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Appendix

List of connected product and related service data

In the following, we as Comacchio S.p.A. (hereinafter "Comacchio" or "we" or "us") inform you in accordance with Art. 3 Para. 2 Data Act (Regulation (EU) 2023/2854) about the complete list of connected product and related service data that is generated through the use of a Comacchio CH series drilling rig equipped with the Comacchio ComNect telemetry system (hereinafter "product", "connected drilling rig" or "rig").

Five different data files are available to clients for download at the Comacchio ComNect portal under the link http://comnect.comacchio.com:

- CSV file with ending "- EL": contains time series of relevant machine variables stored at a frequency which can be defined by the user (default is 1 Hz) during a single working day (ECU must be ON). In the following, the data contained in it will be grouped under the name "Machine data".
- CSV file with ending "- EP": contains a subset of the previous file limited to the actual time frame in which the construction of one element took place.
- CSV file with ending "- EA": contains a list of all warnings and error messages collected and stored at every occurrence (appearance or resolution) during a single working day (ECU must be ON). In the following, the data contained in it will be grouped under the name "Alarm data".
- TXT file with ending "- TD": contains information about the version of the software installed on the machine, the construction site, the element built on site, and the sampling interval. Additionally, it includes time series of relevant production variables stored with the sampling interval defined by the user (default is 1 second) during the construction of one element. In the following, the data contained in it will be grouped under the name "Production data".
- JSON file with work plan: contains information provided by the client through the ComNect portal and related to a list of elements to be built for a specific construction site. In the following, the data contained in it will be grouped under the name "Work plan data".

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Machine data

Description: machine data provides general information about the rig, its status, position, engine working conditions and consumption, and sensors failures

Trade secrets: no

Collection frequency: raw product data is monitored every 200 ms. The last occurrence in the frequency interval specified by the user (typically 1 s) is recorded

Data size: ca. 28 MB for 24 h registration

Data category: connected product data

Name	Type	Description
TimeStamp	datetime	Single timestamp corresponding to the actual measurement time
Latitude	float	Approximate latitude of the rig based on SIM card location (in °)
Longitude	float	Approximate longitude of the rig based on SIM card location (in °)
Coolant_Level	float	Coolant level expressed as percentage of tank capacity (in %)
Coolant_Temp	float	Temperature of the coolant (in °C)
Engine_Oil_Level	float	Engine oil level expressed as percentage of tank capacity (in %)
Engine_Oil_Temp	float	Engine oil temperature (in °C)
Engine_Oil_Pressure	float	Working pressure of engine oil (in bar)
Engine_Rpm	int	Rotational speed of the engine shaft (in rpm)
Engine_Total_Hours	float	Cumulative operating hours of the engine (in h)
Battery_Voltage	float	Engine battery voltage (in mV)
Engine_Work_Load	float	Position of the engine accelerator control (in %)
Engine_Fuel_Rate	float	Actual engine fuel consumption (in l/h)

Engine_Total_Consumption	float	Total engine fuel consumption (in l)
Pd_Kelly_Perc	int	Kelly pull-down utilization (in %)
Pd_Casing_Perc	int	Casing pull-down utilization (in %)
Pd_Casing_Status	boolean	Casing mode (ON/OFF)
Rotary_Rpm	Int	Rotational speed of the rotary (in rpm)
Mast_Incl_X	float	Inclination of the mast in X-direction (transversal) (in °)
Mast_Incl_Y	float	Inclination of the mast in Y-direction (longitudinal) (in °)
Mast_Inclination_Fault	boolean	Fault indicator of the mast inclinometer (ON/OFF)
Mast_Lateral_Position	float	Measurement from linear sensor for the determination of the transversal movement of the mast (in µm)
Mast_Lateral_Position_Fault	boolean	Fault indicator of the linear sensor (ON/OFF)
Mast_Working_Radius	int	Actual working radius of the mast (in mm)
Mast_Working_Radius_Fault	boolean	Fault indicator of the mast working radius sensor (ON/OFF)
Winch_I_Rope_Force	int	Rope force of main winch (in kN)
Winch_I_Rope_Force_Fault	boolean	Fault indicator of the load sensor at the main winch (ON/OFF)
Winch_II_Rope_Force	int	Rope force of auxiliary winch (in kN)
Winch_II_Rope_Force_Fault	boolean	Fault indicator of the load sensor at the auxiliary winch (ON/OFF)
Hydraulic_Oil_Temperature	int	Temperature of the hydraulic oil (in °C)
Hydraulic_Oil_Temperature_Fault	boolean	Fault indicator of the temperature sensor of the hydraulic oil (ON/OFF)
Hydraulic_Oil Level	int	Hydraulic oil level expressed as percentage of tank capacity (in %)
Hydraulic_Oil Level Fault	boolean	Fault indicator of sensor responsible for hydraulic oil level (ON/OFF)

