

EUROMAP 84.1	OPC UA interfaces for plastics and rubber machinery – Extrusion – Part 1: General Type Definitions
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<p>EUROMAP 84.1 (Release 2.00) is identical with OPC 40084-1 (Release 2.00) and VDMA 40084-1:2022-08</p>

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Foreword

This specification was created by a joint working group of the OPC Foundation and EUROMAP. It is adopted identically as VDMA Specification.

Compared with the previous version, the following changes have been made:

Version	Changes
OPC 40084-1, Version 1.01 (identical with VDMA 40084-1:2021-06 and EUROMAP 84.1, Version 1.01)	Types for describing rolls and gaps added.
OPC 40084-1, version 2.00 (identical with VDMA 40084-1:2022-07 and EUROMAP 84.1, version 2.00)	<p>Use of OPC UA for machinery:</p> <ul style="list-style-type: none"> – Changed entry point from <i>DeviceSet</i> to <i>Machines Object</i> – Changes in <i>ExtrusionDeviceType</i>: <ul style="list-style-type: none"> – Replaced <i>MachineInformation</i> (<i>MachineInformationType</i> from OPC 40083) with <i>Identification</i> (<i>MachineIdentificationType</i> from OPC 40001-1) – Replaced <i>Status</i> by <i>MachineryItemState</i> and <i>MachineryOperationMode</i> <p>Security policy added to be referenced by other parts</p> <p>Conformance units and profiles added</p>

EUROMAP

EUROMAP is the European umbrella association of the plastics and rubber machinery industry which accounts for annual sales of around 13.5 billion euro and a 40 per cent share of worldwide production. Almost 75 per cent of its European output is shipped to worldwide destinations. With global exports of 10.0 billion euro, EUROMAP's around 1,000 machinery manufacturers are market leaders with nearly half of all machines sold being supplied by EUROMAP members.

EUROMAP provides technical recommendations for plastics and rubber machines. In addition to standards for machine descriptions, dimensions and energy measurement, interfaces between machines feature prominently. The provision of manufacturer independent interfaces ensures high levels of machine compatibility.

OPC Foundation

OPC is the interoperability standard for the secure and reliable exchange of data and information in the industrial automation space and in other industries. It is platform independent and ensures the seamless flow of information among devices from multiple vendors. The OPC Foundation is responsible for the development and maintenance of this standard.

OPC UA is a platform independent service-oriented architecture that integrates all the functionality of the individual OPC Classic specifications into one extensible framework. This multi-layered approach accomplishes the original design specification goals of:

- Platform independence: from an embedded microcontroller to cloud-based infrastructure
- Secure: encryption, authentication, authorization and auditing
- Extensible: ability to add new features including transports without affecting existing applications
- Comprehensive information modelling capabilities: for defining any model from simple to complex

1 Scope

The OPC 40084 series provides OPC UA information models for extrusion. The different parts describe the extrusion line as a whole, and the different components. This part provides general types that are used for extrusion. Together with OPC 40083, which defines general type definitions for the complete sector plastics and rubber machinery, it is the basis for all other parts.

Different architectures are possible for the information flow between the components of an extrusion line and towards an MES. With the separated information models for the different components of an extrusion line three scenarios (and combinations of them) are possible:

- Each component has an own OPC server and is connected directly to an MES
- A line control collects all data from the components and forward these to the MES. The exchange between the line control and the components can be realised by OPC UA, but also by other technologies (e.g. field bus, EUROMAP 27)
- The line control is included in an extruder

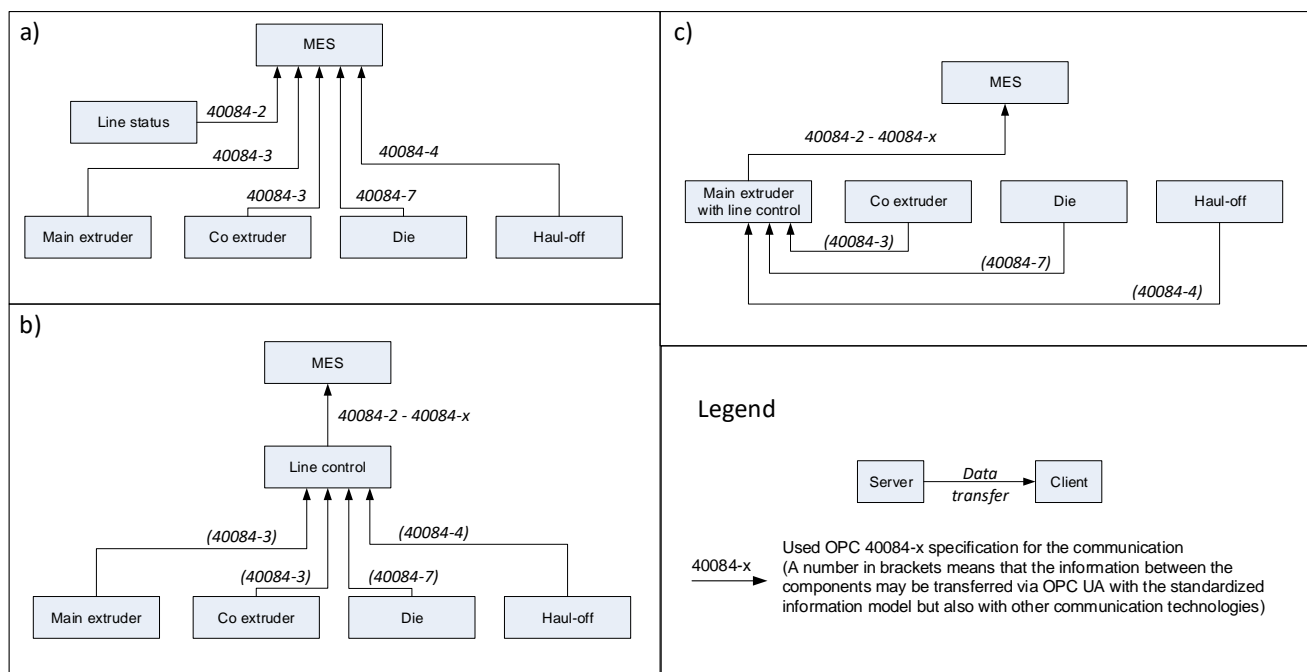


Figure 1 – Different possibilities for the data flow

A server providing information for several components inside one extrusion line (here with the *LineId* "42") would have the following structure (example):

