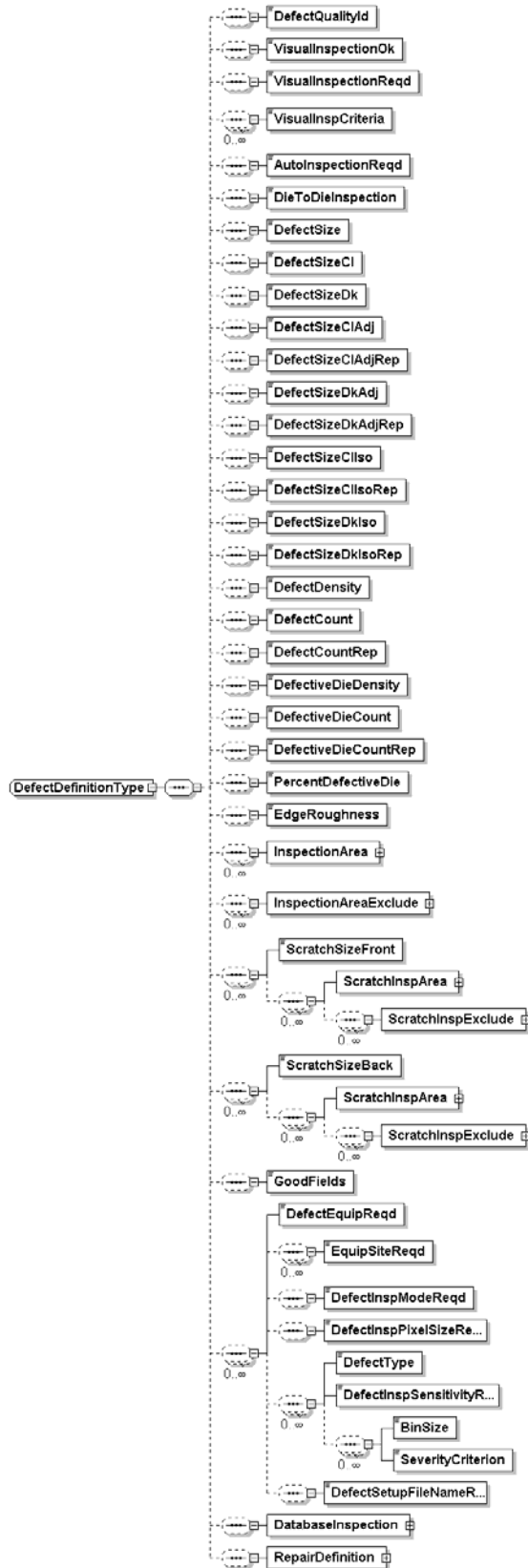
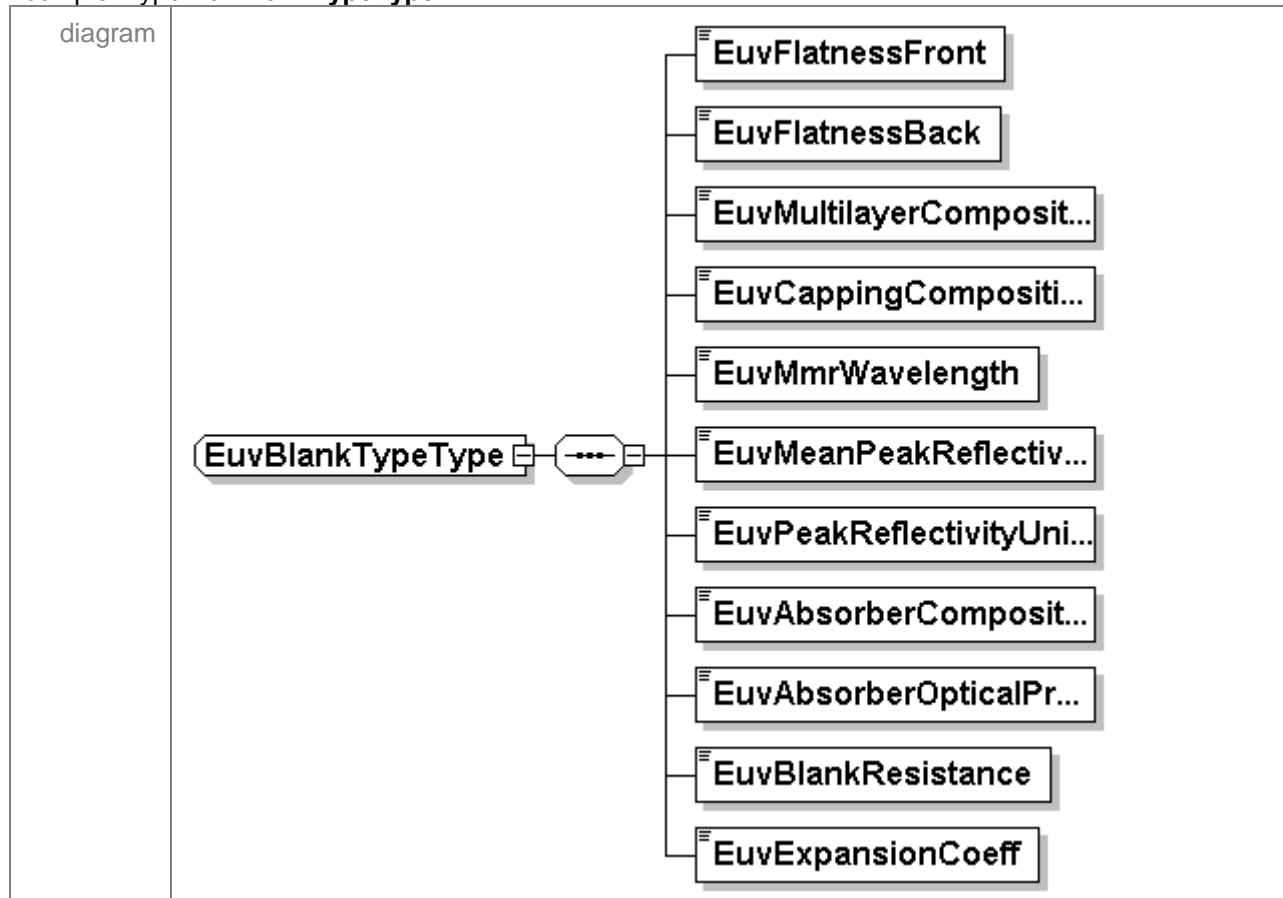


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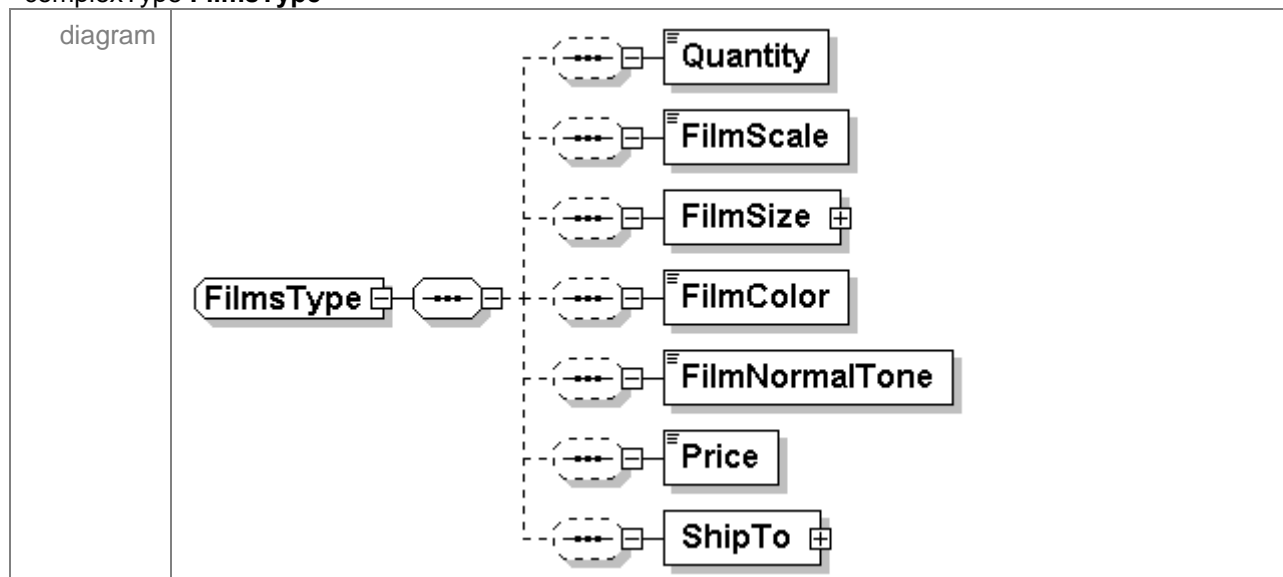
diagram



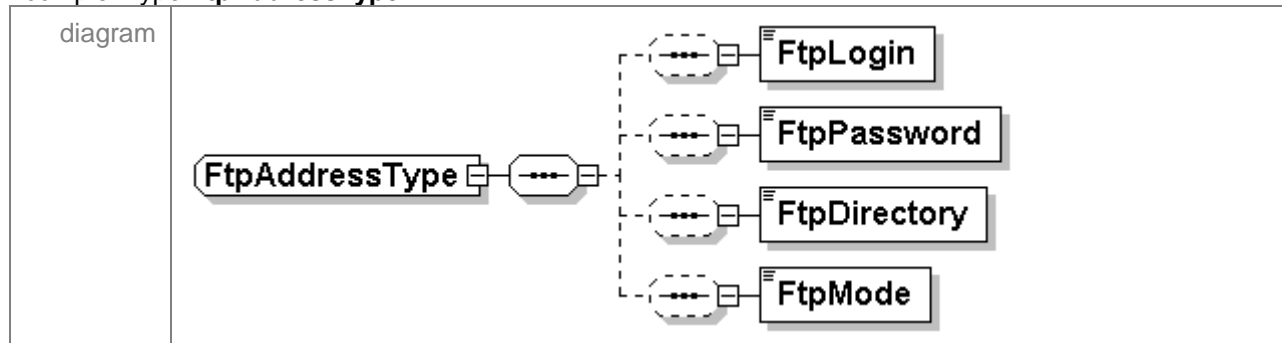
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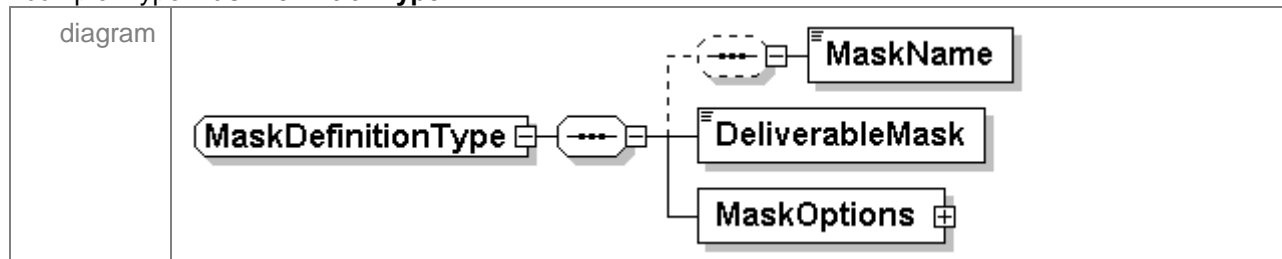
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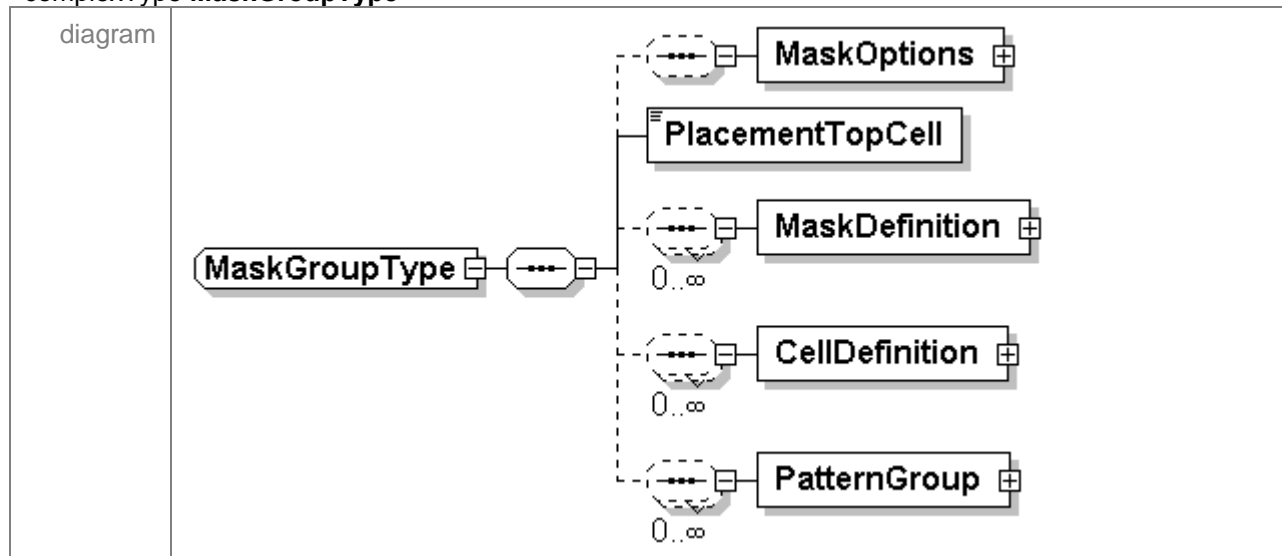
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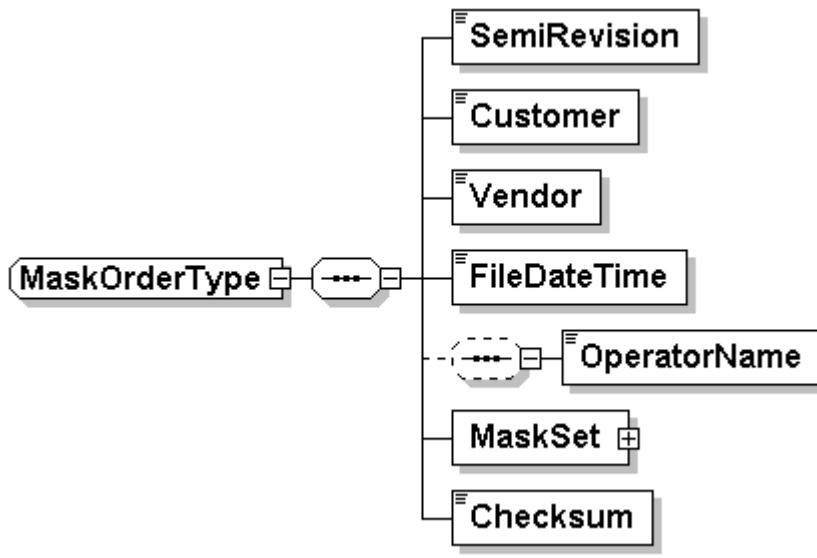
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[illegible]

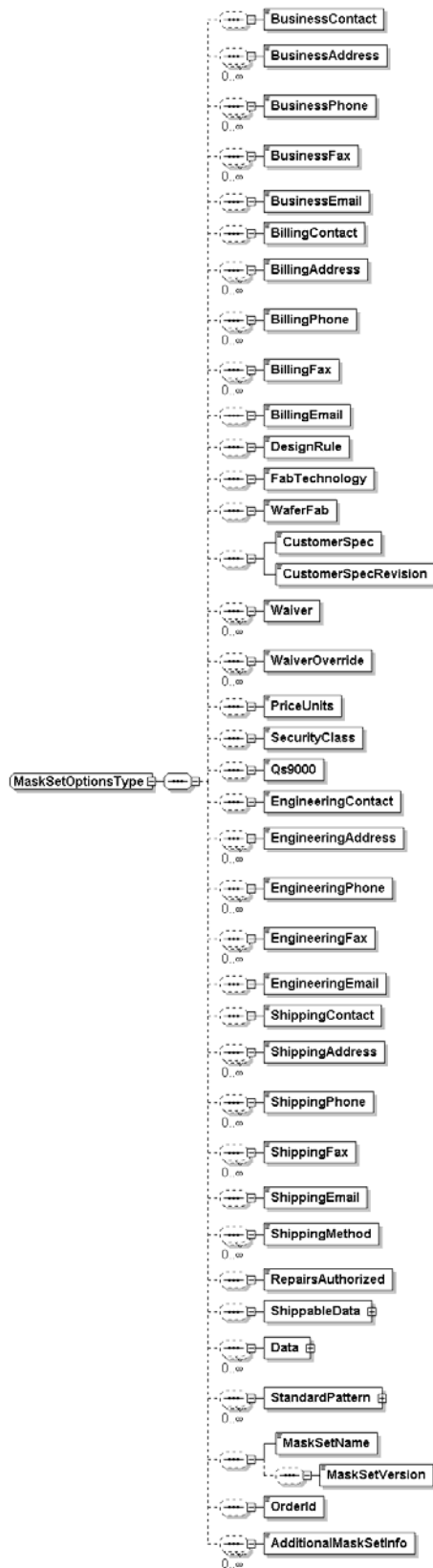
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diagram

