

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 1.00) is identical with OPC 40084-1 (Release 1.00) and VDMA 40084-1:2020-06</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.

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

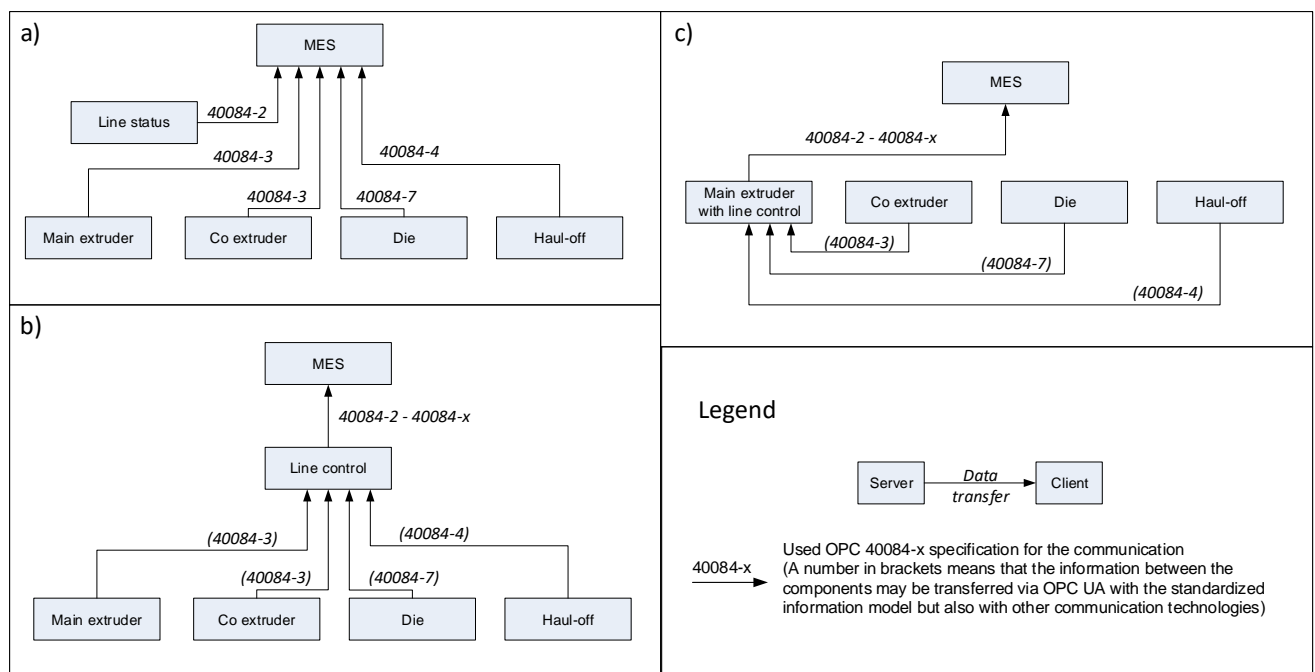


Figure 1 – Different possibilities for the data flow

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

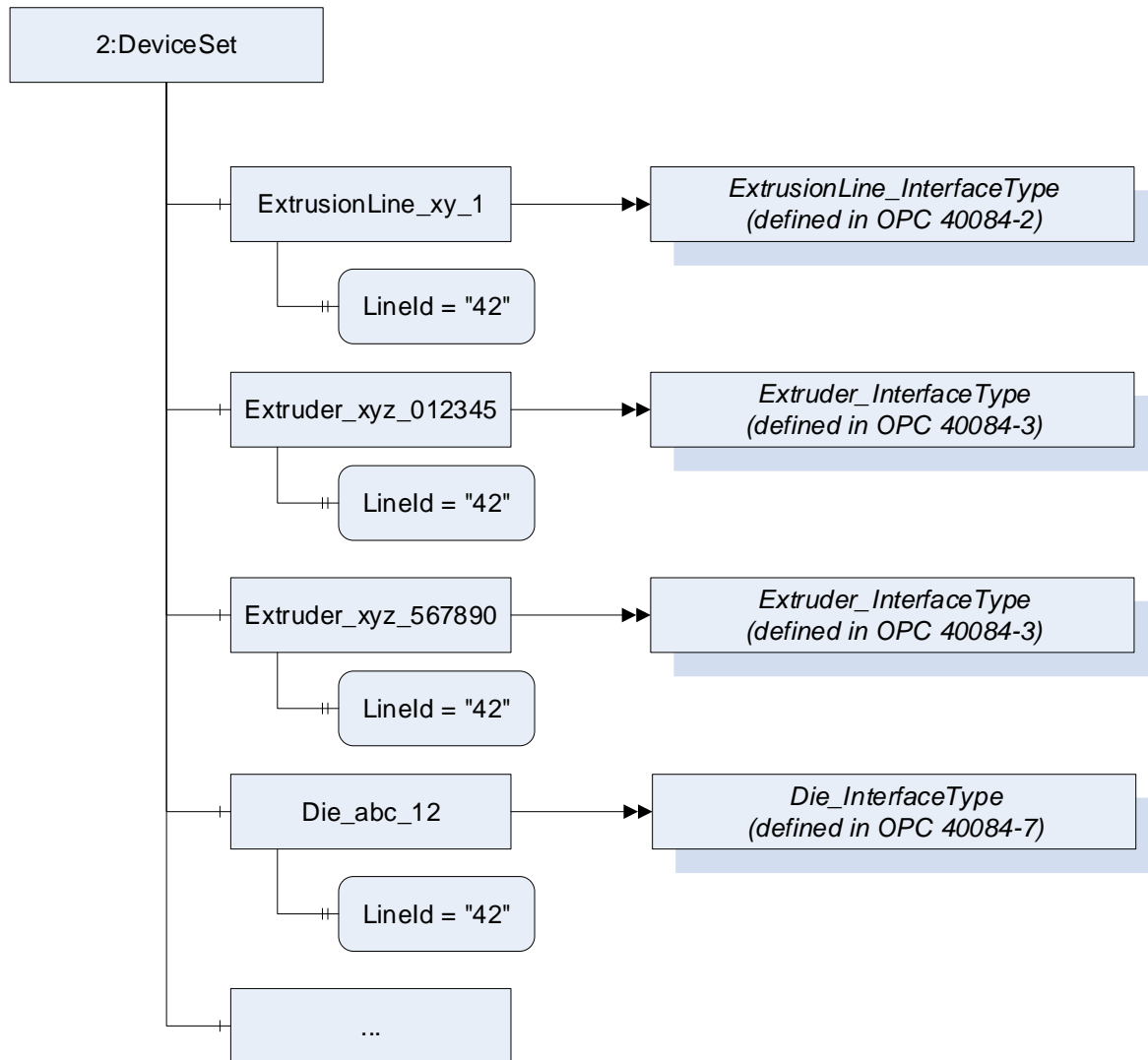


Figure 2 – Example structure of a server representing several components of an extrusion line

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 10000-9, *OPC Unified Architecture - Part 9: Alarms and Conditions*

<http://www.opcfoundation.org/UA/Part9/>

OPC 10000-11, *OPC Unified Architecture - Part 11: Historical Access*

<http://www.opcfoundation.org/UA/Part11/>

OPC 10001-1, *OPC Unified Architecture V1.04 - Amendment 1: AnalogItem Types*

<http://www.opcfoundation.org/UA/Amendment1/>

OPC 10001-3, *OPC Unified Architecture V1.04 - Amendment 3: Method Metadata*

<http://www.opcfoundation.org/UA/Amendment3/>

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

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

OPC 40083: OPC UA interfaces for plastics and rubber machinery – General Type definitions (version 1.02)

<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.

