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Advanced Fluid Conditioning Solutions®
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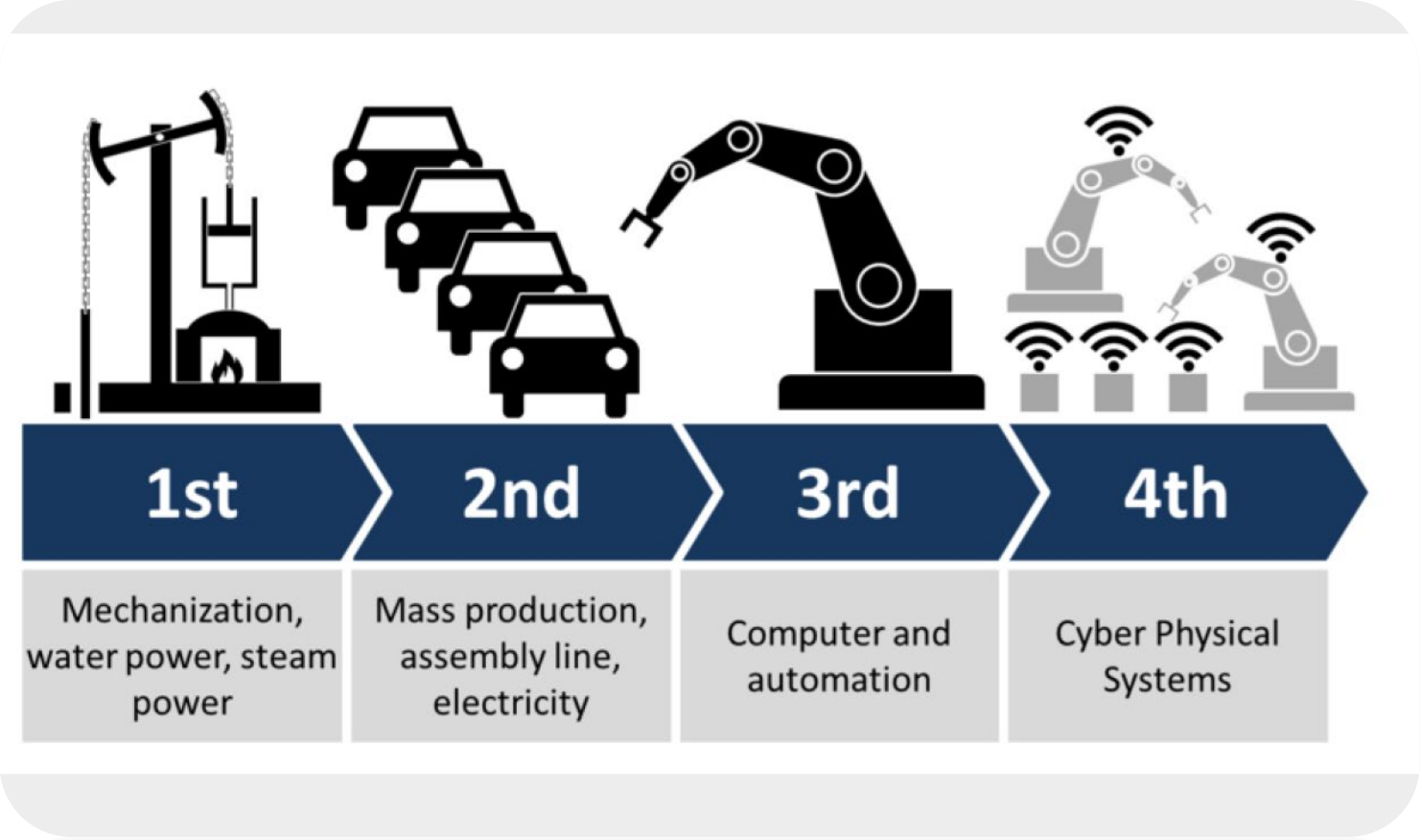
CONDITION MONITORING AND INDUSTRY 4.0

Kris Mikulan
Filter Systems Group Product Manager

Understanding Industry 4.0

- Industrial era of:
  - Smart machines
  - Data-driven production facilities
    - Automatic information exchange
    - Triggered actions
    - Independent control

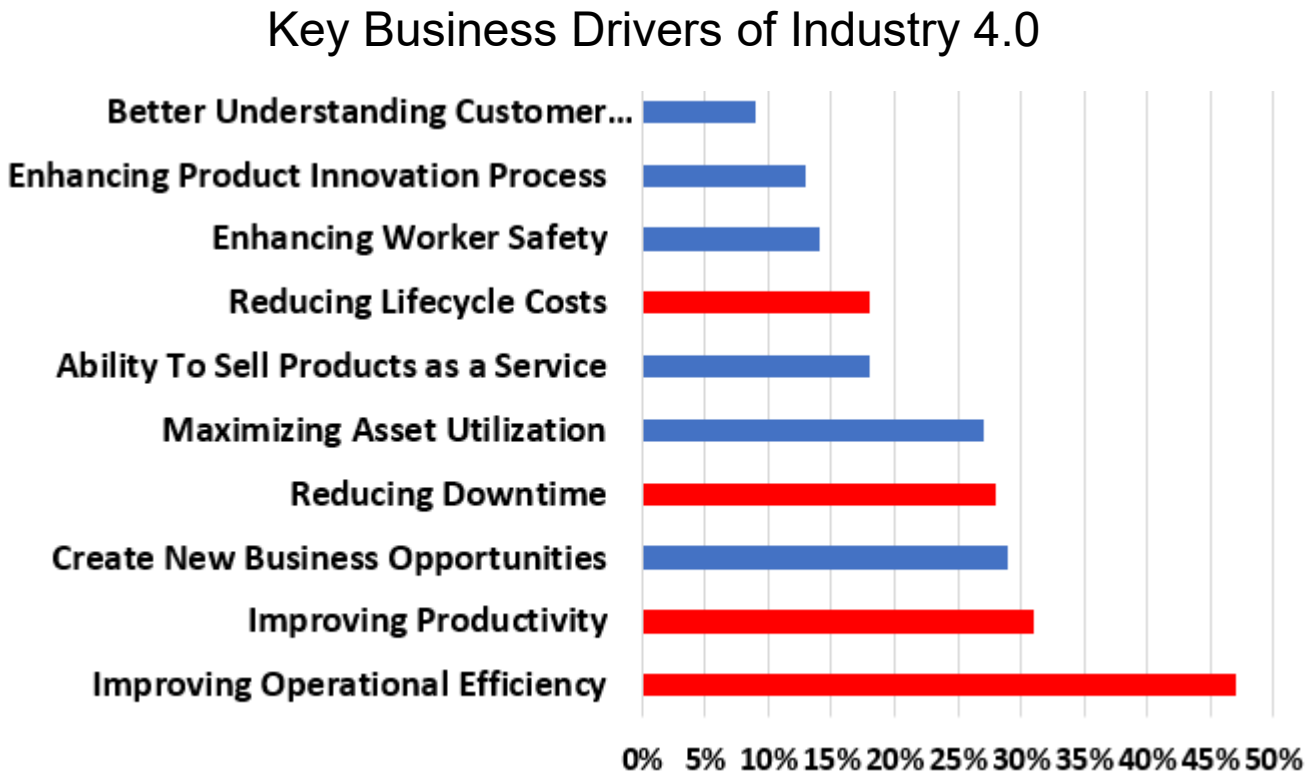
- Terms under the I 4.0 umbrella:
  - IIoT
  - Digitalization
  - Predictive/Proactive Maintenance
  - Big Data



Understanding Industry 4.0

Leveraging data to:

- Improve:
  - Manufacturing processes
  - Material/resource usage
  - Supply chain
  - Product life cycle
  - Safety
- Development of existing and new business models
- Make informed decisions



Source: Morgan Stanley – Automation World Industrial Automation Survey. AlphaWise

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Approach to Industry 4.0

Make Data (Source)	Move Data (Transfer)	Manage Data (Process)	Manipulate Data (Use)	Monetize Data (Business Models)
- Sensors **- Valves** **- Memory** **- Filter** **- Pumps** **- Power units** **- Cooler / chiller** **- Controllers** **- Fluid maintenance system** with communication interfaces	**"Gateways"** *Interface which allows a data exchange between different communication networks.*	**Software:** • **Collecting data** • **Data storage** (DB management) • **Data processing** • **Data access** • **User management** • **Messages & alarms management** • **Visualization** • **…**	**KPIs**	**Direct marketing + via trade & dealership network**
			Causes of error	**Rental models**
			CM + Interpretation	**E-commerce**
			Prediction of states, process behavior, quality	**Pay Per Use**
IT systems (SAP,…) Databases. Simulations,…	For example, also IO-link master with IoT gateway function		**Auto. Generation: alarm/messages, reports recommended action**	**Digital services**
				Subscription
			AI / Machine learning	**Solution provider**
				Pay on benefit
	Telematics			**License**
		Industry PC, PC/ server (IT system), Cloud (ext. server of service providers)		**…**

Maintenance Targets

- Condition-based Maintenance Planning
- Early Detection of Damages and possible failures
- Avoiding of unplanned Shutdowns
- Increase of Machine Availability, Safety and Productivity
- Utilization of the full Machine Lifetime
- Reduction of Lifecycle Costs (LCC) and Total Cost of Ownership (TCO)

Strategic Maintenance

Performance Level Strategies	Tool
Proactive	Continuous improvement
Predictive	Continuous Status monitoring
Preventive	
Reactive	Failure-based maintenance

Information is useless unless targeted actions are taken to improve the profitability.

- **Predictive**: Estimating residual life expectancy
- **Proactive**: Increasing residual life expectancy

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Relative maintenance Costs

	Reactive	Preventive	Predictive
Planned maintenance	20 %	50 %	20 %
Unplanned maintenance	50 %	5 %	3 %
Production failure	30 %	10 %	3 %
Fluid Condition Monitoring investment	0 %	0 %	10 %
Total costs	**100 %**	**65 %**	**36 %**

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Component condition sensors

- Pumps
- Valves
- Filter
- Accumulators
- Cooler


VS 3000


EY1356


HPT 500


BIS


P0

Fluid condition sensors

- Solid particle contamination
- Wear
- Water saturation
- Fluid condition


AS 3000


AS 1000


CS 1000


MCS 1000


CSM-E


HYTRAX


CMP


FCU 1315


Total Fluid Life


Total Fluid Health

Machine (Process) input

- Pressure
- Temperature
- Fill level
- Flow rate
- Vibration
- Energy


HDA


ETS 4100


HNS3000


EVS 3100


HFS 2100

Sensors – Pressure Transmitters

Electronic Pressure Transmitters	HDA 4800	HDA 4700	HDA 4400	HDA 4300	HDA 4100	HDA 4800 Steel version	HDA 7400	HDA 8700	HDA 8400	HDA 9000	HPT 500
											
Accuracy (BFSL)	0.125	0.25	0.5	0.5	0.5	0.125	0.5	0.25	0.5	0.5	3.0
Low pressure (up to 500 psi)	✓	✓	✓	✓	✓	✓				✓	
High pressure (from 500 psi)	✓	✓	✓			✓	✓	✓	✓	✓	✓
Relative pressure	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Absolute pressure					✓						
Differential pressure											✓
Analog output	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Available as individual units	✓	✓	✓	✓	✓	✓	✓				
OEM product for large volume production							✓	✓	✓	✓	
Flush membrane		✓	✓	✓			✓				
CANopen Version		✓					✓				
ECE type authorization *(approved for road vehicles)*								✓	✓		
Approval for potentially explosive atmospheres		✓	✓	✓	✓						
Ship approval		✓	✓	✓	✓						
UL approval	✓	✓	✓	✓	✓		✓	✓	✓		
Hydrogen approval			✓						✓		
Enhanced functional safety		✓						✓			