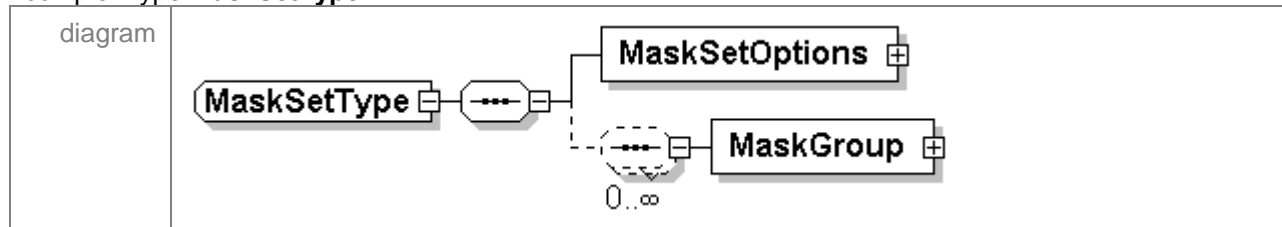


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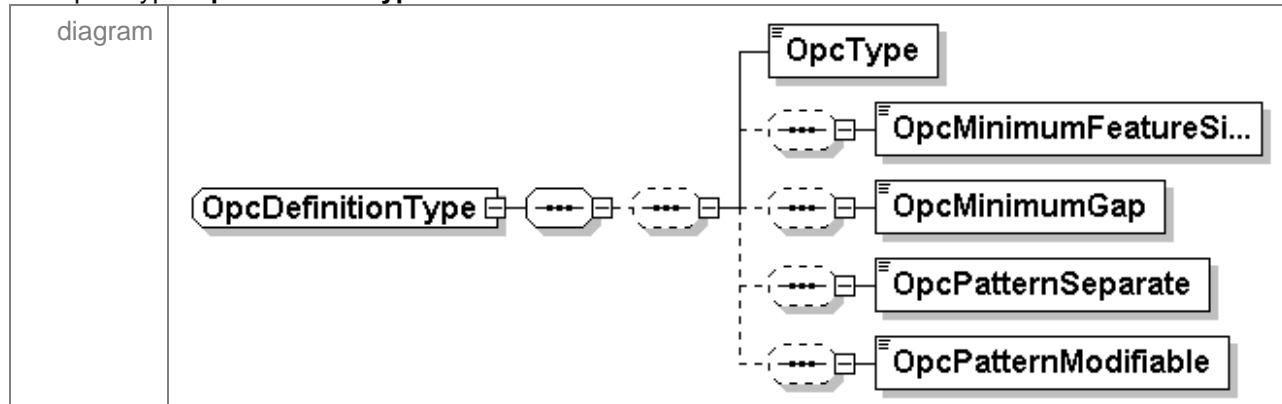
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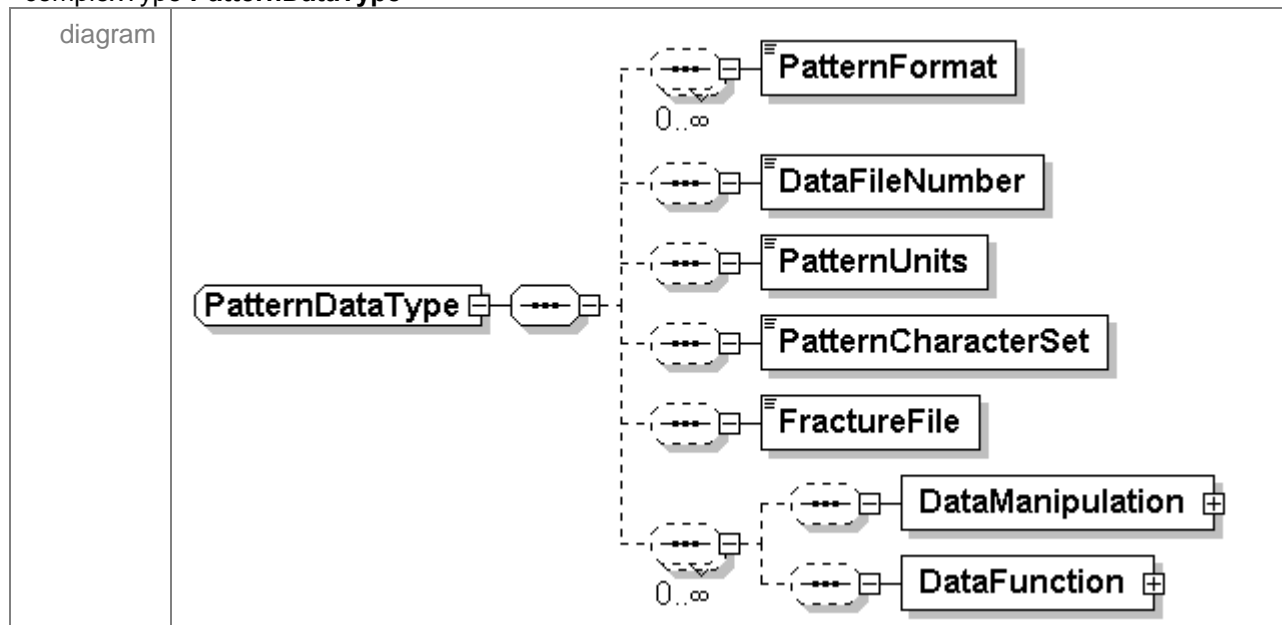
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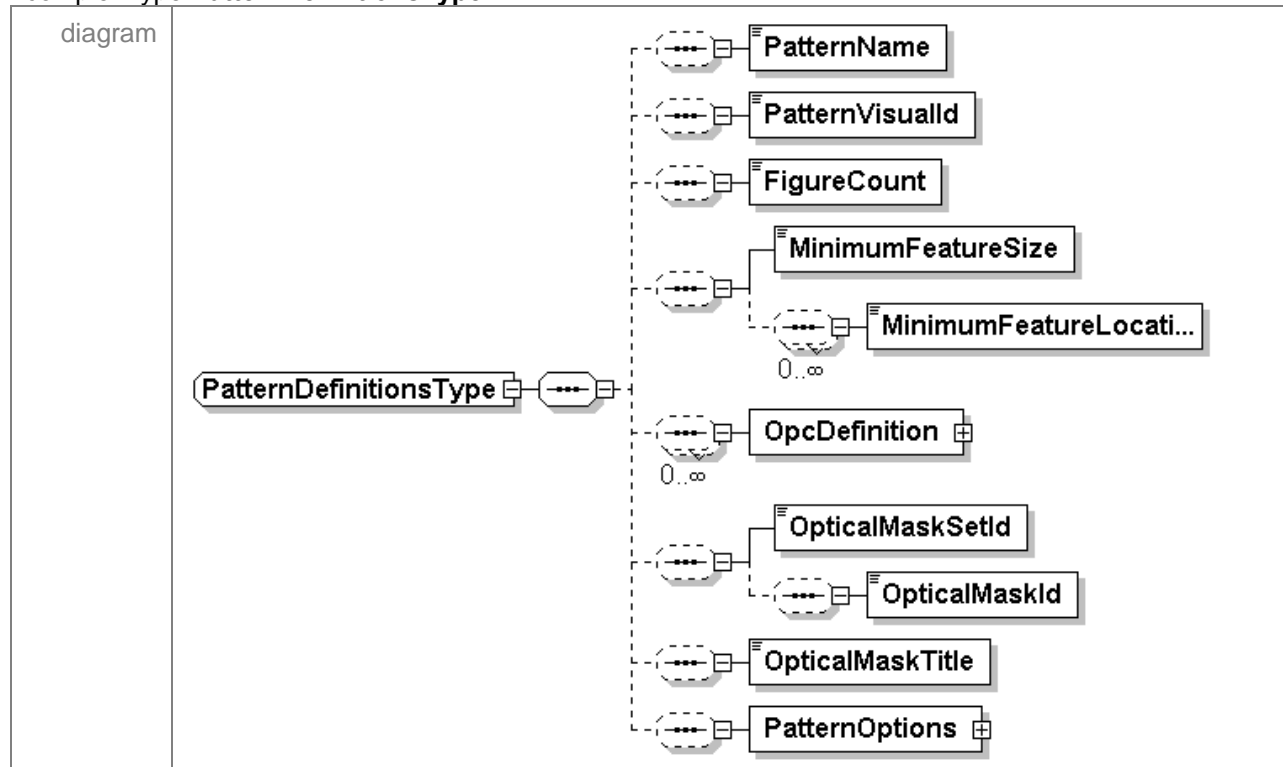
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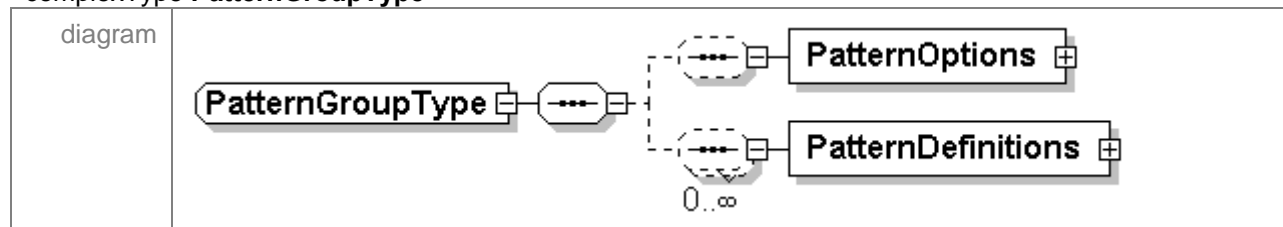
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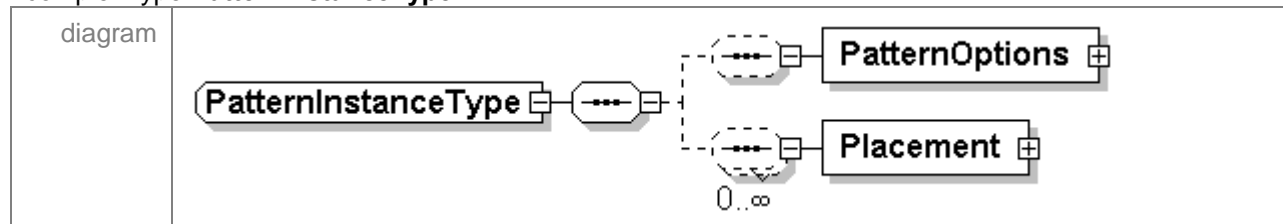
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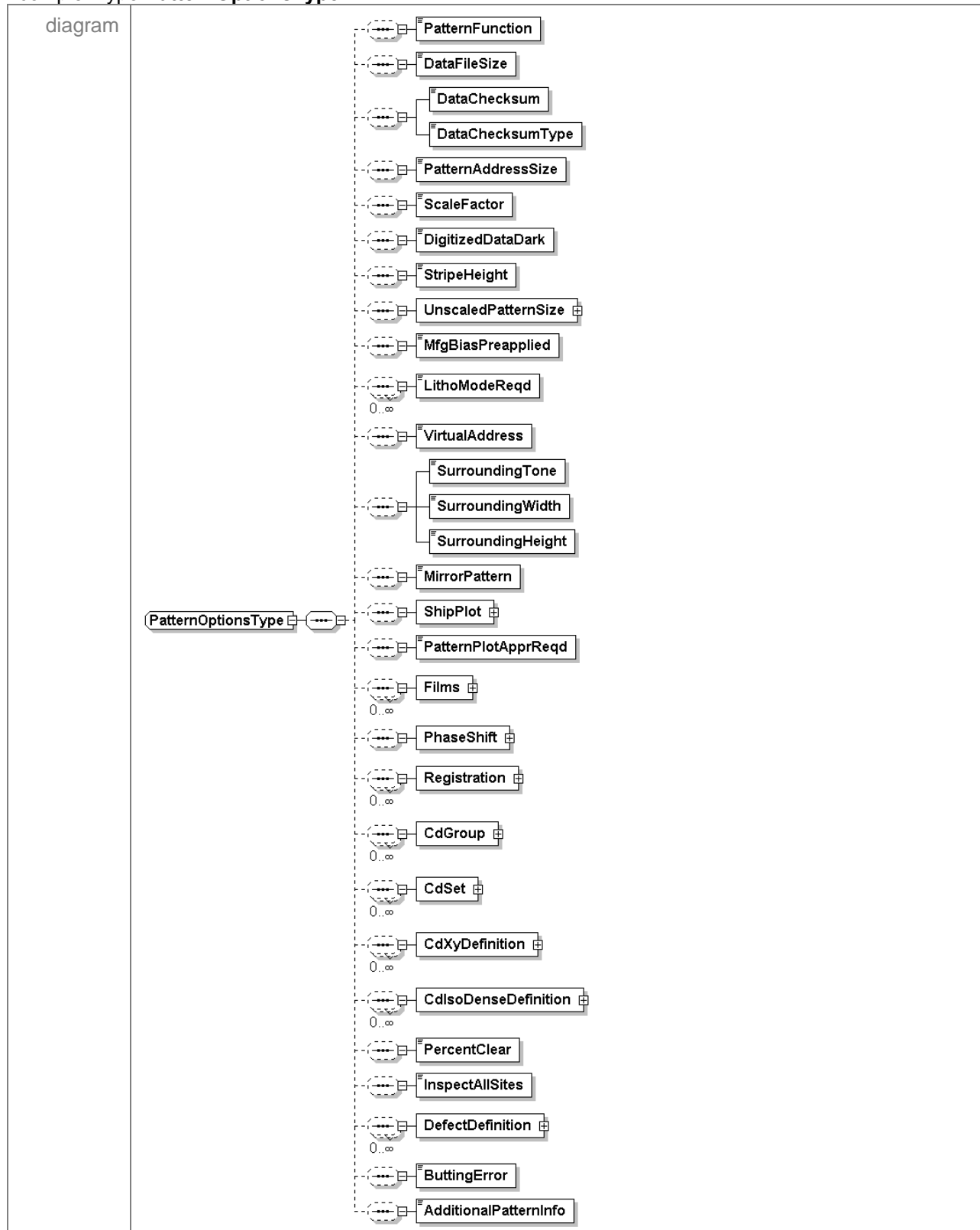
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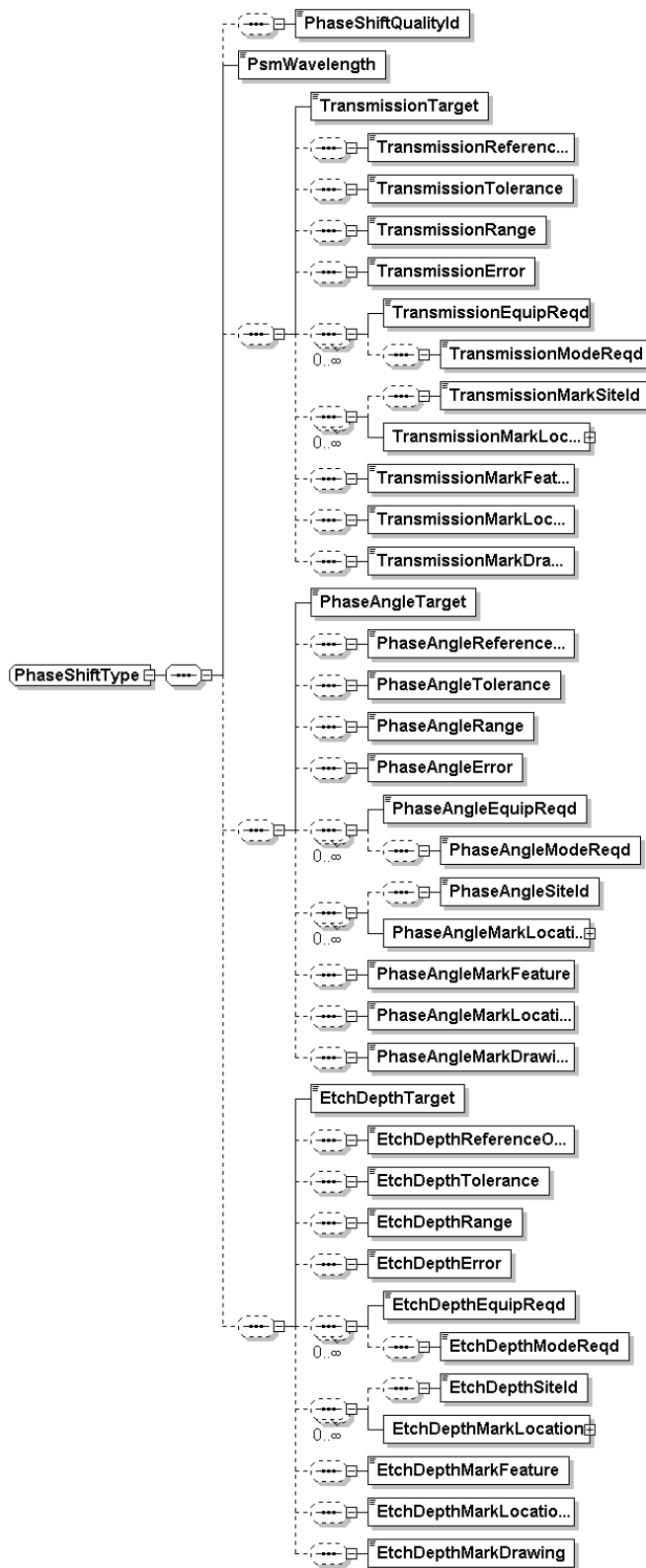


