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**Dentistry — General requirements for
instruments and related accessories used
in dental implant placement and treatment**

*Médecine bucco-dentaire — Exigences générales relatives aux
instruments et aux accessoires connexes utilisés en implantologie dentaire*



Reference number
ISO 13504:2012(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13504 was prepared by Technical Committee ISO/TC 106, *Dentistry*, Subcommittee SC 4, *Dental instruments*.

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Introduction

The use of dental implants is increasing throughout the world. Due to improved and new applications of dental implants, the need for better instruments and related accessories to be used in the placement of dental implants and the further manipulation of connecting parts in the craniofacial area is also growing. Dental implants need to be approved by local authorities.

However, instruments used in the placement of dental implants are different and need a different approval procedure. This International Standard is intended to harmonize the approval procedures and to reduce the costs caused by repeated approval and test procedures in different countries.

Materials present in instruments used in dental implant procedures have proven to be well tolerated. Potential adverse reactions cannot be totally ruled out but such reactions are to be mitigated.

However, long-term clinical experience of the use of the materials referred to in this International Standard has shown that an acceptable level of biological response can be expected when they are used in appropriate applications and when instruments are manufactured under appropriate design considerations and processes.

Due to different stainless steel standards, Annex B has been added. This gives cross-references to designations of stainless steels which are listed in other international, regional or national standards designation systems.

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Dentistry — General requirements for instruments and related accessories used in dental implant placement and treatment

1 Scope

This International Standard specifies general requirements for the manufacture of instruments and related accessories used in the placement of dental implants and further manipulations of connecting parts in the craniofacial area.

It is applicable to single-use and reusable instruments, regardless of whether they are manually driven or connected to a power-driven system.

It is not applicable to the power-driven system itself, nor to the dental implant or to parts intended to be connected to the dental implant.

With regard to safety, this International Standard gives requirements for classification, intended performance, performance attributes, material selection, performance evaluation, manufacture, sterilization and information to be supplied by the manufacturer.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1942, *Dentistry — Vocabulary*

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 5832-2, *Implants for surgery — Metallic materials — Part 2: Unalloyed titanium*

ISO 5832-3, *Implants for surgery — Metallic materials — Part 3: Wrought titanium 6-aluminium 4-vanadium alloy*

ISO 7405, *Dentistry — Evaluation of biocompatibility of medical devices used in dentistry*

ISO 10993-1, *Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process*

ISO 11135-1, *Sterilization of health care products — Ethylene oxide — Part 1: Requirements for development, validation and routine control of a sterilization process for medical devices*

ISO 11137-1, *Sterilization of health care products — Radiation — Part 1: Requirements for development, validation and routine control of a sterilization process for medical devices*

ISO 14155, *Clinical investigation of medical devices for human subjects — Good clinical practice*

ISO 14971, *Medical devices — Application of risk management to medical devices*

ISO 15223-1, *Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied — Part 1: General requirements*

ISO 17664, *Sterilization of medical devices — Information to be provided by the manufacturer for the processing of resterilizable medical devices*

ISO 17665-1, *Sterilization of health care products — Moist heat — Part 1: Requirements for the development, validation and routine control of a sterilization process for medical devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942 and the following apply.

3.1

transient usage

usage for less than 60 min in any one clinical procedure

3.2 Instruments

3.2.1

surgically invasive device

device which penetrates into the human body through the surface of the body, with the aid or in the context of a surgical operation

3.2.2

instrument used in dental implant placement and treatment

surgically invasive device, used with a transient usage for the preparation of bone and tissue in the craniofacial region, to be used in the placement of dental implants and the further manipulation of connecting parts

3.2.3

accessory used in dental implant placement and treatment

non-surgically invasive device, used with a transient usage in direct or indirect contact with the human body, to be used in the placement of dental implants and the further manipulation of connecting parts

3.3 Stainless steel

3.3.1

stainless steel

steel, the main alloying element of which is chromium, of at least 10,5 % (mass fraction) Cr and maximum 1,2 % (mass fraction) C, and the primary importance of which is its resistance to corrosion