Sensors – Pressure Switches

Electronic Pressure Switches	EDS 3400	EDS 3300	EDS 3100	EDS 300	EDS 8000	EDS 1700	EDS 4400	EDS 4300	EDS 4100	EDS 820	EDS 810	EDS 710	EDS 410
													
Accuracy (BFSL)	0.5	0.5	0.5	0.5	0.5	0.25	0.5	0.5	0.5	0.5	0.5	0.5	1.0
Low pressure (up to 500 psi)		✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
High pressure (from 500 psi)	✓			✓	✓	✓	✓			✓	✓	✓	✓
Relative pressure	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
Absolute pressure			✓						✓				
Number of switching outputs	2	2	2	2	2	4	2	2	2	2	2	1	2
Analog output	✓	✓	✓	✓		✓							
Digital display	✓	✓	✓	✓	✓	✓							
Programmable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Factory-set (not field-adjustable)							✓	✓	✓		✓	✓	✓
DESINA-compliant	✓	✓	✓										
VDMA Menu Navigation	✓	✓	✓		✓								
Available as individual units	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
OEM product for large volume production							✓	✓	✓		✓	✓	✓
Flush membrane	✓	✓											
IO-Link interface	✓	✓	✓							✓			
ECE type authorization *(approved for road vehicles)*											✓		
Approval for potentially explosive atmospheres							✓	✓	✓				
Ship approval				✓									
UL approval	✓	✓	✓		✓						✓		

Sensor – Temperature Transmitters

Electronic Temperature Transmitters	ETS 4100 		ETS 4500 		ETS 7000 	HTT 8000 
Accuracy % (max. error)	0.8		2.0		2.0	3.0
Temperature range -13 to +212°F (-25 to 100 °C)	✓		✓		✓	✓
Pressure-resistant to 1812 psi		✓		✓	✓	✓
Pressure-resistant to 8700 psi	✓		✓			
Probe length in mm	6	50–350	10.7	50–350	10	16
Analog output	✓		✓		✓	✓
Available as individual units	✓		✓		✓	
OEM product for large volume production						✓
Approval for potentially explosive atmospheres	✓		✓			
Protection type	IP 65		IP 65		IP 67	IP 67

Sensors – Temperature Switches

Electronic Temperature Switches	ETS 3200 	ETS 3800 	ETS 320 	ETS 380 	ETS 1700 	HTS 8000 
Accuracy (max. error)	1 °C	1 °C	1 °C	1 °C	1 °C	3 %
Pressure-resistant to 8700 psi	✓		✓			
Integrated probe	✓		✓			✓
Separate probe		✓		✓	✓	
Number of switching outputs	2	2	2	2	4	2
Analog output	✓	✓	✓	✓	✓	
Digital display	✓	✓	✓	✓	✓	
Programmable	✓	✓	✓	✓	✓	
Tank mounting	✓					
Factory-set *(not field-adjustable)*						✓
VDMA Menu Navigation	✓	✓				
Available as individual units	✓	✓	✓	✓	✓	
OEM product for large volume production						✓
IO-Link interface	✓	✓				
UL approval	✓	✓				

Sensors – Flow Meters and Flow Switches

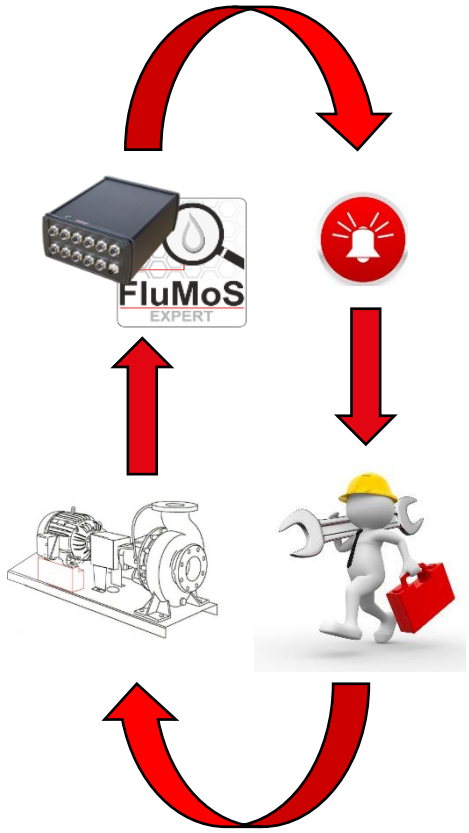
Flow Rate Transmitters, Flow Switches	EVS 3110	EVS 3100	HFS 2100	HFS 2500	HFT 2100	HFT 2500	HFT 3100
							
Accuracy (max. error) in %	2	2	10	5	10	3	2
Measurement principle	Turbine	Turbine	Float principle	Float principle	Float principle	Float principle	Turbine
Pressure-resistant	✓	✓	✓	✓	✓	✓	✓
Water-based media	✓			✓		✓	
Oil / viscous fluids		✓	✓		✓		
Direction of flow optional	✓	✓					✓
Installation position optional	✓	✓	✓	✓	✓	✓	✓
Max. number of switching contacts			2	2			
Analog output	✓	✓			✓	✓	✓
HART protocol							✓
Display			✓	✓			
ATEX approval			✓	✓			
ATEX IECEx intrinsically safe							✓
ATEX IECEx CSA flameproof enclosure							✓

Sensors – Level

Level Sensors	ENS 3000	HNS 526	HNT 1000	HNS 3000
				
Measurement principle	Capacitive	Ultrasound-based	Magnetostrictive	Magnetostrictive
Measuring range	250 to 730	280 to 6,400	250 to 2,500	250 to 2,500
With temperature sensor	✓			✓
Mechanical connection	Screw connection	M30x1	G 3/4	G 3/4
Electrical connection	M12x1	M12x1	M12x1 cable outlet	M12x1
Number of switching outputs	1, 2 + 4	1 + 2		1, 2 + 4
Analog output	✓	✓	✓	✓
CANopen Version			✓	
VDMA Menu Navigation	✓	✓		✓
IO-Link interface	✓			✓
UL approval	✓			
Fields of application	Industry	Industry	Industry, mobile	Industry, mobile

Service Equipment

	HMG 500	HMG 510	HMG 2500	HMG 4000	HDA 4748-H	ETS 4148-H	EVS 3108-H	HDA 4748-HCSI	ETS 4748-HCSI
									
Portable data recorder	✓	✓	✓	✓					
Touch				✓					
Number of measurement inputs	2	2	4	38					
Interface		USB	USB	USB RS 232					
Measurement inputs	HSI	HSI	HSI frequency	HSI HCSI analog frequency					
Connection to CAN bus				✓				✓	✓
Visualization		CMWIN	HMGWIN	HMGWIN					
Automatic sensor recognition, HSI / HCSI					✓	✓	✓	✓	✓
Measured variable					Pressure	Temperature	Flow rate	Pressure	Temperature



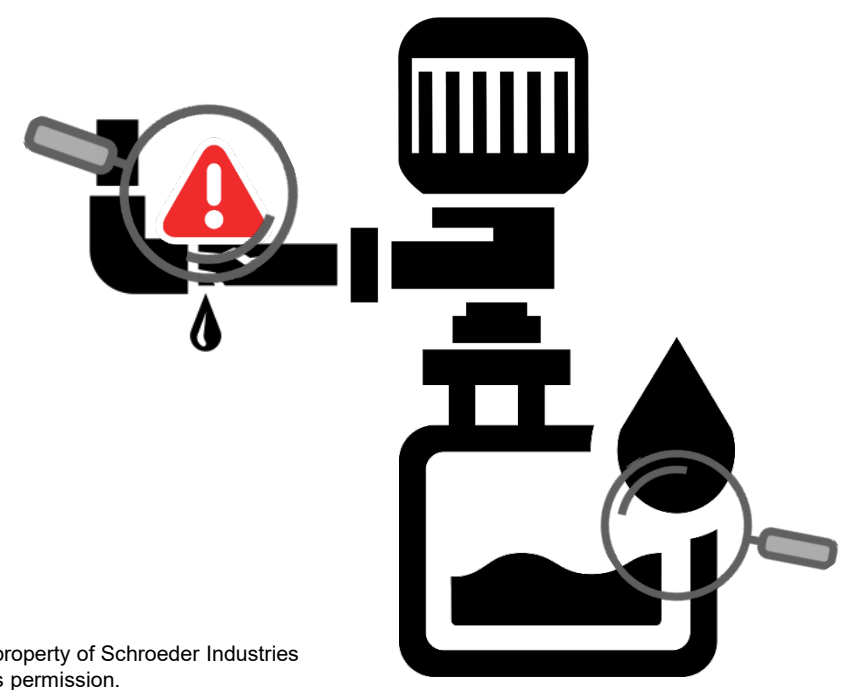
Demands on Modern Condition Monitoring Systems

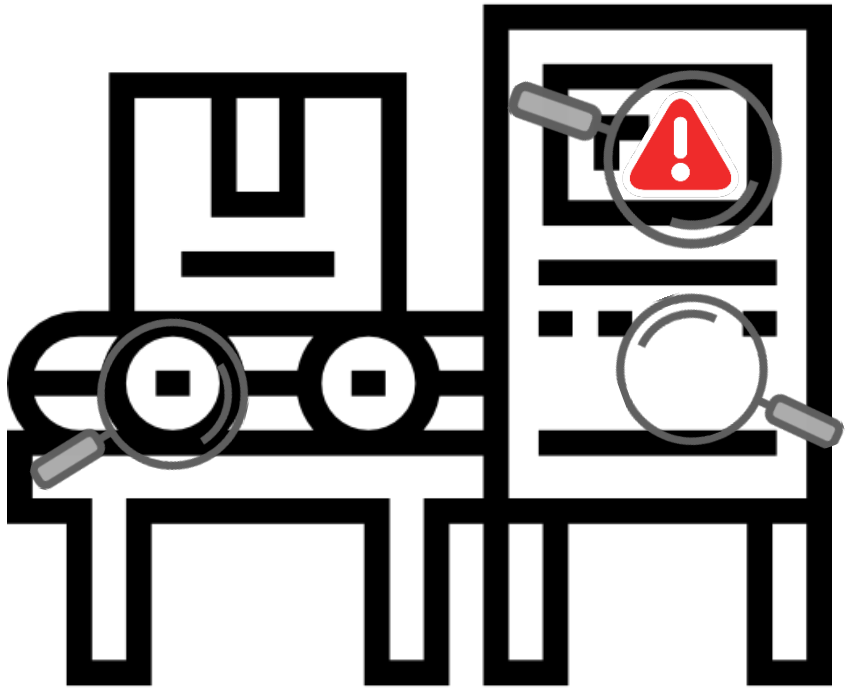
- **Clear Measured Values** describing machinery condition (Monitoring of limit values)
- If possible, **No Expert Knowledge Required** for data interpretation
- Develop of **Maintenance Instructions and Constant Improvements**
- **Optimal Analysis of Machinery Condition** before damages occur
- **Modular** expandable (A system has to grows with its tasks)

What is Condition Monitoring? **Why** is it Important?

Condition monitoring is the process of **watching critical parameters within machinery**. This is to help identify a significant change which is **revealing of a developing issue.**

Anything can be monitored. As long as there is a sensor that can support it.

