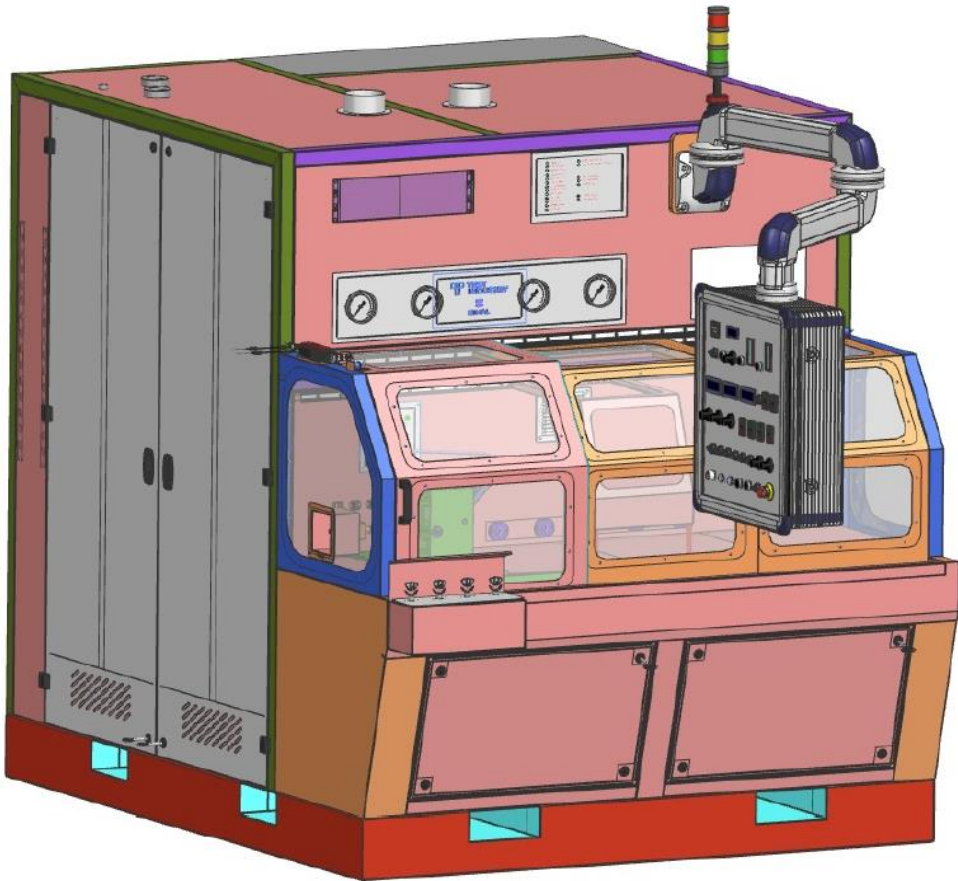
METRIC Cartridge - 420 bar
Pilot Operated with anti-cavitation
Poppet type