3.3.2

austenitic stainless steel

corrosion-resistant steel, typically with composition of less than 0,2 % (mass fraction) C, at least 16% (mass fraction) Cr, typically about 18 % (mass fraction) Cr and over 8 % (mass fraction) Ni, which cannot be hardened by heat treatment

3.3.3

martensitic stainless steel

corrosion-resistant steel with low to medium carbon, with at least 0,1 % (mass fraction) C and between 12 % (mass fraction) and 19 % (mass fraction) Cr, which can be hardened by quenching and tempering

3.3.4

precipitation-hardening stainless steel

corrosion-resistant steel with a high strength resulting from the precipitation of intermetallic compounds (the formation of very fine intermetallic phases, carbides and Laves phases in the structure) by a final heat treatment at relatively low temperature

4 Classification

4.1 Intended usage (application)

For the purposes of this International Standard, instruments used in dental implant placement and treatment are classified as follows, according to their intended usage (application), as stated by the manufacturer.

- Type 1: energized or motor driven instruments.
- Type 2: instruments for manual use (hand instruments).

4.2 Tissue contact

For the purposes of this International Standard, instruments used in dental implant placement and treatment are classified as follows, according to their intended main tissue contact within the working environment.

- Class 1: hard tissue.
- Class 2: soft tissue.
- Class 3: without tissue contact.

4.3 Reprocessing

For the purposes of this International Standard, instruments used in dental implant placement and treatment are classified as follows, according to their intended use determined by reprocessing requirements.

- Group 1: multiple use.
- Group 2: single use.

5 Intended performance

The intended performance of an instrument used in dental implant placement and treatment shall be described and documented by addressing the following:

- a) functional characteristics;
- b) intended conditions of use, according to Clause 4.

NOTE The following should be taken into account:

- published standards;
- published clinical and scientific literature;
- validated test results.

The extent to which the intended performance of an instrument has been achieved shall be determined (see Clause 8).

6 Performance attributes

The development of the performance attributes of an instrument used in dental implant placement and treatment in order to meet the level intended by the manufacturer shall take into account at least the following:

- a) physical, mechanical and metallurgical properties of the instrument materials (see Clauses 7 and 8);
- b) microbiological and particulate contamination levels (see Clauses 8, 10 and 11);
- c) usability, cleaning and maintenance (see Clause 8 and Clause 10);

- d) potential deterioration of the material's characteristics due to sterilization and storage (see Clauses 7, 8 and 9);
- e) effects of contact between the instrument and the human body, the implant and other instruments (see Clause 8);
- f) shape and dimensions of the instrument, including their possible effects on the body (see Clause 8);
- g) wear characteristics of materials and the effect of wear and wear products on the instrument and the human body (see Clauses 7 and 8);
- h) insertion, removal and interconnection of parts (see Clause 8);
- i) extent of fluid leakage and/or diffusion of substances into or out of instruments (see Clauses 7 and 8).

Tolerances for dimensions for an instrument used in dental implant placement and treatment shall be specified. If no specific tolerances are specified, the general tolerances for drawings shall be in accordance with ISO 2768-1.

7 Material selection

Materials for the manufacture of instruments used in dental implant placement and treatment shall be selected with regard to the properties required for the intended purpose, taking into account the effects of manufacture, handling, sterilization and storage (see Clause 8).

The suitability of a given material for a particular application shall be demonstrated by either:

- a) design evaluation in accordance with Clause 8; or
- b) selection from the materials specified in Annex A, which are found suitable by proven clinical use in similar applications.

NOTE Refer to the Introduction for additional information.

If other materials are used, a biological evaluation for the final product or representative samples from the final product shall be made in accordance with ISO 7405 and ISO 10993-1.