Engine_Fuel_Level	int	Engine fuel level expressed as percentage of tank capacity (in %)
Engine_Fuel_Level_Fault	boolean	Fault indicator of sensor responsible for engine fuel level (ON/OFF)
Machine_Incl_X	float	Pitch of the uppercarriage (in °)
Machine_Incl_Y	float	Roll of the uppercarriage (in °)
Machine_Incl_Fault	boolean	Fault indicator of the inclinometer installed on uppercarriage (ON/OFF)
Line_1_Info	string	Variable reporting the warning messages
Line_2_Alarm	string	Variable reporting the error messages
Mast_Rig_Inclination	Float	Transversal inclination of the mast during rigging/derigging (in °)
Mast_Rig_Inclination_Fault	boolean	Fault indicator of the inclinometer installed on mast for rigging/derigging operations (ON/OFF)
Depth_Tool_Value	int	Depth reached by the drilling tool (in mm)
Machine_SN	string	Serial number of the connected drilling rig
Machine_Model	string	Model of the connected drilling rig
Machine_Version	string	Version of the software installed on the connected drilling rig
Mode_ext_RADIO	boolean	Radio mode (ON/OFF)
Mode_ext_DRILL	boolean	Drill mode (ON/OFF)
Mode_ext_TRAVEL	boolean	Travel mode (ON/OFF)
Mode_cabin_WORK	boolean	Work mode (ON/OFF)
Mode_cabin_TRACK	boolean	Track mode (ON/OFF)
Mode_cabin_RIG	boolean	Rigging/Derigging mode (ON/OFF)
Pilot_Lamp_Status	boolean	Status of pilot indicator (ON/OFF)

Winch_I_Released_Status	boolean	Release status of main winch (ON/OFF)
Winch_I_StopDown_Status	boolean	Break status of main winch (ON/OFF)
Main_Filter_Clogging	boolean	Clogging of main filter (ON/OFF)
Pilot_Filter_Clogging	boolean	Clogging of filter for pilot line (ON/OFF)
Engine_T3_Air_Filter_Clogging	boolean	Clogging of air filter in T3 engine (ON/OFF)
Engine_T3	boolean	Type of engine on the rig (T3 is ON, T5 is OFF) (ON/OFF)
Rig_Step_1	boolean	Indicator of mast position 1 in rigging mode: horizontal (ON/OFF)
Rig_Step_2	boolean	Indicator of mast position 2 in rigging mode: inclined (ON/OFF)
Rig_Step_3	boolean	Indicator of mast position 3 in rigging mode: vertical, extended boom (ON/OFF)
Rig_Step_4	boolean	Indicator of mast position 4 in rigging mode: vertical, (ON/OFF)
Bypass_Safety_Status	boolean	Indicator for the status of the bypass of safety controls (ON/OFF)
Oil_Filter_Water	boolean	Clogging of the filter on return line when the rig uses bio-oil (ON/OFF)
ECU_Alive	boolean	Indicator showing when the control unit is ON (ON/OFF)
Pressure0	int	Pressure of pump serving the pilot line (bar)
Pressure0_Sensor_Fault	boolean	Fault indicator of pressure sensor of the pump serving the pilot line (ON/OFF)
Pressure1	int	Pressure of pump 1 (bar)
Pressure1_Sensor_Fault	boolean	Fault indicator of pressure sensor of pump 1 (ON/OFF)
Pressure2	int	Pressure of pump 2 (bar)
Pressure2_Sensor_Fault	boolean	Fault indicator of pressure sensor of pump 2 (ON/OFF)
Pressure3	int	Pressure of pump 3 (bar)

Pressure3_Sensor_Fault	boolean	Fault indicator of pressure sensor of pump 3 (ON/OFF)
Pressure4	int	Pressure of the pump serving the engine cooling system (bar)
Pressure4_Sensor_Fault	boolean	Fault indicator of pressure sensor of the pump serving the engine cooling system (ON/OFF)
Pressure5	int	Pressure of the pump serving the hydraulic oil cooling system (bar)
Pressure5_Sensor_Fault	boolean	Fault indicator of pressure sensor of the pump serving the hydraulic oil cooling system (ON/OFF)
Pressure6	int	Pressure of the rotary drive (bar)
Pressure6_Sensor_Fault	boolean	Fault indicator of pressure sensor of the rotary drive (ON/OFF)
Pressure7	int	Pressure of the pull down winch (bar)
Pressure7_Sensor_Fault	boolean	Fault indicator of pressure sensor of the pull down winch (ON/OFF)
Pressure8	int	Pressure of the main winch (bar)
Pressure8_Sensor_Fault	boolean	Fault indicator of pressure sensor of the main winch (ON/OFF)
Pressure9	int	Pressure of the auxiliary winch (bar)
Pressure9_Sensor_Fault	boolean	Fault indicator of pressure sensor of the auxiliary winch (ON/OFF)

Alarm data

Description: alarm data provides information about alarms sent in format J1939 by the engine control unit

Trade secrets: no

Collection frequency: raw product data is recorded at every variation/occurrence of errors or warnings.