Sistema



Integrazione con test



Simulazione guidata

VALVOLA IN PROVA <input type="button" value="Imposta valvola in prova"/>		CONFIGURAZIONI TEST IN DATABASE <input type="button" value="Seleziona test"/> <input type="button" value="Cancella test"/>		<input type="button" value="Aggiorna database"/> <input type="button" value="Cancella filtri"/> <input type="button" value="Apri database"/>																								
		<table border="1"> <thead> <tr> <th>VALVOLA</th> <th>BANCO</th> <th>CONFIGURAZIONE</th> <th>COMMENTO</th> </tr> </thead> <tbody> <tr> <td>VALVE_42</td> <td>BANCO SPERIMENTALE</td> <td>CONFIGURAZIONE F</td> <td>figurazione con porta di carico a va</td> </tr> <tr> <td>SPCO_S08_simple</td> <td>BANCO SPERIMENTALE</td> <td>CONFIGURAZIONE C</td> <td>va rapporto di pilotaggio ritegni pilo</td> </tr> <tr> <td>RVS0_S10_simple</td> <td>BANCO SPERIMENTALE</td> <td>CONFIGURAZIONE A</td> <td>/min, Spring N, 50 bar, input rampa</td> </tr> <tr> <td></td> <td>BANCO SPERIMENTALE</td> <td>CONFIGURAZIONE D</td> <td>overshoot relief</td> </tr> <tr> <td>SVD0_S10_simple</td> <td>BANCO SPERIMENTALE</td> <td>CONFIGURAZIONE B</td> <td>ratteristiche con deviatore elettrova</td> </tr> </tbody> </table>		VALVOLA	BANCO	CONFIGURAZIONE	COMMENTO	VALVE_42	BANCO SPERIMENTALE	CONFIGURAZIONE F	figurazione con porta di carico a va	SPCO_S08_simple	BANCO SPERIMENTALE	CONFIGURAZIONE C	va rapporto di pilotaggio ritegni pilo	RVS0_S10_simple	BANCO SPERIMENTALE	CONFIGURAZIONE A	/min, Spring N, 50 bar, input rampa		BANCO SPERIMENTALE	CONFIGURAZIONE D	overshoot relief	SVD0_S10_simple	BANCO SPERIMENTALE	CONFIGURAZIONE B	ratteristiche con deviatore elettrova	VALVOLA <input type="button" value="RVS0_S10_si..."/> <input type="button" value="SPCO_S08_si..."/> <input type="button" value="SVD0_S10_s..."/> <input type="button" value="VALVE_42"/>
VALVOLA	BANCO	CONFIGURAZIONE	COMMENTO																									
VALVE_42	BANCO SPERIMENTALE	CONFIGURAZIONE F	figurazione con porta di carico a va																									
SPCO_S08_simple	BANCO SPERIMENTALE	CONFIGURAZIONE C	va rapporto di pilotaggio ritegni pilo																									
RVS0_S10_simple	BANCO SPERIMENTALE	CONFIGURAZIONE A	/min, Spring N, 50 bar, input rampa																									
	BANCO SPERIMENTALE	CONFIGURAZIONE D	overshoot relief																									
SVD0_S10_simple	BANCO SPERIMENTALE	CONFIGURAZIONE B	ratteristiche con deviatore elettrova																									
Banco sperimentale #1_100L/min 1353/09 <input type="button" value="Seleziona"/>		Banco sperimentale #2_100L/min 1789/21 <input type="button" value="Seleziona"/>		BANCO <input type="button" value="BANCO SPERIMENTALE #1_100 L/MIN"/> <input type="button" value="BANCO SPERIMENTALE #2_100 L/MIN"/> <input type="button" value="BANCO SPERIMENTALE #3_200 L/MIN"/>																								
Banco sperimentale #3_200L/min 1610/17 <input type="button" value="Seleziona"/>				CONFIGURAZIONE <input type="button" value="CONFIGURAZIONE A"/> <input type="button" value="CONFIGURAZIONE B"/> <input type="button" value="CONFIGURAZIONE C"/> <input type="button" value="CONFIGURAZIONE D"/> <input type="button" value="CONFIGURAZIONE F"/>																								
				<input type="button" value="Pulisci interfaccia"/> <input type="button" value="Apri istruzioni"/>																								

Supporto decisionale

The diagram illustrates a hydraulic system with the following components and connections:

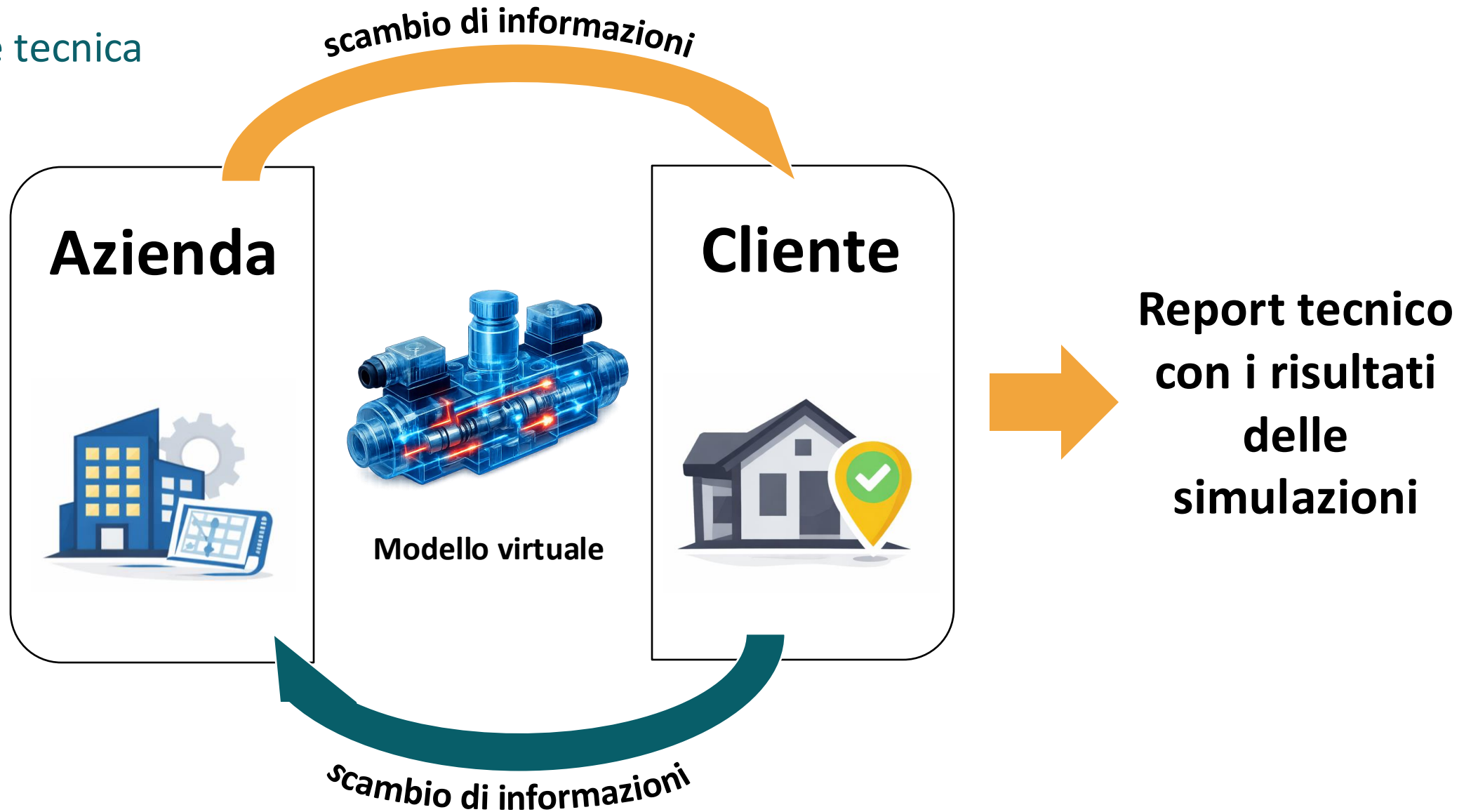
- 1:** Motor connected to a pump (2).
- 2:** Pump connected to a relief valve (4).
- 3:** Reservoir connected to the pump and relief valve.
- 4:** Relief valve with ports P and T.
- 5:** 4/3-way directional valve with ports P, T, A, and B.
- 6:** Check valve with ports A and B.
- 7:** 3-way directional valve with ports P, A, and B.
- 8:** 4/3-way directional valve with ports P, T, A, and B.
- 9:** Check valve with ports A and B.
- 10:** 3-way directional valve with ports P, A, and B.
- 11:** Cylinder with ports R and C.

Callouts and associated windows:

- portA, portP:** Callout to a cylinder component with a parameter window showing settings for `signal_area_multiplier`, `PA_area`, `PA_name`, `PA_smoothness`, `orifice_model`, `POChar`, and `DiamLines`.
- Port1, Port2:** Callout to a valve component with a parameter window showing settings for `Component`, `Name`, `Class`, `Path`, `FluidIndex`, and `SpringCode`.
- portA, portB, portP, portT:** Callout to a valve component with a parameter window showing settings for `signal_area_multiplier`, `PA_area`, `PA_name`, `PA_smoothness`, `orifice_model`, `POChar`, and `DiamLines`.
- Port1, Port2:** Callout to a relief valve component with a parameter window showing settings for `Component`, `Name`, `Class`, `Path`, `FluidIndex`, `SpringCode`, and `CrackingPressure`.

Graph: A line graph titled "cylinder stroke" showing stroke (mm) on the y-axis (ranging from -100 to 700) versus time (s) on the x-axis (ranging from 0 to 12). The stroke starts at 0, rises to a peak of approximately 600 mm at 4 seconds, and then gradually decays back to 0 mm by 10 seconds.

