



The Printer Working Group

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Working Draft

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## PWG 3D Print Job Ticket and Associated Capabilities v1.0 (PJT3D)

Status: Stable

Abstract: This document describes the PWG Semantic Model Print3D service schema for embedded Job Tickets. The schema is based on the IPP 3D Printing Extensions v1.0 (3D) and suitable for data exchange and embedding within common 3D file formats such as 3MF and 3D PDF documents so that user intent is preserved regardless of the transport or workflow used.

This document is a Working Draft. For a definition of a "Working Draft", see: <http://ftp.pwg.org/pub/pwg/general/pwg-process30.pdf>

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This document is available electronically at:

- <http://ftp.pwg.org/pub/pwg/ipp/wd/wd-smpjt3d10-20170627.docx>
- <http://ftp.pwg.org/pub/pwg/ipp/wd/wd-smpjt3d10-20170627.pdf>

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47 manufacturers, print server developers, operating system providers, network operating  
48 system providers, network connectivity vendors, and print management application  
49 developers. The group is chartered to make printers and the applications and operating  
50 systems supporting them work together better. All references to the PWG in this  
51 document implicitly mean “The Printer Working Group, a Program of the IEEE ISTO.” In  
52 order to meet this objective, the PWG will document the results of their work as open  
53 standards that define print related protocols, interfaces, procedures and conventions.  
54 Printer manufacturers and vendors of printer related software will benefit from the  
55 interoperability provided by voluntary conformance to these standards.

56 In general, a PWG standard is a specification that is stable, well understood, and is  
57 technically competent, has multiple, independent and interoperable implementations with  
58 substantial operational experience, and enjoys significant public support.

59 For additional information regarding the Printer Working Group visit:

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61 Contact information:

62 The Printer Working Group  
63 c/o The IEEE Industry Standards and Technology Organization  
64 445 Hoes Lane  
65 Piscataway, NJ 08854  
66 USA  
67

68 **About the Internet Printing Protocol Workgroup**

69 The Internet Printing Protocol (IPP) workgroup has developed a modern, full-featured  
70 network printing protocol, which is now the industry standard. IPP allows a print client to  
71 query a printer for its supported capabilities, features, and parameters to allow the  
72 selection of an appropriate printer for each print job. IPP also provides job information prior  
73 to, during, and at the end of job processing.

74 For additional information regarding IPP visit:

75 <http://www.pwg.org/ipp/>

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76 Implementers of this document are encouraged to join the IPP mailing list in order to  
77 participate in any discussions of the document. Suggested additions, changes, or  
78 clarification to this document, should be sent to the IPP mailing list for consideration.

79

80



129 [Figure 1 - Print3DServiceType Schema](#) ..... 11  
130 [Figure 2 - Print3DJobType Schema](#) ..... 12  
131 [Figure 3 - Print3DJobTicketType Schema](#) ..... 13  
132  
133

**Deleted:** Figure 1 - Print3DServiceType Schema - 9  [2]

## 136 1. Introduction

137 The IPP 3D Printing Extensions v1.0 [PWG5100.21] defines an extension to the Internet  
138 Printing Protocol (IPP) that supports printing of physical objects by Additive Manufacturing  
139 devices such as three-dimensional (3D) printers. This document defines an XML schema  
140 representing the semantic elements and values of the IPP 3D model, allowing conversion  
141 of IPP Job Tickets and Printer Capabilities into an XML format suitable for data exchange  
142 and embedding within common 3D file formats such as 3MF [3MF] and 3D PDF  
143 [ECMA363] [ISO14739] [ISO32000].

144 The Print3D schema [SCHEMA] is automatically generated from the IANA IPP registry by  
145 the IPP Registry project's [IPPREGISTRY] "regtosm" tool. This schema is based in part on  
146 the PWG Print Job Ticket and Associated Capabilities Version 1.0 (PJT) [PWG5108.07]  
147 which defines an XML schema for the IPP 2D model.