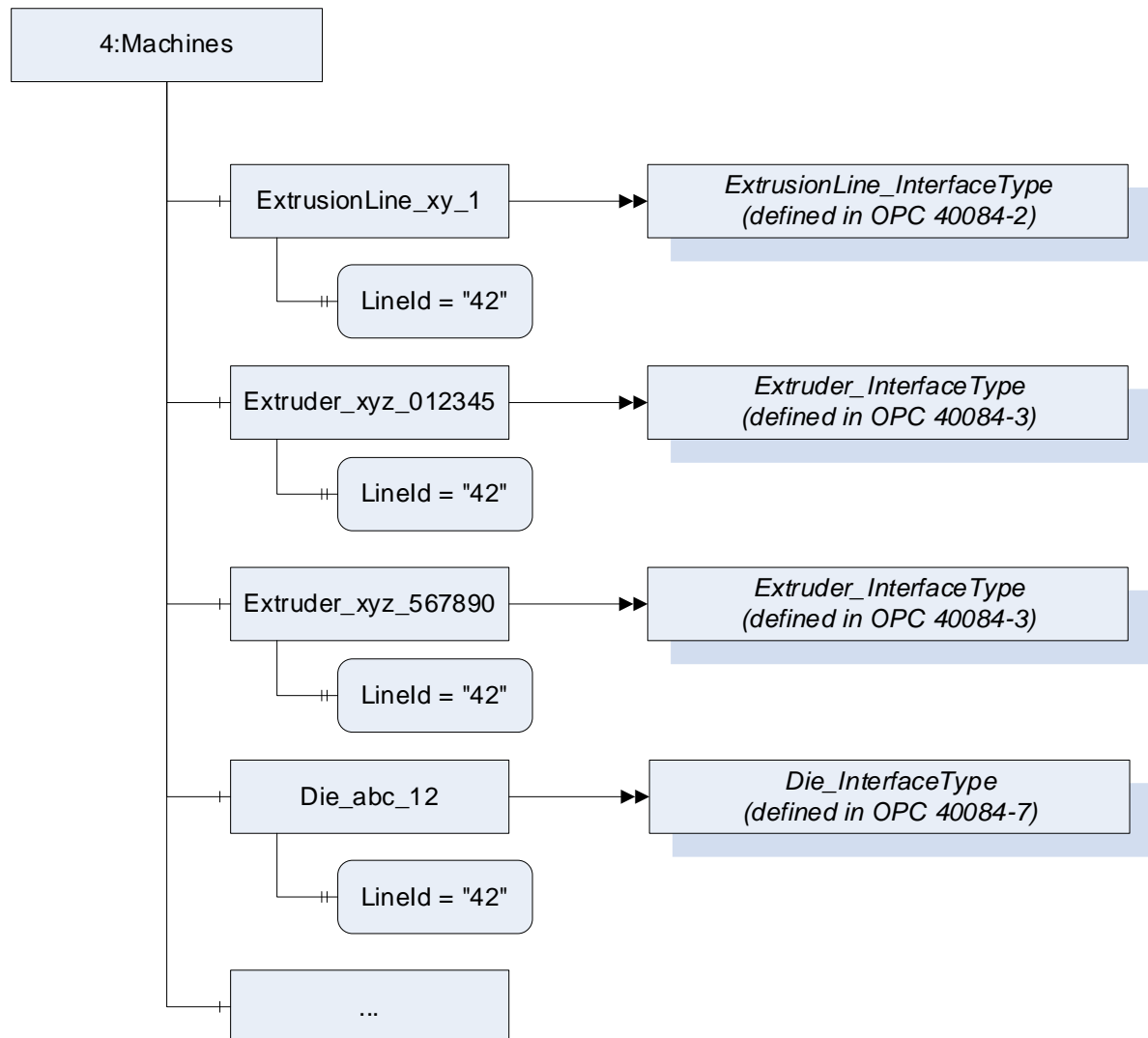


Figure 2 – Example structure of a server representing several components of an extrusion line

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

OPC 10000-1, *OPC Unified Architecture - Part 1: Overview and Concepts*

<http://www.opcfoundation.org/UA/Part1/>

OPC 10000-2, *OPC Unified Architecture - Part 2: Security Model*

<http://www.opcfoundation.org/UA/Part2/>

OPC 10000-3, *OPC Unified Architecture - Part 3: Address Space Model*

<http://www.opcfoundation.org/UA/Part3/>

OPC 10000-4, *OPC Unified Architecture - Part 4: Services*

<http://www.opcfoundation.org/UA/Part4/>

OPC 10000-5, *OPC Unified Architecture - Part 5: Information Model*

<http://www.opcfoundation.org/UA/Part5/>

OPC 10000-6, *OPC Unified Architecture - Part 6: Mappings*

<http://www.opcfoundation.org/UA/Part6/>

OPC 10000-7, *OPC Unified Architecture - Part 7: Profiles*

<http://www.opcfoundation.org/UA/Part7/>

OPC 10000-8, *OPC Unified Architecture - Part 8: Data Access*

<http://www.opcfoundation.org/UA/Part8/>

OPC 10000-16, *OPC Unified Architecture - Part 16: State Machines*

<http://www.opcfoundation.org/UA/Part16/>

OPC 10000-100, *OPC Unified Architecture - Part 100: Devices*

<http://www.opcfoundation.org/UA/Part100/>

OPC 40001-1, *OPC UA for Machinery - Part 1: Basic Building Blocks*

<http://www.opcfoundation.org/UA/Machinery/>

OPC 40083: *OPC UA interfaces for plastics and rubber machinery – General Type definitions*

<http://www.opcfoundation.org/UA/PlasticsRubber/GeneralTypes>

3 Terms, definitions and conventions

3.1 Overview

It is assumed that basic concepts of OPC UA information modelling are understood in this specification. This specification will use these concepts to describe the OPC 40084-1 Information Model. For the purposes of this document, the terms and definitions given in the documents referenced in Clause 2 apply.

Note that OPC UA terms and terms defined in this specification are *italicized* in the specification.

3.2 Conventions used in this document

The conventions described in OPC 40083 apply.

4 General information to OPC UA interfaces for plastics and rubber machinery and OPC UA

For general information on OPC UA interfaces for plastics and rubber machinery and OPC UA see OPC 40083.

5 Use cases

OPC 40084-1 provides *Object, Data and Variable Type* definitions to be used in the following parts of the OPC 40084 series for extrusion. The intention is to create an interoperability between the different machines in an extrusion line.

6 ExtrusionDeviceType

6.1 ExtrusionDeviceType Definition

This OPC UA *ObjectType* is used as base type for all components of an extrusion line (except the information model describing the extrusion line as a whole). This *ObjectType* is abstract, the different components of an extrusion line use derived *Types* with the necessary specific extensions.