Collaborazione tecnica



Tre scenari

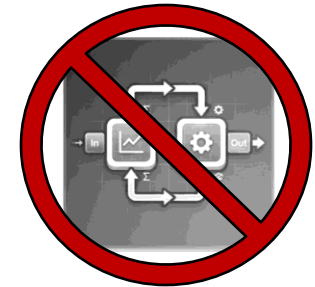
Stesso software



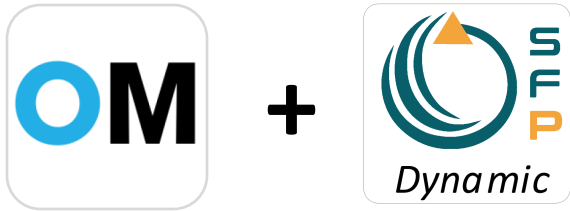
Software diverso



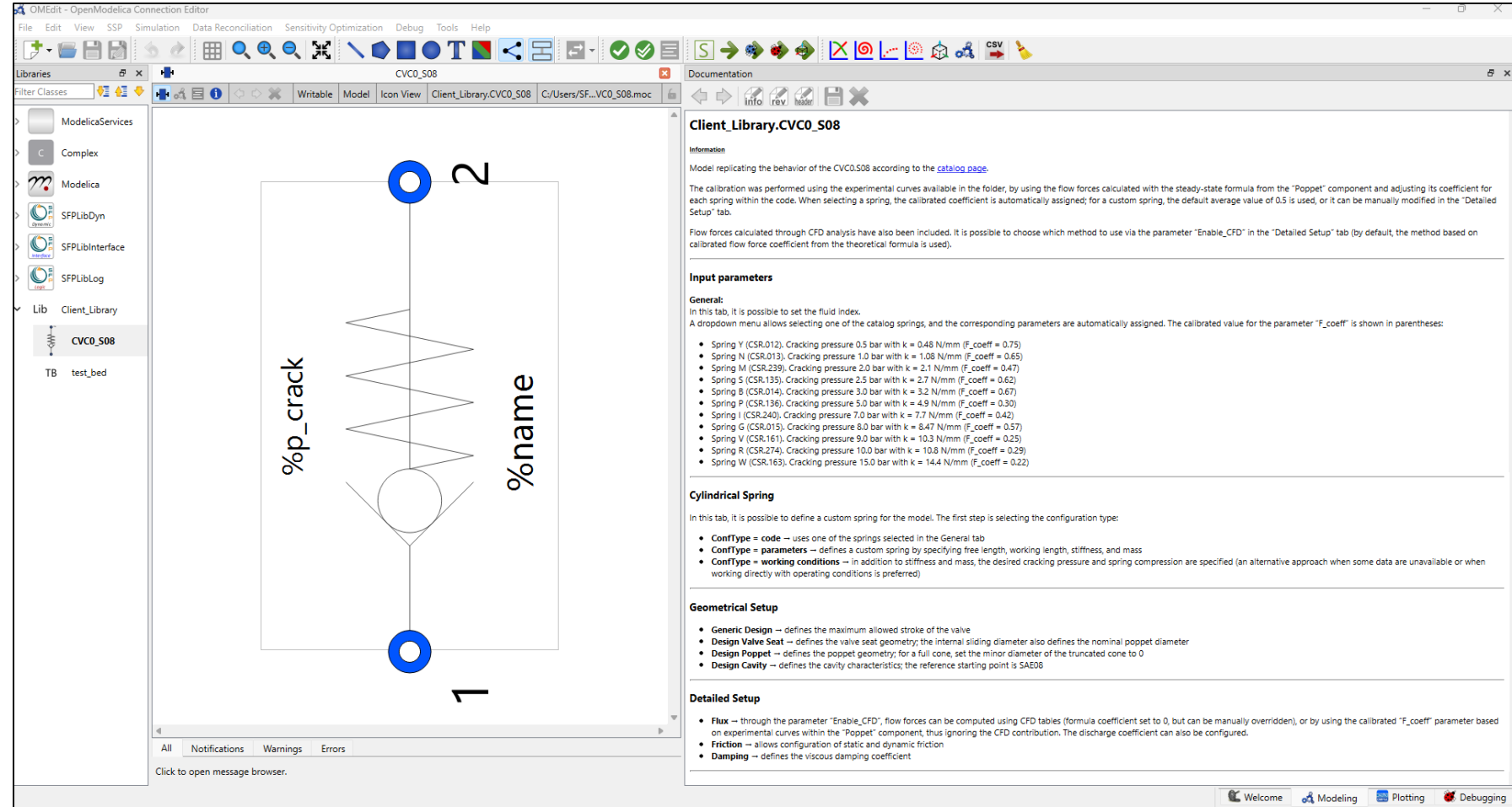
Nessun software



Esempio – stesso software



- Libreria in formato '.mol'
- Modelli criptati in cui è visibile solo icona e documentazione
- Possibilità di selezionare parametri modificabili e variabili calcolate
- Connessione diretta plug & play



The screenshot displays the OMEdit - OpenModelica Connection Editor interface. The main window shows a library component named 'CVC0_S08' from the 'Client_Library' folder. The component is represented by a spring symbol with two ports labeled '1' and '2'. The spring is labeled with '%p_crack' and '%name'. The right-hand pane shows the documentation for 'Client_Library.CVC0_S08', which includes information about the model, input parameters, and detailed setup options.