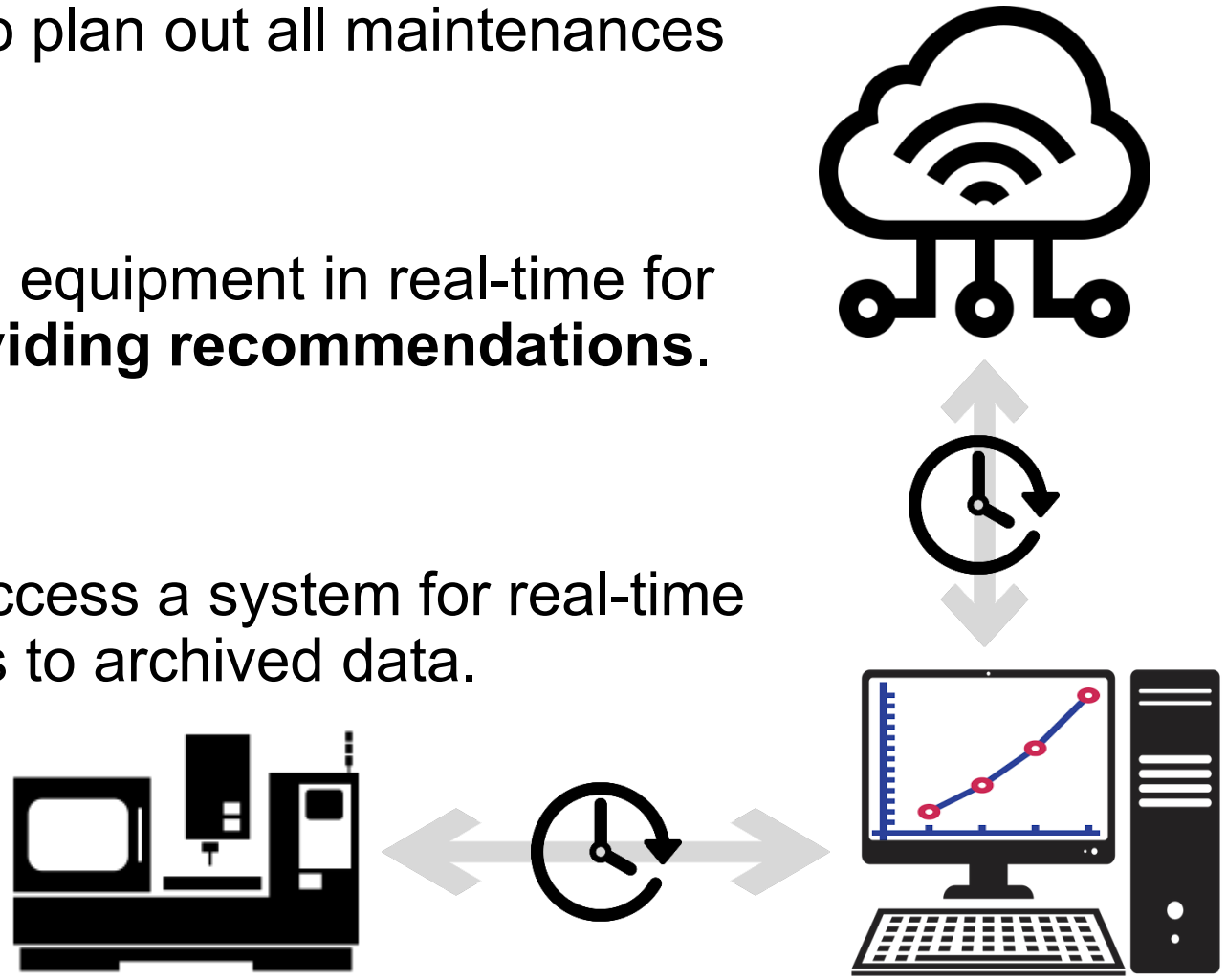




- Proactive maintenance is all about **fixing the problem before it occurs** and having the means to plan out all maintenances required.

- A IoT platform can access multiple equipment in real-time for **condition monitoring**, while **providing recommendations**. All remotely over a network.

- Pair this all together to remotely access a system for real-time data analysis, while having access to archived data.

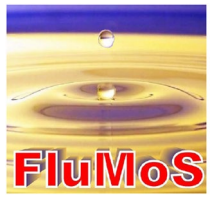


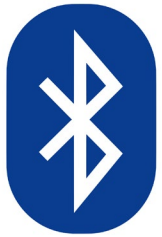
The Evolution of Filter Systems IoT











Basic Integration
- Single Sensor
- Simple Data Retrieval

Advanced Integration
- Real-Time Condition Monitoring
- Data Logging & Reporting
- Remote Monitoring

High Integration (IoT)
- Programmable Functionality
- Feedback for Predictive Analytics
- Full Automation

REACTIVE → PREDICTIVE → PROACTIVE

PREDICTIVE - HY-TRAX® Contamination Monitoring System

FACT: Continuous duty particle counters require constant pressure and flow for accurate readings

What happens if customer's systems don't meet the minimum conditions?

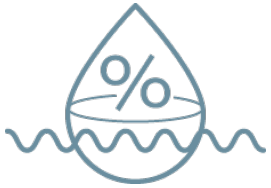
Our HyTrax® Systems are designed for monitoring fluid conditions in reservoirs or low pressure lines.

- Real-time ISO fluid condition for oils up to 700cSt
- Manually controlled version easily tied into customer PLC
- Telematics Communication Module sends data via GSM Cellular Communications or Ethernet to a secure web-based "Dashboard".

Schroeder Pro: Total Fluid Life

- Advanced portable fluid condition monitoring unit

Particulate Contamination
- ISO, NAS & SAE

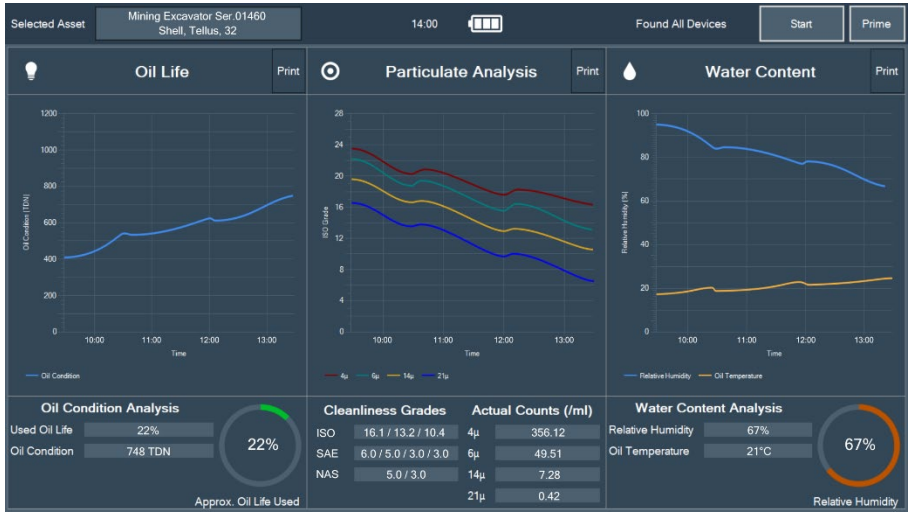


Relative Water Content
- % Saturation

Oil Life Indication
- Electrochemical composition
- Relative to new fluid condition

Total Fluid Life | Sensors

- Laser particle counter ~ ±0.5 of an ISO code, ±0.1% repeatability
- Water sensor ~ ±3% accuracy, full scale
- Oil life sensor ~ Tan Delta Full Spectrum Holistic Oil Condition
  - Ratio of conductance and capacitance
  - 500 pre-loaded fluid profiles
  - Ability to profile new fluids



Manufacturer	Oil Name	Viscosity	Application	Min. Temp. (°C)	Max. Temp. (°C)
Avia Oils	Bantleon Synto		Hydraulic	-20	120
Avia Oils	Basic	68	Hydraulic	-20	120
Avia Oils	HV1		Hydraulic	-20	120
Avia Oils	Plus		Engine	-20	120
Avia Oils	Plus Arctic		Engine	-20	120
Batoyle	Titan	320	Gear	-20	120
Fuchs	Cassida GL	220	Gear	-20	120
Fuchs	Cassida GL	460	Gear	-20	120
Fuchs	Cassida HF	46	Hydraulic	-20	120
Shell	Helix HX5	15W40	Engine	-20	120
Interflon	Finlube			-20	120
Millers Oils	TruckSyn FE	5W30	Engine	-20	120
Mobil	1005		Engine	-20	120
MOD	Mineral OMD90		Engine	-20	120
Petro Canada	Duron	15W40	Engine	-20	120
Petro Canada	FG AW	32	Hydraulic	-20	120
Petro Canada	FG AW	46	Hydraulic	-20	120
Petro Canada	FG AW	68	Hydraulic	-20	120
Petro Canada	FG AW	100	Hydraulic	-20	120

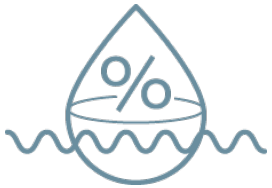
Custom Oils

Schroeder Pro: Total Fluid Health

Advanced portable fluid condition monitoring unit

Particulate Categorization

Particulate Contamination
- ISO, NAS & SAE

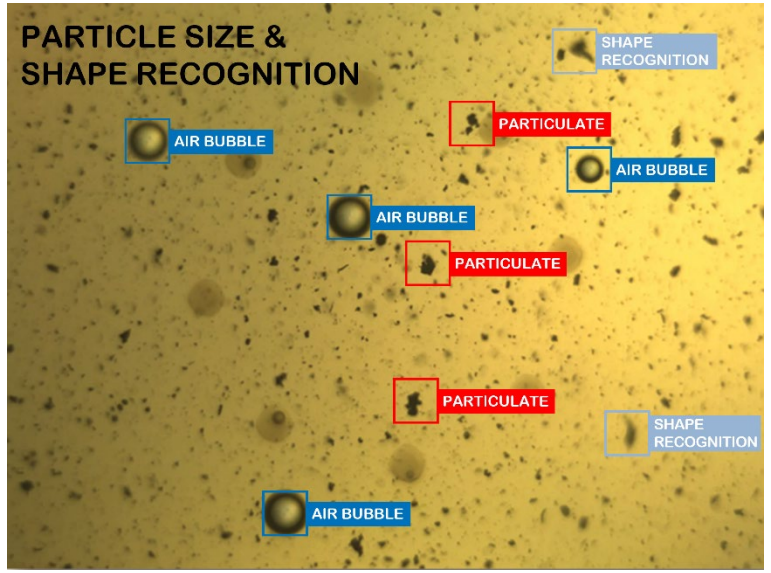


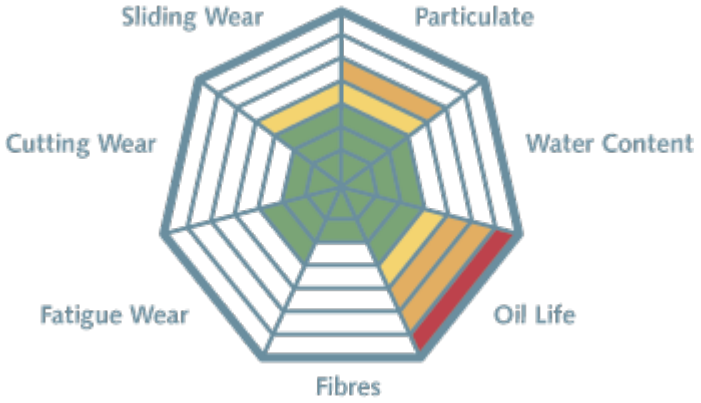
Relative Water Content
- % Saturation

Oil Life Indication
- Electrochemical composition
- Relative to new fluid condition