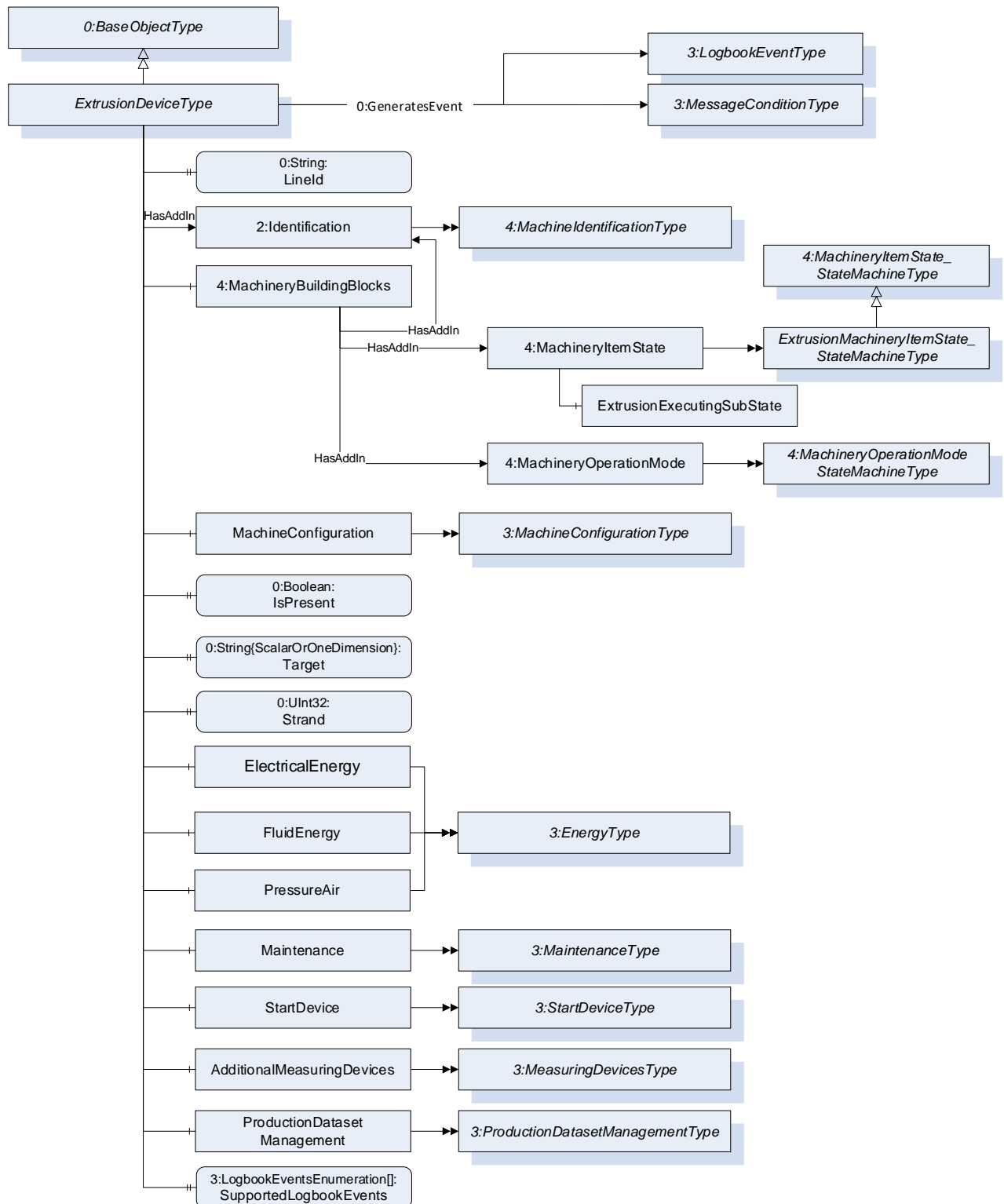


Figure 3 – ExtrusionDeviceType Overview

Table 1 – ExtrusionDeviceType Definition

Attribute	Value				
BrowseName	ExtrusionDeviceType				
IsAbstract	True				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	Lineld	0:String	0:PropertyType	M, RW
0:HasAddIn	Object	2:Identification		4:MachineIdentificationType	M
0:HasComponent	Object	4:MachineryBuildingBlocks		0:FolderType	M
0:HasComponent	Object	MachineConfiguration		3:MachineConfigurationType	O
0:HasProperty	Variable	IsPresent	0:Boolean	0:PropertyType	M, RO
0:HasProperty	Variable	Target	0:String{ScalarOrOneDimension}	0:PropertyType	O, RO
0:HasProperty	Variable	Strand	0:UInt32	0:PropertyType	O, RO
0:HasComponent	Object	ElectricalEnergy		3:EnergyType	O
0:HasComponent	Object	FluidEnergy		3:EnergyType	O
0:HasComponent	Object	PressureAir		3:EnergyType	O
0:HasComponent	Object	Maintenance		3:MaintenanceType	O
0:HasComponent	Object	StartDevice		3:StartDeviceType	O
0:HasComponent	Object	AdditionalMeasuringDevices		3:MeasuringDevicesType	O
0:HasComponent	Object	ProductionDatasetManagement		3:ProductionDatasetManagementType	O
0:HasProperty	Variable	SupportedLogbookEvents	3:LogbookEventsEnumeration[]	0:PropertyType	M, RO
0:GeneratesEvent	ObjectType	3:MessageConditionType	Defined in OPC 40083		
0:GeneratesEvent	ObjectType	3:LogbookEventType	Defined in OPC 40083		
Conformance Units					
Extrusion Device					

6.2 Lineld

This *Property* indicates to which extrusion line the extruder belongs to (e.g. “blown film line 2”).

6.3 Identification and MachineryBuildingBlocks

The *MachineIdentificationType* is defined in OPC UA for Machinery (OPC 40001-1) and provides basic information on a machine/device.

For the *InstanceDeclaration* the *ModellingRules* of the *Properties Model* and *DeviceClass* are overridden to mandatory and the *Property ControllerName* is added.

The *Object MachineryBuildingBlocks* contains building blocks from OPC UA for Machinery as defined in OPC 40001-1. For this version of OPC 40084-1, the *Object* uses the two *AddIns MachineryItemState* and *MachineryOperationMode*, where for the first a sub-state machine with substates for *Executing* is added.

Table 2 – ExtrusionDeviceType Additional Subcomponents

BrowsePath	References	NodeClass	BrowseName	Data Type	Type Definition	Other
2:Identification	0:HasProperty	Variable	2:Model	0:LocalizedText	0:PropertyType	M, RO
2:Identification	0:HasProperty	Variable	2:DeviceClass	0:String	0:PropertyType	M, RO
2:Identification	0:HasProperty	Variable	ControllerName	0:String	0:PropertyType	M, RO
4:MachineryBuildingBlocks	0:HasAddIn	Object	2:Identification		4:MachineIdentificationType	M
4:MachineryBuildingBlocks	0:HasAddIn	Object	4:MachineryItemState		ExtrusionMachineryItemState_MachineType	M
4:MachineryBuildingBlocks	0:HasAddIn	Object	4:MachineryOperationMode		4:MachineryOperationMode_StateMachineType	M

The *ControllerName Property* represents the name of the machine controller (e.g. “CP22xx”).

6.3.1 Extension of MachineryItemState

For this specification the *MachineryItemState* defined in OPC UA for Machinery is extended by a *SubStateMachine* for the *State Executing*.

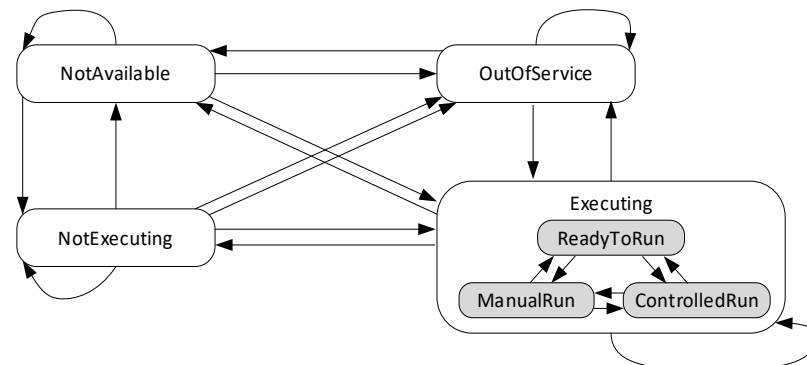


Figure 4 – Extended MachineryItemState

For this, the *ExtrusionMachineryItemState_StateMachineType* is defined in Table 3.