Client_Library.CVC0_S08

Information

Model replicating the behavior of the CVC0.S08 according to the [catalog page](#).

The calibration was performed using the experimental curves available in the folder, by using the flow forces calculated with the steady-state formula from the "Poppet" component and adjusting its coefficient for each spring within the code. When selecting a spring, the calibrated coefficient is automatically assigned; for a custom spring, the default average value of 0.5 is used, or it can be manually modified in the "Detailed Setup" tab.

Flow forces calculated through CFD analysis have also been included. It is possible to choose which method to use via the parameter "Enable_CFD" in the "Detailed Setup" tab (by default, the method based on calibrated flow force coefficient from the theoretical formula is used).

Input parameters

General:

In this tab, it is possible to set the fluid index.

A dropdown menu allows selecting one of the catalog springs, and the corresponding parameters are automatically assigned. The calibrated value for the parameter "F_coeff" is shown in parentheses:

- Spring Y (CSR.012), Cracking pressure 0.5 bar with k = 0.48 N/mm (F_coeff = 0.75)
- Spring N (CSR.013), Cracking pressure 1.0 bar with k = 1.08 N/mm (F_coeff = 0.65)
- Spring M (CSR.239), Cracking pressure 2.0 bar with k = 2.1 N/mm (F_coeff = 0.47)
- Spring S (CSR.135), Cracking pressure 2.5 bar with k = 2.7 N/mm (F_coeff = 0.62)
- Spring B (CSR.014), Cracking pressure 3.0 bar with k = 3.2 N/mm (F_coeff = 0.67)
- Spring P (CSR.136), Cracking pressure 5.0 bar with k = 4.9 N/mm (F_coeff = 0.39)
- Spring I (CSR.240), Cracking pressure 7.0 bar with k = 7.7 N/mm (F_coeff = 0.42)
- Spring G (CSR.015), Cracking pressure 8.0 bar with k = 8.47 N/mm (F_coeff = 0.57)
- Spring V (CSR.161), Cracking pressure 9.0 bar with k = 10.3 N/mm (F_coeff = 0.25)
- Spring R (CSR.274), Cracking pressure 10.0 bar with k = 10.8 N/mm (F_coeff = 0.29)
- Spring W (CSR.163), Cracking pressure 15.0 bar with k = 14.4 N/mm (F_coeff = 0.22)

Cylindrical Spring

In this tab, it is possible to define a custom spring for the model. The first step is selecting the configuration type:

- **ConfType = code** → uses one of the springs selected in the General tab
- **ConfType = parameters** → defines a custom spring by specifying free length, working length, stiffness, and mass
- **ConfType = working conditions** → in addition to stiffness and mass, the desired cracking pressure and spring compression are specified (an alternative approach when some data are unavailable or when working directly with operating conditions is preferred)

Geometrical Setup

- **Generic Design** → defines the maximum allowed stroke of the valve
- **Design Valve Seat** → defines the valve seat geometry; the internal sliding diameter also defines the nominal poppet diameter
- **Design Poppet** → defines the poppet geometry; for a full cone, set the minor diameter of the truncated cone to 0
- **Design Cavity** → defines the cavity characteristics; the reference starting point is SAE08