Total Fluid Health | Sensors

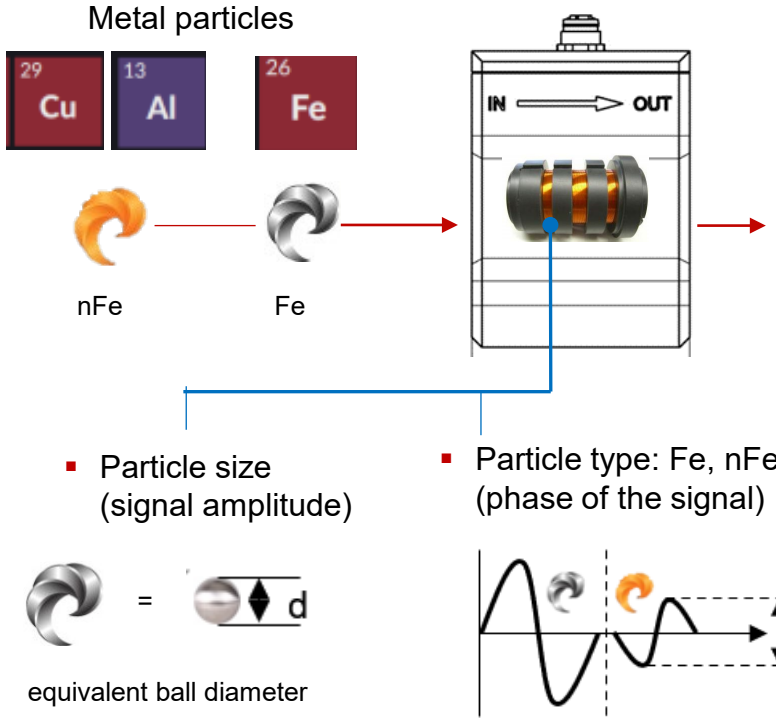
- Digital imaging sensor
  - Categorizes according to:
    - fatigue wear
    - cutting wear
    - sliding wear
    - fibers
  - Negates air bubbles and water molecules
- Laser particle counter
- Water sensor
- Oil life sensor





Metallic Contamination Sensor
MCS 1000

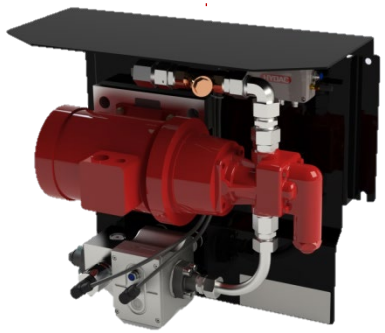
Measurement principle

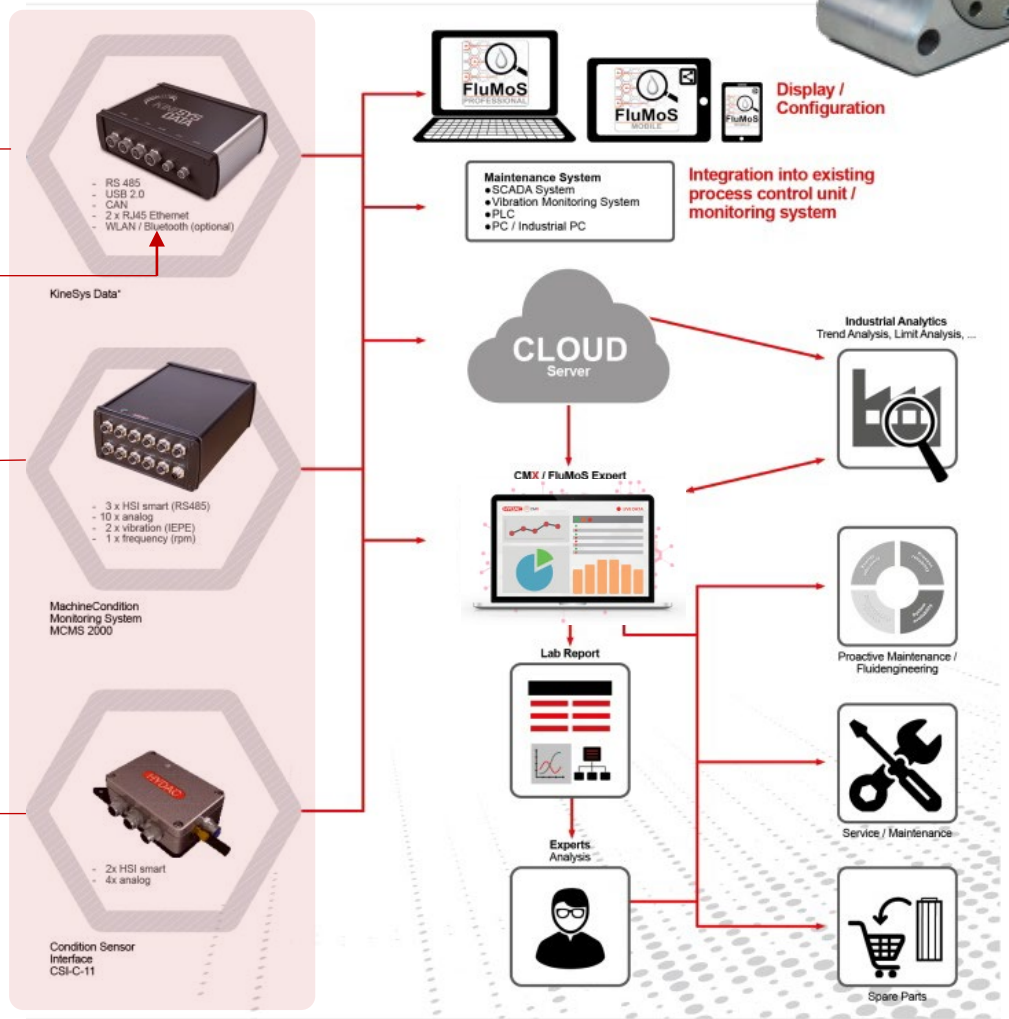


- Inductive measuring system (throughput measuring cell)
- Determination of metal particles in the fluid
- Particle classification:
  - **Sizes**
    - 6 size classes/ bins (3 Fe, 3 nFe)
    - In accordance with ISO 16232
  - **Metallurgical property**
    - Fe: gear-tooth systems, roller bearings …
    - nFe: Bearings, brass cages (roller bearing), pump bodies made of aluminum…

MCS System Integration & IIoT

- Stand alone Condition Monitoring System
- Integration in Control, Condition Monitoring (CM) and SCADA systems via sensor interfaces
- Via Edge-Device in HYDAC CMX (Cloud)





Interfaces of MCS 1x80:

- 2 x switching outputs
- RS485 (Modbus RTU)
- Ethernet (Modbus TCP)

Interfaces of MCS 1x80:

- 2 x switching outputs
- CAN (CANopen)
- Ethernet (Modbus TCP)

GYR Nodes

- GYR Node Series (Green-Yellow-Red Nodes) are proportional visual/electrical units that tell **Condition Monitoring at a glance** using the universal color meanings of Green, Yellow, and Red.

These units can **stand alone**
(No need for a higher source to decode the data)
or
Pass through data
(A 4-20mA signal from the host sensor to a higher source)

- These Nodes are easy to install and sum up the status of a machine in seconds!

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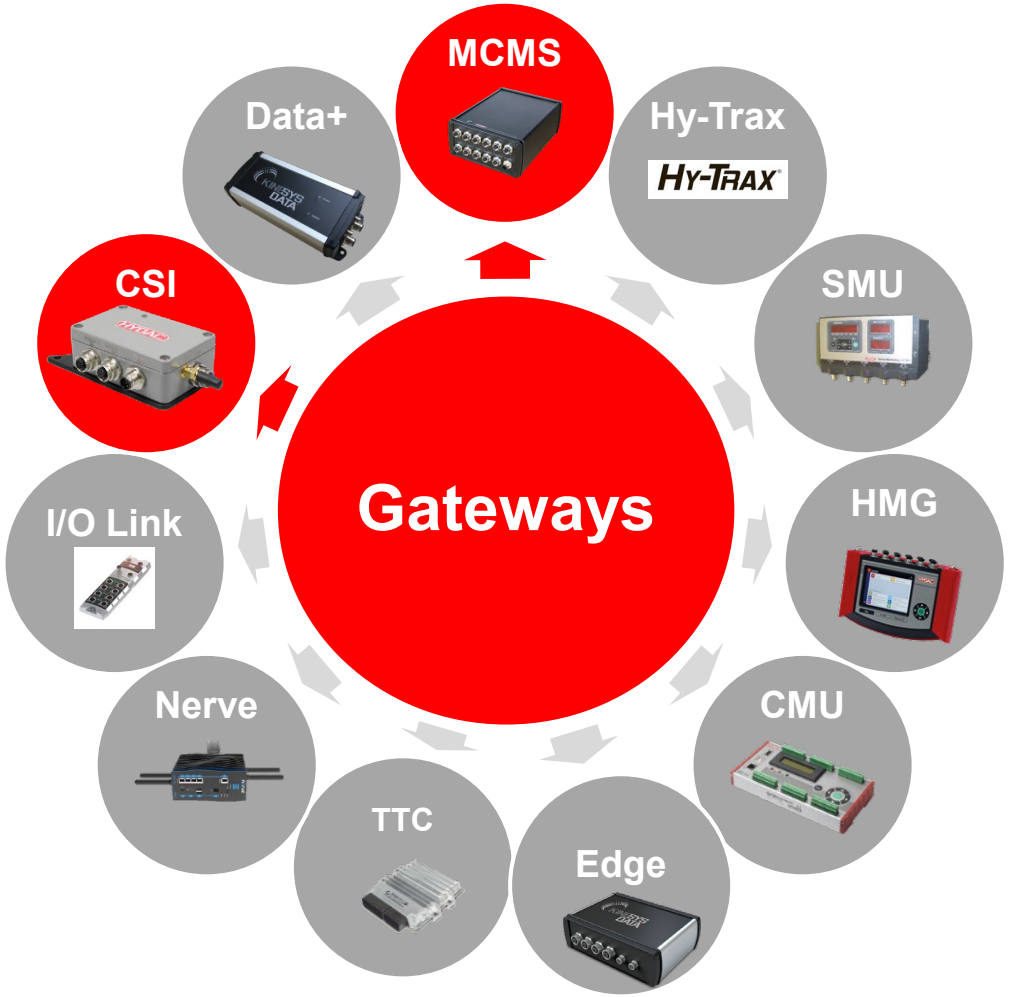
"Gateways"
Interface which allows a data exchange between different communication networks.