### 148 1.1 Output Intent Versus Device Process and Control

149 As with [PWG5108.07], the focus of 3D printing using the Print3DService schema defined  
150 in this document is the specification of output intent and not the processes or device  
151 control needed to produce a given output. Clients can specify general material selections  
152 ("red PLA", "brown wood PLA", "clear ABS", etc.), print preferences and quality, and  
153 whether supports and rafts should be printed. Printers then use implementation specific  
154 device control and (ordered) processes to satisfy the Client-supplied output intent when  
155 processing the Job.

156 Besides enabling simpler, easier to use Client software that is less likely to fail due to  
157 minor implementation differences, this model also prevents the Client from providing  
158 dangerous device control instructions that exceed safe operating parameters or disable  
159 critical safety interlocks.

## 160 2. Terminology

### 161 2.1 Printing Terminology

162 Normative definitions and semantics of printing terms are imported from IETF Printer MIB  
163 v2 [RFC3805], IETF Finisher MIB [RFC3806], and IETF Internet Printing Protocol/1.1:  
164 Model and Semantics [RFC8011].

165 *Document*: An object created and managed by a Printer that contains the description,  
166 processing, and status information. A Document object may have attached data and is  
167 bound to a single Job.

168 *Intent*: The preferences for the processing and description properties of a Job or  
169 Document.

170 *Job*: An object created and managed by a Printer that contains description, processing,  
171 and status information. The Job also contains zero or more Document objects.

172 *Job Receipt*: A data object that contains information on the actual values of processing  
173 Elements used when a Job was processed.

174 *Job Ticket*: A data object that contains the Job-level Intent (processing and description  
175 Elements).

176 *Printer*: A print Service or hardware device that supports 3D printing.

177 *Service*: A program that accepts and processes requests to create, monitor and manage  
178 Jobs. The Service accepts and processes requests to monitor and control the status of the  
179 Service itself and its associated Resources. A Service may be hosted either locally or  
180 remotely from the Printer.

## 181 2.2 Other Terminology

182 *Element*: A term used to convey structure and relationships in XML Document instances.  
183 An Element can contain both content and Elements. Complex Elements are composed, at  
184 least in part, of other Elements.

## 185 2.3 Acronyms and Organizations

186 *3D PDF Consortium*: <http://www.3dpdfconsortium.org/>

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187 *3MF Consortium*: 3D Manufacturing Format Consortium, <http://www.3mf.io/>

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188 *ISO*: International Organization for Standardization, <http://www.iso.org/>

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189 *ODL*: Object Definition Language

190 *PWG*: Printer Working Group, <http://www.pwg.org/>

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191



## 192 **3. Rationale for the PWG 3D Print Job Ticket and Associated** 193 **Capabilities v1.0 (PJT3D)**

194 Existing specifications define the following:

- 195 1. The IPP 3D Printing Extensions v1.0 (3D) [PWG5100.21] defines an extension  
196 to the Internet Printing Protocol (IPP) that supports printing of physical objects  
197 by Additive Manufacturing devices such as three-dimensional (3D) printers;
- 198 2. The W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures  
199 [XSD11-1] specifies the XML Schema Definition Language, which offers facilities  
200 for describing the structure and constraining the contents of XML documents,  
201 including those which exploit the XML Namespace facility;
- 202 3. The W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes  
203 [XSD11-2] defines facilities for defining datatypes to be used in XML Schemas  
204 as well as other XML specifications;
- 205 4. The 3D Manufacturing Format Core Specification & Reference Guide v1.1 [3MF]  
206 defines an XML schema and file format for describing 3D objects with one or  
207 more materials;
- 208 5. The Universal 3D File Format [ECMA363] defines a binary format for 3D objects  
209 embedded in PDF files;
- 210 6. Document management -- 3D use of Product Representation Compact (PRC)  
211 format -- Part 1: PRC 10001 [ISO14739] defines a binary format for 3D objects  
212 embedded in PDF files; and
- 213 7. Document management — Portable document format — Part 1: PDF 1.7  
214 [ISO32000] defines a binary file format that supports embedded 3D objects with  
215 one or more materials.

216 Therefore, this PWG 3D Print Job Ticket and Associated Capabilities document should  
217 define an XML schema that represents the IPP attributes and values needed to support  
218 embedding of Job Tickets in 3D document files, data exchange of Printer capabilities,  
219 Printer status, Job Receipts, Job Status, and Job Tickets, and workflows utilizing XML data  
220 models.