Detailed Setup

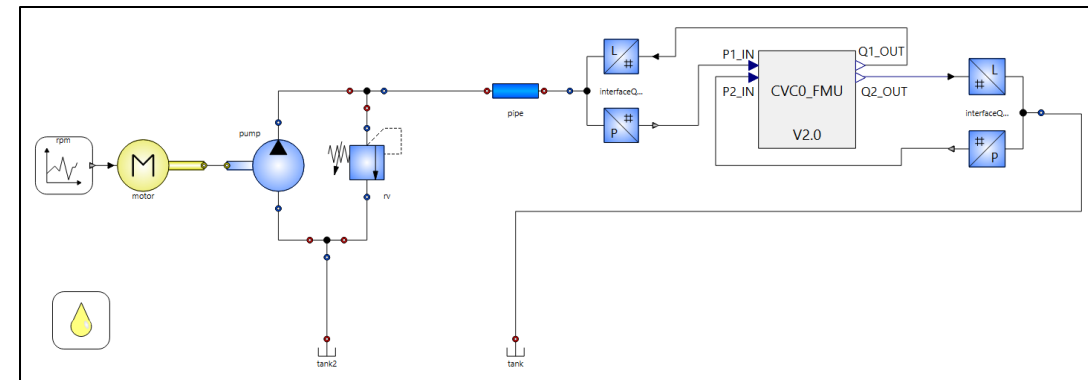
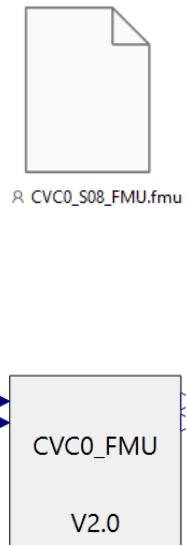
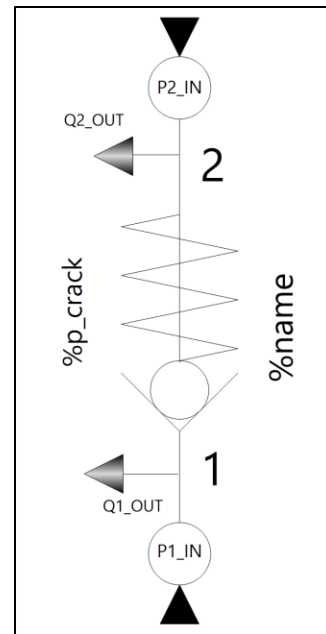
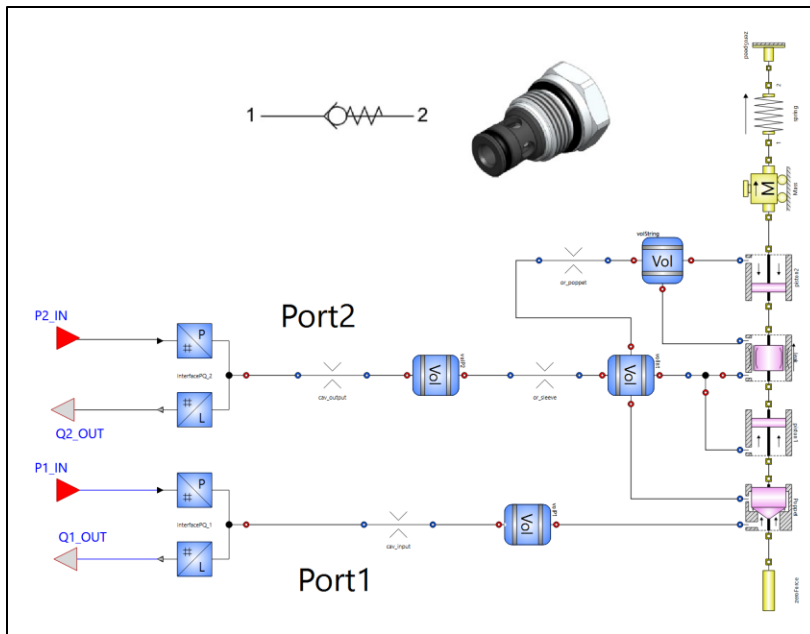
- **Flux** → through the parameter "Enable_CFD", flow forces can be computed using CFD tables (formula coefficient set to 0, but can be manually overridden), or by using the calibrated "F_coeff" parameter based on experimental curves within the "Poppet" component, thus ignoring the CFD contribution. The discharge coefficient can also be configured.
- **Friction** → allows configuration of static and dynamic friction
- **Damping** → defines the viscous damping coefficient

Esempio – software diverso

- ❑ La Functional Mock-up Interface (FMI) è uno standard gratuito che definisce un'interfaccia per lo scambio di modelli di simulazione dinamica utilizzando una combinazione di file
- ❑ È supportato da oltre 180 software e gestito come progetto dell'associazione Modelica



<https://fmi-standard.org/>



Esempio – nessun software

MSL (Modelica Standard Library)

Modelica

- UsersGuide
- Blocks
- ComplexBlocks
- Clocked
- StateGraph
- Electrical
- Magnetic
- Mechanics
- Fluid
- Media
- Thermal
- Math
- ComplexMath
- Utilities
- Constants
- Icons
- Units

Fluid

- UsersGuide
- Examples
- System
- Vessels
- Pipes
- Machines
- Valves
- Fittings
- Sources
- Sensors
- Interfaces
- Types
- Dissipation
- Utilities

Modelica

Modelica Standard Library - Version 4.0.0

Information

The package **Modelica**® is a **standardized** and **free** package that is developed by the "Modelica Association Project - Libraries". Its development is coordinated with the Modelica® language from the Modelica Association, see <https://www.Modelica.org>. It is also a **Library**. It provides model components in many domains that are based on standardized interface definitions. Some typical examples are

For an introduction, have especially a look at:

- [Overview](#) provides an overview of the Modelica Standard Library inside the [User's Guide](#).
- [Release Notes](#) summarizes the changes of new versions of this package.
- [Contact](#) lists the contributors of the Modelica Standard Library.
- The **Examples** packages in the various libraries, demonstrate how to use the components of the corresponding sublibrary.