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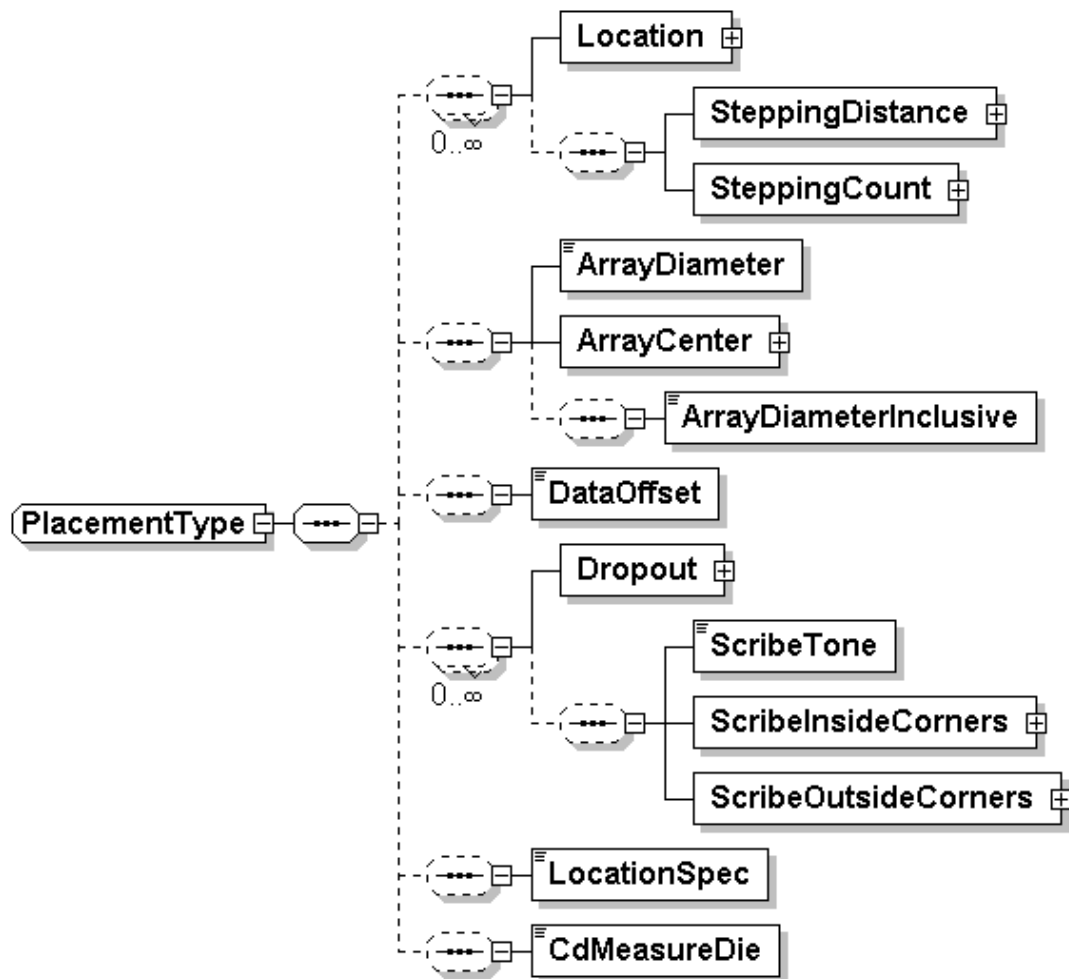
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diagram



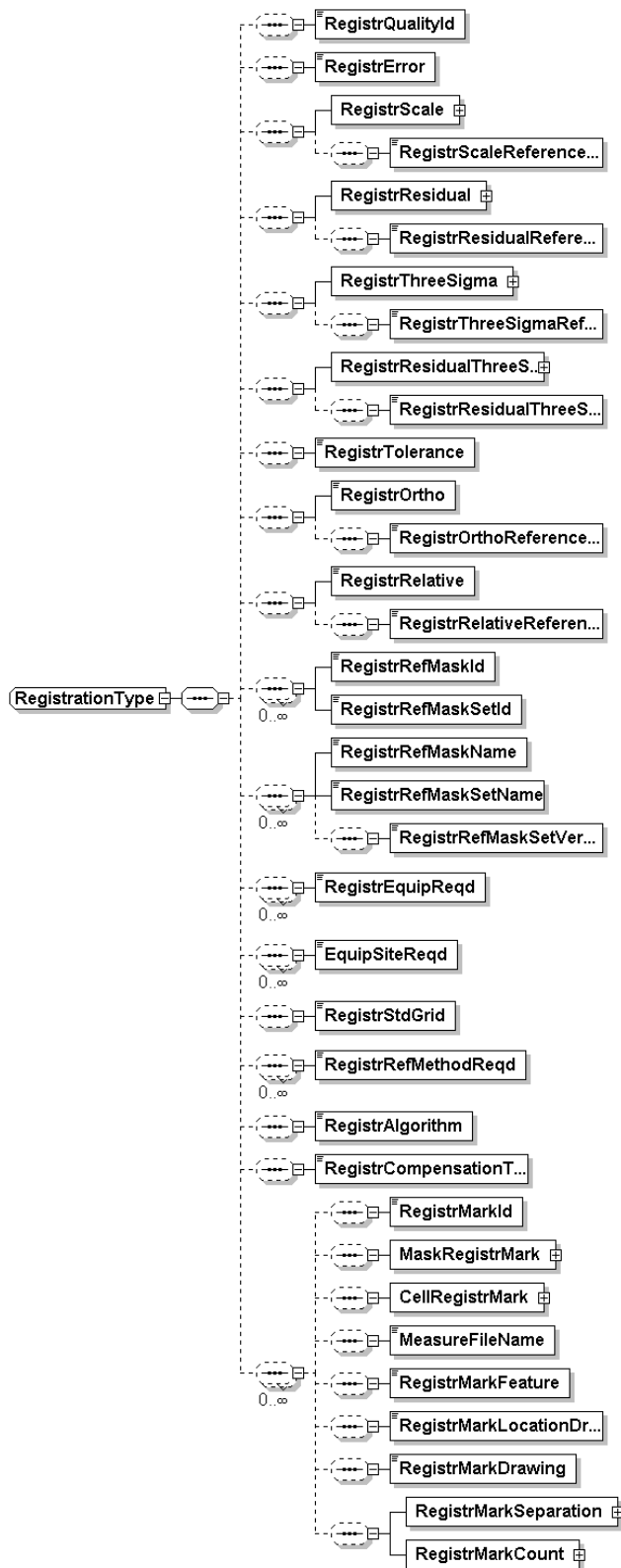
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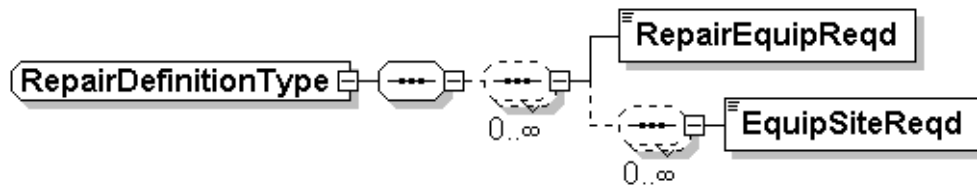
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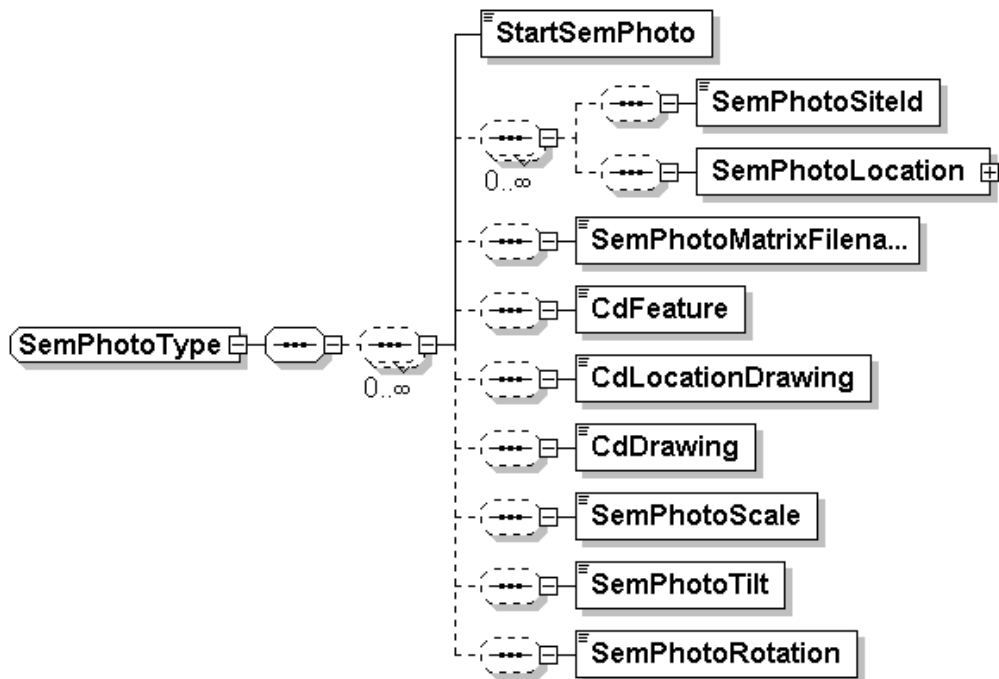
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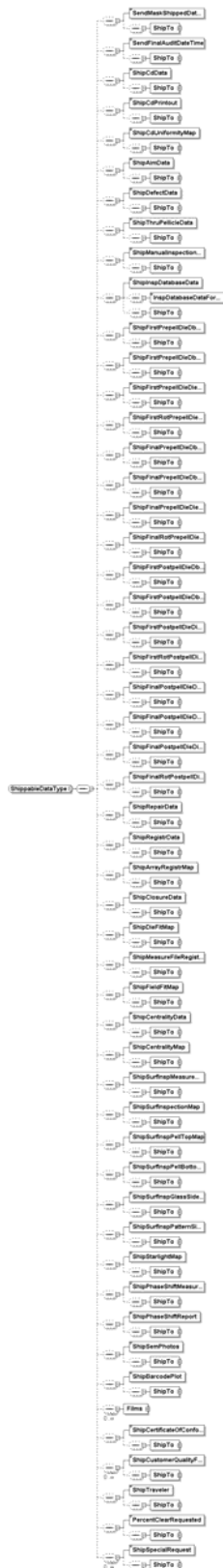
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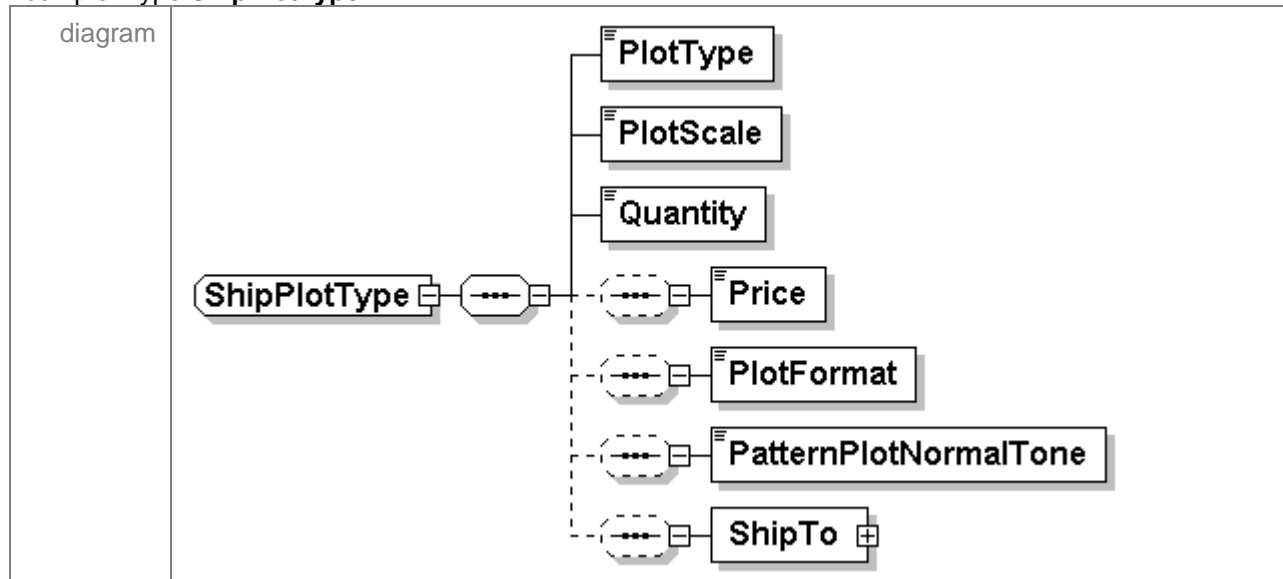


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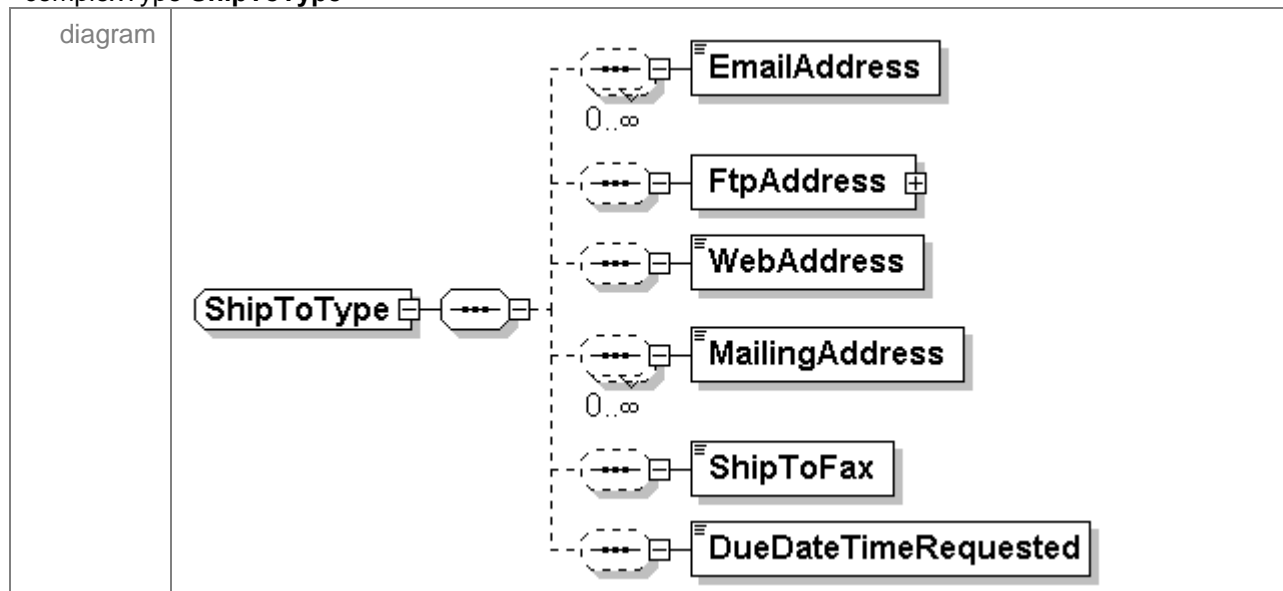
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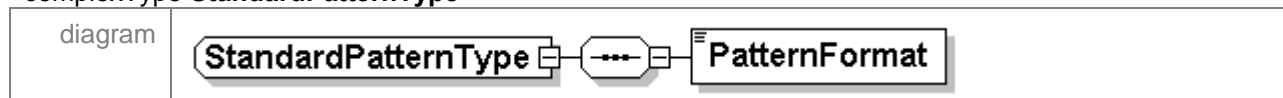
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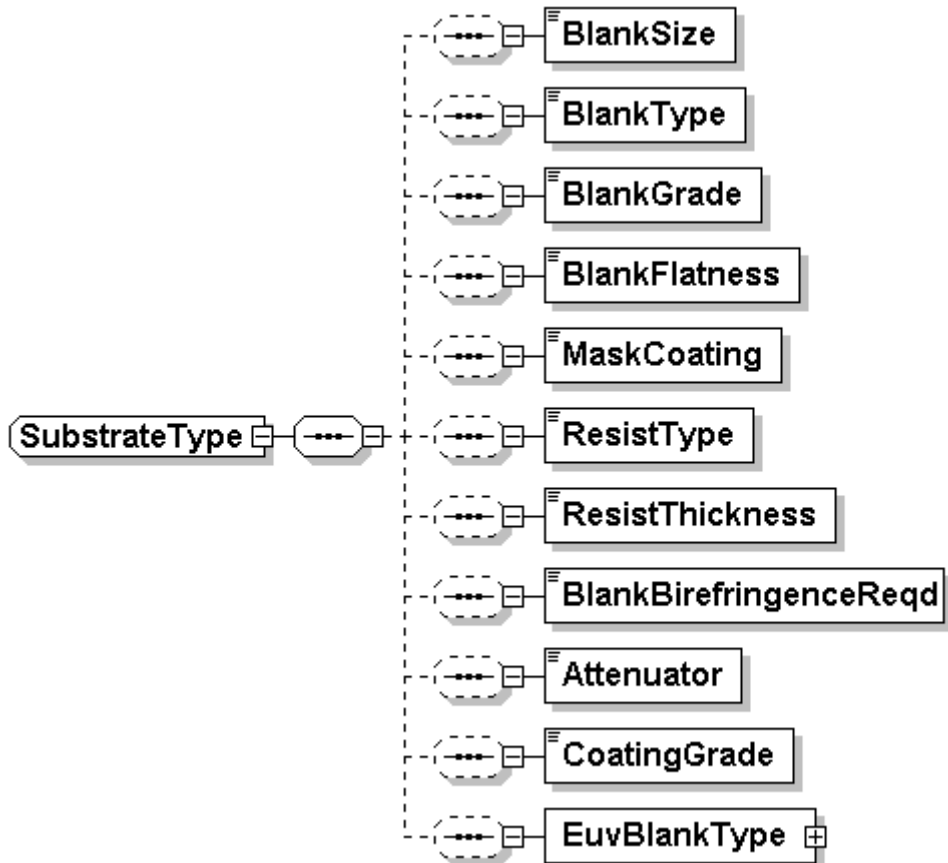