### 221 **3.1 Use Cases**

#### 222 **3.1.1 Web-Based Submission of 3MF File**

223 Jane has a 3D model she wishes to print using a commercial 3D printing provider. The  
224 provider supports 3MF files but only allows submission using a HTML form on their web  
225 site. Jane uses the software on her Client device to select the materials and required  
226 dimensional accuracy, and then exports the 3D model to a 3MF file with an embedded Job  
227 Ticket. She then submits the file for printing by the provider.

### 228 3.1.2 Job Accounting using Receipts

229 A print provider needs to produce machine-readable records of every Job that is printed  
230 that are provided to customers to report what work has been performed, the billing  
231 department to determine the cost of each Job, and the operations group to track when to  
232 order supplies and perform maintenance. The receipts need to record the amount and type  
233 of materials used, the total processing time, and any issues that were encountered during  
234 printing. The provider generates a standalone file for each Job, providing copies to the  
235 customers, billing department, and operations group.

### 236 3.2 Out of Scope

237 The following are considered out of scope for this document:

- 238 1. Reporting of actual monetary values associated with Jobs.

### 239 3.3 Design Requirements

240 The design requirements for this document are:

- 241 1. Define PWG Semantic Model elements and values that correspond to their IPP  
242 counterparts; and
- 243 2. Define a named PWG Semantic Model schema incorporating the elements and  
244 values so that Job Tickets and their associated capabilities can be exchanged.

245

## 246 4. The Print3D Schema

247 The Print3D schema defines a PWG Semantic Model schema for an abstract 3D printing  
 248 Service based on the IPP 3D Printing Extensions v1.0 (3D) [PWG5100.21]. The  
 249 "Print3DServiceType" and "Print3DJobType" types define the abstract data models for the  
 250 Service and its Jobs. The "Print3DJobTicketType" type defines the abstract data model for  
 251 the Job Ticket that is typically embedded in a 3D document file.

252 The schema itself is organized into four schema description ("XSD") files:

253 "Print3DService.xsd": This file defines the Print3D service types and includes all of  
 254 the other files.

255 "PwgCommon.xsd": This file defines the elements mapped from IPP attributes.

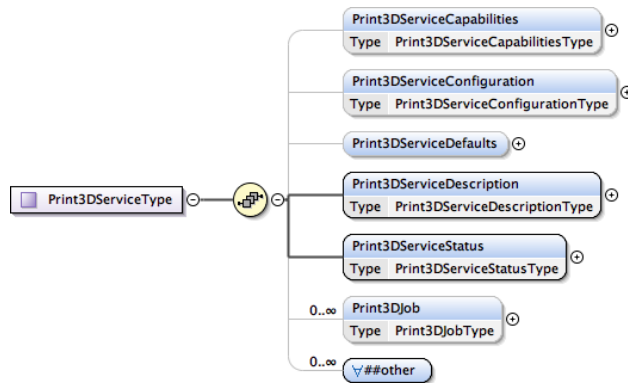
256 "PwgTypes.xsd": This file defines the base IPP types.

257 "PwgWellKnownValues.xsd": This file defines the well-known values of registered  
 258 IPP enum and keyword attributes.

259 The schema namespace URL is "http://www.pwg.org/schemas/smpjt3d10".

### 260 4.1 Print3DServiceType

261 Figure 1 shows the "Print3DServiceType" type which describes an instance of the abstract  
 262 3D printing service and contains the capabilities, configuration, description, status, and  
 263 Jobs list.



264  
 265 **Figure 1 - Print3DServiceType Schema**

266 **4.1.1 Print3DServiceCapabilities**

267 This Element contains the supported and "ready" values for each of the Job Ticket  
 268 elements. Ready values are those that the Printer can use without operator intervention.