This version of the Modelica Standard Library consists of

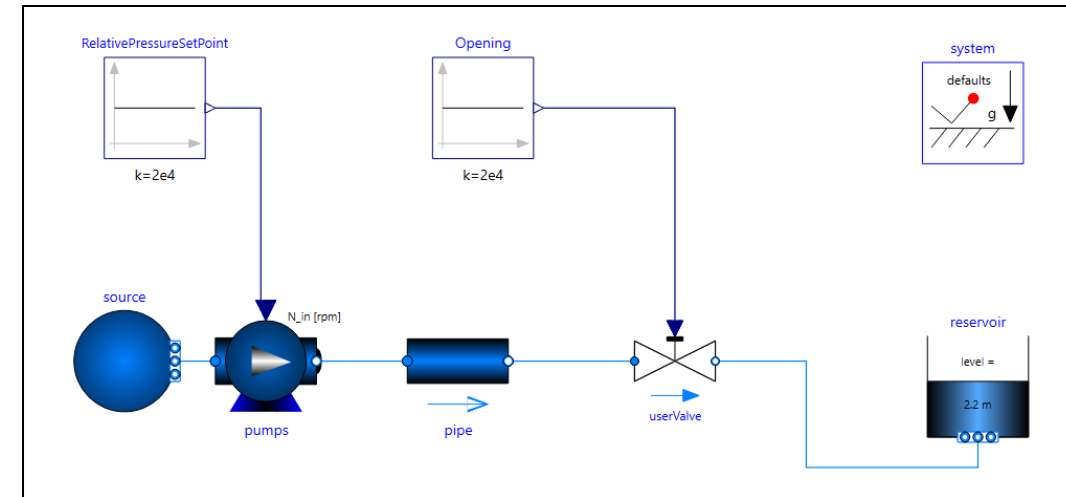
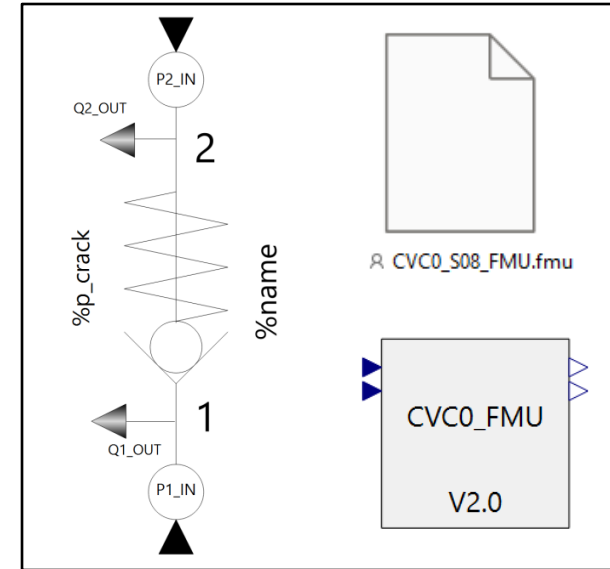
- **1417** component models and blocks,
- **512** example models, and
- **1219** functions

that are directly usable (= number of public, non-partial, non-internal and non-obsolete classes). It is fully compliant to [Modelica Specific](#) been tested with Modelica tools from different vendors.