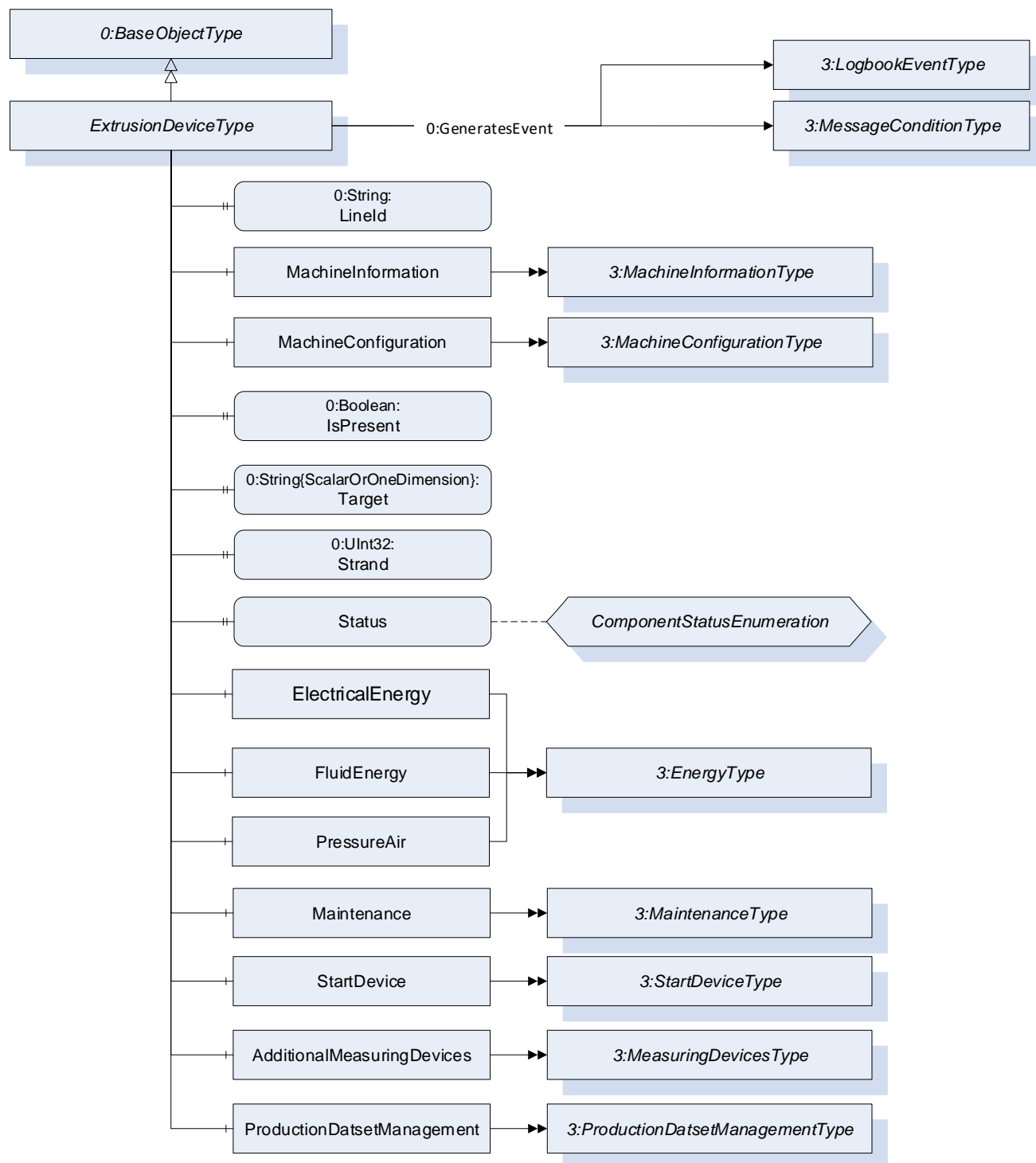


Figure 3 – ExtrusionDeviceType Overview

Table 1 – ExtrusionDeviceType Definition

Attribute	Value				
BrowseName	ExtrusionDeviceType				
IsAbstract	True				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of 0:BaseObjectType defined in OPC UA Part 5					
0:HasProperty	Variable	LineId	0:String	0:PropertyType	M, RW
0:HasComponent	Object	MachineInformation		3:MachineInformationType	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:HasProperty	Variable	Status	ComponentStatusEnumeration	0:PropertyType	M, 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:GeneratesEvent	ObjectType	3:MessageConditionType	Defined in OPC 40083		
0:GeneratesEvent	ObjectType	3:LogbookEventType	Defined in OPC 40083		

6.2 LineId

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

6.3 MachineInformation

The *MachineInformationType* is defined in OPC 40083 and provides basic information on a machine/device.