269 **4.1.2 Print3DServiceConfiguration**

270 This Element contains information about the Printer sub-units.

271 **4.1.3 Print3DServiceDefaults**

272 This Element contains the default Job Ticket values for the Printer.

273 **4.1.4 Print3DServiceDescription**

274 This Element contains descriptive values for the Printer, including its name and owner.

275 **4.1.5 Print3DServiceStatus**

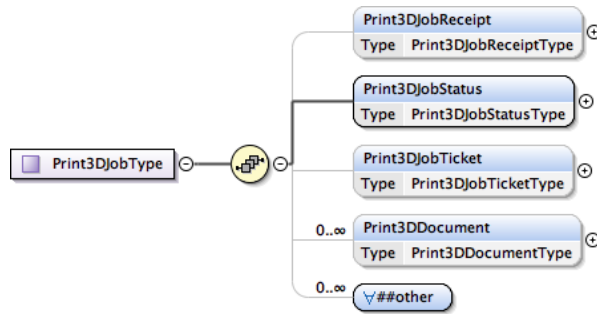
276 This Element contains state values for the Printer.

277 **4.1.6 Print3DJob**

278 This Element contains the list of active and previously completed 3D print Jobs.

279 **4.2 Print3DJobType**

280 Figure 2 shows the "Print3DJobType" type which describes an instance of the abstract 3D  
 281 print Job and contains the Job Receipt, Job Ticket, Job status, and Documents list.



282

283

**Figure 2 - Print3DJobType Schema**

284 **4.2.1 Print3DJobReceipt**

285 This Element contains the Job Receipt for a completed Job.

286 **4.2.2 Print3DJobStatus**

287 This Element contains the Job status information.

288 **4.2.3 Print3DJobTicket**

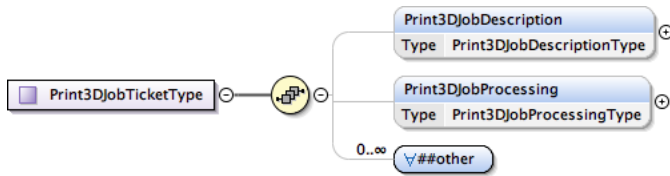
289 This Element contains the Job Ticket for the Job.

290 **4.2.4 Print3DDocument**

291 This Element contains the list of Documents associated with the Job.

292 **4.3 Print3DJobTicketType**

293 Figure 3 shows the "Print3DJobTicketType" type which contains the Job name and  
 294 processing intent.



295

296 **Figure 3 - Print3DJobTicketType Schema**

297 **4.3.1 Print3DJobDescription**

298 This Element contains the Job name and any billing information that was supplied.

299 **4.3.2 Print3DJobProcessing**

300 This Element contains the Job processing intent, including the list of materials to use,  
 301 required print accuracy, and so forth.

302

303 **5. Internationalization Considerations**

304 For interoperability and basic support for multiple languages, conforming implementations  
305 support:

- 306 1. The Universal Character Set (UCS) Transformation Format -- 8 bit (UTF-8)  
307 [STD63] encoding of Unicode [UNICODE] [ISO10646]; and
- 308 2. The Unicode Format for Network Interchange [RFC5198] which requires  
309 transmission of well-formed UTF-8 strings and recommends transmission of  
310 normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

311 Unicode NFC is defined as the result of performing Canonical Decomposition (into base  
312 characters and combining marks) followed by Canonical Composition (into canonical  
313 composed characters wherever Unicode has assigned them).

314 **6. Security Considerations**

315 The security considerations for this document are the same as those described in the IPP  
316 3D Printing Extensions v1.0 (3D) [PWG5100.21].

317 **7. References**

318 [3MF] "3D Manufacturing Format Core Specification & Reference Guide  
319 v1.1", <http://www.3mf.io/specification>

320 [ECMA363] "Universal 3D File Format", ECMA-363

321 [IPPREGISTRY] "ISTO-PWG IPP Registry Repository",  
322 <https://github.com/istopwg/ippregistry>

323 [ISO10646] "Information technology -- Universal Coded Character Set (UCS)",  
324 ISO/IEC 10646:2014

325 [ISO14739] "Document management -- 3D use of Product Representation  
326 Compact (PRC) format -- Part 1: PRC 10001", ISO 14739-1:2014

327 [ISO32000] "Document management — Portable document format — Part 1: PDF  
328 1.7", ISO 32000-1:2008