Table 3 – ExtrusionMachineryItemState_StateMachineType definition

Attribute	Value				
BrowseName	ExtrusionMachineryItemState_StateMachineType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of 4: <i>MachineryItemState_StateMachineType</i> defined in OPC UA for Machinery					
0:HasProperty	Variable	0:DefaultInstanceBrowseName	0:QualifiedName	0:PropertyType	
0:HasComponent	Object	4:NotAvailable		0:StateType	
0:HasComponent	Object	4:OutOfService		0:StateType	
0:HasComponent	Object	4:Executing		0:StateType	
0:HasComponent	Object	4:NotExecuting		0:StateType	
0:HasComponent	Object	4:FromNotAvailableToOutOfService		0:TransitionType	
0:HasComponent	Object	4:FromNotAvailableToNotExecuting		0:TransitionType	
0:HasComponent	Object	4:FromNotAvailableToExecuting		0:TransitionType	
0:HasComponent	Object	4:FromNotAvailableToNotAvailable		0:TransitionType	
0:HasComponent	Object	4:FromOutOfServiceToNotAvailable		0:TransitionType	
0:HasComponent	Object	4:FromOutOfServiceToNotExecuting		0:TransitionType	
0:HasComponent	Object	4:FromOutOfServiceToExecuting		0:TransitionType	
0:HasComponent	Object	4:FromOutOfServiceToOutOfService		0:TransitionType	
0:HasComponent	Object	4:FromNotExecutingToNotAvailable		0:TransitionType	
0:HasComponent	Object	4:FromNotExecutingToOutOfService		0:TransitionType	
0:HasComponent	Object	4:FromNotExecutingToExecuting		0:TransitionType	
0:HasComponent	Object	4:FromNotExecutingToNotExecuting		0:TransitionType	
0:HasComponent	Object	4:FromExecutingToNotAvailable		0:TransitionType	
0:HasComponent	Object	4:FromExecutingToOutOfService		0:TransitionType	
0:HasComponent	Object	4:FromExecutingToNotExecuting		0:TransitionType	
0:HasComponent	Object	4:FromExecutingToExecuting		0:TransitionType	
0:HasComponent	Object	4:ExtrusionExecutingSubState		ExtrusionExecutingSubState_StateMachineType	M

The *InstanceDeclarations* of the *ExtrusionMachineryItemState_StateMachineType* have additional *Attribute* values defined in Table 4

Table 4 – ExtrusionMachineryItemState_StateMachineType Attribute Values for Child Nodes

BrowsePath	Value Attribute	Description Attribute
0:DefaultInstanceBrowseName	MachineryItemState	The default BrowseName for instances of the type
4:NotAvailable		The machine is not available and does not perform any activity (e.g., switched off, in energy saving mode)
4:OutOfService		The machine is not functional and does not perform any activity (e.g., error, blocked)
4:NotExecuting		The machine is available & functional and does not perform any activity. It waits for an action from outside to start or restart an activity
4:Executing		The machine is available & functional and is actively performing an activity (pursues a purpose)
4:FromNotAvailableToOutOfService		Transition from state NotAvailable to state OutOfService
4:FromNotAvailableToNotExecuting		Transition from state NotAvailable to state NotExecuting
4:FromNotAvailableToExecuting		Transition from state NotAvailable to state Executing
4:FromNotAvailableToNotAvailable		Transition from state NotAvailable to state NotAvailable
4:FromOutOfServiceToNotAvailable		Transition from state OutOfService to state NotAvailable
4:FromOutOfServiceToNotExecuting		Transition from state OutOfService to state NotExecuting
4:FromOutOfServiceToExecuting		Transition from state OutOfService to state Executing
4:FromOutOfServiceToOutOfService		Transition from state OutOfService to state OutOfService
4:FromNotExecutingToNotAvailable		Transition from state NotExecuting to state NotAvailable
4:FromNotExecutingToOutOfService		Transition from state NotExecuting to state OutOfService
4:FromNotExecutingToNotExecuting		Transition from state NotExecuting to state NotExecuting
4:FromExecutingToNotAvailable		Transition from state Executing to state NotAvailable
4:FromExecutingToOutOfService		Transition from state Executing to state OutOfService
4:FromExecutingToNotExecuting		Transition from state Executing to state NotExecuting
4:FromExecutingToExecuting		Transition from state Executing to state Executing
4:NotAvailable 0:StateNumber	0	
4:OutOfService 0:StateNumber	1	
4:NotExecuting 0:StateNumber	2	
4:Executing 0:StateNumber	3	
4:FromNotAvailableToOutOfService 0:TransitionNumber	0	
4:FromNotAvailableToExecuting 0:TransitionNumber	1	
4:FromNotAvailableToNotExecuting 0:TransitionNumber	2	
4:FromOutOfServiceToNotAvailable 0:TransitionNumber	3	
4:FromOutOfServiceToExecuting 0:TransitionNumber	4	
4:FromOutOfServiceToNotExecuting 0:TransitionNumber	5	
4:FromExecutingToNotAvailable 0:TransitionNumber	6	
4:FromExecutingToOutOfService 0:TransitionNumber	7	
4:FromExecutingToNotExecuting 0:TransitionNumber	8	
4:FromNotExecutingToNotAvailable 0:TransitionNumber	9	

4:FromNotExecutingToOutOfService	0:TransitionNumber	10	
4:FromNotExecutingToExecuting	0:TransitionNumber	11	
4:FromNotAvailableToNotAvailable	0:TransitionNumber	12	
4:FromOutOfServiceToOutOfService	0:TransitionNumber	13	
4:FromExecutingToExecuting	0:TransitionNumber	14	
4:FromNotExecutingToNotExecuting	0:TransitionNumber	15	

The components of the *ExtrusionMachineryItemState_StateMachineType* have additional *References* which are defined in Table 5. As extension to the *MachineryItemState_StateMachineType* the *State Executing* gets an additional reference to the *ExtrusionExecutingSubState*.

Table 5 – ExtrusionMachineryItemState_StateMachineType Additional Reference

SourceBrowsePath	Reference Type	Is Forward	TargetBrowsePath
4:FromNotAvailableToOutOfService	0:FromState	True	4:NotAvailable
	0:ToState	True	4:OutOfService
4:FromNotAvailableToExecuting	0:FromState	True	4:NotAvailable
	0:ToState	True	4:Executing
4:FromNotAvailableToNotExecuting	0:FromState	True	4:NotAvailable
	0:ToState	True	4:NotExecuting
4:FromOutOfServiceToNotAvailable	0:FromState	True	4:OutOfService
	0:ToState	True	4:NotAvailable
4:FromOutOfServiceToExecuting	0:FromState	True	4:OutOfService
	0:ToState	True	4:Executing
4:FromOutOfServiceToNotExecuting	0:FromState	True	4:OutOfService
	0:ToState	True	4:NotExecuting
4:FromExecutingToNotAvailable	0:FromState	True	4:Executing
	0:ToState	True	4:NotAvailable
4:FromExecutingToOutOfService	0:FromState	True	4:Executing
	0:ToState	True	4:OutOfService
4:FromExecutingToNotExecuting	0:FromState	True	4:Executing
	0:ToState	True	4:NotExecuting
4:FromNotExecutingToNotAvailable	0:FromState	True	4:NotExecuting
	0:ToState	True	4:NotAvailable
4:FromNotExecutingToOutOfService	0:FromState	True	4:NotExecuting
	0:ToState	True	4:OutOfService
4:FromNotExecutingToExecuting	0:FromState	True	4:NotExecuting
	0:ToState	True	4:Executing
4:FromNotAvailableToNotAvailable	0:FromState	True	4:NotAvailable
	0:ToState	True	4:NotAvailable
4:FromOutOfServiceToOutOfService	0:FromState	True	4:OutOfService
	0:ToState	True	4:OutOfService
4:FromExecutingToExecuting	0:FromState	True	4:Executing
	0:ToState	True	4:Executing
4:FromNotExecutingToNotExecuting	0:FromState	True	4:NotExecuting
	0:ToState	True	4:NotExecuting
4:Executing	0:HasSubStateMachine	True	ExtrusionExecutingSubState

6.3.2 Definition of ExtrusionExecutingSubState_StateMachineType

The *ExtrusionExecutingSubState_StateMachineType* is used for a *SubStateMachine* which divides the *Executing State* into *ReadyToRun*, *ManualRun* and *ControlledRun*. This *SubStateMachine* is not active if the parent *State Executing* is not active. In this case the *CurrentState* and *LastTransition Variables* of the *ExtrusionExecutingSubState* state machine shall have a status equal to *Bad_StateNotActive*.