8 Performance evaluation

8.1 General

Instruments shall be evaluated in association with the implant system they are designed for, in order to demonstrate that the intended performance (see Clause 5) is achieved. Safety shall be demonstrated by pre-clinical evaluation and by carrying out a risk analysis in accordance with ISO 14971.

If the instrument is intended for reuse, its suitability for reprocessing shall be evaluated.

NOTE In certain circumstances a clinical evaluation can also be required.

8.2 Pre-clinical evaluation

If pre-clinical testing of instruments is required, the testing shall simulate conditions of intended use.

8.3 Clinical evaluation

If a clinical evaluation is required, it shall be conducted using the associated implant system under the intended conditions of use. If a clinical investigation is carried out, it shall be managed in accordance with ISO 14155.

9 Manufacturing

9.1 General

Instruments shall be manufactured to specifications in accordance with the required performance attributes (see Clause 6).

NOTE The application of quality management systems as described in ISO 13485 might be appropriate.

9.2 Technical documentation

The technical documentation of the manufacturer shall include at least the information required in Clauses 4 to 8, 10 and 11.

10 Reprocessing

10.1 Products supplied sterile

Instruments which are labelled “STERILE” shall comply with the corresponding regional or national regulation.

Sterilization processes shall be validated and routinely controlled.

If instruments are to be sterilized by ethylene oxide, ISO 11135-1 applies.

If instruments are to be sterilized by radiation, ISO 11137-1 applies.

If instruments are to be sterilized by moist heat, ISO 17665-1 applies.

10.2 Products provided non-sterile

For instruments which are supplied non-sterile, the manufacturer shall specify at least one appropriate sterilization method such that the functional safety of the product is not adversely affected. If multiple sterilizations are not allowed, this shall be stated [see 11.4. c)].

10.3 Reprocessing information

For instruments which are supplied non-sterile or claimed to be resterilizable, the manufacturer shall provide information on the processing of these instruments in accordance with ISO 17664.

11 Information to be supplied by the manufacturer

11.1 General

All packages shall bear a label which indicates the full contents. If the label does not list the full contents of the package, a contents list shall be enclosed. If symbols are to be used, they shall be in accordance with ISO 15223-1.

11.2 Marking on instruments

Instruments and related accessories used in dental implant placement and treatment shall be marked with the following:

- a) name or registered trademark of the manufacturer;
- b) lot number (batch code) or serial number, where appropriate;
- c) reference number (catalogue/article number), where appropriate;
- d) size indication, if needed for safe selection or use;

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- e) depth marking, where appropriate;
- f) colour code, where appropriate.

If the marking would affect the intended performance, or the instrument is too small to be legibly marked, the information required shall be given on the label.

NOTE "Legibly" means visible without magnification.

11.3 Labelling on the package

The labelling on the package shall contain at least the following information:

- a) name and address of the manufacturer;
- b) lot number (batch code) or serial number, where appropriate;
- c) reference number (catalogue/article number), where appropriate;
- d) for instruments intended for single use only, a label stating "For single use only" or a symbol in accordance with ISO 15223-1.

In addition, if the instrument is supplied sterile from the manufacturer, the following information shall be given on the labelling on the package:

- e) expiry date;
- f) symbol for "STERILE" in accordance with ISO 15223-1;
- g) symbol for the sterilization process used in accordance with ISO 15223-1.

11.4 Instructions for use

If the instrument cannot be used safely without instructions for use, these shall be provided.

If instructions for use are provided by the manufacturer of instruments used in dental implant placement and treatment, the instructions for use shall include at least the following information:

- a) name and address of the manufacturer;
- b) date of issue of the instructions for use;
- c) if the instrument bears an indication that it is for single use only, information on known characteristics and technical factors known to the manufacturer that could pose a risk if the instrument is to be re-used.

Additional information for the user may be provided at the discretion of the manufacturer in an electronic format (e.g. webpage, DVD).

Annex A (normative)

Materials found acceptable for instrument manufacture

A.1 Materials

The nature of the direct or indirect contact with the human body shall be considered when selecting the materials used in dental implant placement and treatment.