329 [PWG5100.21] M. Sweet, "IPP 3D Printing Extensions v1.0 (3D)", PWG 5100.21-  
330 2017, [http://ftp.pwg.org/pub/pwg/candidates/cs-ipp3d10-20170210-  
331 5100.21.pdf](http://ftp.pwg.org/pub/pwg/candidates/cs-ipp3d10-20170210-5100.21.pdf)

332 [PWG5108.07] P. Zehler, "PWG Print Job Ticket and Associated Capabilities Version  
333 1.0 (PJT)", PWG 5108.07-2012,

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334 <http://ftp.pwg.org/pub/pwg/candidates/cs-sm20-pjt10-20120801-5108.07.pdf>

336 [RFC5198] J. Klensin, M. Padlipsky, "Unicode Format for Network Interchange", RFC 5198, March 2008, <http://tools.ietf.org/html/rfc5198>

338 [RFC8011] M. Sweet, I. McDonald, "Internet Printing Protocol/1.1: Model and Semantics", RFC 8011, January 2017, <http://tools.ietf.org/html/rfc8011>

340 [SCHEMA] "PWG Print3D Schema", <http://ftp.pwg.org/pub/pwg/sm3/schemas/smpit3d10-20170420.zip>

342 [STD63] F. Yergeau, "UTF-8, a transformation format of ISO 10646", RFC 3629/STD 63, November 2003, <http://tools.ietf.org/html/rfc3629>

344 [UAX15] Unicode Consortium, "Normalization Forms", UAX#15, June 2014, <http://www.unicode.org/reports/tr15/tr15-41.html>

346 [UNICODE] Unicode Consortium, "Unicode Standard", Version [10.0.0](#), June [2017](#), <http://www.unicode.org/versions/Unicode10.0.0/>

348 [XSD11-1] "W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures", April 2012, <https://www.w3.org/TR/2012/REC-xmlschema11-1-20120405/>

351 [XSD11-2] "W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes", April 2012, <https://www.w3.org/TR/2012/REC-xmlschema11-2-20120405/>

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## 354 8. Author's Address

355 Primary author:

356 Michael Sweet  
357 Apple Inc.  
358 1 Infinite Loop  
359 MS 111-HOMC  
360 Cupertino, CA 95014  
361 msweet@apple.com

362 Additional contributors:

363 Ira McDonald (High North)  
364 Paul Tykodi (TCS)  
365 William Wagner (TIC)  
366 Peter Zehler (Xerox)

## 370 9. Sample Print3DJobTicket

371 The following 3D print job ticket specifies four copies of an object printed with two  
372 materials - blue PLA for the object and a dissolvable PLA for the supports - at normal  
373 quality with supports and rafts:

```
374 <?xml version="1.0" encoding="UTF-8"?>
375 <pwg:Print3DJobTicket xsi:schemaLocation="Print3DService.xsd"
376   xmlns:pwg="http://www.pwg.org/schemas/smpjt3d10"
377   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
378   <pwg:Print3DJobProcessing>
379     <pwg:Copies>4</pwg:Copies>
380     <pwg:MaterialsCol>
381       <pwg:MaterialColor>blue</pwg:MaterialColor>
382       <pwg:MaterialPurpose>InFill</pwg:MaterialPurpose>
383       <pwg:MaterialPurpose>Shell</pwg:MaterialPurpose>
384       <pwg:MaterialType>pla</pwg:MaterialPurpose>
385     </pwg:MaterialsCol>
386     <pwg:MaterialsCol>
387       <pwg:MaterialPurpose>Base</pwg:MaterialPurpose>
388       <pwg:MaterialPurpose>Support</pwg:MaterialPurpose>
389       <pwg:MaterialType>pva-dissolvable</pwg:MaterialPurpose>
390     </pwg:MaterialsCol>
391     <pwg:PlatformTemperature>60</pwg:PlatformTemperature>
392     <pwg:PrintBase>Raft</pwg:PrintBase>
393     <pwg:PrintSupports>Material</pwg:PrintSupports>
394     <pwg:Quality>Normal</pwg:Quality>
395   </pwg:Print3DJobProcessing>
396   <pwg:Print3DJobDescription>
397     <pwg:DocumentMetadata>creator=Jane Doe</pwg:DocumentMetadata>
398     <pwg:DocumentMetadata>date=2017-03-27T12:34:56Z</pwg:DocumentMetadata>
399     <pwg:JobName>Sample 3D Print Job</pwg:JobName>
400   </pwg:Print3DJobDescription>
401 </pwg:Print3DJobTicket>
```