Table 6 – ExtrusionExecutingSubState_StateMachineType

Attribute	Value				
BrowseName	ExtrusionExecutingSubState_StateMachineType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:FiniteStateMachineType defined in OPC 10000-16, i.e. inheriting the InstanceDeclarations of that Node.					
0:HasComponent	Object	ReadyToRun		0:StateType	
0:HasComponent	Object	ManualRun		0:StateType	
0:HasComponent	Object	ControlledRun		0:StateType	
0:HasComponent	Object	FromReadyToRunToManualRun		0:TransitionType	
0:HasComponent	Object	FromManualRunToReadyToRun		0:TransitionType	
0:HasComponent	Object	FromReadyToRunToControlledRun		0:TransitionType	
0:HasComponent	Object	FromControlledRunToReadyToRun		0:TransitionType	
0:HasComponent	Object	FromManualRunToControlledRun		0:TransitionType	
0:HasComponent	Object	FromControlledRunToManualRun		0:TransitionType	
Conformance Units					
Extrusion Device					

The difference between *NotExecuting* and *ReadyToRun* is that in the state *NotExecuting* also the heating is switched off and in the state *ReadyToRun* it is switched on (but no movement of the screw).

The *InstanceDeclaration* of the *ExtrusionExecutionSubState_StateMachineType* has additional *Attribute* values defined in Table 7.

Table 7 – ExtrusionExecutingSubState_StateMachineType Attribute Values for Child Nodes

SourceBrowsePath	Value	Description
ReadyToRun		Component is not running but able to start immediately (e.g. heating is switched on, set temperatures have been reached)
ManualRun		Component is running with manually set parameters
ControlledRun		Component is running with controlled parameters
FromReadyToRunToManualRun		Transition from state ReadyToRun to state ManualRun
FromManualRunToReadyToRun		Transition from state ManualRun to state ReadyToRun
FromReadyToRunToControlledRun		Transition from state ReadyToRun to state ControlledRun
FromControlledRunToReadyToRun		Transition from state ControlledRun to state ReadyToRun
FromManualRunToControlledRun		Transition from state ManualRun to state ControlledRun
FromControlledRunToManualRun		Transition from state ControlledRun to state ManualRun
ReadyToRun 0:StateNumber	0	
ManualRun 0:StateNumber	1	
ControlledRun 0:StateNumber	2	
FromReadyToRunToManualRun 0:TransitionNumber	0	
FromManualRunToReadyToRun 0:TransitionNumber	1	
FromReadyToRunToControlledRun 0:TransitionNumber	2	
FromControlledRunToReadyToRun 0:TransitionNumber	3	
FromManualRunToControlledRun 0:TransitionNumber	4	
FromControlledRunToManualRun 0:TransitionNumber	5	

The components of the *ExtrusionExecutingSubState_StateMachineType* have additional *References* which are defined in Table 8.

Table 8 – ExtrusionExecutingSubState_StateMachineType Additional References

SourceBrowsePath	Reference Type	Is Forward	TargetBrowsePath
FromReadyToRunToManualRun	0:FromState	True	ReadyToRun
	0:ToState	True	ManualRun
FromManualRunToReadyToRun	0:FromState	True	ManualRun
	0:ToState	True	ReadyToRun
FromReadyToRunToControlledRun	0:FromState	True	ReadyToRun
	0:ToState	True	ControlledRun
FromControlledRunToReadyToRun	0:FromState	True	ControlledRun
	0:ToState	True	ReadyToRun
FromManualRunToControlledRun	0:FromState	True	ManualRun
	0:ToState	True	ControlledRun
FromControlledRunToManualRun	0:FromState	True	ControlledRun
	0:ToState	True	ManualRun

6.4 MachineConfiguration

The *MachineConfigurationType* is defined in OPC 40083 and provides information on the current configuration of a machine/device.

6.5 IsPresent

The *IsPresent* Property provides information if the component is physically installed and connected.

NOTE: Can be *False* e.g. when an external server is used for component.

6.6 Target

This *Property* informs where the material/melt from this device goes to (e.g. the target of an extruder can be a die, but also a melt-pump). The value shall be equal to the value of the *Property UserMachineName* inside the *MachineConfiguration Object* of the relevant component.

Note: Using the *NodeId* of the device not possible because the components may have different servers. In this case the *NodeIds* are not unique in the complete extrusion line. It is also possible to fill a descriptive *String* in the *Target* property if the target component has no OPC UA representation.

6.7 Strand

Strand is used when several products (two pipes is parallel, foil cut into several smaller foils) are produced in parallel. It is only used for a component, which can be unambiguously assigned to one of the products.

6.8 ElectricalEnergy

Electrical energy of the component. The *EnergyType* is defined in OPC 40083.

6.9 FluidEnergy

Energy for the cooling of the component with fluid. The *EnergyType* is defined in OPC 40083.

6.10 PressureAir

Consumption of pressure air of the component (volume at standard conditions). The *EnergyType* is defined in OPC 40083.

6.11 Maintenance

The *MaintenanceType* is defined in OPC 40083.

6.12 StartDevice

This *Object* is used to give information on the starting status of a device and optional to switch devices on and off via the interface. The *StartDeviceType* is defined in OPC 40083.

6.13 AdditionalMeasuringDevices

This *Objects* is a container for possible additional measuring devices used in the component. The *MeasuringDevicesType* is defined in OPC 40083.

NOTE: "Additional" because the specifications for the concrete components may define some fixed types of measuring devices (e.g. for temperatures, pressures...).

6.14 ProductionDatasetManagement

The *ProductionDatasetManagementType* is defined in OPC 40083 and provides functionalities for the management of recipes/machine settings.

6.15 SupportedLogbookEvents

This list of *LogbookEventsEnumeration* gives information which *LogbookEvents* are supported by the machine. The *LogbookEventsEnumeration* is defined in OPC 40083.

6.16 Events

A Component may generate Events of *MessageConditionType* and *LogbookEventType* (see OPC 40083).

NOTE: Which logbook events are supported is stored in *SupportedLogbookEvents*.

7 ExtrusionMessageClassificationEnumeration

This *Enumeration* specifies the values to be used in the *Classification* property in the *MessageConditionType* and related logbook events to indicate which machine part has caused the message. These events are fired by the instance of the *ExtrusionDeviceType* and are defined in OPC 40083.