The materials specified in Annex A are found acceptable for the manufacture of instruments.

A.2 Stainless steels

The specification of the chemical composition of stainless steels shall be in accordance with ISO 15510, if applicable. The designation for the stainless steel shall be in accordance with ISO 15510, if applicable.

EXAMPLE The designation for a commonly used stainless steel is X5CrNi18-10.

For instruments used in dental implant placement and treatment manufactured with stainless steel, the compositions specified in Table A.1, Table A.2 and Table A.3 are acceptable.

The listing and the order number in the tables is according to their increasing carbon content, specified in the third column. If a range is given, the medium value is used for the ordering.

Table A.1 — Austenitic stainless steels

Number	Designation	% (mass fraction), maximum values unless indicated otherwise										
		C	Si	Mn	P	S ^a	N	Cr	Mo	Ni	Others	
1	X1NiCrMoCu25-20-5	0,02	0,75	2,00	0,035	0,015	0,15	19,0 to 22,0	4,0 to 5,0	23,5 to 26,0	Cu: 1,00 to 2,00	
2	X2CrNi18-9	0,03	1,00	2,00	0,045	0,030	0,12 to 0,22	17,5 to 19,5	—	8,0 to 11,0	—	
3	X2CrNiMo18-14-3 ^b	0,03	1,00	2,00	0,025	0,015	0,10	17,0 to 19,0	2,5 to 3,2	13,0 to 15,0	—	
4	X5CrNi18-10	0,07	1,00	2,00	0,045	0,030	0,10	17,5 to 19,5	—	8,0 to 10,5	—	
5	X5CrNiMo17-12-2	0,08	1,00	2,00	0,045	0,030	0,10	16,0 to 18,0	2,0 to 3,0	10,0 to 13,0	—	
6	X6CrNiTi18-10	0,08	1,00	2,00	0,045	0,030	—	17,0 to 19,0	—	9,0 to 12,0	Ti: 5xC to 0,70	
7	X6CrNiMoTi17-12-2	0,08	1,00	2,00	0,045	0,030	—	16,5 to 18,5	2,0 to 2,5	10,5 to 13,5	Ti: 5xC to 0,70	
8	X10CrNiS18-9	0,12	1,00	2,00	0,060	≥ 0,15	0,10	17,0 to 19,0	—	8,0 to 10,0	Cu:1,0	
9	X10CrNi18-8	0,05 to 0,15	2,00	2,00	0,045	0,030	0,10	16,0 to 19,0	0,8	6,0 to 9,5	—	

^a Particular ranges of sulfur mass fraction may provide improvement in certain properties. For polishability, a controlled sulfur mass fraction of 0,015 % maximum is recommended.

^b Not included in ISO 15510:2010.