Comment [MRS1]: MS1: Use PVA not PLA

Deleted: 1

## 402 10. Sample Print3DServiceCapabilities

403 The following 3D print service capabilities describe a printer that supports up to two  
404 materials simultaneously and has blue PLA and dissolvable PLA loaded:

```
405 <?xml version="1.0" encoding="UTF-8"?>
406 <pwg:Print3DServiceCapabilities xsi:schemaLocation="Print3DService.xsd"
407   xmlns:pwg="http://www.pwg.org/schemas/smpjt3d10"
408   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
409
410   <!-- Support millimeters and nanometers for accuracy -->
411   <pwg:AccuracyUnitsSupported>Mm</pwg:AccuracyUnitsSupported>
412   <pwg:AccuracyUnitsSupported>Nm</pwg:AccuracyUnitsSupported>
413
414   <!-- Support 1 to 999 copies -->
415   <pwg:CopiesSupported>
416     <pwg:LowerBound>1</pwg:LowerBound>
417     <pwg:UpperBound>999</pwg:UpperBound>
```



```

419     </pwg:CopiesSupported>
420
421     <!-- Support 3MF and STL -->
422     <pwg:DocumentFormatSupported>model/3mf</pwg:DocumentFormatSupported>
423     <pwg:DocumentFormatSupported>application/sla</pwg:DocumentFormatSupported>
424
425     <!-- Material amounts in grams -->
426     <pwg:MaterialAmountUnitsSupported>G</pwg:MaterialAmountUnitsSupported>
427
428     <!-- 2.85mm filaments -->
429     <pwg:MaterialDiameterSupported>
430       <pwg:LowerBound>2850000</pwg:LowerBound>
431       <pwg:UpperBound>2850000</pwg:UpperBound>
432     </pwg:MaterialDiameterSupported>
433
434     <!-- Supported purposes -->
435     <pwg:MaterialPurposeSupported>All</pwg:MaterialPurposeSupported>
436     <pwg:MaterialPurposeSupported>Base</pwg:MaterialPurposeSupported>
437     <pwg:MaterialPurposeSupported>InFill</pwg:MaterialPurposeSupported>
438     <pwg:MaterialPurposeSupported>Shell</pwg:MaterialPurposeSupported>
439     <pwg:MaterialPurposeSupported>Support</pwg:MaterialPurposeSupported>
440
441     <!-- Supported rates -->
442     <pwg:MaterialRateSupported>
443       <pwg:LowerBound>1</pwg:LowerBound>
444       <pwg:UpperBound>250</pwg:UpperBound>
445     </pwg:MaterialRateSupported>
446     <pwg:MaterialRateUnitsSupported>Ml_second
447     </pwg:MaterialRateUnitsSupported>
448
449     <!-- Shell thickness -->
450     <pwg:MaterialShellThicknessSupported>
451       <pwg:LowerBound>0</pwg:LowerBound>
452       <pwg:UpperBound>4000000</pwg:UpperBound>
453     </pwg:MaterialShellThicknessSupported>
454
455     <!-- Temperatures -->
456     <pwg:MaterialTemperatureSupported>
457       <pwg:LowerBound>180</pwg:LowerBound>
458       <pwg:UpperBound>260</pwg:UpperBound>
459     </pwg:MaterialTemperatureSupported>
460
461     <!-- Supported types -->
462     <pwg:MaterialTypeSupported>nylon</pwg:MaterialTypeSupported>
463     <pwg:MaterialTypeSupported>pet</pwg:MaterialTypeSupported>
464     <pwg:MaterialTypeSupported>pla</pwg:MaterialTypeSupported>
465     <pwg:MaterialTypeSupported>pla-conductive</pwg:MaterialTypeSupported>
466     <pwg:MaterialTypeSupported>pla-stone</pwg:MaterialTypeSupported>
467     <pwg:MaterialTypeSupported>pla-wood</pwg:MaterialTypeSupported>
468     <pwg:MaterialTypeSupported>pla-dissolvable</pwg:MaterialTypeSupported>
469
470     <!-- Support Blue, Orange, and Red PLA, and Dissolvable PVA -->
471     <pwg:MaterialsColDatabase>
472       <pwg:MaterialColor>blue</pwg:MaterialColor>
473       <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
474       <pwg:MaterialKey>pla-blue</pwg:MaterialKey>