Table 9 – ExtrusionMessageClassificationEnumeration Definition

Name	Value	Description
OTHER	0	This value is used if none of the other entries below apply.
LINE_CONTROL	1	Line control
MATERIAL_HANDLING	2	Material handling (from silo to processing machine)
PRE_HEATING	3	Pre-heating, drying of input material
FEEDING	4	Feeding unit
DOSING	5	Dosing unit
EXTRUDER	6	Extruder
VACUUM_STATION	7	Vacuum station
FILTER	8	Filter
MELT_PUMP	9	Melt pump
DIE	10	Profile die, pipe die, ...
COOLING	11	Cooling
HAUL_OFF	12	Haul-off
CORRUGATOR	13	Corrugator
SAW	14	Saw
CALIBRATION	15	Calibration
ROLL_STACK	16	Roll stack
MDO	17	Machine direction orientation
BIAX	18	Biaxial orientation
CUTTING	19	Cutting
WINDER	20	Winder
PELLETIZING	21	Pelletizing
DRYER	22	Drying of product/output material (e.g. after underwater cutting)
HANDLING_SYSTEM	23	Handling system for produced products (e.g. robot stacking profiles)
LAMINATION_SYSTEM	24	Lamination system
MEASURING_SYSTEM	25	Measuring System (e.g. thickness measurement)
QUALITY_SYSTEM	26	Quality system (e.g. camera inspection)
MANUAL_INSPECTION	27	Manual inspection (message generated due to quality input by the operator)
MANUAL_OPERATION	28	Manual operation (message generated due to action of the operator, e.g. changing of machine mode)

8 TemperatureZones

8.1 ExtrusionTemperatureZonesType

This *ObjectType* is a container for temperature zones inside of a component of an extrusion line. It is formally defined in Table 10.

Table 10 – ExtrusionTemperatureZonesType Definition

Attribute	Value				
BrowseName	ExtrusionTemperatureZonesType				
IsAbstract	False				
References	Node Class	BrowseName	Data Type	TypeDefinition	Other
Subtype of 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	0:NodeVersion	0:String	0:PropertyType	M, RO
0:HasComponent	Object	StartTempering		3:StartDeviceType	O
0:HasComponent	Object	Maintenance		3:MaintenanceType	O
0:HasComponent	Object	TemperatureZone_<Nr>		ExtrusionTemperatureZoneType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEventType			

When instances for temperature zones are created, the *BrowseNames* shall be “TemperatureZone_<Nr>” where <Nr> is a three-digit number with leading zeros, starting with “001”. The *ExtrusionTemperatureZoneType* is defined in Table 11.

StartTempering: Main switch for all temperature zones in the container. The single zones have own switches/status → AND-connection!

8.2 ExtrusionTemperatureZoneType

This *ObjectType* represents one temperature zone inside of a component of an extrusion line. It is formally defined in Table 11.

Table 11 – ExtrusionTemperatureZoneType Definition

Attribute	Value				
BrowseName	ExtrusionTemperatureZoneType				
IsAbstract	False				
References	Node Class	BrowseName	Data Type	TypeDefinition	Other
Subtype of 3:MeasuringDeviceType defined in OPC 40083					
0:HasComponent	Variable	NominalHeatingPower	0:Double	0:AnalogUnitType	O, RO
0:HasComponent	Variable	NominalCoolingPower	0:Double	0:AnalogUnitType	O, RO
0:HasComponent	Variable	ControllerOutput	0:Double	0:AnalogUnitType	O, RO
0:HasComponent	Object	ElectricalCurrent		3:MonitoredParameterType	O

NOTES: The temperature of the zone is stored inside the *MonitoredParameter* object of the *MeasuringDeviceType*. The *TemperatureZoneType* differs from the *TemperatureZoneType* defined in OPC 40083 to make use of the new *MeasuringDeviceType*.

8.2.1 NominalHeatingPower

Indication of the nominal heating power of the zone in kW. If the zone is only a cooling zone, this variable is not used.

8.2.2 NominalCoolingPower

Indication of the nominal cooling power of the zone in kW. If the zone is only a heating zone, this variable is not used.

8.2.3 ControllerOutput

Actual ratio of the used nominal power in %. Values from -100 (=max. cooling) to +100 (max. heating).

8.2.4 ElectricalCurrent

Actual electrical current of the zone in A.

9 Rolls and Gaps

Several machines in an extrusion lines (e.g. calenders) contain rolls and gaps between rolls.

9.1 RollsType

The *RollsType* defines a container for several rolls inside of a component of an extrusion line. It is formally defined in Table 12.

Table 12 – RollsType Definiton

Attribute	Value				
BrowseName	RollsType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	0:NodeVersion	0:String	0:PropertyType	M, RO
0:HasComponent	Object	Roll_<Nr>		RollType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEvent			

9.2 RollType

The *RollType* described a single roll. It is formally defined in Table 13.

Table 13 – RollType Definiton

Attribute	Value				
BrowseName	RollType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	Id	0:String	0:PropertyType	M, RO
0:HasProperty	Variable	Name	0:LocalizedText	0:PropertyType	O, RO
0:HasProperty	Variable	MasterRollId	0:String	0:PropertyType	O, RO
0:HasComponent	Object	Drive		3:DriveType	M
0:HasComponent	Object	Temperature		ExtrusionTemperatureZoneType	O
0:HasComponent	Object	CrossAxisLeft		3:MonitoredParameterType	O
0:HasComponent	Object	CrossAxisRight		3:MonitoredParameterType	O
0:HasComponent	Object	PeripheralDevices		RollPeripheralDevicesType	O
0:HasComponent	Object	RollBending		RollBendingType	O

9.2.1 Id

Id of the roll

9.2.2 Name

(Human readable) name of the roll

9.2.3 MasterRollId

Id of the master roll. If a roll is the master roll then MasterRollId = Id.

9.2.4 Drive

Information about the drive of the roll. The *DriveType* is defined in OPC 40083.

9.2.5 Temperature

Temperature of the roll.

9.2.6 CrossAxisLeft, CrossAxisRight

Axis crossing of the roll on both sides (in the direction of the material flow). The *MonitoredParameterType* is defined in OPC 40083.

Unit: mm or inch

9.2.7 RollPeripheralDevices

A roll can be equipped with infrared heating systems and/or cleaning systems. Their representations are put into the container *RollPeripheralDevices*. The *RollPeripheralDevicesType* is formally defined in Table 14.

Table 14 – RollPeripheralDevicesType Definiton

Attribute	Value				
BrowseName	RollPeripheralDevicesType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	0:NodeVersion	0:String	0:PropertyType	M, RO
0:HasComponent	Object	InfraredHeatingSystem_<Nr>		3:StartDeviceType	OP
0:HasComponent	Object	CleaningSystem_<Nr>		3:StartDeviceType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEvent			

The *StartDeviceType* used for the infrared heating systems and cleaning systems is defined in OPC 40083.

9.2.8 RollBending

If roll bending is used, the monitoring of the positions of the reference points are described with the *RollBendingType*. It is formally defined in Table 15.

Table 15 – RollBendingType Definiton

Attribute	Value				
BrowseName	RollBendingType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	0:NodeVersion	0:String	0:PropertyType	M, RO
0:HasComponent	Object	ReferencePoint_<Nr>		3:MeasuringDeviceType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEvent			

9.3 GapsType

The *GapsType* defines a container for several gaps between two rolls (e.g. of a calender). It is formally defined in Table 16.

Table 16 – GapsType Definiton

Attribute	Value				
BrowseName	GapsType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	0:NodeVersion	0:String	0:PropertyType	M, RO
0:HasComponent	Object	Gap_<Nr>		GapType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEvent			

9.4 GapType

The *GapType* describes a gap between two rolls. It is formally defined in Table 17.