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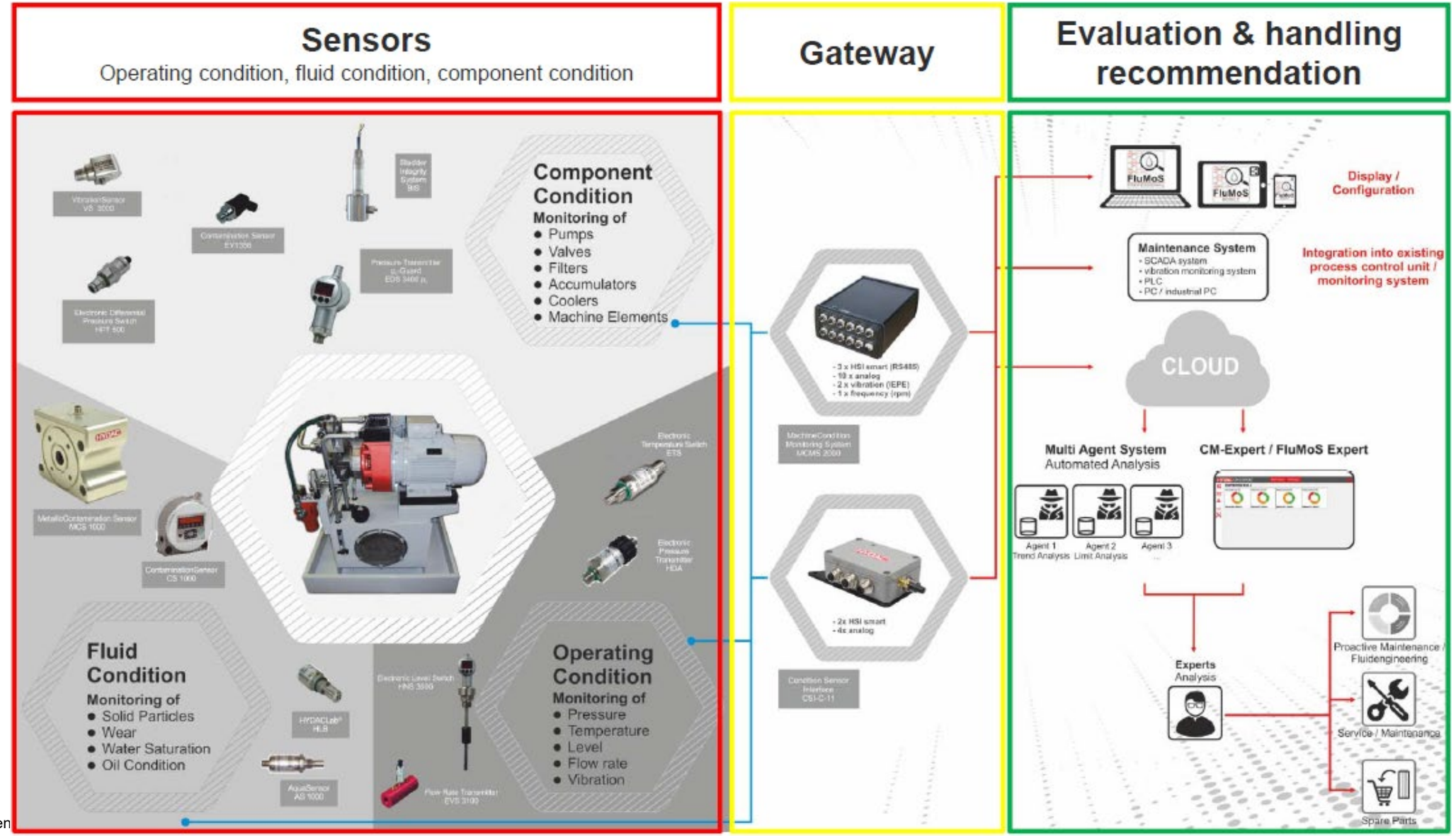


CSI-C-11

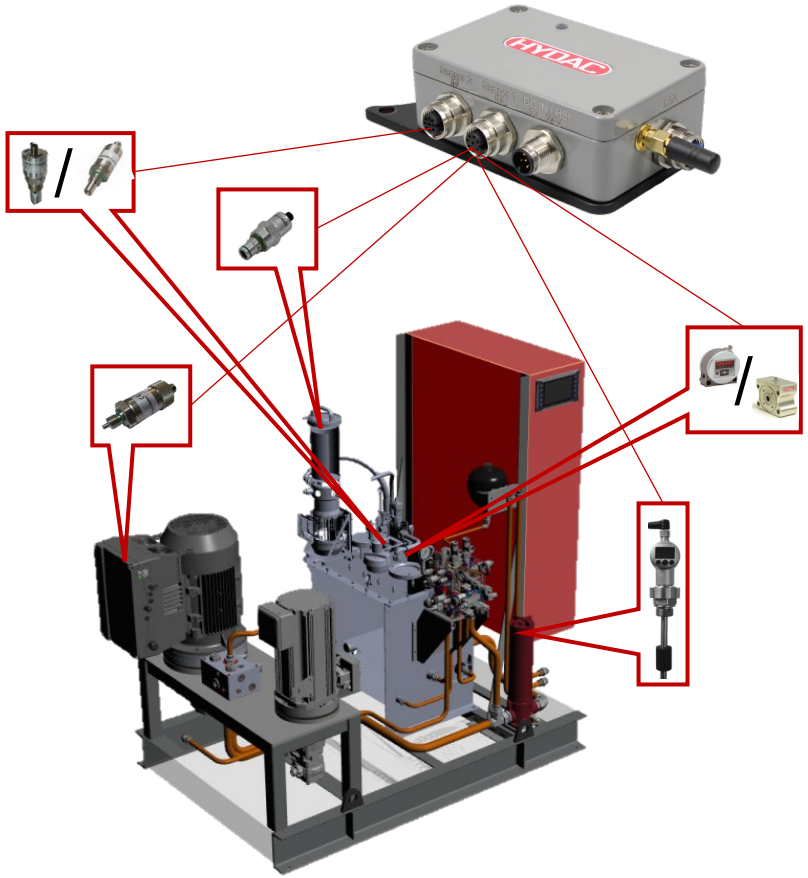
Connectivity:
- 2 x HYDAC HSI sensors
- **4 x Analog signals**

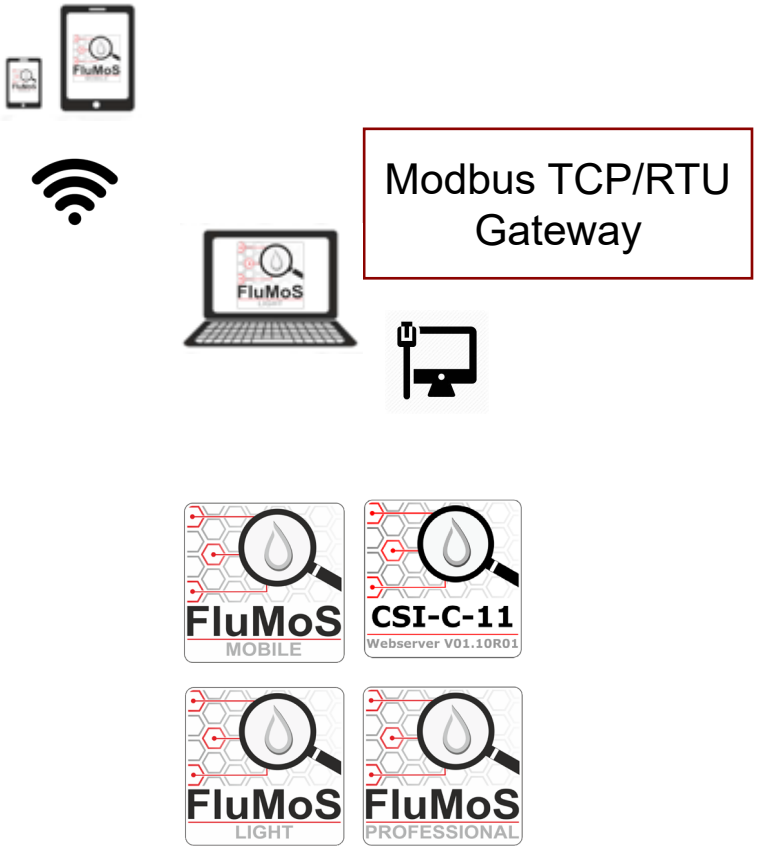
Communication:
- HSI TCP/IP / Modbus TCP

Network Interface:
- LAN → Ethernet
- WLAN → WiFi (FluMoS Mobile)

Data logger:
- 64MB

Plug & Play





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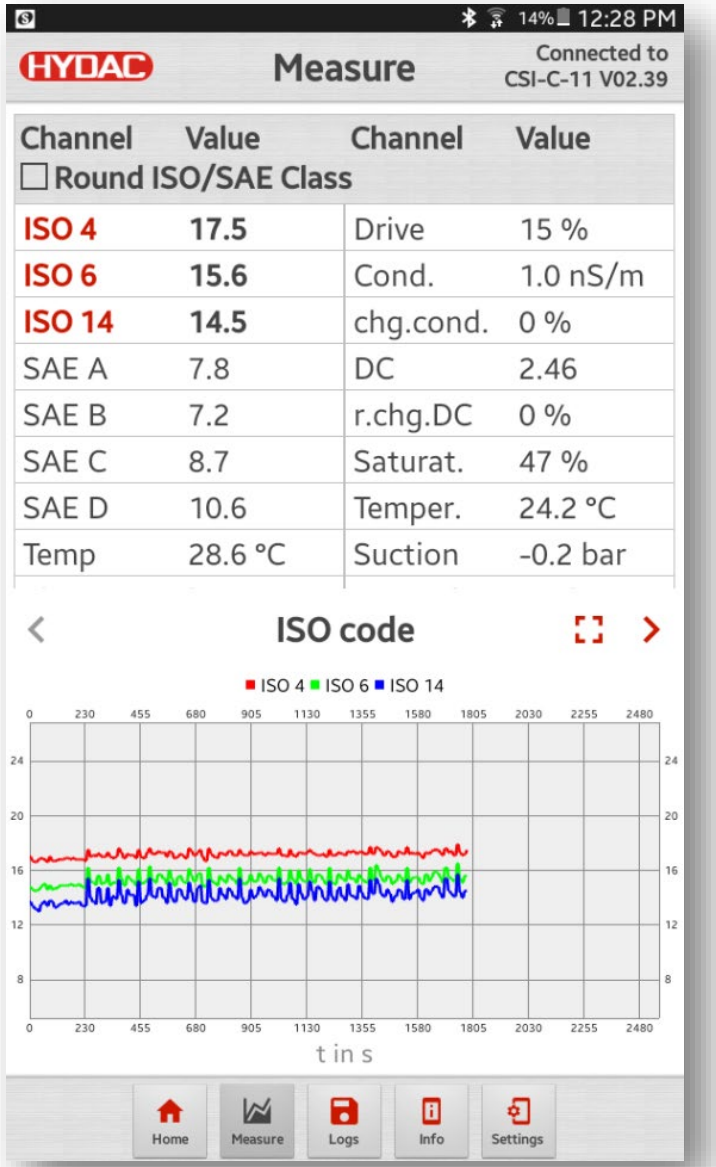
CSI-C-11

- **FluMoS Mobile®** Android Application
  - Connection via WiFi signal
    - Signal produced by CSI-C-11
  - Measure Menu
    - Visual analysis of measurement data
  - Logs Menu
    - Download and transfer data logs
  - Info Menu
    - Device info and status messages
  - Settings Menu
    - Set device parameters, alarms, email, etc.