```

**Moved down [1]:**  
 <pwg:MaterialTypeSupported>pla-dissolvable</pwg:MaterialTypeSupported>

**Comment [MRS2]:** MS1: PVA is dissolvable, not PLA

**Moved (insertion) [1]**

**Deleted:** 1

**Deleted:** PLA

```

480     <pwg:MaterialName>Blue PLA</pwg:MaterialName>
481     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
482     <pwg:MaterialTemperature>
483       <pwg:LowerBound>210</pwg:LowerBound>
484       <pwg:UpperBound>235</pwg:UpperBound>
485     </pwg:MaterialTemperature>
486     <pwg:MaterialType>pla</pwg:MaterialPurpose>
487   </pwg:MaterialsColDatabase>
488   <pwg:MaterialsColDatabase>
489     <pwg:MaterialColor>orange</pwg:MaterialColor>
490     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
491     <pwg:MaterialKey>pla-orange</pwg:MaterialKey>
492     <pwg:MaterialName>Orange PLA</pwg:MaterialName>
493     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
494     <pwg:MaterialTemperature>
495       <pwg:LowerBound>210</pwg:LowerBound>
496       <pwg:UpperBound>235</pwg:UpperBound>
497     </pwg:MaterialTemperature>
498     <pwg:MaterialType>pla</pwg:MaterialPurpose>
499   </pwg:MaterialsColDatabase>
500   <pwg:MaterialsColDatabase>
501     <pwg:MaterialColor>red</pwg:MaterialColor>
502     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
503     <pwg:MaterialKey>pla-red</pwg:MaterialKey>
504     <pwg:MaterialName>Red PLA</pwg:MaterialName>
505     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
506     <pwg:MaterialTemperature>
507       <pwg:LowerBound>210</pwg:LowerBound>
508       <pwg:UpperBound>235</pwg:UpperBound>
509     </pwg:MaterialTemperature>
510     <pwg:MaterialType>pla</pwg:MaterialPurpose>
511   </pwg:MaterialsColDatabase>
512   <pwg:MaterialsColDatabase>
513     <pwg:MaterialColor>clear-white</pwg:MaterialColor>
514     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
515     <pwg:MaterialKey>pva-dissolvable</pwg:MaterialKey>
516     <pwg:MaterialName>Dissolvable PVA</pwg:MaterialName>
517     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
518     <pwg:MaterialType>pva-dissolvable</pwg:MaterialPurpose>
519   </pwg:MaterialsColDatabase>
520
521   <!-- Red PLA and Dissolvable PVA are loaded -->
522   <pwg:MaterialsColReady>
523     <pwg:MaterialColor>red</pwg:MaterialColor>
524     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
525     <pwg:MaterialKey>pla-red</pwg:MaterialKey>
526     <pwg:MaterialName>Red PLA</pwg:MaterialName>
527     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
528     <pwg:MaterialTemperature>
529       <pwg:LowerBound>210</pwg:LowerBound>
530       <pwg:UpperBound>235</pwg:UpperBound>
531     </pwg:MaterialTemperature>
532     <pwg:MaterialType>pla</pwg:MaterialPurpose>
533   </pwg:MaterialsColReady>
534   <pwg:MaterialsColReady>
535     <pwg:MaterialColor>clear-white</pwg:MaterialColor>