Table A.2 — Martensitic stainless steels

Number	Designation	% (mass fraction), maximum values unless indicated otherwise										
		C	Si	Mn	P	S ^a	N	Cr	Mo	Ni	Others	
1	X15Cr13	0,12 to 0,17	1,00	1,00	0,040	0,015	—	12,0 to 14,0	—	—	—	
2	X17CrNi16-2	0,12 to 0,22	1,00	1,50	0,040	0,030	—	15,0 to 17,0	—	1,50 to 2,50	—	
3	X20Cr13	0,16 to 0,25	1,00	1,50	0,040	0,030	—	12,0 to 14,0	—	—	—	
4	X20CrNiMoS13-1 ^b	0,21 to 0,24	1,00	1,00	0,040	0,200	—	12,5 to 14,0	1,00 to 1,20	0,75 to 1,10	—	
5	X30CrMoN15-1 ^b	0,25 to 0,35	1,00	1,00	0,040	0,025	—	14,0 to 16,0	0,85 to 1,10	0,3 to 0,5	—	
6	X30Cr13	0,26 to 0,35	1,00	1,50	0,040	0,030	—	12,0 to 14,0	—	—	—	
7	X39CrMo17-1	0,33 to 0,45	1,00	1,50	0,040	0,015	—	15,5 to 17,5	0,80 to 1,30	1,00	—	
8	X46Cr13	0,43 to 0,50	1,00	1,00	0,040	0,030	—	12,5 to 14,5	—	—	—	
9	X50CrMoV15	0,45 to 0,55	1,00	1,00	0,040	0,015	—	14,0 to 15,0	0,50 to 0,80	—	V: 0,10 to 0,20	
10	X46CrS13	0,43 to 0,50	1,00	2,00	0,040	0,15 to 0,35	—	12,5 to 14,0	—	—	—	
11	X65Cr13 ^b	0,58 to 0,70	1,00	1,00	0,045	0,015	—	12,5 to 14,5	—	—	—	
12	X68Cr17	0,60 to 0,75	1,00	1,00	0,040	0,030	—	16,0 to 18,0	0,75	0,60	—	
13	X90CrMoV18 ^b	0,85 to 0,95	1,00	1,00	0,040	0,015	—	17,0 to 19,0	0,90 to 1,30	—	V: 0,07 to 0,12	
14	X105CrMo17 ^b	0,95 to 1,20	1,00	1,00	0,040	0,015	—	16,0 to 18,0	0,40 to 0,80	—	—	

^a Particular ranges of sulfur mass fraction may provide improvement in certain properties. For polishability, a controlled sulfur mass fraction of 0,015 % maximum is recommended.

^b Not included in ISO 15510:2010.

Table A.3 — Precipitation-hardening stainless steels

Number	Designation	% (mass fraction), maximum values unless indicated otherwise										
		C	Si	Mn	P	S ^a	N	Cr	Mo	Ni	Others	
1	X5CrNiCuNb16-4	0,07	1,00	1,50	0,040	0,030	—	15,0 to 17,0	0,60	3,0 to 5,0	Cu: 3,0 to 5,0 Nb: 0,15 to 0,45	
2	X1CrNiMoAlTi12-9-2	0,015	0,10	0,10	0,010	0,005	0,01	11,5 to 12,5	1,85 to 2,15	8,5 to 9,5	Ti: 0,28 to 0,37 Al: 0,60 to 0,80	
a	Particular ranges of sulfur mass fraction may provide improvement in certain properties. For polishability, a controlled sulfur mass fraction of 0,015 % maximum is recommended.											

A.3 Titanium and titanium alloys

For instruments used in dental implant placement and treatment manufactured with titanium, the material requirement for titanium Grade 2 or Grade 4 from ISO 5832-2 applies.

For instruments used in dental implant placement and treatment manufactured with titanium alloys, the material requirement for Ti 6-Al 4-V alloy from ISO 5832-3 applies.

A.4 Ceramic materials

For instruments used in dental implant placement and treatment manufactured with ceramic materials, Table A.4 applies.

Table A.4 — Ceramic materials

Name	Ceramic composite		
Elements	ZrO ₂	Al ₂ O ₃	Y ₂ O ₃
Content [% (mass fraction)]	74 to 78	3,6 to 4,2	18 to 22

A.5 Hard metals

For instruments used in dental implant placement and treatment manufactured with hard metals, Table A.5 applies.

Table A.5 — Hard metal

Name	WC-Co hard metal		
Elements	WC	Co	additional carbide
Content [% (mass fraction)]	88 to 94	6 to 12	remainder

A.6 Coatings (only additive procedures)

The following coatings are suitable for instruments used in dental implant placement and treatment:

- titanium nitride;
- titanium carbide;
- zirconium nitride;
- diamond-like carbon (DLC).

A.7 Surface treatment

The following surface treatments are suitable for instruments used in dental implant placement and treatment:

- anodisation of titanium;
- electro polishing;
- passivation.

NOTE See ISO 15730 for further guidance.

A.8 Polymers

The specification of the composition of polymers is difficult. Therefore only the following main groups are given as examples of polymers suitable for instruments used in dental implant placement and treatment.