FluMoS MOBILE

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- **CSI-C-11 Webserver**
  - Similar functions to FluMoS Mobile
  - Connection via Ethernet to PC or Switch

CSI-C-11
Webserver V01.10R01

Enter IP address into web browser of networked PC(s)

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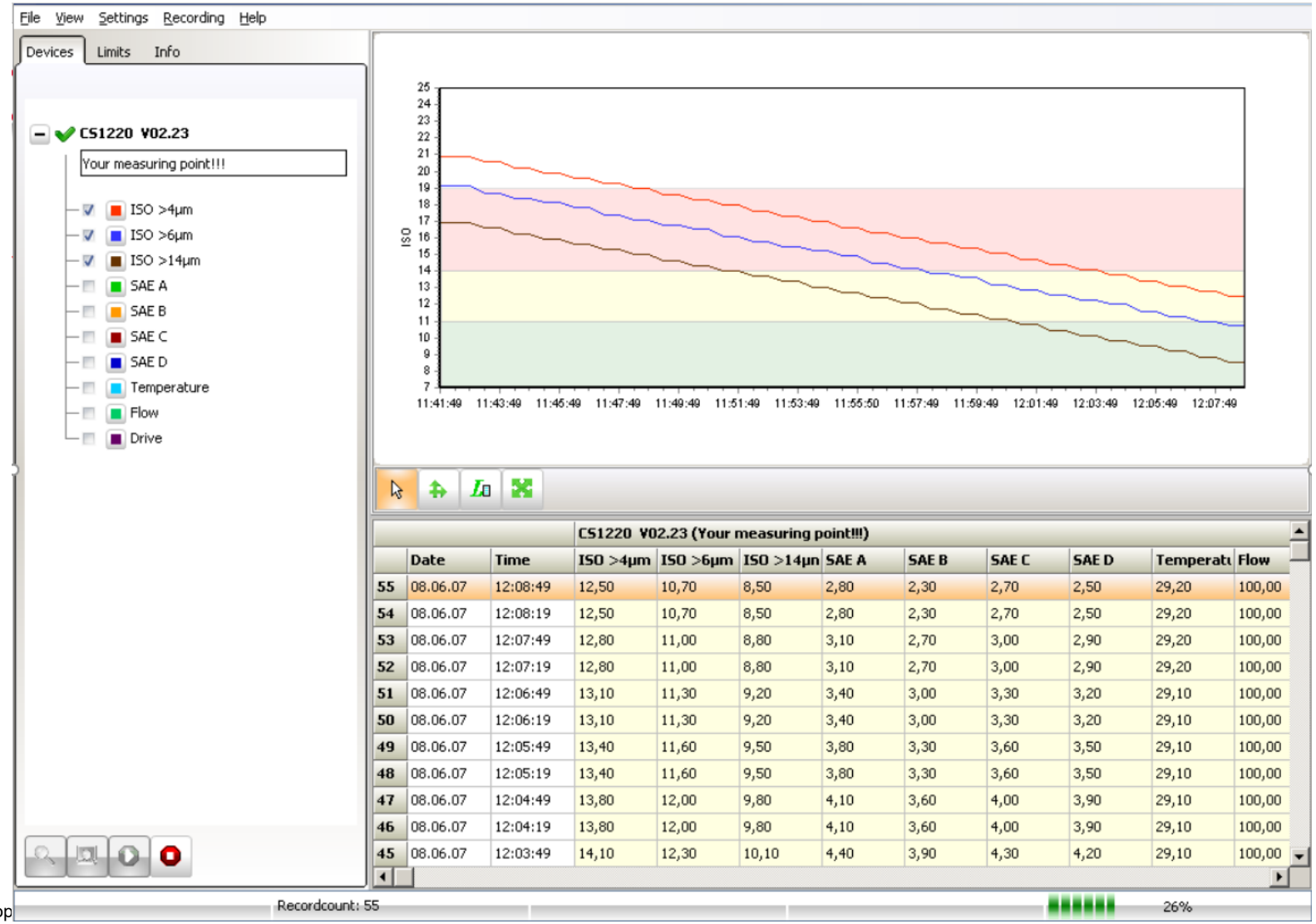
FLUMOS SOFTWARE

- **FluMoS Light and Professional**
  - Visual analysis of measurement data
  - Connection via Ethernet to PC or Switch
  - x3 CSI-C-11 Gateways ~ Light (free)
  - x16 CSI-C-11 Gateways ~ Professional ($)
  - Cannot modify settings of connected CSI-C-11



	Date	Time	ISO >4µm	ISO >6µm	ISO >14µm	SAE A	SAE B	SAE C	SAE D	Temperatu	Flow
55	08.06.07	12:08:49	12,50	10,70	8,50	2,80	2,30	2,70	2,50	29,20	100,00
54	08.06.07	12:08:19	12,50	10,70	8,50	2,80	2,30	2,70	2,50	29,20	100,00
53	08.06.07	12:07:49	12,80	11,00	8,80	3,10	2,70	3,00	2,90	29,20	100,00
52	08.06.07	12:07:19	12,80	11,00	8,80	3,10	2,70	3,00	2,90	29,20	100,00
51	08.06.07	12:06:49	13,10	11,30	9,20	3,40	3,00	3,30	3,20	29,10	100,00
50	08.06.07	12:06:19	13,10	11,30	9,20	3,40	3,00	3,30	3,20	29,10	100,00
49	08.06.07	12:05:49	13,40	11,60	9,50	3,80	3,30	3,60	3,50	29,10	100,00
48	08.06.07	12:05:19	13,40	11,60	9,50	3,80	3,30	3,60	3,50	29,10	100,00
47	08.06.07	12:04:49	13,80	12,00	9,80	4,10	3,60	4,00	3,90	29,10	100,00
46	08.06.07	12:04:19	13,80	12,00	9,80	4,10	3,60	4,00	3,90	29,10	100,00
45	08.06.07	12:03:49	14,10	12,30	10,10	4,40	3,90	4,30	4,20	29,10	100,00

FluMoS LIGHT

FluMoS PROFESSIONAL

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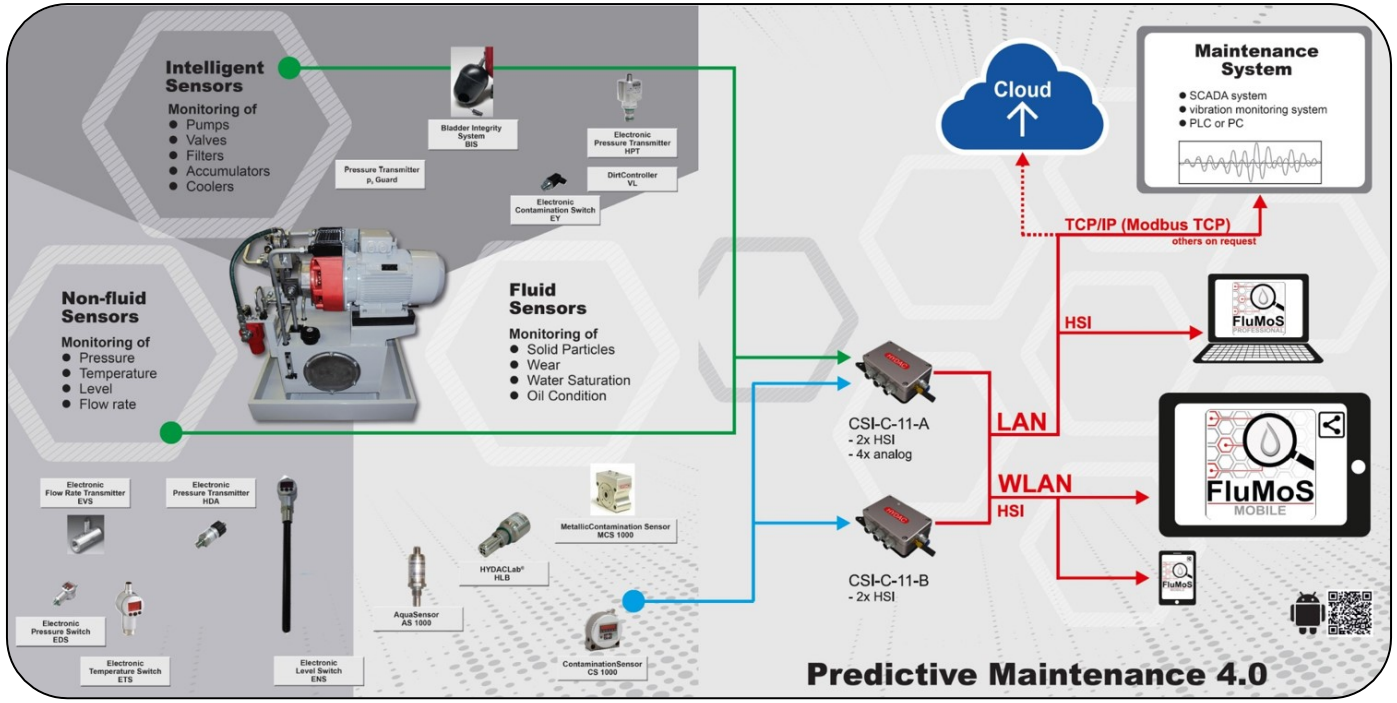
CSI-C-11

Value:

- Easy integration and connectivity
- Software development not required
- Vehicle for:
  - Predictive maintenance
  - Early detection of defects and imminent damage
  - Preventing unplanned machine downtime
  - Improved system availability, safety, productivity
  - Reduced life cycle costs (LLC)
  - Reduced total operating costs (TCO)



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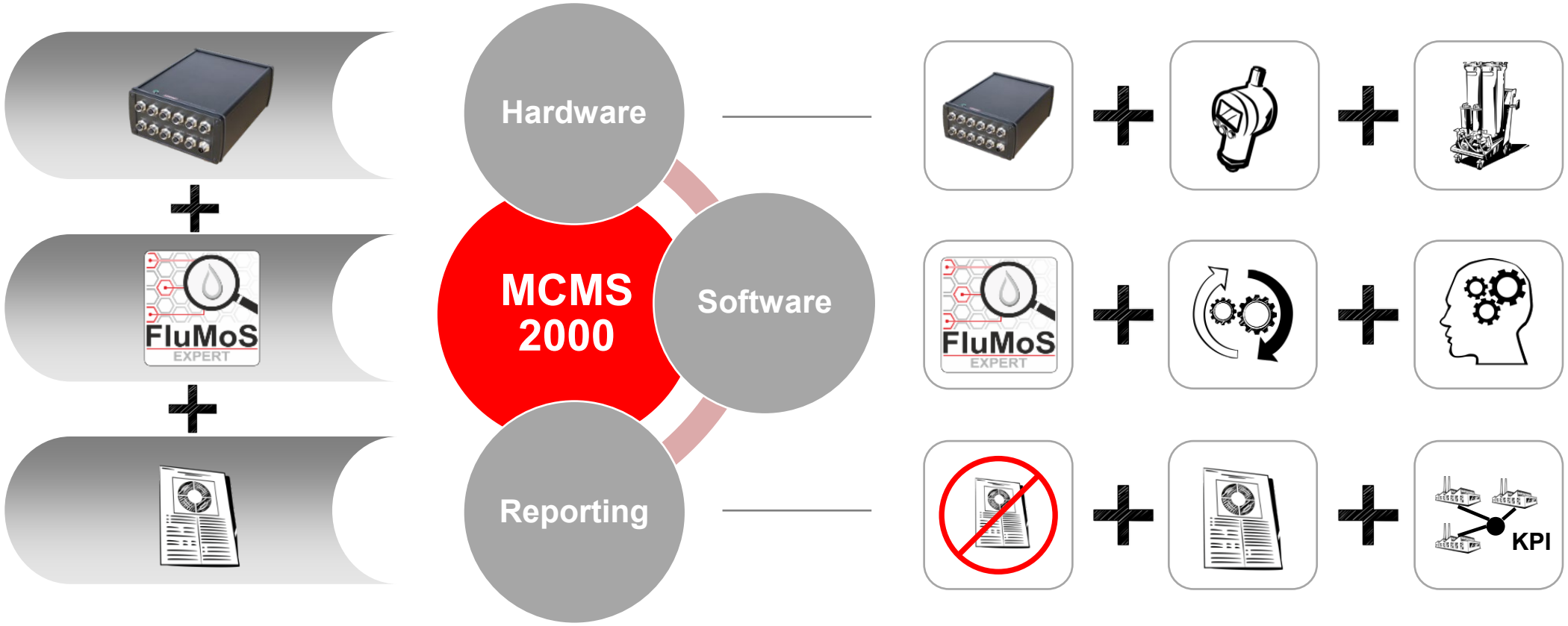
MCMS-2000