Table 17 – GapType Definition

Attribute	Value				
BrowseName	GapType				
IsAbstract	False				
References	Node Class	BrowseName	Data Type	Type Definition	Other
Subtype of the 0:BaseObjectType defined in OPC 10000-5					
0:HasProperty	Variable	Id	0:String	0:PropertyType	M, RO
0:HasProperty	Variable	RollId1	0:String	0:PropertyType	M, RO
0:HasProperty	Variable	RollId2	0:String	0:PropertyType	M, RO
0:HasComponent	Object	DistanceLeft		3:MonitoredParameterType	O
0:HasComponent	Object	DistanceRight		3:MonitoredParameterType	O
0:HasComponent	Variable	IsClosed	0:Boolean	0:BaseDataVariableType	O, RO
0:HasComponent	Object	ContactForce	0:Double	3:MonitoredParameterType	O, RO
0:HasProperty	Variable	StockingGuidelsPresent	0:Boolean	0:PropertyType	O, RO

9.4.1 Id

Id of the gap.

9.4.2 RollId1, RollId2

Ids of the rolls which create the gap.

9.4.3 DistanceLeft, DistanceRight

Distances between the rolls on both sides (in the direction of the material flow). The *MonitoredParameterType* is defined in OPC 40083.

Unit: mm or inch

9.4.4 IsClosed

True, when the rolls forming the gaps are in working position.

9.4.5 ContactForce

Contact force between the rolls (mainly measured indirectly via the fluid pressure). The *MonitoredParameterType* is defined in OPC 40083.

Unit: N or lbf

9.4.6 StockingGuidelsPresent

Information if a stocking guide is present.

10 Profiles and Conformance Units

10.1 Conformance Units

This chapter defines the corresponding *Conformance Units* for OPC 40084-1.

Table 18 – Conformance Units for OPC 40084-1

Category	Title	Description
Server	Extrusion Device	Supports the <i>ExtrusionDeviceType</i> with all its mandatory <i>InstanceDeclarations</i> . There is at least one instance of the <i>ExtrusionDeviceType</i> or a subtype representing a machine/component of an extrusion line.
Server	Extrusion Production Dataset Management	Supports the <i>3:ProductionDatasetManagementType</i> (defined in OPC 40083) with all its mandatory <i>InstanceDeclarations</i> . There is the component <i>ProductionDatasetManagement</i> available in the instance of the <i>ExtrusionDeviceType</i> or a subtype representing a machine/component of an extrusion line.

10.2 Profiles

10.2.1 Profile list

Table 19 lists all *Profiles* defined in this document and defines their URIs.

Table 19 – Profile URIs for OPC UA for Machinery

Profile	URI
Extrusion v2 Extrusion Device Basic Server Profile	http://opcfoundation.org/UA-Profile/PlasticsRubber/Extrusion_v2/ExtrusionDeviceBasic
Extrusion v2 Production Dataset Management Server Facet	http://opcfoundation.org/UA-Profile/PlasticsRubber/Extrusion_v2/ProductionDatasetManagement

10.2.2 Server Facets

10.2.2.1 Overview

The following sections specify the *Facets* available for *Servers* that implement the OPC 40084-1 companion specification. Each section defines and describes a *Facet* or *Profile*.

10.2.2.2 Extrusion Device Basic Server Profile

Table 20 defines a *Profile* that provides the basic functionalities of an device in an extrusion line managed in an OPC UA Server.

Table 20 – Extrusion v2 Extrusion Device Basic Server Profile

Group	Conformance Unit / Profile Title	Mandatory / Optional
Server	0:Embedded Server 2017 (defined in OPC 10000-7)	M
Server	0:ComplexType Server Facet (defined in OPC 10000-7)	M
Server	0:Standard Event Subscription Server Facet (defined in OPC 10000-7)	M
Server	0:Method Server Facet (defined in OPC 10000-7)	M
Server	2:BaseDevice Server Facet (defined in OPC 10000-100)	M
Security	0:SecurityPolicy [B] – Basic256Sha256	M
Extrusion	Extrusion Device	M

10.2.2.3 Extrusion v2 Production Dataset Management Server Facet

Table 21 defines a *Facet* that provides the *ProductionDatasetManagement Object* in the OPC UA Server.

Table 21 – Extrusion v2 Production Dataset Management Server Facet

Group	Conformance Unit / Profile Title	Mandatory / Optional
Extrusion	Extrusion Production Dataset Management	M

10.2.3 Client Facets

This version of the specification does not define any *Client Facets*.

11 Namespaces

11.1 Namespace Metadata

Table 22 defines the namespace metadata for this specification. The *Object* is used to provide version information for the namespace and an indication about static *Nodes*. Static *Nodes* are identical for all *Attributes* in all *Servers*, including the *Value Attribute*. See OPC 10000-5 for more details.

The information is provided as *Object* of type *NamespaceMetadataType*. This *Object* is a component of the *Namespaces Object* that is part of the *Server Object*. The *NamespaceMetadataType ObjectType* and its *Properties* are defined in OPC 10000-5.

The version information is also provided as part of the *ModelTableEntry* in the *UANodeSet XML* file. The *UANodeSet XML* schema is defined in OPC 10000-6.

Table 22 – NamespaceMetadata Object for this Specification

Attribute	Value	
BrowseName	http://opcfoundation.org/UA/PlasticsRubber/Extrusion_v2/GeneralTypes/	
Property	DataType	Value
NamespaceUri	String	http://opcfoundation.org/UA/PlasticsRubber/Extrusion_v2/GeneralTypes/
NamespaceVersion	String	2.00
NamespacePublicationDate	DateTime	2022-05-01
IsNamespaceSubset	Boolean	False
StaticNodeIdsTypes	IdType[]	0
StaticNumericNodeIdRange	NumericRange[]	
StaticStringNodeIdPattern	String	

11.2 Handling of OPC UA Namespaces

Namespaces are used by OPC UA to create unique identifiers across different naming authorities. The *Attributes NodeId* and *BrowseName* are identifiers. A *Node* in the *UA AddressSpace* is unambiguously identified using a *NodeId*. Unlike *NodeIds*, the *BrowseName* cannot be used to unambiguously identify a *Node*. Different *Nodes* may have the same *BrowseName*. They are used to build a browse path between two *Nodes* or to define a standard *Property*.

Servers may often choose to use the same namespace for the *NodeId* and the *BrowseName*. However, if they want to provide a standard *Property*, its *BrowseName* shall have the namespace of the standards body although the namespace of the *NodeId* reflects something else, for example the *EngineeringUnits Property*. All *NodeIds* of *Nodes* not defined in this document shall not use the standard namespaces.

Table 23 provides a list of mandatory and optional namespaces used in an OPC 40084-1 OPC UA *Server*.