The designation of the following polymers is in accordance with ISO 1043-1:

- a) polytetrafluoroethylene (PTFE);
- b) polyetheretherketone (PEEK);
- c) polyamide (PA), e.g. PA 6, PA 6.6;
- d) polyoxymethylene (POM);
- e) polypropylene (PP), e.g. PP-HI (polypropylene, high impact);
- f) polyphenylene sulfone (PPSU);
- g) acrylonitrile-butadiene-styrene plastic (ABS);
- h) silicone plastic (SI);
- i) polyetherimide (PEI).

Annex B (informative)

Cross-referencing of steel grades specified in international, regional or national standards

The following tables give cross-references to designations of stainless steels which are listed in other international, regional or national standards designation systems and which are identical or comparable to the steels specified in this International Standard.

The following abbreviations apply:

EN	European Standard
JIS	Japanese Industrial Standard
AISI	American Iron and Steel Institute
GB	Chinese Standard
UNS	Unified Numbering System for Metals and Alloys

Table B.1 — Cross-references for austenitic stainless steels

ISO	ISO	EN	JIS	AISI	UNS	GB
This International Standard	ISO 7153-1:1991	EN 10088-1:2005	JIS G 4303:2005	—	A959	GB/T20878/ISC
1	—	1.4539	SUS 890L	304L	N08904	S39042
2	—	1.4311	SUS 304LN	304LN	S30453	S30453
3 ^b	—	1.4441	SUS 316L	316LVM	F 138	—
4	M ^a	1.4301	SUS 304	304	S30400	S30408
5	—	1.4401	SUS 316	316	S31600	S31608
6	—	1.4541	SUS 321	321	S32100	S32168
7	P ^a	1.4571	SUS 316 Ti	316 Ti	S31635	—
8	N ^a	1.4305	SUS 303	303	S30300	S30317
9	—	1.4310	SUS 301	301	S30100	S30110

^a The chemical composition specified in ISO 7153-1:1991 is slightly different from ISO 15510:2010.

^b Not included in ISO 15510:2010.

Table B.2 — Cross-references for martensitic stainless steels

ISO	ISO	EN	JIS	AISI	UNS	GB
This International Standard	ISO 7153-1:1991	EN 10088-1:2005	JIS G 4303:2005	—	A959	GB/T20878/ISC
1	A ^a	1.4024	—	410	S41000	—
2	—	1.4057	SUS 431	431	S43100	S43120
3	B	1.4021	SUS 420J1	420A	S42000	S42020
4 ^b	—	1.4197	—	—	—	—
5 ^b	—	1.4108	—	—	—	—
6	—	1.4028	SUS 420J2	420F	S42000	S42020
7	—	1.4122	—	—	S43409	—
8	D ^a	1.4034	—	420C	S42000	S42040
9	I ^a	1.4116	—	—	S42077	—
10	—	1.4035	—	420F	—	—
11 ^b	—	1.4037	—	—	—	—
12	S ^a	1.4040	SUS 440A	440A	S44002	S44070
13 ^b	R ^a	1.4112	—	440B	—	—
14 ^b	—	1.4125	SUS 440C	440C	S44096	—

^a The chemical composition specified in ISO 7153-1:1991 is slightly different from ISO 15510:2010.

^b Not included in ISO 15510:2010.

Table B.3 — Cross-references for precipitation-hardening stainless steels

ISO	ISO	EN	JIS	AISI	UNS	GB
This International Standard	ISO 7153-1:1991	EN 10088-1:2005	JIS G 4303:2005	—	A959	GB/T20878/ISC
1	—	1.4542	SUS 630	17-4	S17400	S51740
2	—	1.4530	—	—	—	—

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- [12] ISO 15883-2, *Washer-disinfectors — Part 2: Requirements and tests for washer-disinfectors employing thermal disinfection for surgical instruments, anaesthetic equipment, bowls, dishes receivers, utensils, glassware, etc.*
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