Systemic Approach to Increase Machine Availability



MCMS 2000 - Hardware Overview

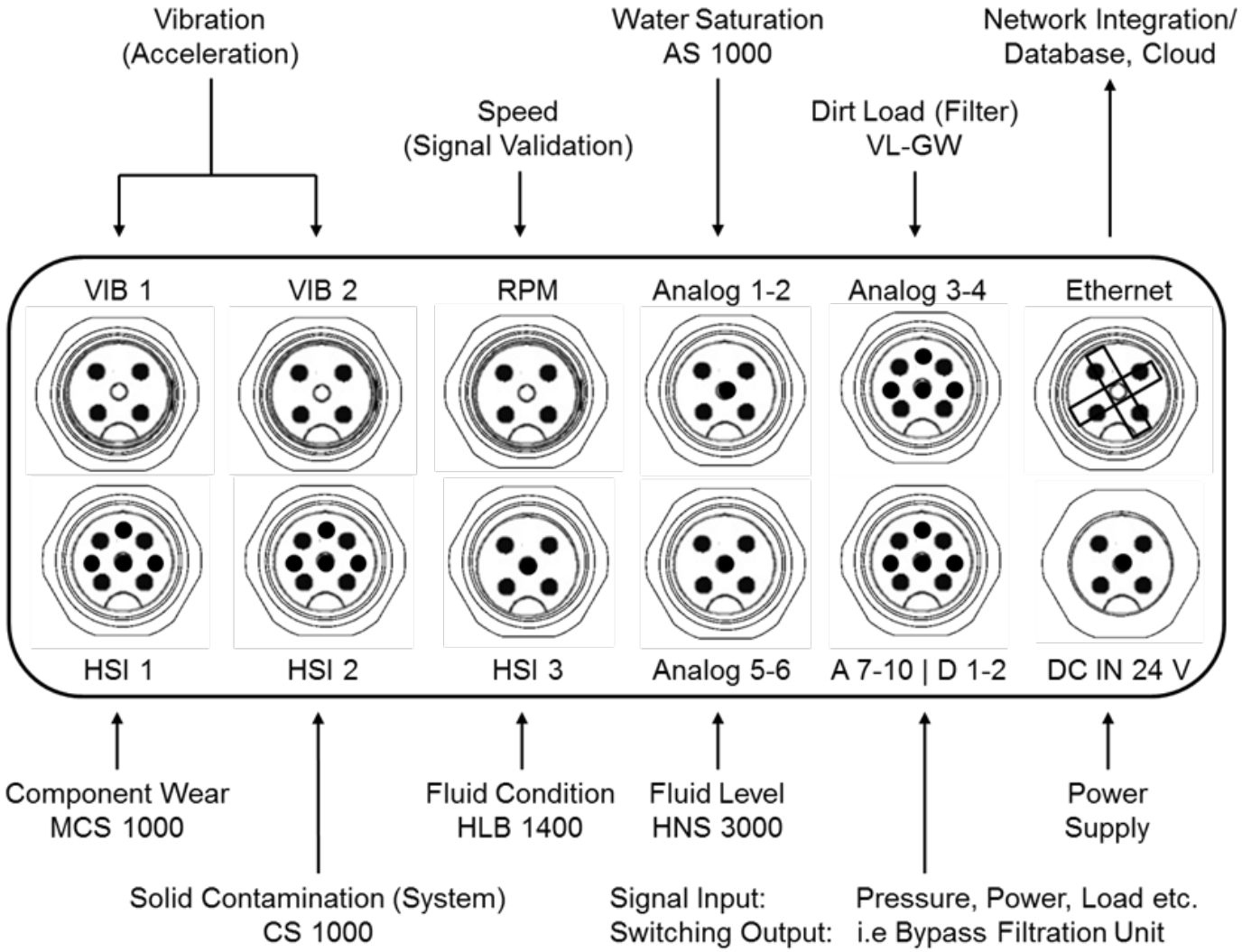
The MCMS 2000 is a complete machine condition monitoring and diagnosis system for machines and units that are critical to process, which consists of the following individual components:

- Data logger for connection of sensors and temporary storage of measured values.
- Fluid Monitoring Software Suite (FluMoS Expert) for measurement data logging, visualization, analysis and system parameterization.
- Reporting (equipment condition, performance and a cause analysis)

MCMS 2000 - Connections Overview

The following sensors can be connected:

- **2 IEPE Accelerometers** (e.g. HYDAC VS 3000 Vibration Sensor)
- **1 Speed Sensor**
- **3 HYDAC SMART Fluid sensors** (HSI SMART)
- **10 Analog Sensors** (8 x 4-20 mA; 2 x 0-10 V)



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MCMS-2000

Hardware:

- MCMS Interface

- Signal and data logger, and storage device
- Preprocessing and transfer
- 16 Inputs / 2 Outputs / 1 Ethernet

- Sensors

- Condition sensors (component, fluid, machine input)

- Service Units & Output Devices

- Service units (filtration, dehydration, varnish mitigation)
- Signaling devices (beacons)
- Emergency shutdown

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MCMS-2000

Software:

- Data Analysis Software Suite FluMoS Expert

- Data visualization, correlation and analysis
- Administration of up to 200 MCMS data loggers on single dashboard

- Application Modules

- Software modules
  - Relative to application
  - Includes typical limit values, correlations, and algorithms

- Expert Modules

- Expert modules
  - Comprehensive analysis of advanced sensor signals
    - E.g. Vibration

FluMos Expert Software

In addition to the data logger unit, the following software suite is included in the scope of delivery of MCMS.

- FluMoS Expert Start-Up Assistant
- FluMoS Expert Server Manager
- FluMoS Expert Client Admin
- FluMoS Expert Client User

Used for:

- Visualization, Correlation & Analysis of Measurement Data
- Condition Monitoring and Productivity Comparison of up to 200 Machines in one Software
- Management & Storage of Condition Monitoring Reports
- Export of stored Measurement Data & Reports
- Expandable thanks to optional Software Modules and Apps

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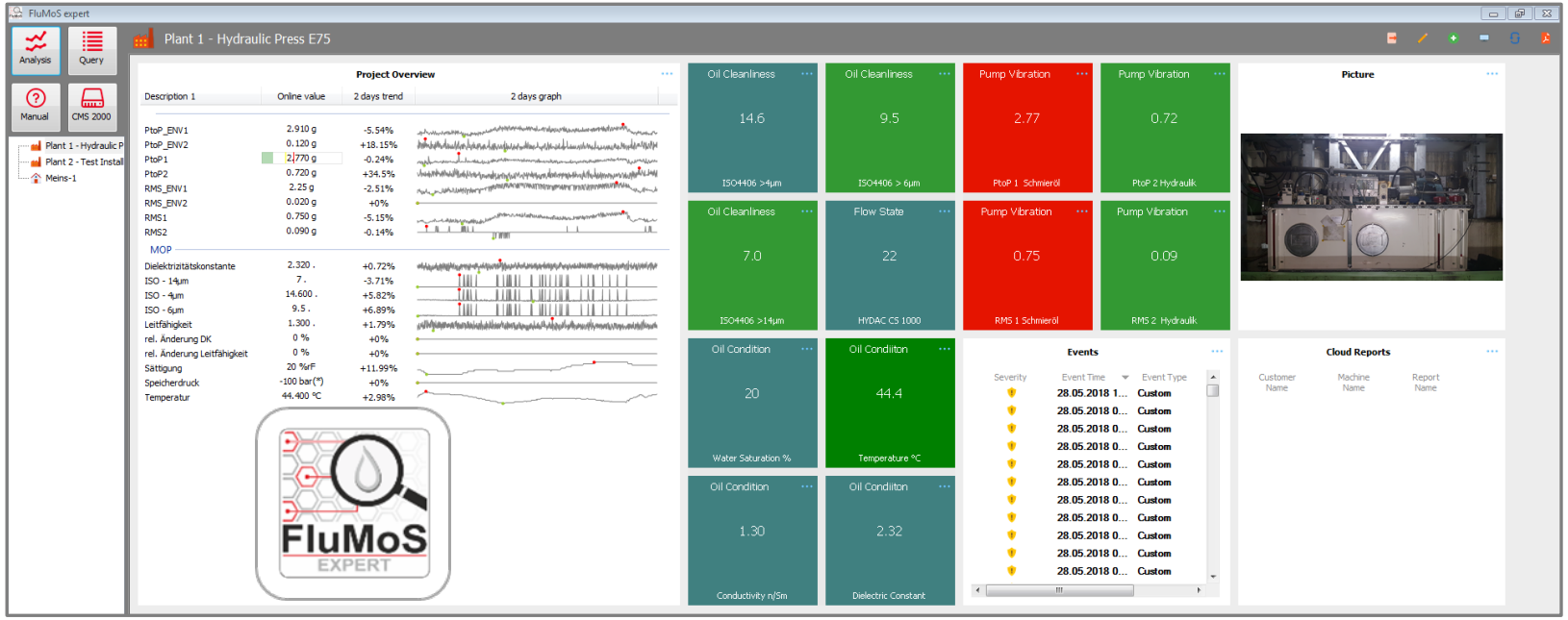
MCMS-2000

- Software Navigation:
  - Data Analysis
  - Managing Projects
  - Online Support
  - Adding CMS
- Dashboards:
  - Dashboards



- Configurable Dashboards based on predefined modules
- Dashboard Modules available for (extract):
  - Trending of Measurement Data
  - Displaying and Managing of Alarms
  - Managing Condition Monitoring Reports (Archive)

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MCMS-2000

Reporting:

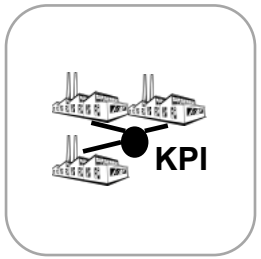
- Reports by user

- Data manipulated and monetized by user
- Reports generated by user

- Condition reports by HYDAC

- Condition monitoring by HYDAC Monitoring Center
- Reports generated by HYDAC

- Performance reports by HYDAC



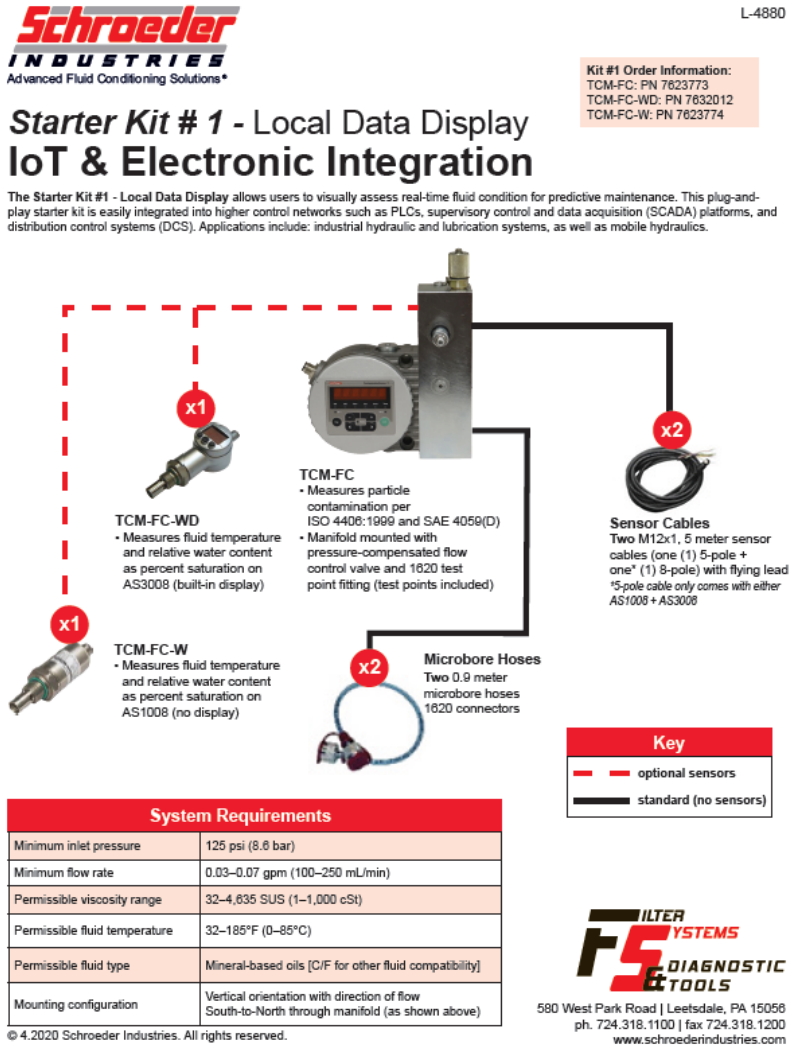
- Performance of condition monitoring by HYDAC
- Reports generated by HYDAC

Electronic Starter Kits

- **<u>The Starter Kit #1 - Local Data Display</u>** allows users to **visually** assess real-time fluid condition for predictive maintenance on the sensors itself.