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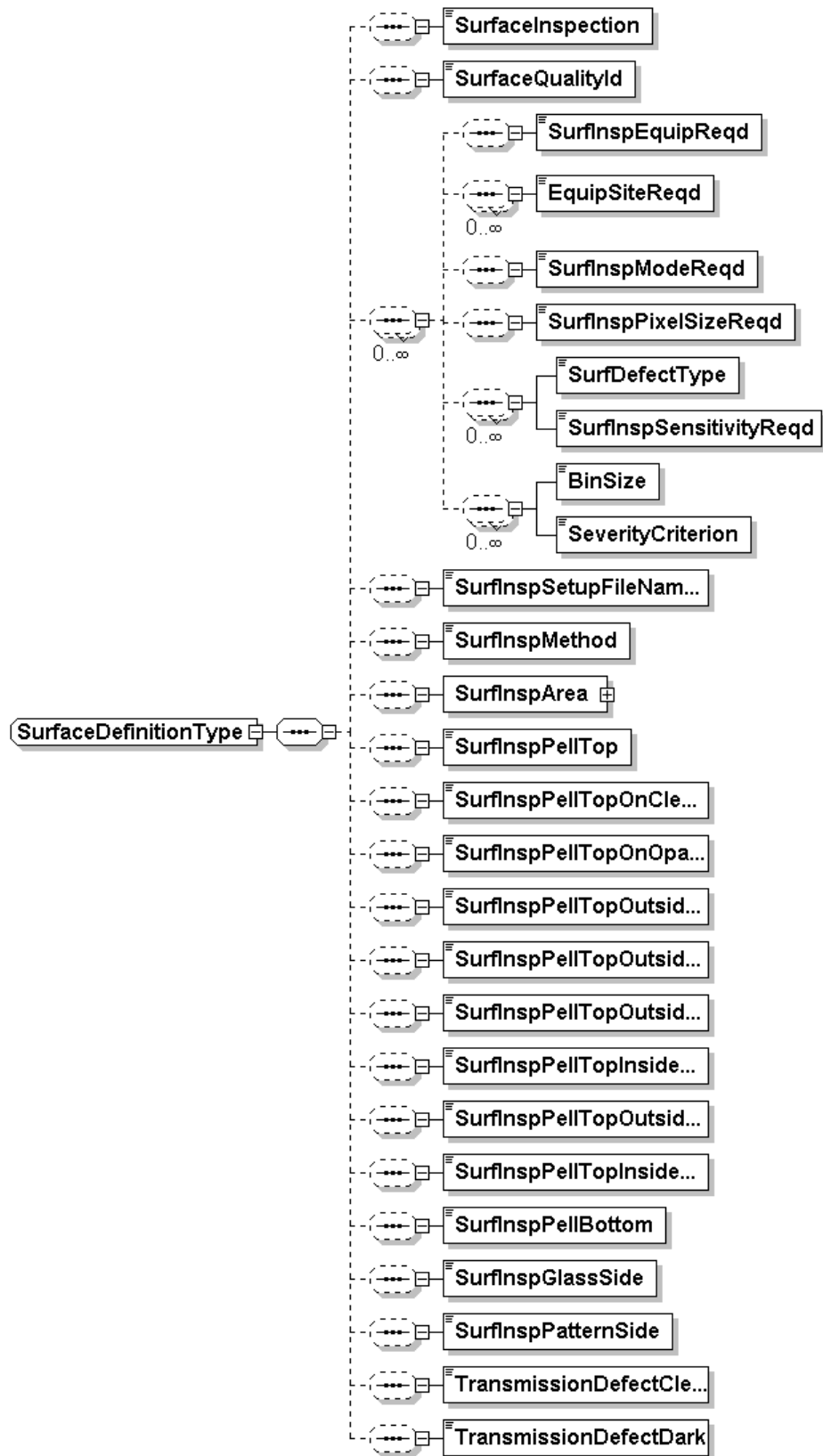
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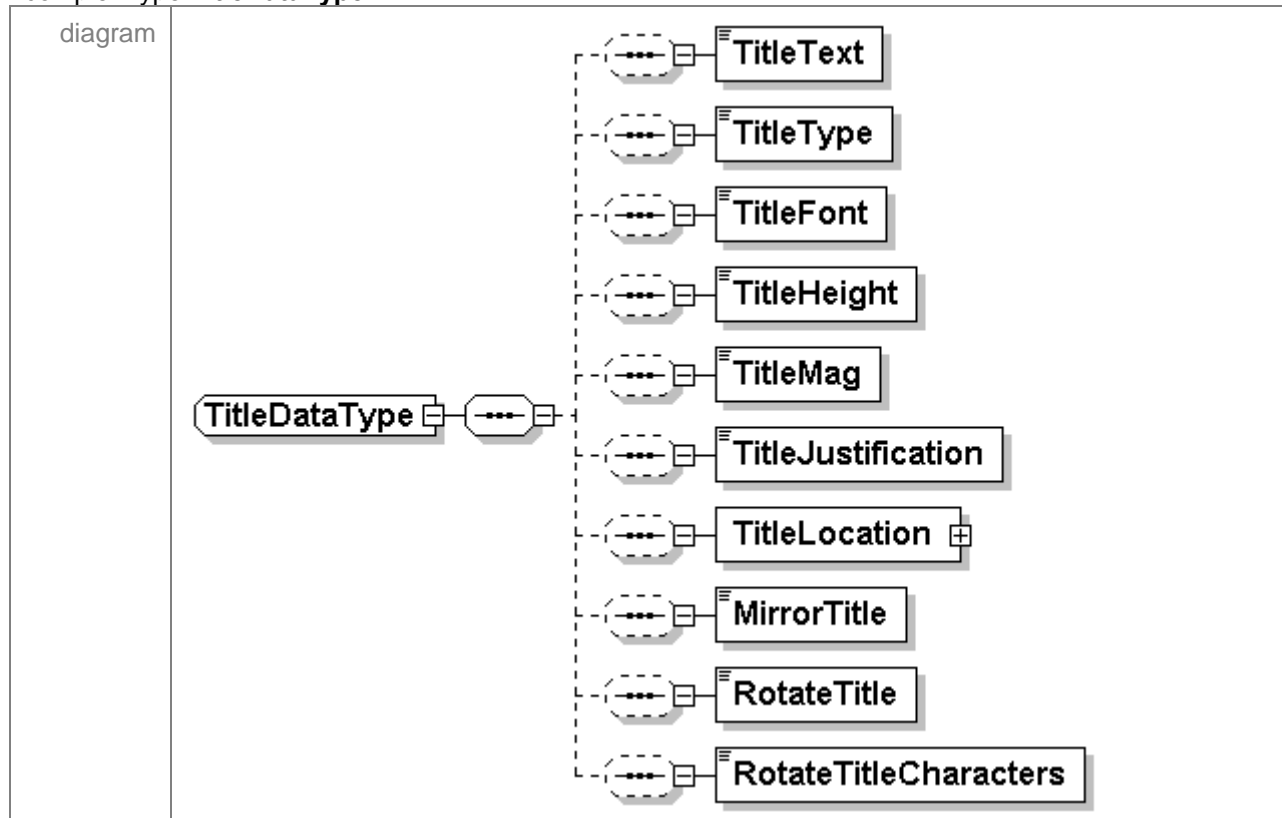


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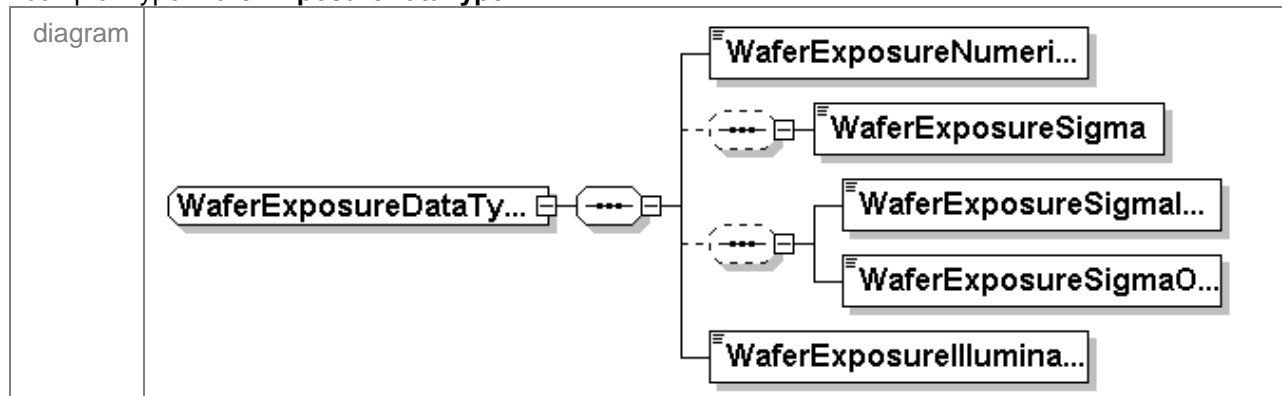
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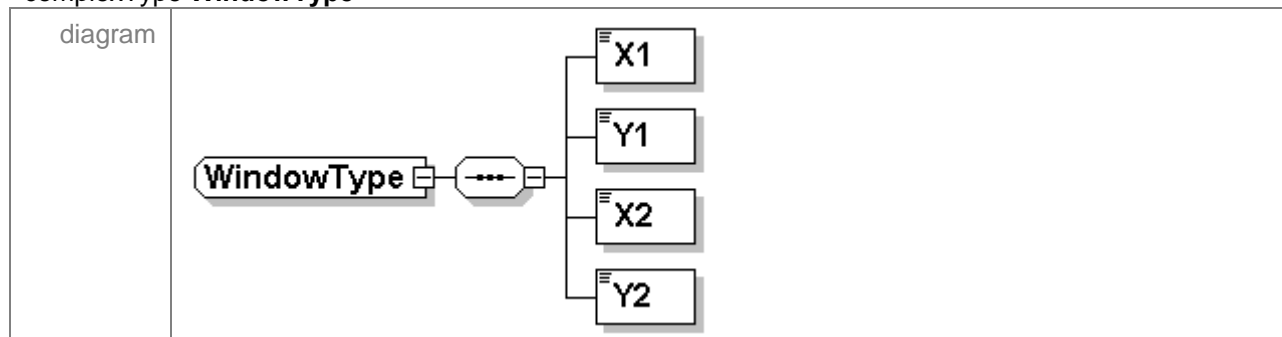
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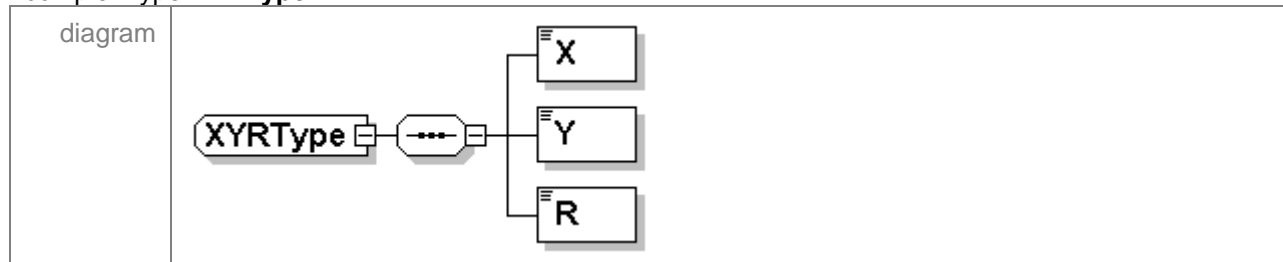
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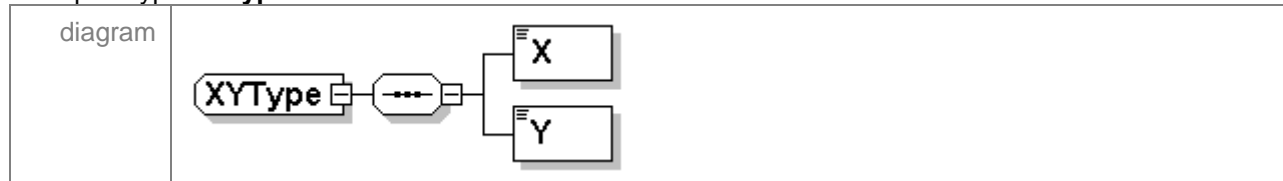
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complexType **XYRType**



complexType **XYType**



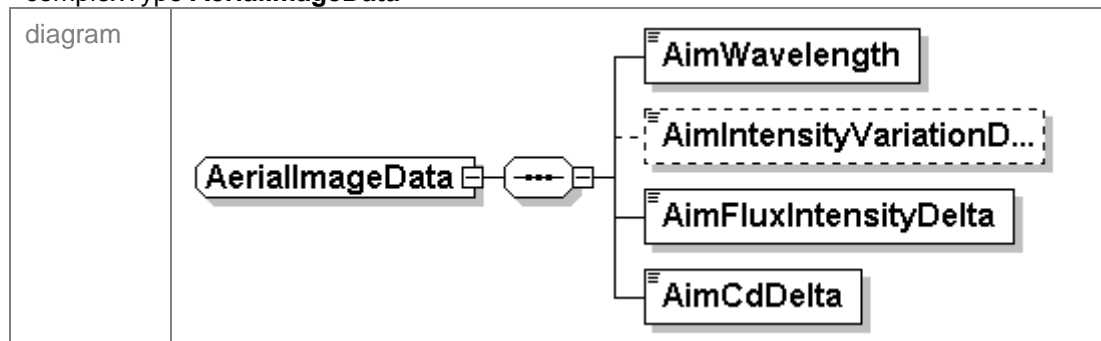
RELATED INFORMATION 10

SEMI PHOTOMASK MASK RESULTS STRUCTURE TREE DIAGRAM

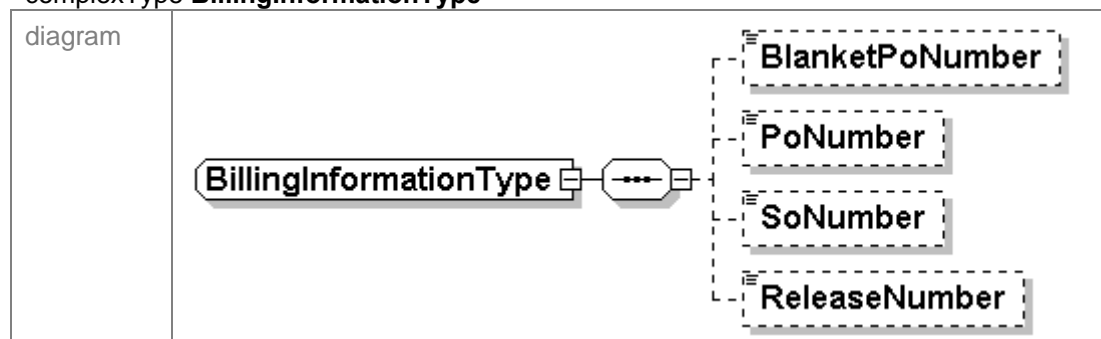
NOTICE: The information contained in this related information is not an official part of SEMI P10, and it is not intended to modify or supercede the official standard. Rather, this example is offered as an aid to visualizing possible output from software which might implement the <mask_results> portion of the standard in XML format.

Note: All portions of the tree were scaled to fit within single pages. In cases where a portion of the tree is very long, this causes the text to be very small. Such portions of the tree will be more easily read by viewing them with a text editor or text viewer and using an increased magnification.