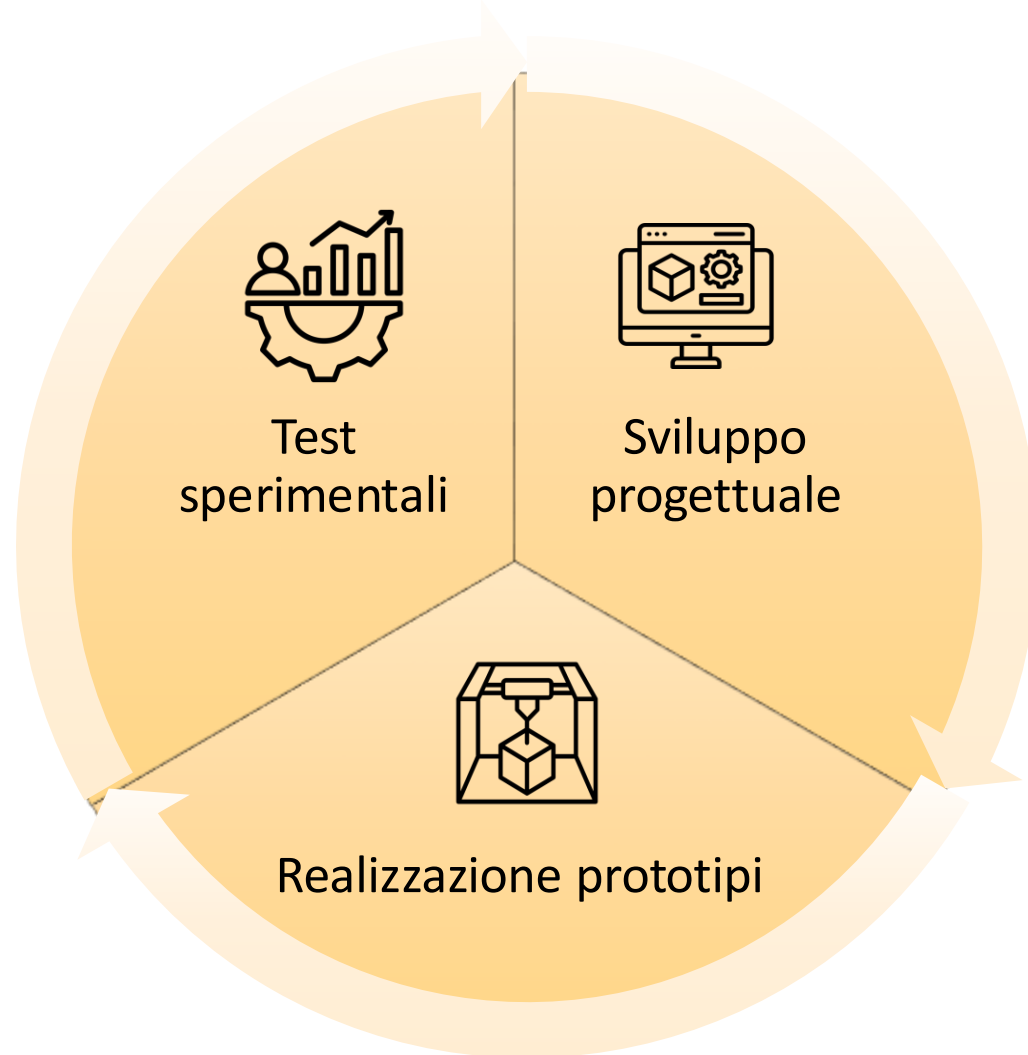
Licensed by the Modelica Association under the 3-Clause BSD License
Copyright © 1998-2020, Modelica Association and [contributors](#).

*This Modelica package is **free** software and the use is completely at **your own risk**; it can be redistributed and/or modified under the **license**. For license conditions (including the disclaimer of warranty) visit <https://modelica.org/licenses/modelica-3-clause-bsd>.*

Modelica® is a registered trademark of the Modelica Association.



Cosa cambia



R&D / Progettazione

- Bozza valvola + modello dinamico in parallelo
- Decisioni più accurate prima dell'hardware
- Meno varianti → convergenza più rapida



Test & Validazione

- Correlazione simulazione ↔ dati sperimentali
- Meno iterazioni di test → meno sprechi
- Troubleshooting quotidiano più veloce

Cliente / Applicazione

- Valutazione condizioni estreme (es. portate elevate)
- Previsione criticità
- Modelli come strumento di collaborazione tecnica

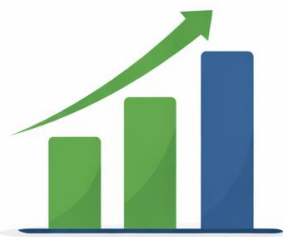
Come iniziare



Caso pilota



Modello del
componente/sistema



Integrazione software in
azienda



Completa il questionario (2–3 minuti) per accedere al materiale aggiuntivo:

- modelli virtuali realizzati durante la sessione
- libreria trial SmartFluidPower
- possibilità di una breve consulenza tecnica sul tuo caso applicativo



<https://tally.so/r/PdXza5>