Table 23 – Namespaces used in an OPC 40084-1 Server

NamespaceURI	Description	Use
http://opcfoundation.org/UA/	Namespace for <i>NodeIds</i> and <i>BrowseNames</i> defined in the OPC UA specification. This namespace shall have namespace index 0.	Mandatory
Local Server URI	Namespace for nodes defined in the local server. This may include types and instances used in a device represented by the server. This namespace shall have namespace index 1.	Mandatory
http://opcfoundation.org/UA/DI/	Namespace for <i>NodeIds</i> and <i>BrowseNames</i> defined in OPC 10000-100. The namespace index is server specific.	Mandatory
http://opcfoundation.org/UA/PlasticsRubber/GeneralTypes/	Namespace for <i>NodeIds</i> and <i>BrowseNames</i> defined in OPC 40083. The namespace index is server specific.	Mandatory
http://opcfoundation.org/UA/Machinery/	Namespace for <i>NodeIds</i> and <i>BrowseNames</i> defined in OPC 40001-1. The namespace index is server specific.	Mandatory
http://opcfoundation.org/UA/PlasticsRubber/Extrusion_v2/GeneralTypes/	Namespace for <i>NodeIds</i> and <i>BrowseNames</i> defined in this specification. The namespace index is server specific.	Mandatory
Vendor specific types and instances	A server may provide vendor specific types like types derived from <i>MachineType</i> or <i>MachineStatusType</i> or vendor specific instances of devices in a vendor specific namespace.	Optional

Table 24 provides a list of namespaces and their index used for *BrowseNames* in this specification. The default namespace of this specification is not listed since all *BrowseNames* without prefix use this default namespace.

Table 24 – Namespaces used in this specification

NamespaceURI	Namespace Index	Example
http://opcfoundation.org/UA/	0	0:NodeVersion
http://opcfoundation.org/UA/DI/	2	2:DeviceClass
http://opcfoundation.org/UA/PlasticsRubber/GeneralTypes/	3	3:EnergyType
http://opcfoundation.org/UA/Machinery/	4	4:MachineIdentificationType

Annex A (normative)

OPC 40084-1 Namespace and mappings

A.1 Namespace and identifiers for OPC 40084-1 Information Model

This appendix defines the numeric identifiers for all of the numeric *NodeIds* defined in this specification. The identifiers are specified in a CSV file with the following syntax:

<SymbolName>, <Identifier>, <NodeClass>

Where the *SymbolName* is either the *BrowseName* of a *Type Node* or the *BrowsePath* for an *Instance Node* that appears in the specification and the *Identifier* is the numeric value for the *NodeId*.

The *BrowsePath* for an *Instance Node* is constructed by appending the *BrowseName* of the instance *Node* to the *BrowseName* for the containing instance or type. An underscore character is used to separate each *BrowseName* in the path. Let's take for example, the *MachineInformationType ObjectType Node* which has the *ControllerName Property*. The **Name** for the *ControllerName InstanceDeclaration* within the *MachineInformationType* declaration is: *MachineInformationType_ControllerName*.

The *NamespaceUri* for all *NodeIds* defined here is

http://opcfoundation.org/UA/PlasticsRubber/Extrusion_v2/GeneralTypes/

The CSV released with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/Extrusion_v2/GeneralTypes/2.00/NodeIds.csv

NOTE: The latest CSV that is compatible with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/Extrusion_v2/GeneralTypes/NodeIds.csv

A computer processible version of the complete Information Model defined in this specification is also provided. It follows the XML Information Model schema syntax defined in Part 6.

The Information Model Schema released with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/Extrusion_v2/GeneralTypes/2.00/Opc.Ua.PlasticsRubber.Extrusion_v2.GeneralTypes.NodeSet2.xml

NOTE: The latest Information Model schema that is compatible with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/Extrusion_v2/GeneralTypes/Opc.Ua.PlasticsRubber.Extrusion_v2.GeneralTypes.NodeSet2.xml

Annex B (informative)

Mapping from version 1.01 to 2.00

B.1 Identification

In the *ExtrusionDeviceType*, the *Object MachineInformation* (*MachineInformationType* from OPC 40083) has been replaced by *Identification* (*MachineIdentificationType* from OPC 40001-1).

Table 25 – Comparison of machine identification in v1.01 and v2.0

Version 1.01 <i>MachineInformation</i>		Version 2.00 <i>Identification</i>	
Inherited from <i>ComponentType</i>			
Applied from <i>IVendorNameplateType</i>		Applied from <i>IVendorNameplateType</i>	
Manufacturer	mandatory (override in <i>MachineInformationType</i>)	Manufacturer	mandatory
ManufacturerUri	optional	ManufacturerUri	optional
Model	mandatory (override in <i>MachineInformationType</i>)	Model	mandatory (override in instance declaration of <i>Identification Object</i> in <i>ExtrusionDeviceType</i>)
ProductCode	optional	ProductCode	optional
HardwareRevision	optional	HardwareRevision	optional
SoftwareRevision	optional	SoftwareRevision	optional
DeviceRevision	optional	<i>Not applied in MachineIdentificationType</i>	
DeviceManual	optional	<i>Not applied in MachineIdentificationType</i>	
DeviceClass	mandatory (override in <i>MachineInformationType</i>)	DeviceClass	mandatory (override in instance declaration of <i>Identification Object</i> in <i>ExtrusionDeviceType</i>)
SerialNumber	mandatory (override in <i>MachineInformationType</i>)	SerialNumber	mandatory
ProductInstanceUri	optional	ProductInstanceUri	mandatory
RevisionCounter	optional	<i>Not applied in MachineIdentificationType</i>	
Applied from <i>ITagNameplateType</i>		Applied from <i>ITagNameplateType</i>	
AssetId	optional	AssetId	optional
ComponentName	optional	ComponentName	optional
Added in <i>MachineInformationType</i> (OPC 40083)			
ControllerName	mandatory	ControllerName	Added in instance declaration of <i>Identification Object</i> in <i>ExtrusionDeviceType</i>
SupportedLogbookEvents	mandatory	SupportedLogbookEvents	Addid in <i>ExtrusionDeviceType</i>
		Additional Properties from <i>IMachineryItem VendorNameplateType</i>	
<i>No matching Property in v 1.01</i>		YearOfConstruction	optional
<i>No matching Property in v 1.01</i>		MonthOfConstruction	optional
<i>No matching Property in v 1.01</i>		InitialOperationDate	optional
		Additional Property from <i>IMachineTagNameplateType</i>	
<i>LocationName in MachineConfiguration</i>		Location	optional

B.2 Status

In the *ExtrusionDeviceType*, the *Variable Status* has been replaced by the two state machines *MachineryItemState* and *MachineryOperationMode* (see OPC 40001-1). The state machine *MachineryItemState* is extended by a sub state machine *ExtrusionExecutingSubState*.

As the status information is now split into two states, there is no one-to-one relation between the old states in version 1.01 and the new ones in version 2.0. For example, MALFUNCTION and MAINTENANCE which are separate states in version 1.01 can occur at the same time with the *MachineryItemState OutOfService* and *MachineryOperationMode Maintenance* when there is an error during maintenance.

Table 26 – Comparison of machine status in v1.01 and v2.0

Version 1.01 <i>ExtrusionDeviceType</i> → <i>Status</i>		Version 2.00 <i>Identification</i>	
Name	Value	<i>MachineryItemState</i>	<i>MachineryOperationMode</i>
OFFLINE	0	NotAvailable	any
IDLE	1	NotExecuting	any
PREPARING	2	Executing (with any substate)	Setup
READY_TO_RUN	3	Executing with sub state ReadyToRun	Processing
MANUAL_RUN	4	Executing with sub state ManualRun	Processing
CONTROLLED_RUN	5	Executing with sub state ControlledRun	Processing
MALFUNCTION	6	OutOfService	any
MAINTENANCE	7	any	Maintenance