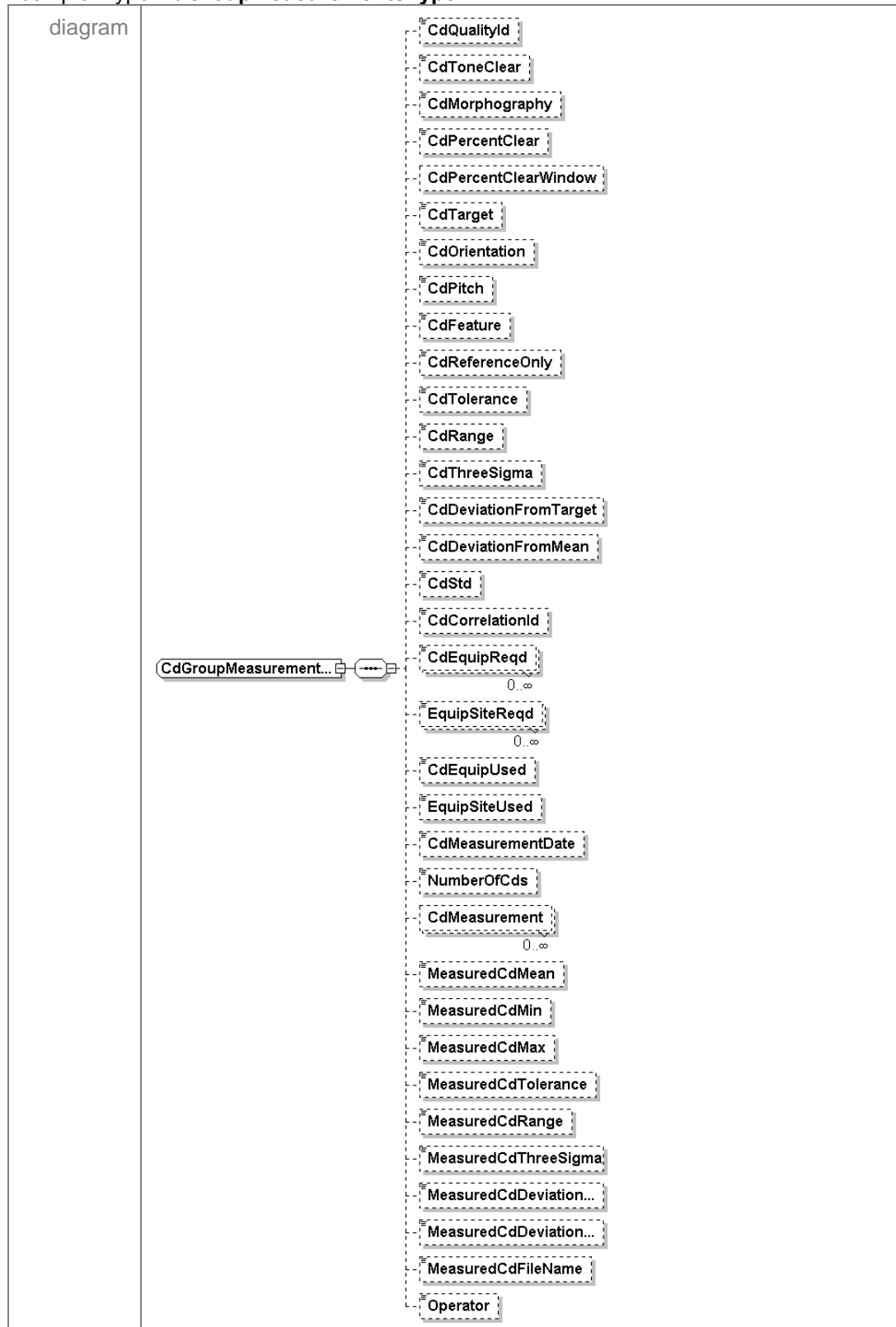
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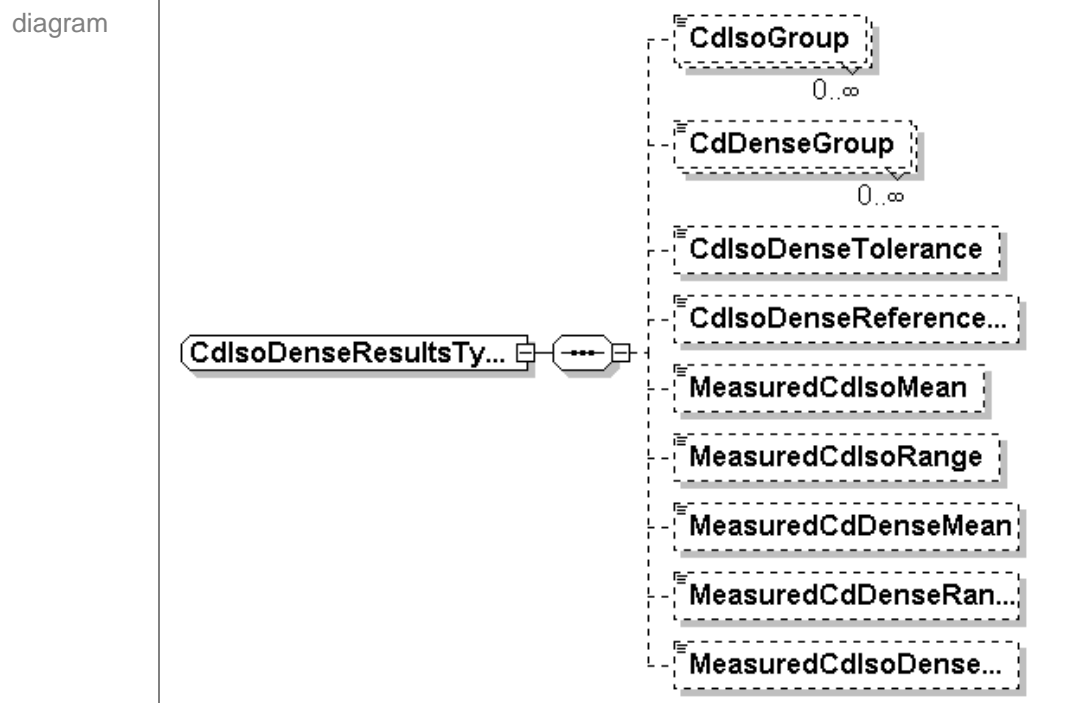
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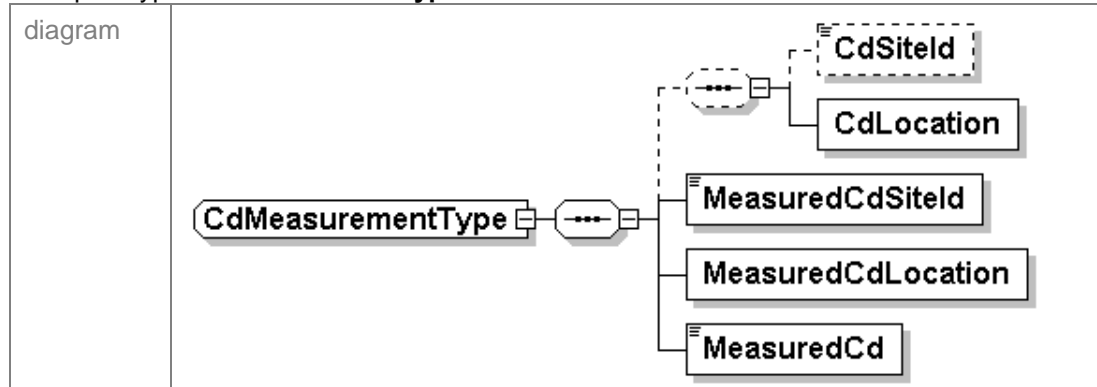
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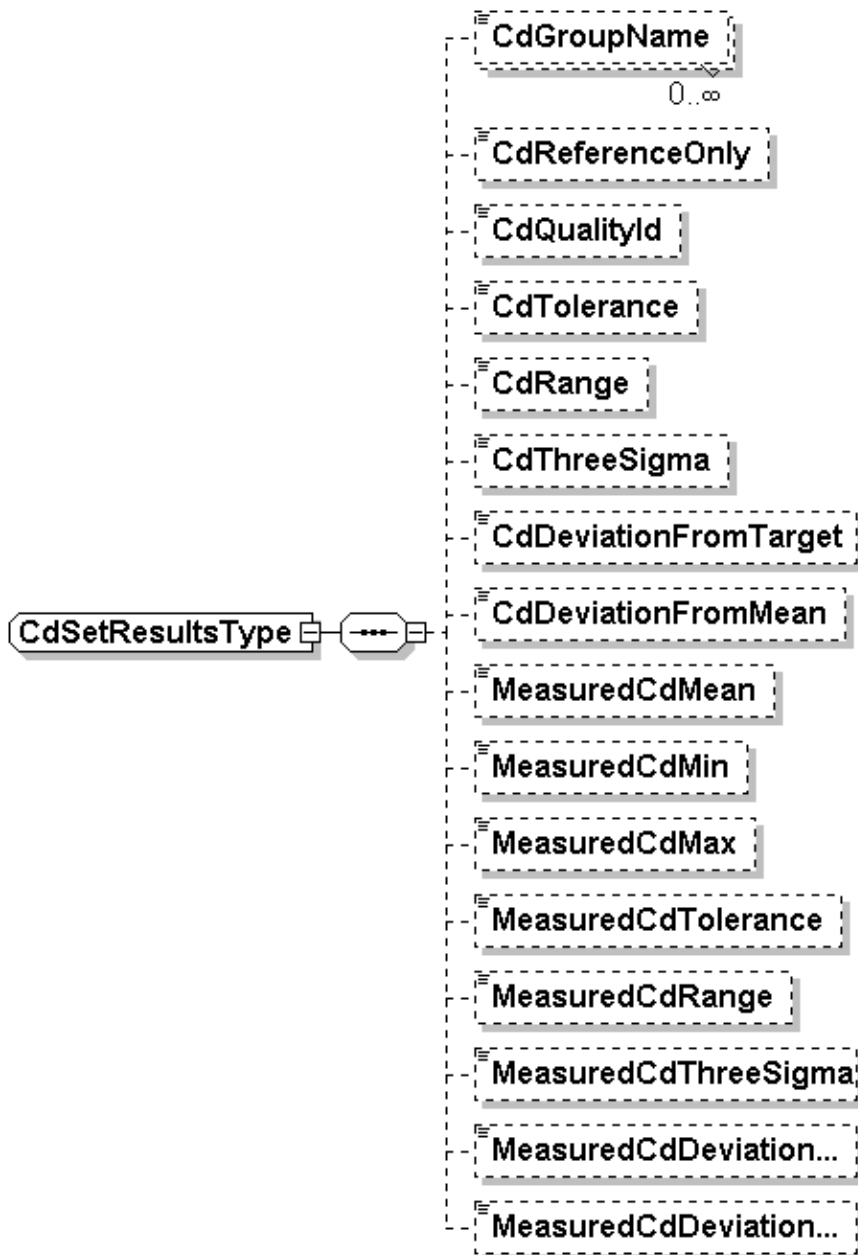


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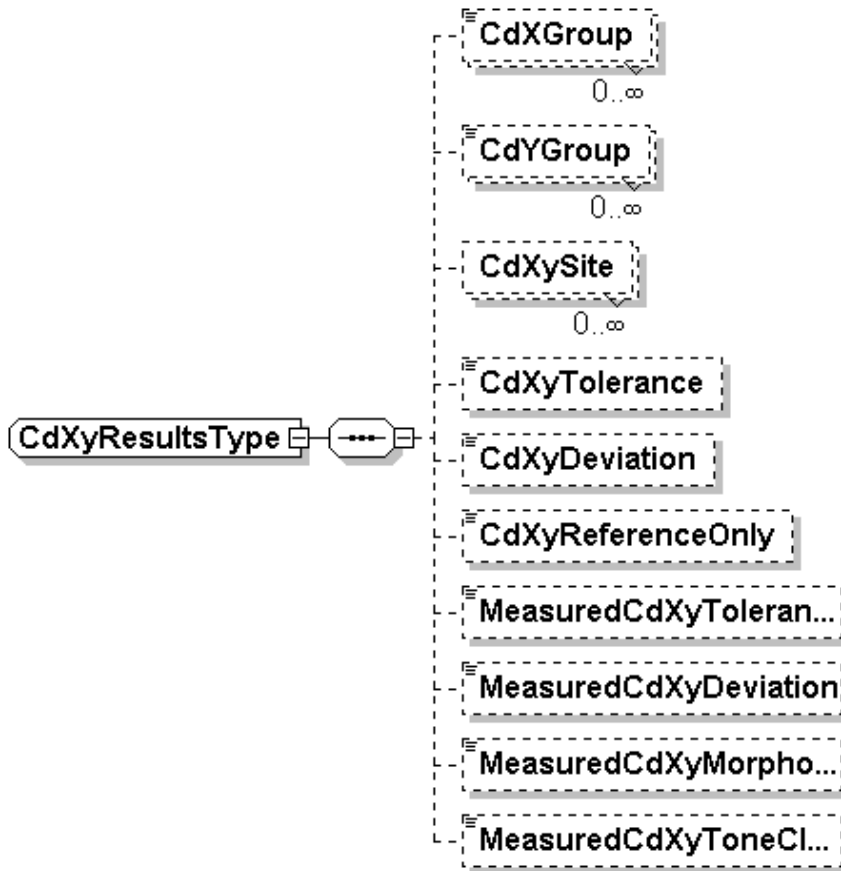
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diagram