- The following can be read from the sensors:
  - Particle Counts (ISO or NAS)
  - Water Saturation (Percentage)
  - Temperature (°F or °C)

- Minimum System Requirements:
  - Minimum inlet pressure 125 psi (8.6 bar)
  - Minimum flow rate 0.03–0.07 gpm (100–250 mL/min)



L-4880

Kit #1 Order Information:
TCM-FC: PN 7623773
TCM-FC-WD: PN 7632012
TCM-FC-W: PN 7623774

Starter Kit # 1 - Local Data Display
IoT & Electronic Integration

The Starter Kit #1 - Local Data Display allows users to visually assess real-time fluid condition for predictive maintenance. This plug-and-play starter kit is easily integrated into higher control networks such as PLCs, supervisory control and data acquisition (SCADA) platforms, and distribution control systems (DCS). Applications include: industrial hydraulic and lubrication systems, as well as mobile hydraulics.

System Requirements	
Minimum inlet pressure	125 psi (8.6 bar)
Minimum flow rate	0.03–0.07 gpm (100–250 mL/min)
Permissible viscosity range	32–4,635 SUS (1–1,000 cSt)
Permissible fluid temperature	32–185°F (0–85°C)
Permissible fluid type	Mineral-based oils [C/F for other fluid compatibility]
Mounting configuration	Vertical orientation with direction of flow South-to-North through manifold (as shown above)

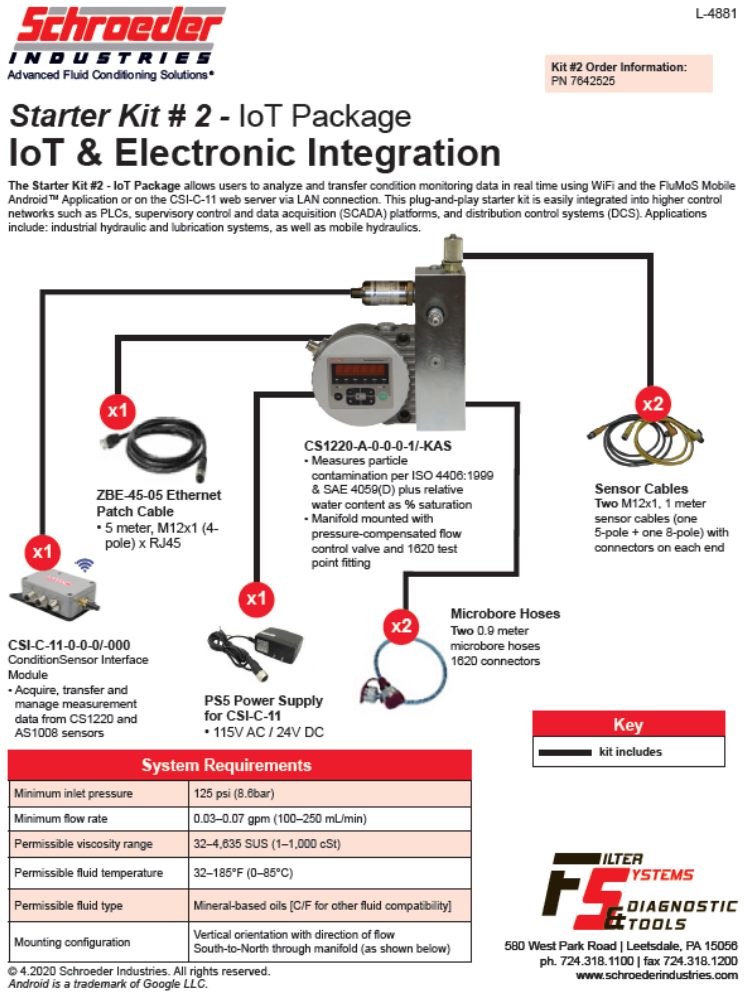
580 West Park Road | Leetsdale, PA 15056
ph. 724.318.1100 | fax 724.318.1200
www.schroederindustries.com

Electronic Starter Kits

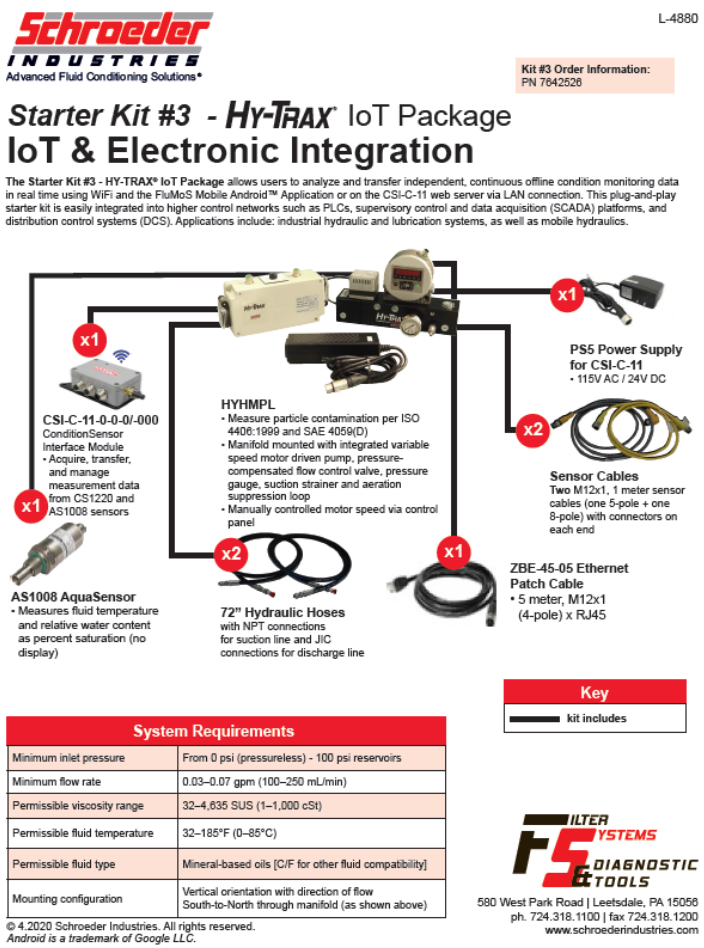
- **<u>The Starter Kit #2 - IoT Package</u>** allows users to **visually** or **remotely** assess real-time fluid condition for predictive maintenance.

- Analyzation and transferring of condition monitoring data in real time is possible through using the FluMoS Mobile Android™ App via the Wi-Fi **or** using the CSI-C-11 web server via a LAN connection.

- The following can be read from the sensors:
  - Particle Counts (ISO or NAS)
  - Water Saturation (Percentage)
  - Temperature (°F or °C)

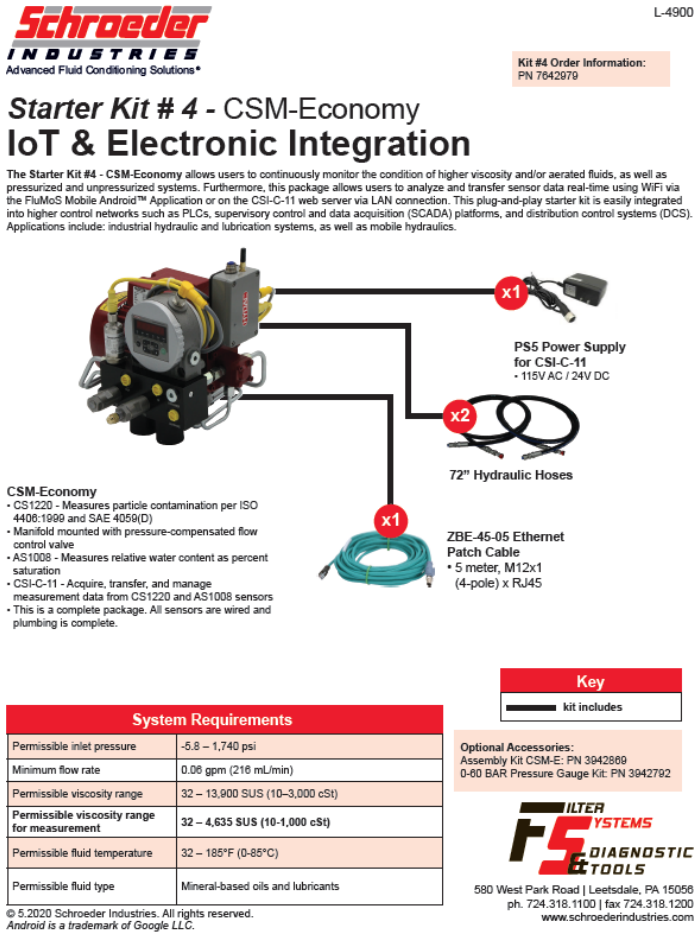


Electronic Starter Kits



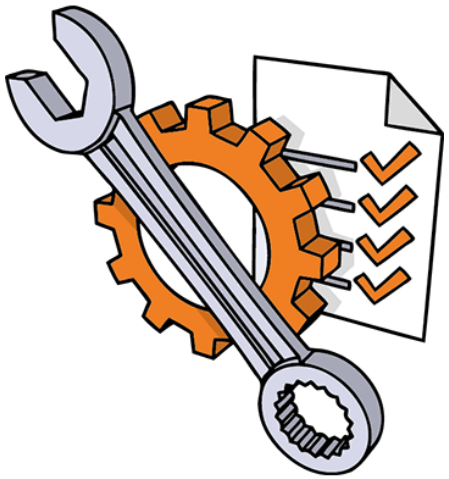
- **The Starter Kit #3 - HY-TRAX® IoT Package** allows users to **visually** or **remotely** assess real-time fluid condition for predictive maintenance in an **independent** hydraulic circuit.
- Analyzation and transferring of condition monitoring data in real time is possible through the CSI-C-11.
- Manifold mounted sensors with an integrated variable speed motor driven pump with motor speed manually controlled via control panel.
- The following can be read from the sensors:
  - Particle Counts (ISO or NAS)
  - Water Saturation (Percentage)
  - Temperature (°F or °C)

Electronic Starter Kits

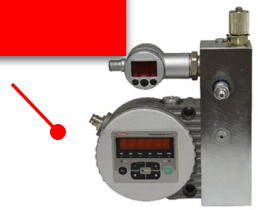


- **The Starter Kit #4 – CSM-E Economy IoT Package** allows users to **visually** or **remotely** assess real-time fluid condition for predictive maintenance in an **independent** hydraulic circuit that can handle higher viscosity or aerated fluids.
- Analyzation and transferring of condition monitoring data in real time is possible through the CSI-C-11.
- Manifold mounted sensors with an integrated motor driven pump with an air bubble suppression system.
- The following can be read from the sensors:
  - Particle Counts (ISO or NAS)
  - Water Saturation (Percentage)
  - Temperature (°F or °C)

Filter Systems IoT in 4D



- Observe
- Predictive
- Learn
- Proactive



Monitoring

Fluid Monitoring

Machine Condition Reporting

HYDAC

Diagnostic Products

Fluid Conditioning

Optimization