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 Status

This *Property* represents the current status of the component. The *ComponentStatusEnumeration* is defined in Table 2.

Table 2 – ComponentStatusEnumeration Definition

Name	Value	Description
OFFLINE	0	Component is not connected to OPC UA server. (Will not be set by component it-self, but e.g. by line control providing Information for the component)
IDLE	1	Main switch on, no heating (also timer not running), no movement
PREPARING	2	Heating timer running, heating active, security check, setting, service mode
READY_TO_RUN	3	Temperature for switching drives on reached, drives ready for switching on
MANUAL_RUN	4	Component is running with manually set parameters
CONTROLLED_RUN	5	Component is running with controlled parameters
MALFUNCTION	6	Component has stopped running because of an error (also emergency stop), no re-start possible
MAINTENANCE	7	Component is maintained

6.9 ElectricalEnergy

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

6.10 FluidEnergy

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

6.11 PressureAir

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

6.12 Maintenance

The *MaintenanceType* is defined in OPC 40083.

6.13 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.

6.14 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...).

6.15 ProductionDatasetManagement

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

6.16 Events

A Component may generate Events of *MessageConditionType* and *LogbookEventType*.

NOTE: Which logbook events are supported is stored in the *MachineInformation Object*.

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 3 – 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 4.

Table 4 – ExtrusionTemperatureZonesType Definition

Attribute	Value				
BrowseName	ExtrusionTemperatureZonesType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	TypeDefinition	Other
Subtype of 0:BaseObjectType defined in OPC UA Part 5					
0:HasProperty	Variable	0:NodeVersion	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 5.

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 5.

Table 5 – ExtrusionTemperatureZoneType Definition

Attribute	Value				
BrowseName	ExtrusionTemperatureZoneType				
IsAbstract	False				
References	Node Class	BrowseName	DataType	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 Profiles and Conformance Units

This part of OPC 40084 does not define *Profiles* and *Conformance Units*. They are defined by the parts for the several components of an extrusion line.

10 Namespaces

10.1 Namespace Metadata

Table 6 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 Part5 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 Part5.

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

Table 6 – NamespaceMetadata Object for this Specification

Attribute		Value	
BrowseName		http://opcfoundation.org/UA/PlasticsRubber/Extrusion/GeneralTypes/	
References	BrowseName	DataType	Value
HasProperty	NamespaceUri	String	http://opcfoundation.org/UA/PlasticsRubber/Extrusion/GeneralTypes/
HasProperty	NamespaceVersion	String	1.00
HasProperty	NamespacePublicationDate	DateTime	2020-06-01 00:00:00
HasProperty	IsNamespaceSubset	Boolean	False
HasProperty	StaticNodeIdTypes	IdType[]	{Numeric}
HasProperty	StaticNumericNodeIdRange	NumericRange[]	Null
HasProperty	StaticStringNodeIdPattern	String	Null

10.2 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 7 provides a list of mandatory and optional namespaces used in an OPC 40084-1 OPC UA *Server*.

Table 7 – 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 UA Part 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/PlasticsRubber/Extrusion/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 8 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 8 – 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:MachineInformationType

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/GeneralTypes/>

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

– <http://www.opcfoundation.org/UA/schemas/PlasticsRubber/Extrusion/GeneralTypes/1.00/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/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/GeneralTypes/1.00/Opc.Ua.PlasticsRubber.Extrusion.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/GeneralTypes/Opc.Ua.PlasticsRubber.Extrusion.GeneralTypes.NodeSet2.xml>