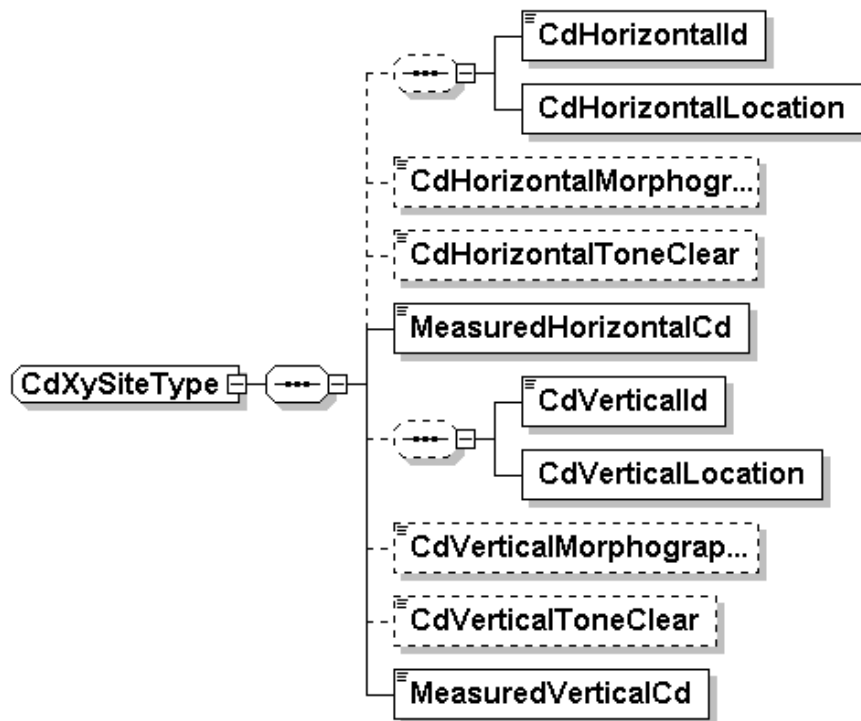
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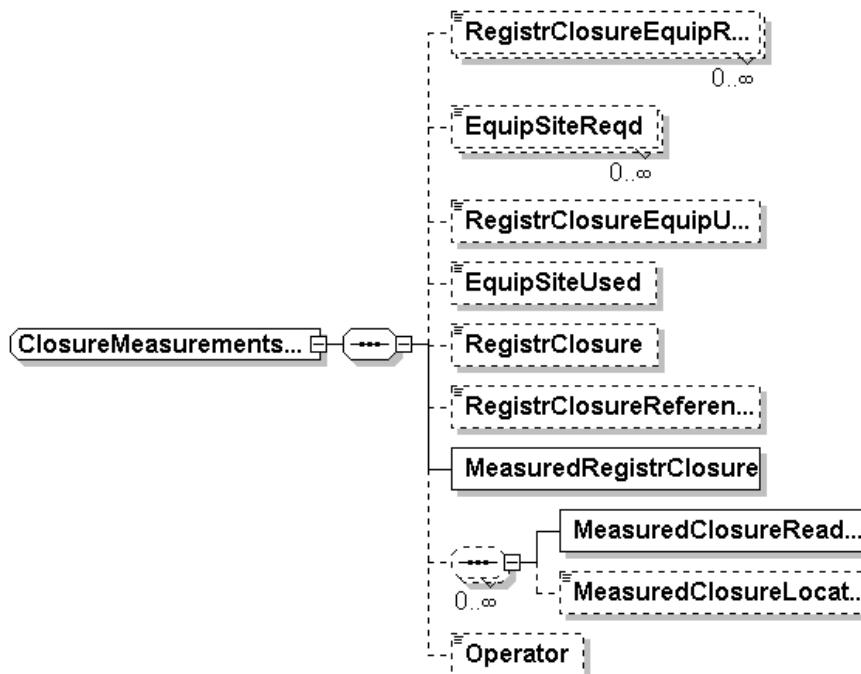
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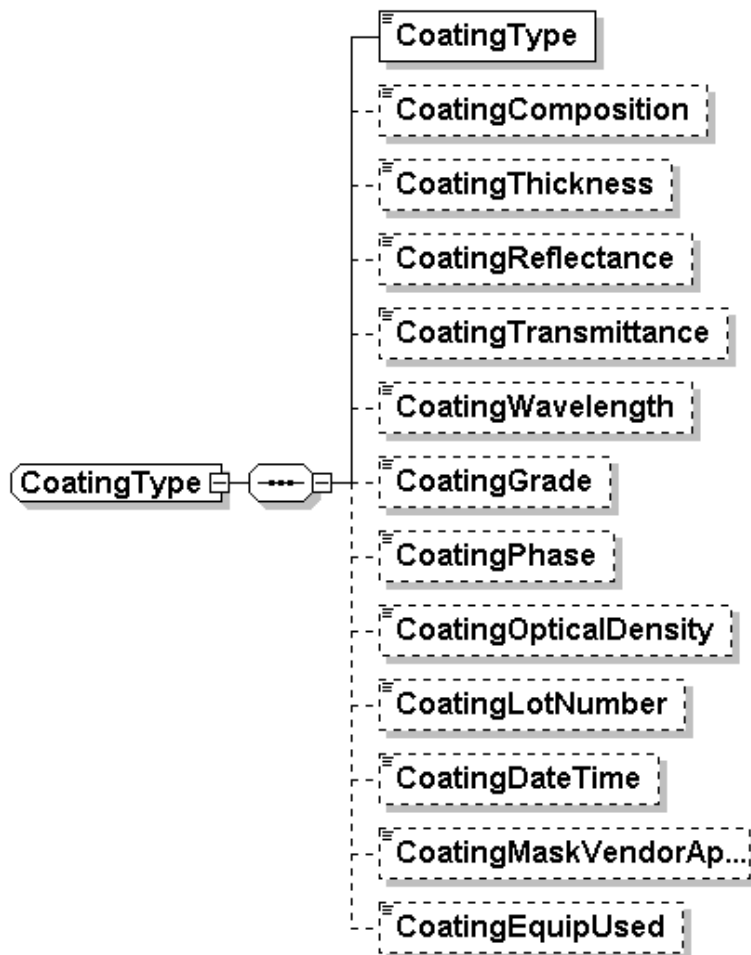
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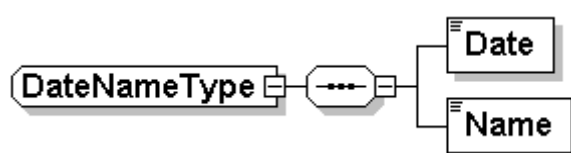
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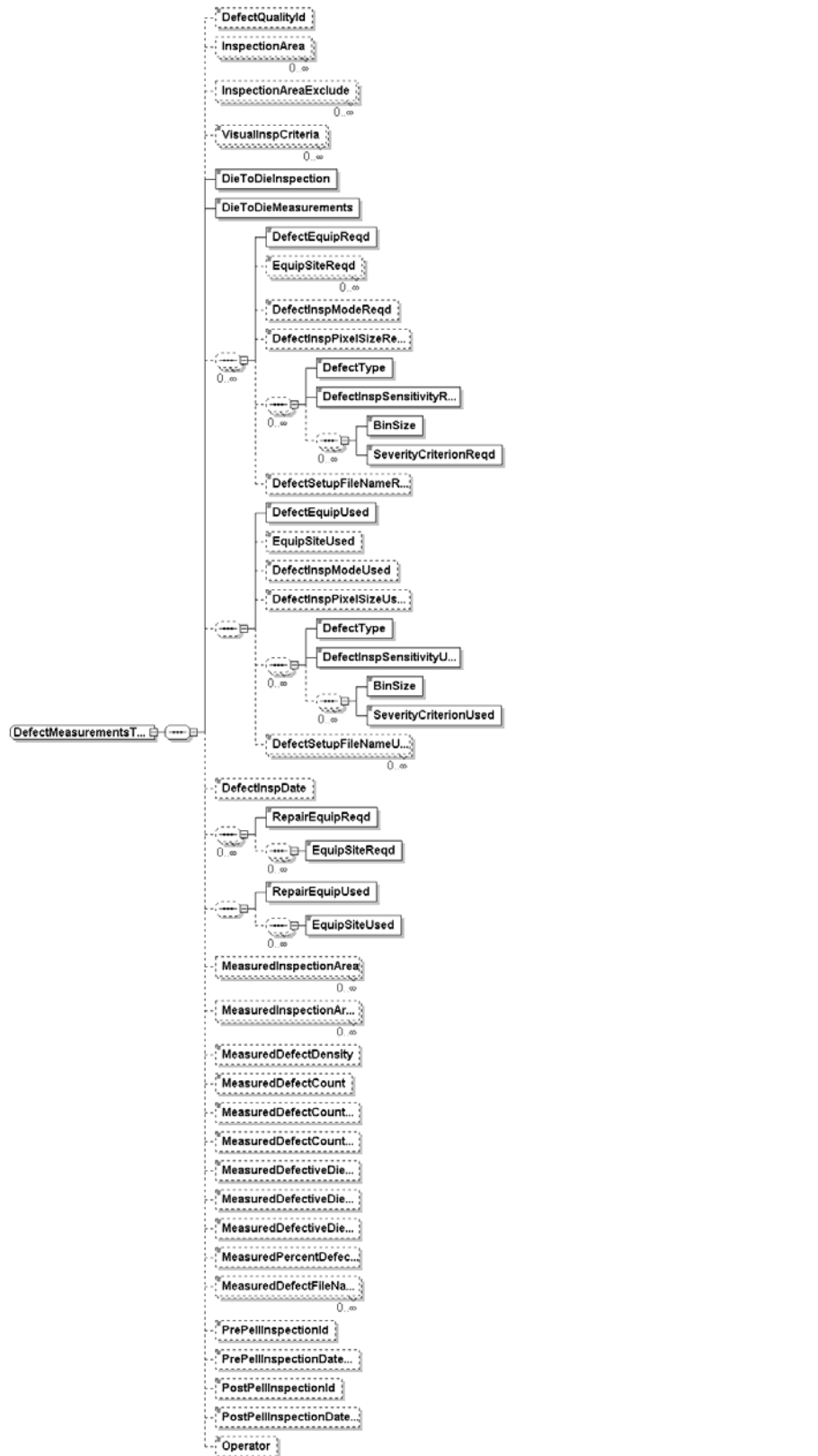
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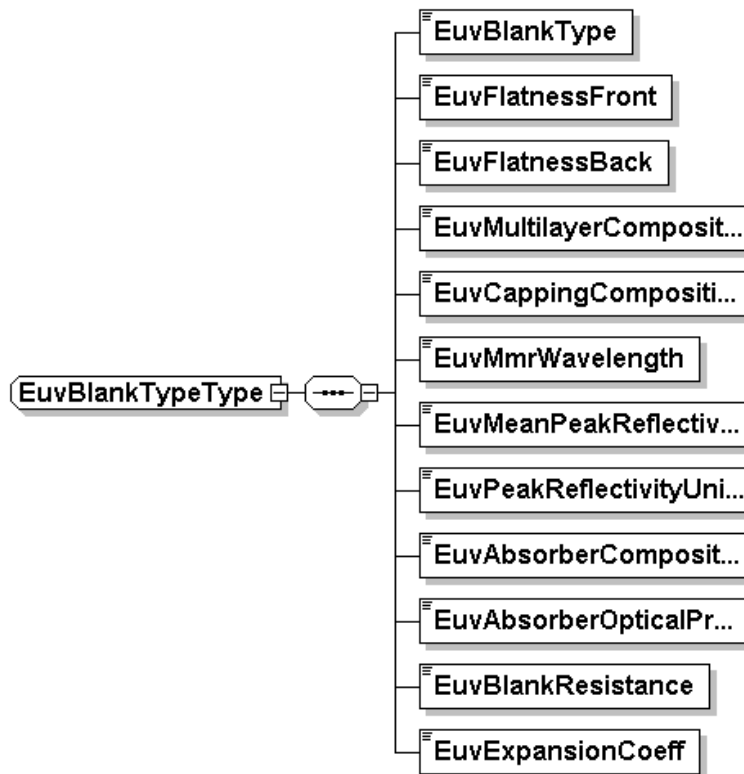
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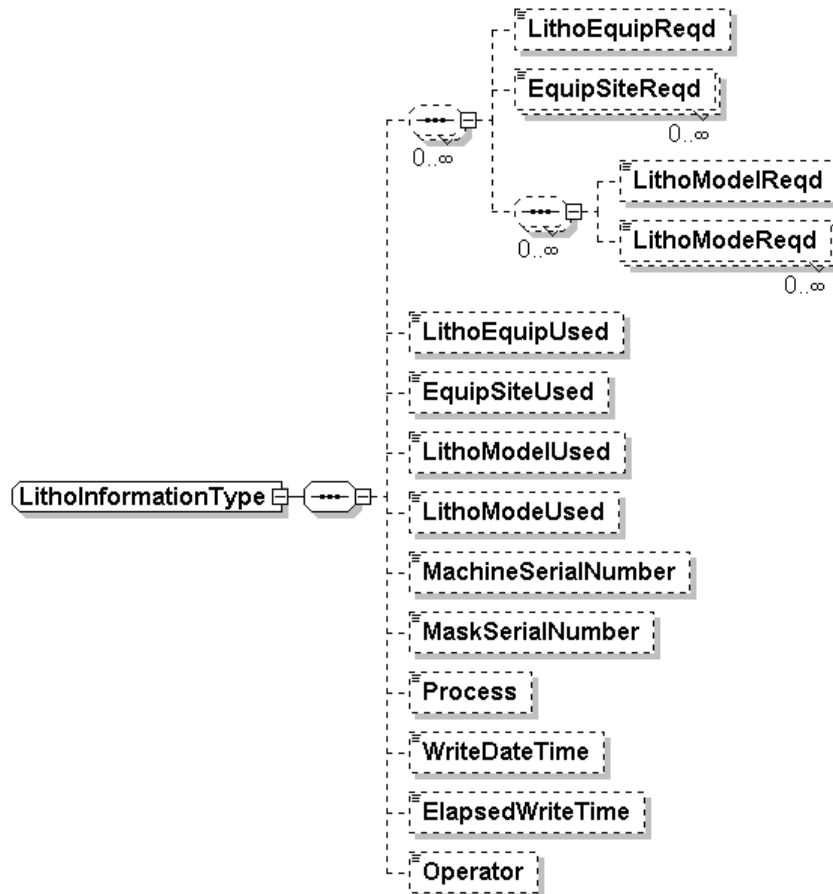
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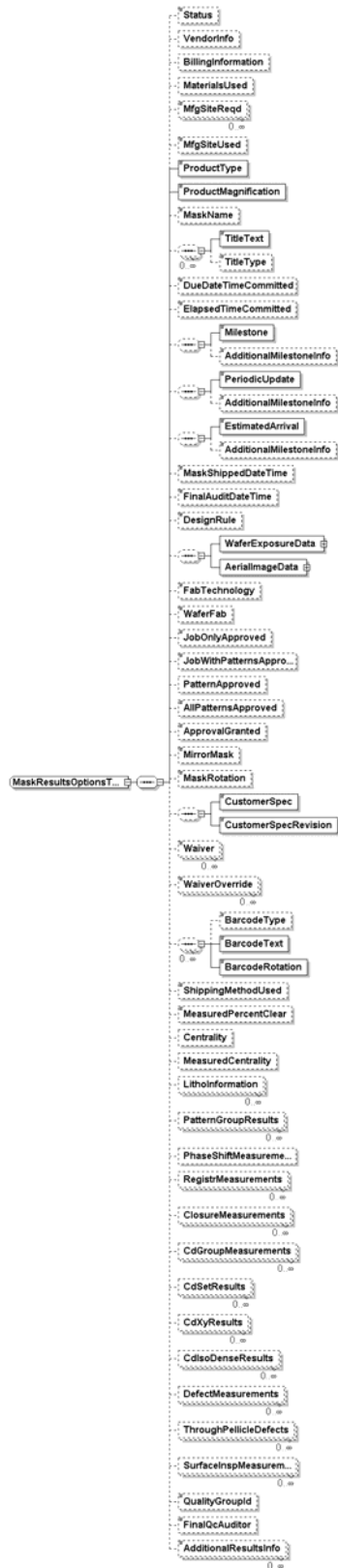
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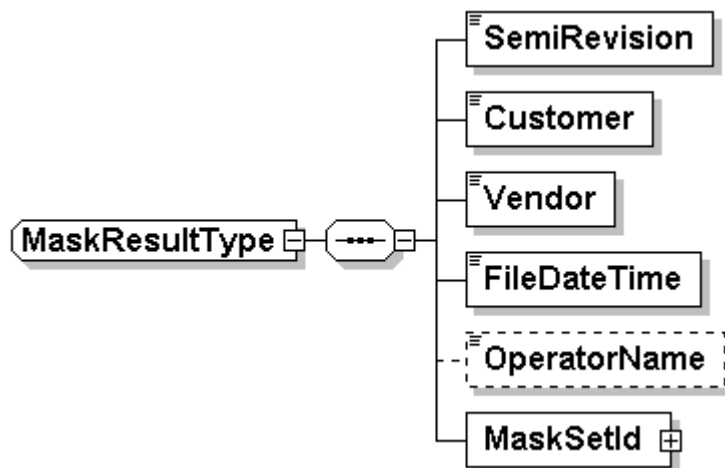
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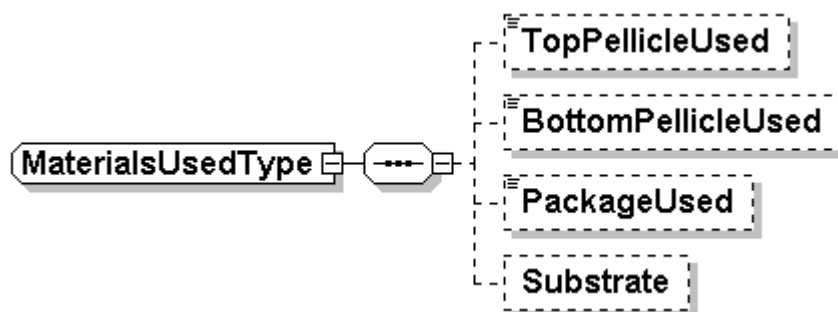
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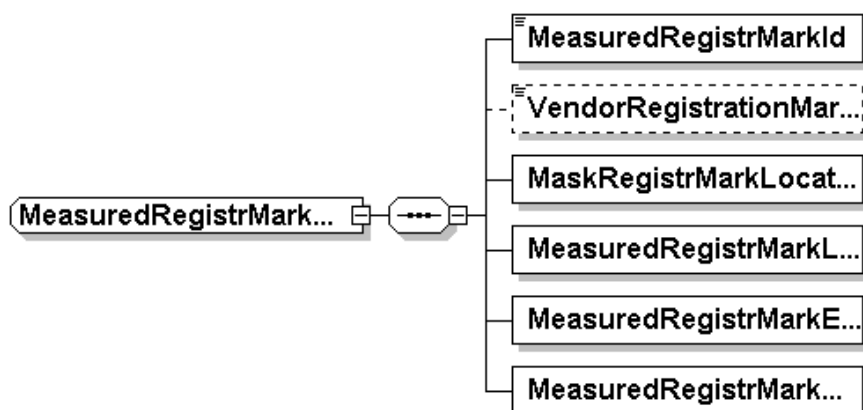
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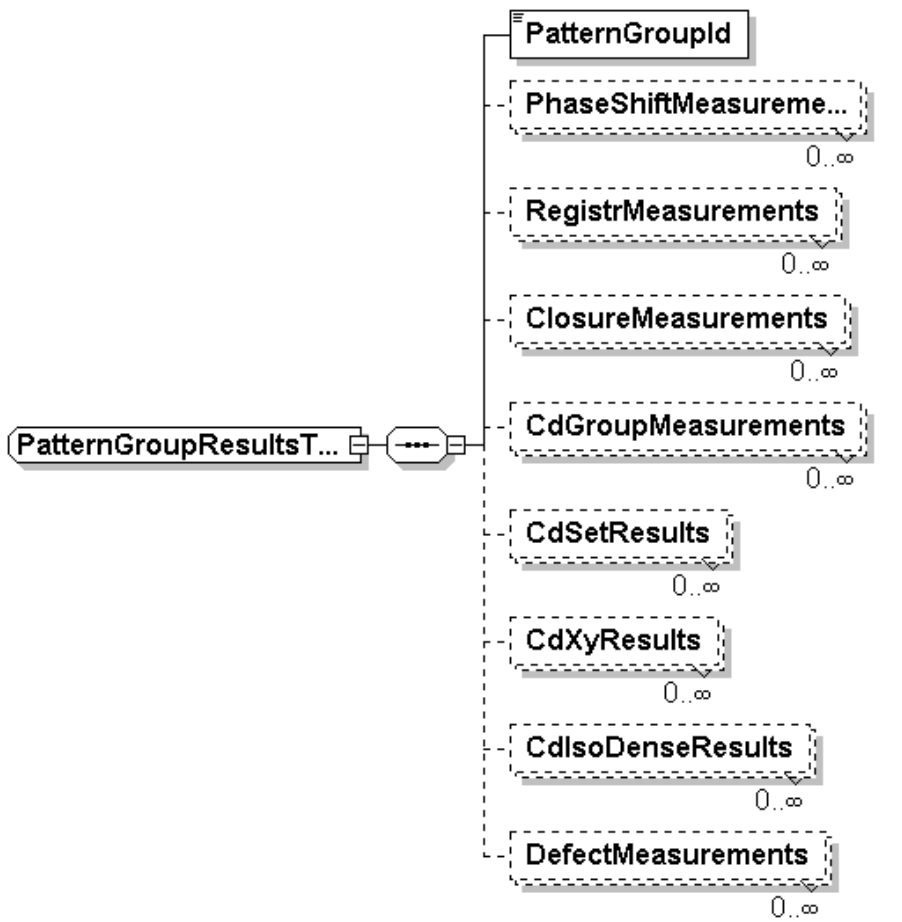
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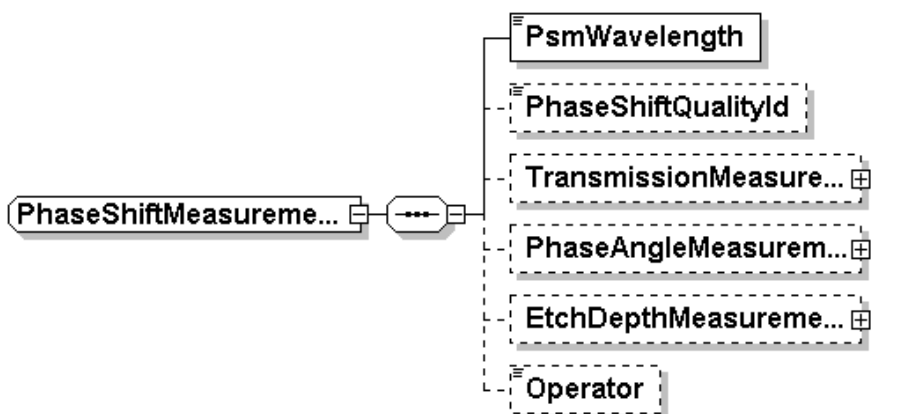
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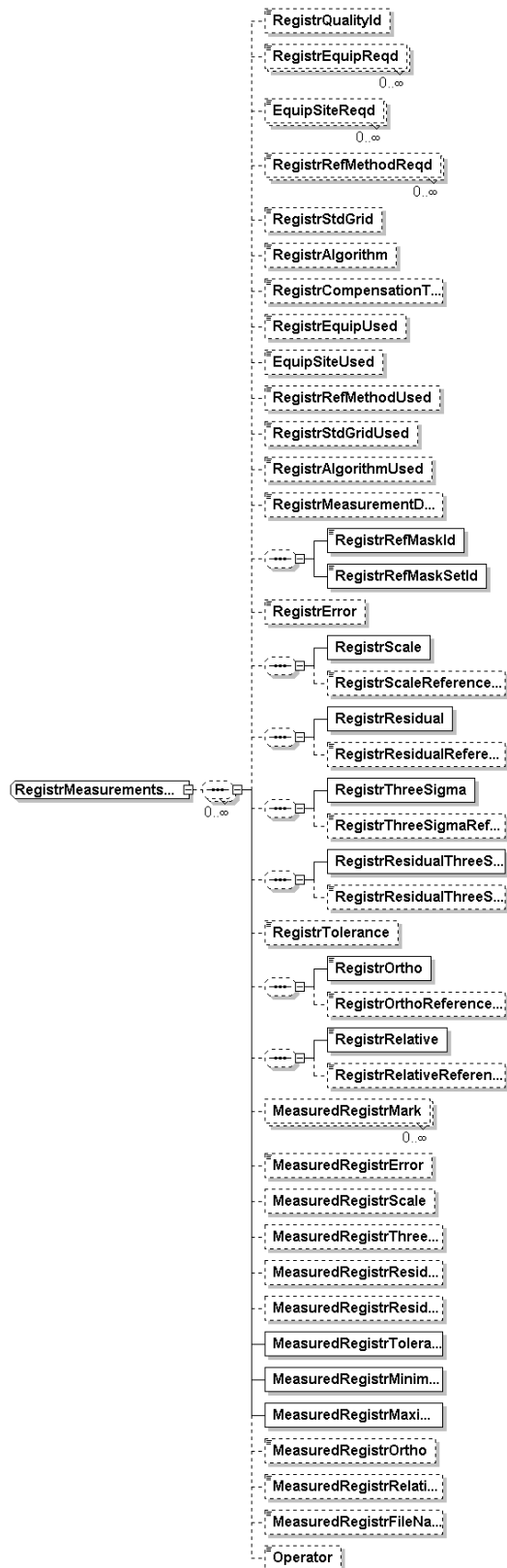
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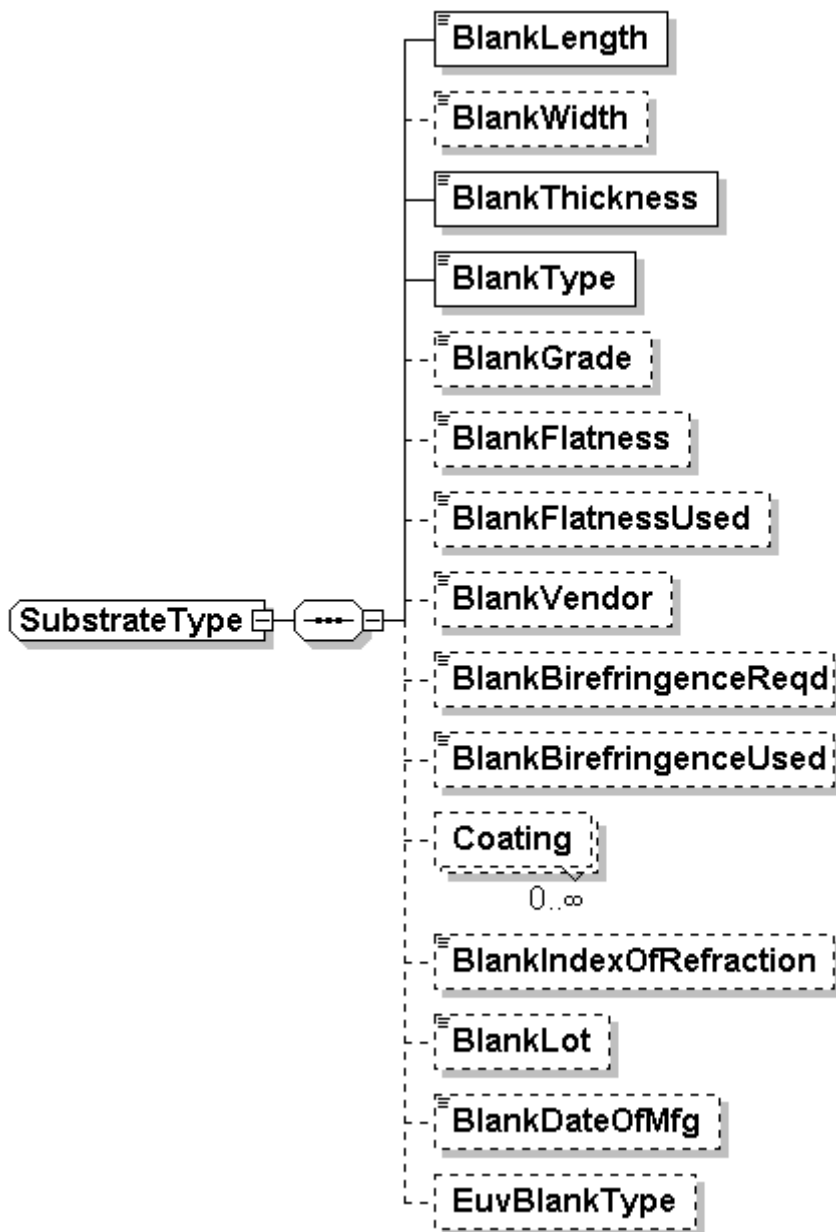
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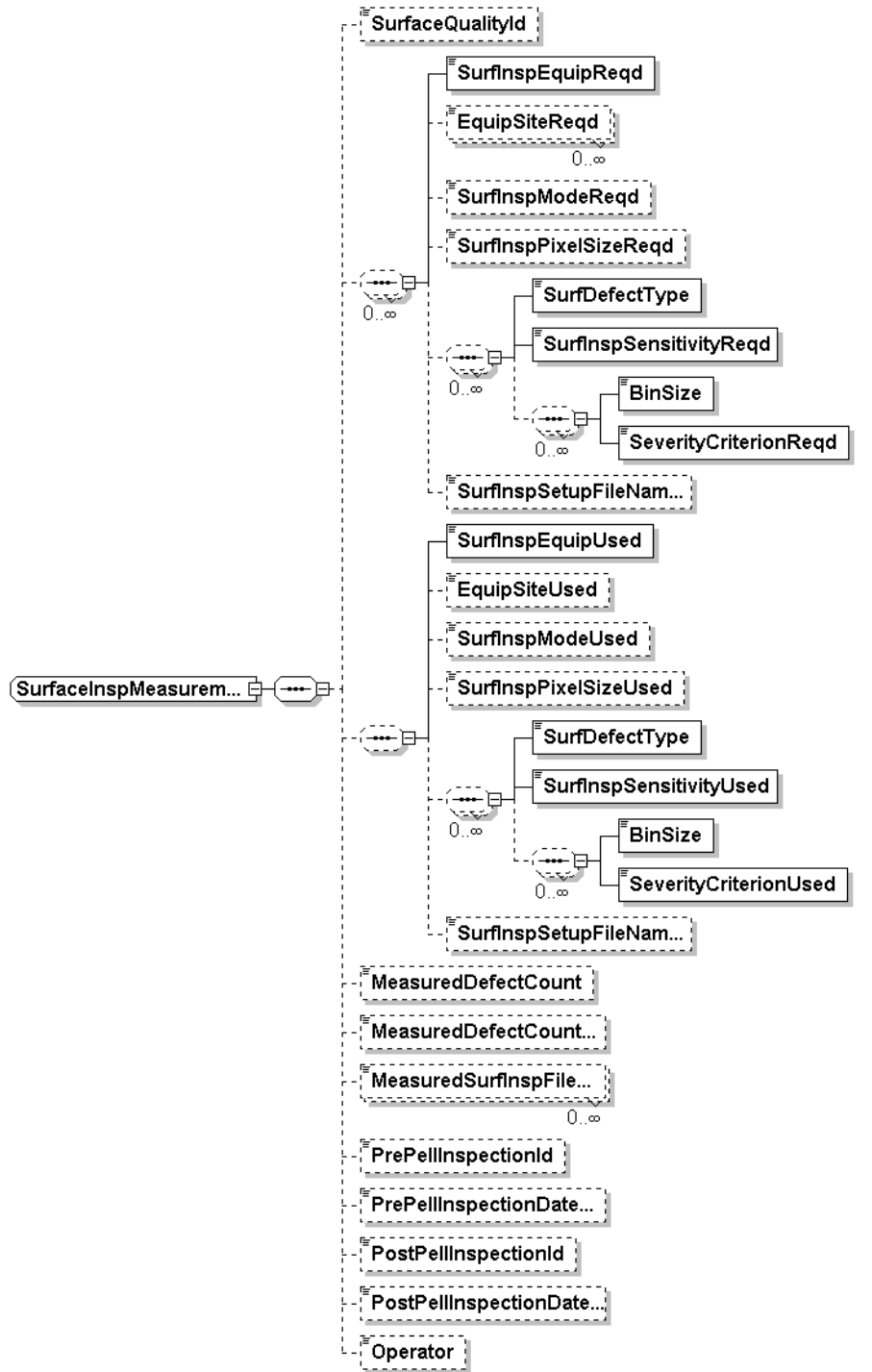
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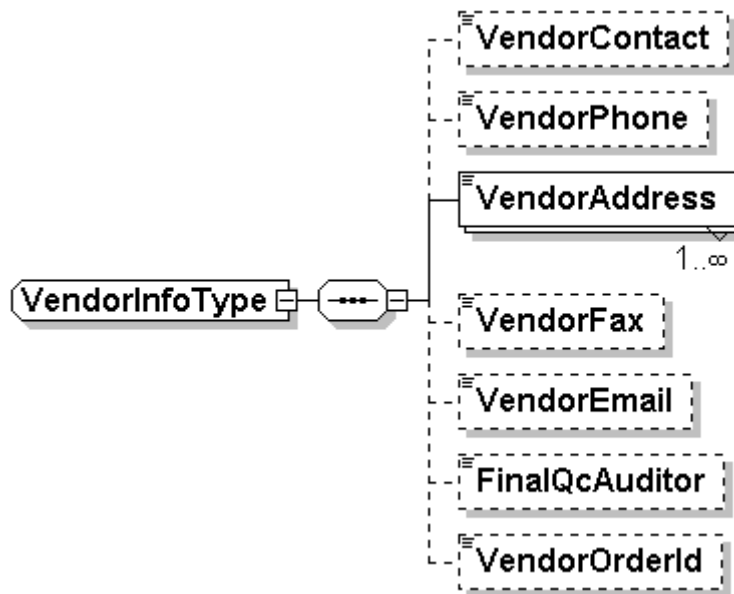
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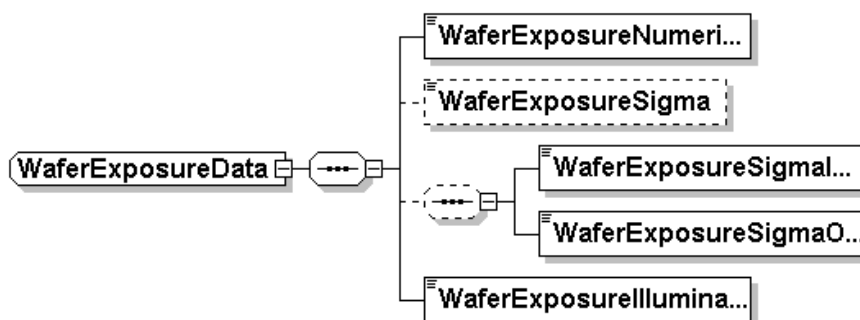
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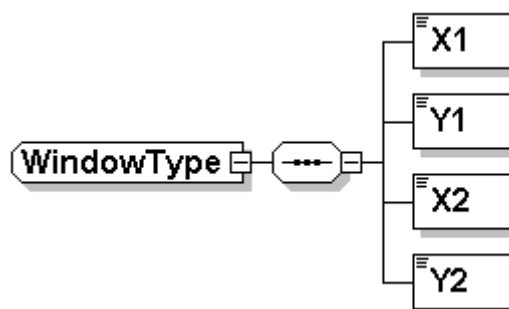
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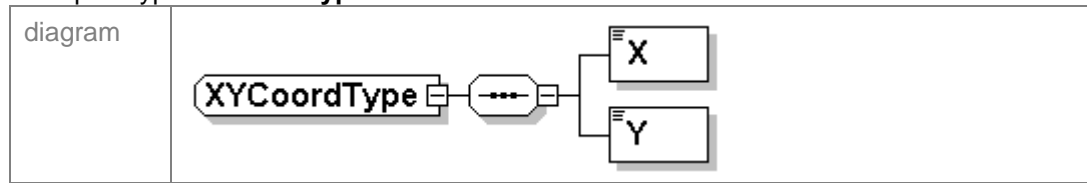