```

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540     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
541     <pwg:MaterialKey>pva-dissolvable</pwg:MaterialKey>
542     <pwg:MaterialName>Dissolvable PVA</pwg:MaterialName>
543     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
544     <pwg:MaterialType>pva-dissolvable</pwg:MaterialPurpose>
545 </pwg:MaterialsColReady>
546
547 <!-- Maximum number of materials per job -->
548 <pwg:MaxMaterialsColSupported>2</pwg:MaxMaterialsColSupported>
549
550 <!-- Supported platform temperatures -->
551 <pwg:PlatformTemperatureSupported>
552   <pwg:LowerBound>40</pwg:LowerBound>
553   <pwg:UpperBound>100</pwg:UpperBound>
554 </pwg:PlatformTemperatureSupported>
555
556 <!-- Brims, Rafts, and Skirts are supported -->
557 <pwg:PrintBaseSupported>Brim</pwg:PrintBaseSupported>
558 <pwg:PrintBaseSupported>None</pwg:PrintBaseSupported>
559 <pwg:PrintBaseSupported>Raft</pwg:PrintBaseSupported>
560 <pwg:PrintBaseSupported>Skirt</pwg:PrintBaseSupported>
561
562 <!-- Supported supports -->
563 <pwg:PrintSupportsSupported>Material</pwg:PrintSupportsSupported>
564 <pwg:PrintSupportsSupported>None</pwg:PrintSupportsSupported>
565 <pwg:PrintSupportsSupported>Standard</pwg:PrintSupportsSupported>
566
567 <!-- Supported qualities -->
568 <pwg:QualitySupported>Draft</pwg:QualitySupported>
569 <pwg:QualitySupported>High</pwg:QualitySupported>
570 <pwg:QualitySupported>Normal</pwg:QualitySupported>
571 </pwg:Print3DServiceCapabilities>

```

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## 572 11. IPP Mapping

573 The mapping of the IPP 3D Printing Extensions to the PWG 3D Print Job Ticket and  
 574 Associated Capabilities follows the mapping defined in section 21 of the PWG Print Job  
 575 Ticket and Associated Capabilities Version 1.0 [PWG5108.07].

576 In addition:

- 577 1. Similar to the handling of "media-color" and "media-type", IPP "material-color"  
 578 and "material-type" keyword values are preserved (hyphenated lowercase)  
 579 instead of converting them to TitleCase; and
- 580 2. IPP attributes using the 1setOf syntax are mapped to unbounded elements  
 581 instead of an element containing an unbounded sequence.  
 582

## 586 12. Change History

### 587 12.1 June 27, 2017

- 588 [1. MS1: Change "pla-dissolvable" to "pva-dissolvable"](#)
- 589 [2. Section 7: Unicode 10 has been released.](#)

### 590 12.2 May 4, 2017

- 591 1. Updated references to 3MF and ISO 10646

### 592 12.3 April 20, 2017

- 593 1. Status: Stable
- 594 2. Section 1.1: device control commands
- 595 3. Section 2.1: remote from the printer
- 596 4. Section 9: Fix MaterialColor, MaterialKey, and MaterialType values
- 597 5. Section 10: Fix MaterialColor, MaterialKey, and MaterialType values
- 598 6. Section 11: Drop operations (item 3)

### 599 12.4 March 27, 2017

- 600 1. Section 1: Reference the PJT and talk about output intent
- 601 2. Section 2: Define Service
- 602 3. Section 4: Added a list of the files in the schema ("roadmap") and the
- 603 namespace URL.
- 604 4. Section 8: Added acknowledgements
- 605 5. Added appendices with sample job ticket, capabilities, and the IPP mapping
- 606 strategy.

### 607 12.5 March 3, 2017

- 608 1. Updated acronym to "PJT3D", filename to "smpjt3d10"
- 609 2. Global: Print3d -> Print3D
- 610 3. Global: Element as a defined term.
- 611 4. Global: Updated all schema figures to reflect new service name.
- 612 5. Abstract: "... suitable for data exchange and embedding within common 3D file
- 613 formats such as ..."
- 614 6. Section 1: Made it clear the schema is generated from the IANA IPP registry.
- 615 7. Section 2.1: Added Intent, Job Receipt, and Job Ticket, Printer
- 616 8. Section 2.2: Replaced "Protocol Terminology" with "Other Terminology", define
- 617 Element
- 618 9. Section 3: Dropped "1.1" from "XML 1.1 schema".
- 619 10. Section 3.1.1: Fixed wording.

620 11. Section 7: Added link to IPP 3D spec.

621 **12.6 February 19, 2017**

622 Initial revision.

623

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