Data size: variable, depending on the number of alarms in 24 h

Data category: connected product data

Name	Type	Description
timestamp	datetime	Single timestamp corresponding to the actual measurement time when a error message occurred
SPN	int	Suspect Parameter Number
FMI	Int	Failure Mode Indicator
OC	int	Occurrence Count
CM	int	Conversion Method
Message	string	The actual error message

Production data

Description: production data is a set of data related to the construction process and refers to the specific technology used to build the element

Trade secrets: no

Collection frequency: production data includes predefined parameters and some machine data. For the latter, values are monitored every 200 ms. The last occurrence in the sampling interval specified by the user (typically 1 s) is recorded and used to calculate derived quantities.

Data size: variable, depending on the construction duration and sampling time.

Data category: variable

Name	Type	Description	Category
rig_tech_code	string	Technology code for the on-board control system	Product data
tech_version	string	Version identifier for the interpretation software	Product data
Jobsite	string	Name of the construction site	Service data
Diameter	int	Diameter of the construction element (in mm)	Service data
Pile-Nr	string	Name of the element built on site	Service data
Sampling	int	Sampling interval for time series used for the production variables (in sec)	Service data
Length-Pile	float	As-built length of the pile (in m)	Product data
Date from	date	Date at the start of the pile	Product data
Time from	time	Time at the start of the pile	Product data
Date to	date	Date at the end of the pile	Product data
Time to	time	Time at the end of the pile	Product data
Volume concrete	float	Total volume of concrete (in m^3)	Product data

Extra consumption	int	Extra consumption based on theoretical volume (in %)	Product data
timestamp	datetime	Single timestamp corresponding to the actual measurement time	Product data
Depth	int	Actual value of depth of the tool from the reference level (in cm)	Product data
Rotary1 pressure	int	Pressure at the rotary (in bar)	Product data
Rotation	int	Rotational speed of the rotary (in rpm)	Product data
Inclination X	int	Inclination of the mast in transversal direction (in °)	Product data
Inclination Y	int	Inclination of the mast in longitudinal direction (in °)	Product data
Kelly speed	int	Speed of the kelly movements (in m/h)	Product data
Concrete pressure	int	Pressure of concrete at the top of the auger (in bar)	Product data
Concrete flow	int	Flow of concrete (in l/min)	Product data
Pile profile	int	Derived radius of the pile compared to the predefined radius (in %)	Product data
Elevation	int	Elevation of the bottom of the tool (in m)	Product data
Pressure AUX1	int	Pressure of the auxiliary fluid (in bar)	Product data
Consumption	int	Consumption of the auxiliary fluid (in l/m)	Product data

Work plan data

Description: work plan data is a set of data and metadata generated when the user decides to organize the piles to be built in an ordered list, which can be sent to the rig to avoid the manual input of the name by the operator

Trade secrets: no

Collection frequency: this type of data is generated and stored once the user decides to create the list

Data size: variable, depending on the list of piles.

Data category: service data

Name	Type	Description
Id	string	Identifier of the work plan (automatically set by the system)
Description	string	Text provided by the user identifying the work plan
CustomerDescription	string	Name of the client (automatically set by the system)
Jobsite	string	Name of the construction site where the work plan is meant to be applied
ReferenceDate	datetime	Timestamp referring to the reference date and time chosen by the user
Piles	array	Array containing the single elements to be planned and built at the construction site
Piles/ Id	string	Identifier of the element (automatically set by the system)
Piles/ ShortCode	int	Consecutive index corresponding to the order in which the element will be listed in the work plan (defined by user)
Piles/ Name	string	Name of the element to be planned and built (defined by user)
Piles/ Description	string	Additional text describing the element to be planned and built (defined by user)
Piles/ PlanningDate	datetime	Timestamp representing the date and time at which the element is planned to be built on site (defined by user)
Piles/ Status	string	Additional text describing the status of the element (defined by user)

Piles/ CreationDate	datetime	Timestamp with the date and time at which the plan for the element has been made (automatically set by the system)
Piles/ CreatedBy	string	User who created the plan for the element (automatically set by the system)
Piles/ ModificationDate	datetime	Timestamp with the date and time at which the plan for the element has been edited (automatically set by the system)
Piles/ ModifiedBy	string	User who edited the plan for the element (automatically set by the system)