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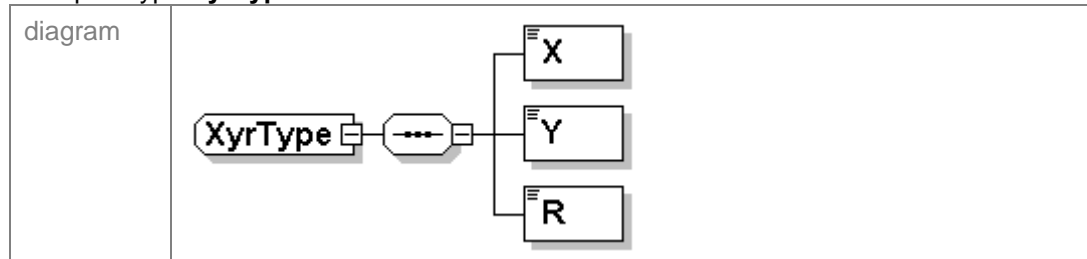
diagram



complexType **XYCoordType**



complexType **XyrType**



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SEMI P11-0997

DETERMINATION OF TOTAL NORMALITY FOR ALKALINE DEVELOPER SOLUTIONS

1 Scope

1.1 An acid-base potentiometric titration to single or multiple inflection points is performed on an automatic recording titrator using standardized hydrochloric acid as the titrant. The normality (meq/mL) is then calculated by the titrator using the data obtained.

2 Apparatus

2.1 Autotitrator

2.2 Glass combination electrode

2.3 Class A grade volumetric pipets in 1 to 25 mL sizes

2.4 250 mL beakers

3 Reagents

3.1 1.0 N Hydrochloric acid (from concentrate or ready to use 1.0 N)

3.2 *Primary Standard* — High-purity sodium carbonate is available from most chemical supply houses, but must be dried at 400 degree centigrade before use. TMAH (tris (hydroxymethyl) aminomethane) is also available from the National Institute of Standards and Technology (Standard Reference Material 723a) for this purpose.

3.3 Buffer solutions, pH 4.0, 7.0, 10.0.

4 Procedure

4.1 Standardize the 1.0 N Hydrochloric acid with the primary standard.

4.2 Standardize the titrator by performing a two point calibration with pH 4.0, 7.0, and 10.0 buffer.

4.3 Pipette an appropriate aliquot (1 to 25 mL) of sample into a 250 mL beaker containing a magnetic stir bar. Sample size should be determined according to the expected normality and the amount of titrant to be dispensed that will give the optimum precision and accuracy. Generally this is between one-half and three-quarters the capacity of the burette. (See the instrument manual for the recommended optimum range.)

4.4 Add deionized water to bring the volume to approximately 150 mL.

4.5 Without delay (to prevent carbon dioxide absorption), begin stirring without a vortex and titrate to beyond the inflection endpoint.

4.6 Determine the exact endpoint and record the volume of titrant consumed at the middle of the inflection endpoint. This will be done automatically on most newer digital titrators. On analog titrators, the inflection point can be determined by using the first derivative mode, or accurately determining the middle of the inflection.

5 Calculation

5.1 Calculate the normality of the sample by the following equation.

$$\text{Normality (N)} = \frac{\text{Volume of titrant (mL)} \times \text{Normality of titrant (N.HCL)}}{\text{Sample Volume (mL)}}$$

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SEMI P12-0997

DETERMINATION OF IRON, ZINC, CALCIUM, MAGNESIUM, COPPER, BORON, ALUMINUM, CHROMIUM, MANGANESE, AND NICKEL IN POSITIVE PHOTORESISTS BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROSCOPY (ICP)

1 Scope

1.1 This procedure is an ICP plasma emission analysis for determination of iron, zinc, calcium, magnesium, copper, boron, aluminum, chromium, manganese, and nickel in photoresist. The applicable concentration range is 0.1 to 1 ppm when the sample is diluted 1 to 4. The precision was found to be within 0.1 ppm in a round robin analysis between four laboratories.

2 Spectrometer

2.1 A grating instrument with resolution sufficient to separate the analytical emission lines in Table 1 is required.

Table 1 Analytical Lines of the Elements

<i>Elements</i>	<i>Analytical Line, nm</i>	<i>Elements</i>	<i>Analytical Line, nm</i>
Aluminum	309.271	Magnesium	285.213
Calcium	317.933	Nickel	231.604
Copper	324.754	Zinc	213.856
Iron	239.562	Chromium	283.563
Boron	208.960	Manganese	257.610

3 Sample Preparation

3.1 The sample is diluted 1/4 (1 part of sample plus 3 parts of solvent weight/weight) in 2-methoxyethanol or another suitable solvent for positive resist. The solvent should contain less than 0.03 ppm of the above elements.

4 Standards

4.1 The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

4.2 The standards are prepared by diluting a concentrated standard of organic-soluble metals in 2-methoxyethanol or other suitable solvent. For example, a 500 ppm standard is diluted to 50 ppm with xylene. This solution is then diluted to 0.25 ppm with 2-methoxyethanol.

5 Plasma Conditions

5.1 The sample is pumped on the region of 0.7 mL/min, usually with a peristaltic pump attached to the

nebulizer. Choose a tubing that is not attacked by methyl cellosolve (for example, polytetrafluoroethylene). The argon plasma flow rate and RF power should be optimized for the sample using settings recommended in the manufacturer's manual. Generally, a plasma gas flow rate of 16 l/min. is necessary to ionize organic solutions and an RF power of 1.7 watts is required.

6 Quantitation

6.1 The detector gain is set by measuring the 0.25 ppm standard. The background is measured with the solvent and several sample measures. The standard and blank should be run intermittently to satisfy reasonable precision. Standard and sample readings should be repeatable within 0.03 ppm. The effect of sample viscosity on delivery of diluted resist to the plasma was not found to be a factor for the resist tested for this procedure. This effect can be checked by adding an internal standard of an element known not to be present in the resist (such as Yttrium) at ppm and checking the emission response vs. external 1 ppm Yttrium standard in the diluting solvent.

7 Calculation

7.1 ppm element (mg/kg = ppm measured \times delution factor (weight/weight)

7.2 *Detection Limit* — The detection limit is a function of the dilution factor and can vary by instrument. The dilution factor should be taken into account in calculation of detection limit.

7.2.1 Detection limit (ppm) = $s \times$ dilution factor where s = standard deviation of instrument readings in ppm.



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SEMI P13-91 (Reapproved 1104)

DETERMINATION OF SODIUM AND POTASSIUM IN POSITIVE PHOTORESISTS BY ATOMIC ABSORPTION SPECTROSCOPY

This standard was technically approved by the Global Micropatterning Committee and is the direct responsibility of the North American Micropatterning Committee. Current edition approved by the North American Regional Standards Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1991.

1 Scope

1.1 This procedure is a flame atomic absorption analytical method for sodium and potassium analysis in photoresist. The applicable concentration range is 0.1 to 1 ppm when the sample is diluted one to four. The precision was found to be within 0.1 ppm in a round-robin analysis between four laboratories.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

2 Referenced Standards

2.1 None.

3 Terminology

3.1.1 *Detection Limit* — the detection limit is a function of the dilution factor and can vary by instrument. The dilution factor should be taken into account in calculation of detection limit.

4 Atomic Absorption Spectrometer

4.1 The analytical wavelength for sodium is 589.0 nm and for potassium is 766.0 nm. The instrument conditions (i.e., slit width, burner gas flow rates) should be set according to the manufacturer's manual (the fuel flow should be set to approximately 1/2 the air flow to optimize for organic solvent). Optimize the nebulizer and lamp alignment to maximize the absorbance of the 1 ppm standard.

5 Sample Preparation

5.1 The sample should be diluted 1/4 (1 part resist and 3 parts of solvents weight/weight) in 2-methoxyethanol or another suitable solvent for positive resist. The solvent should contain less than 0.1 ppm of the element being analyzed.

6 Standards

6.1 The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

6.2 The standards are prepared by diluting a concentrated stock of organic-soluble sodium and potassium. For example, a 500 ppm standard of sodium is diluted to 50 ppm with reagent xylene. This solution is then diluted to 1 ppm with 2-methoxyethanol or another suitable solvent.

7 Procedure

7.1 Set the absorbance reading to zero with the flame ignited and no sample aspirating. Measure the absorbance of the solvent blank. It should not be more than 0.04. Measure the absorbance of the 1 ppm standard and samples. The absorbance of the standard should be in the region of 0.4. Duplicate sample and standard readings should be within 0.01 absorbance. A recovery of 88% was determined when a 1 ppm potassium internal standard was added to the resist tested. The effect of viscosity on delivery to the burner can be determined by adding 2 ppm of a potassium internal standard to the sample and checking the absorbance versus an external 2 ppm potassium standard in the diluting solvent. The potassium level in the resist, if any, should be subtracted.

8 Calculation

ppm (mg/kg) =

$$\frac{\text{Abs. Sample} \times \text{ppm Standard} \times \text{dilution factor} \times R}{\text{Abs. Standard}}$$

R = Recovery factor due to sample viscosity if applicable, for example 1.136 in above example.

Detection limit (ppm) = $s \times \text{dilution factor}$ where s = standard deviation of instrument "readings" in ppm.



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SEMI P14-0997

DETERMINATION OF TIN IN POSITIVE PHOTORESISTS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROSCOPY

1 Scope

1.1 This procedure is a graphite furnace atomic absorption analytical method for tin in photoresist. The applicable concentration range is 0.1 to 1 ppm when the sample is diluted one to ten. The precision was found to be within 0.1 ppm in a round robin analysis between four laboratories.

2 Instrument Conditions

2.1 An atomic absorption spectrometer equipped with a graphite furnace is used with graphite tubes equipped with pyrolytically coated graphite platforms for sampling.

2.2 The 224.6 nm emission line from a hollow cathode tin lamp is used as the analytical absorption line.

Furnace Program*

	<i>Dry Step</i>	<i>Char Step</i>	<i>Atomization Step</i>
Temperature (°C)	110	800	2700
Ramp time (s)	20	20	0 +
Hold time (s)	20	20	5

+ Maximum power heating

* Argon flow rate of 50 mL/min

3 Sample Preparation

3.1 The sample is diluted 1/10 (1 part sample + 9 parts solvents weight/weight) in 2-methoxyethanol or another suitable solvent for positive resist. The solvent should contain less than 0.01 ppm of tin.

4 Standards

4.1 The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

4.2 A 50 ppm tin standard is prepared by diluting a 500 ppm tin standard in oil to 50 ppm with Xylene.

4.3 A 1 ppm standard is made by diluting the 50 ppm standard in 2-methoxyethanol or another suitable solvent.

5 Procedure

5.1 A 20 µL volume of 1 ppm tin standard is transferred to the platform by Eppendorf pipette. The furnace program is run and absorbance measured. The

absorbance of the 1ppm tin standard should be in the range of 0.2 absorbance. Measure the absorbance of the solvent and sample in an identical manner.

6 Calculation

ppm tin (mg/kg) =

$$\frac{\text{Abs. Sample} \times \text{ppm Standard} \times \text{dilution factor}}{\text{Abs. Standard}}$$

6.1 *Detection Limit* — The detection limit is a function of the dilution factor and can vary by instrument. The solution factor should be taken into account in calculation of the detection limit.

6.1.1 Detection limit (ppm) = $s \times \text{dilution factor}$ where s = standard deviation of instrument reading in PPM.

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SEMI P15-92 (Reapproved 1104) DETERMINATION OF SODIUM AND POTASSIUM IN POSITIVE PHOTORESIST METAL ION FREE (MIF) DEVELOPERS BY ATOMIC ABSORPTION SPECTROSCOPY

This standard was technically approved by the Global Micropatterning Committee and is the direct responsibility of the North American Micropatterning Committee. Current edition approved by the North American Regional Standards Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1992.

1 Scope

1.1 This procedure is a flame atomic absorption analytical method for sodium and potassium analysis in photoresist MIF developers. The applicable concentration range is 20 to 1000 ppb.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

2 Referenced Standards

2.1 None.

3 Terminology

3.1 None.

4 Instrument Conditions

4.1 *Atomic Absorption Spectrometer* — The analytical wavelength for sodium is 589 nm and for potassium is 766 nm. The instrument conditions (i.e., slit width, burner gas flow rates) should be set according to the manufacturer's manual. Optimize the nebulizer and lamp alignment to maximize the absorbance of the 1 ppm standard.

5 Standards

5.1 The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

5.2 The standards are prepared by diluting a concentrated stock. For example, a 500 ppm standard of sodium is diluted to 50 ppm with de-ionized water. This solution is then diluted to 1 ppm.

6 Procedure

6.1 No sample preparation nor dilution is required.

6.2 Set the absorbance reading to zero with the flame ignited and no sample aspirating. Measure the absorbance of the 1 ppm standards and samples. The absorbance of the standard should be in the range of 0.2 absorbance. Duplicate sample and standard readings should be within 0.01 absorbance. The effect of viscosity on delivery to the burner can be determined by adding 2 ppm of a potassium internal standard to the sample and checking the absorbance versus an external 2 ppm potassium standard. The potassium level in the developer, if any, should be subtracted.

7 Calculation

$$\text{ppm (mg/kg)} = \frac{\text{Abs. Sample} \times \text{ppm Standard} \times R}{\text{Abs. Standard}}$$

R = Recovery factor due to sample viscosity if applicable.

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SEMI P16-92 (Reapproved 1104) DETERMINATION OF TIN IN POSITIVE PHOTORESIST METAL ION FREE (MIF) DEVELOPERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROSCOPY

This standard was technically approved by the Global Micropatterning Committee and is the direct responsibility of the North American Micropatterning Committee. Current edition approved by the North American Regional Standards Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1992.

1 Scope

1.1 This procedure is a graphite furnace atomic absorption analytical method for tin in photoresist MIF developers. The applicable concentration range is 20 to 1000 ppm.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

2 Referenced Standards

2.1 None.

3 Terminology

3.1 None.

4 Instrument Conditions

4.1 An atomic absorption spectrometer equipped with a graphite furnace is used with graphite tubes equipped with pyrolytic coated graphite platforms for sampling.

4.2 The 224.6 nm emission line from a hollow cathode tin lamp is used as the analytical absorption line.

Table 1 Furnace Program*

	<i>Dry Step</i>	<i>Char Step</i>	<i>Atomization Step</i>
Temperature (°C)	110	800	2700
Ramp time (s)	20	20	0 ^{#2}
Hold time (s)	20	20	5

#1: * Argon flow rate of 50 mL/min

#2: + Maximum power heating

5 Standards

5.1 The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

5.2 A 50 ppm tin standard is prepared by diluting a 500 ppm tin standard to 50 ppm with de-ionized water.

5.3 A 1 ppm standard is made by diluting the 50 ppm standard.

6 Procedure

6.1 No sample preparation nor dilution is required.

6.2 A 20 mL volume of 1 ppm tin standard is transferred to the platform by Eppendorf pipette. The furnace program is run and absorbance measured. The absorbance of the 1 ppm tin standard should be in the range of 0.2 absorbance. Measure the absorbance of the sample in an identical manner.

7 Calculation

$$\text{ppm tin (mg/kg)} = \frac{\text{Abs. Sample} \times \text{ppm Standard}}{\text{Abs. Standard}}$$

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SEMI P17-92 (Reapproved 0299) DETERMINATION OF IRON, ZINC, CALCIUM, MAGNESIUM, COPPER, BORON, ALUMINUM, CHROMIUM, MANGANESE, AND NICKEL IN POSITIVE PHOTORESIST METAL ION FREE (MIF) DEVELOPERS BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROSCOPY (ICP)

This standard was technically reapproved by the Resist Committee and is the direct responsibility of the North American Microlithography Committee. Current edition approved by the North American Regional Standards Committee in October 1998. Initially available at www.semi.org February 1999; to be published February 1999. Originally published in 1992; previously published in 1996.

1 Scope

This procedure is an ICP plasma emission analysis for determination of iron, zinc, calcium, magnesium, copper, boron, aluminum, chromium, manganese, and nickel in photoresist MIF developers. The applicable concentration range and detection limit will depend upon the element and instrument.

2 Spectrometer

An instrument with resolution sufficient to separate the analytical emission lines in Table 1 is required.

Table 1. Analytical Lines of the Elements

<i>Elements Analytical Line</i>	<i>nm</i>
Aluminum	396.152
Calcium	317.933
Copper	324.754
Iron	239.562
Boron	208.960
Magnesium	285.213
Nickel	231.604
Zinc	213.856
Chromium	283.563
Manganese	257.610

3 Standards

The standards should be weight/weight (mg/kg) and should be diluted weight/weight since results will be expressed in mg/kg.

The standards are prepared by diluting a concentrated standard. For example, a 500 ppm standard is diluted to 50 ppm with deionized water. This solution is then diluted to 0.25 ppm.

4 Plasma Conditions

The sample is pumped in the region of 0.7 mL/min. usually with a peristaltic pump attached to the nebulizer. The argon plasma flow rate and RF power should be optimized for the sample using settings recommended in the manufacturer manual. Generally, a plasma gas flow rate of 12 L/min and an RF power of 1.25 kW is required.

5 Quantitation

No sample preparation nor dilution is required.

The detector gain is set by measuring the 0.25 ppm standard. The standard should be run intermittently to satisfy reasonable precision. Standard and sample readings should be repeatable within 0.03 ppm. The effect of sample viscosity on delivery of diluted sample to the plasma was not found to be a factor for this procedure. This effect can be checked by adding an internal standard of an element known not to be present in the sample (such as Yttrium) at 1 ppm and checking the emission response vs. an external 1 ppm Yttrium standard.

6 Calculation

$$\text{ppm element (mg/kg)} = \frac{I_x}{I_s} \times 0.25 \text{ ppm}$$

Where I_x = emission intensity of sample

I_s = emission intensity of 0.25 ppm standard



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SEMI P18-92 (Reapproved 1104)

SPECIFICATION FOR OVERLAY CAPABILITIES OF WAFER STEPPERS

This specification was technically reapproved by the Global Micropatterning Committee and is the direct responsibility of the North American Microlithography Committee. Current edition approved by the North American Regional Standards Committee on August 16, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1992.

1 Scope

1.1 Definitions for the overlay capabilities of wafer steppers are established, consistent with the primary application of wafer stepper (i.e., the manufacturing of very large-scale integrated circuits). Also included are definitions for associated parameters: registration, exposure field, good fields, and alignment.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

2 Referenced Standards

2.1 Statistical methods shall be used in accordance with the procedures in NBS Handbook #91 (Experimental Statistics, by M.G. Natrella) and ASTM STD 15D (Manual on the presentation of data and control chart analysis).

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

3 Terminology

3.1 Definitions

3.1.1 *overlay* — a vector quantity defined at every point on the wafer. It is the difference, \vec{O} , between the vector position, \vec{P}_1 , of a substrate geometry, and the vector position of the corresponding point, \vec{P}_2 , in an overlaying pattern, which may consist of photoresist:

$$\vec{O} = \vec{P}_1 - \vec{P}_2$$

3.1.2 *interfield overlay* (also referred to as field-to-field overlay) — The center of the lens is chosen to be a reference point. The overlay at the reference point in each exposure field is the interfield overlay.

3.1.3 *exposure field* — the area of a wafer covered by a single exposure.

3.1.4 *intrafield overlay* (also referred to as within-a-field overlay) — the overlay within an exposure field,

relative to the overlay at the center of the lens reference location.

NOTE 1: From these definitions, it follows that the overlay at any point on the wafer is the vector sum of interfield and intrafield overlays.

3.1.5 *registration* — a vector quantity defined at every point on the wafer. It is the difference, \vec{R} , between the vector position, \vec{P}_1 , of a substrate geometry, and vector position of the corresponding point, \vec{P}_0 , in a reference grid:

$$\vec{R} = \vec{P}_1 - \vec{P}_0$$

3.1.5.1 The reference grid must be clearly specified in any specification of registration.

3.1.5.2 Interfield and intrafield registration are defined in a manner similar to interfield and intrafield overlay.

3.1.5.3 Overlay may be computed from registration measurements if the same reference standard is used on all systems for determining registration.

3.1.6 *alignment* — the mechanical positioning of reference points on the wafers (“alignment targets”) to the corresponding points on the reticles. The measure of alignment is the overlay at the position on the wafer where the alignment targets are placed.

3.1.7 Registration and overlay vectors shall be decomposed into orthogonal components, X and Y, along the directions of the stepper stage motion.

3.1.8 *good fields* — exposure fields in which the magnitude of the overlay at every point within the field is less than a specified value, V, in both the X and Y directions, exclusive of contributions to overlay from the reticles and non-linear deformations of the wafers during non-stepper processing.

NOTE 2: It should be recognized that contributions from reticles are non-statistical in nature, and that a particular reticle will make the same contributions to overlay and registration in every exposure field in which it is imaged.

3.1.9 *fraction of good field* — the overlay capabilities of wafer steppers shall be quantified in terms of the fraction of good fields, F , out of the total number of fields on the wafer:

$$F = \frac{\text{Number of good fields}}{\text{Number of total fields}}$$

Good fields may also be quantified as a percentage ($100 \times F\%$).

3.1.10 Any specification of overlay must define the applicable exposure field size and the stepping patterns on the wafers over which the specification applies. From Sections 3.1.8 and 3.1.9 it follows that the specification of the overlay capability of wafer steppers consists of at least two additional numbers, the overlay value, V , and the fraction of good fields, F . It is consistent to characterize stepper overlay capability for multiple overlay values, V_1, V_2, \dots with corresponding multiple fractions of good fields, F_1, F_2, \dots

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SEMI P19-92

SPECIFICATION FOR METROLOGY PATTERN CELLS FOR INTEGRATED CIRCUIT MANUFACTURE

Purpose

This document defines several standard test patterns to provide consistent industrywide evaluation and testing of micropatterning equipment, metrology instruments, and processes used in integrated circuit manufacturing.

1 General Specification

1.1 Scope

1.1.1 This specification defines the shape, general size, and recommended placement and design rules (where appropriate) of several basic pattern cells for linewidth metrology, resolution testing, and proximity testing. These standard patterns include cells that can be used for optical microscopy, electron microscopy, and electrical probe testing.

1.1.2 This document does not attempt to specify the measurement techniques to be used in verifying critical dimensions for these test patterns on the reticle. Similarly, this document does not attempt to specify how the printed patterns are to be measured on the wafer. This document specifies only what the patterns are supposed to be; it is left to the user to ensure that the actual pattern conforms to this specification, subject to all other applicable SEMI specifications. A separate SEMI document will specify CD measurement conditions (see Section 1.2.1).

1.2 Applicable Documents

1.2.1 SEMI Standards

SEMI P24 — CD Metrology Procedures

1.3 Definitions

linewidth — In semiconductor technology, at a given cross-section of the line, the distance between the airline material boundaries at some specified height above the interface between the patterned layer in which the line is formed and the underlying layer (see Figure 1).

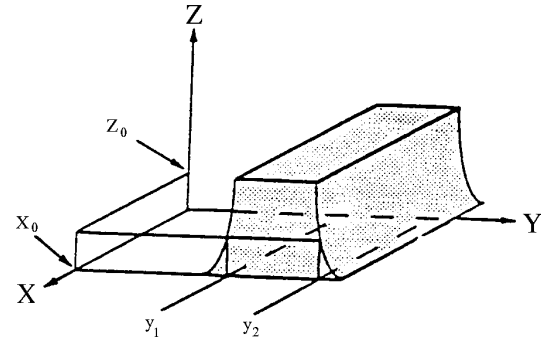


Figure 1
Linewidth (X_0, Z_0) = $Y_2 - Y_1$

NOTE: The physical basis for various methods of measuring linewidth may result in the measurements being carried out at differing heights for the same line at the same cross-section. For this reason, substantial method-dependent differences in measurement results may be expected and it is convenient to identify the method used in expressions such as “SEM linewidth,” “optical linewidth,” or “electrical linewidth” (ASTM F 127). Furthermore, the height at which the measurement is taken shall be qualitatively stated, even if it cannot be quantitatively determined.

feature — areas within a single, continuous boundary (for example, an aggregate image) that have an optical-density value (gray-level range), that is distinct from the background area outside the feature (ASTM D 3849, D 24) (e.g., the simplest element of a pattern, such as a single line, space, or L-bar).

feature group — a small assembly of one or more similar features arranged together, such as three nested L-bars.

nominal feature dimension — the linear dimension of interest, such as the linewidth or contact hole width.

basic cell — an arrangement of features or groups, as defined by this document, based upon a specific, nominal-feature dimension.

composite cell — an arrangement of several basic cells.