Cooperation Centre for Scientific Research Relative to Tobacco

Cigar Smoking Methods Sub-Group

CORESTA Recommended Method No. 64

ROUTINE ANALYTICAL CIGAR-SMOKING MACHINE - SPECIFICATIONS, DEFINITIONS AND STANDARD CONDITIONS

May 2018

CORESTA RECOMMENDED METHOD Nº 64

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ROUTINE ANALYTICAL CIGAR-SMOKING MACHINE SPECIFICATIONS, DEFINITIONS AND STANDARD CONDITIONS

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ROUTINE ANALYTICAL CIGAR-SMOKING MACHINE SPECIFICATIONS, DEFINITIONS AND STANDARD CONDITIONS

(May 2018**)**

0. INTRODUCTION

Cigars are manufactured in a wide range of sizes and shapes and may be fully or partially machine-made or hand-made. Cigars range in length from approximately 65 mm to over 250 mm and in weight from less than 1 g to over 15 g. Diameters typically vary from 6 mm to over 25 mm. Cigar filler may vary in particle size and tobacco types used. This may impact pressure drop and smoking characteristics. Binders and wrappers may be constructed of natural leaf or of reconstituted tobacco sheet materials. Natural leaf binders and wrappers may vary extensively among samples of a given product for thickness, porosity, etc.

Due to the wide range of sizes for this product category, the Cigar Smoking Methods Sub-Group recognised the need to have specialized smoking parameters that differ from those typically used for cigarettes. From the smoking parameters available (Puff Volume, Puff Duration, Puff Period and Butt Length) the Puff Volume was considered to be the most logical parameter to be modulated as a function of the cigar diameter in order to keep the puff velocity constant for cigars with different diameters. In addition, the Puff Duration (1.5 seconds) and Puff Period (40 seconds) were chosen to limit self-extinguishments during machine smoking. These smoking parameters are not intended to reflect human smoking patterns but are simply meant to provide a means for meaningful analytical testing.

Thus a series of CORESTA Recommended Methods have been developed for use with machine smoking of cigar products. These CRMs are applicable to many commercially available products. Some level of deviations may be necessary in order to accommodate products not available or not considered at the time of development of these CRMs.

It must be stated that this method has limitations:

- At the time this method is published, a standardized method for the measurement of cigar diameter has not been developed. Non-cylindrical cigars present a challenge when estimating diameter.
- Available filter traps may not have sufficient capacity for larger cigars.
- The current method has not been validated for handmade cigars. Collaborative studies intended to calculate repeatability and reproducibility have not included such products. This diverse product category includes many formats, shapes and sizes, some of which cannot be tested using this Recommended Method.
- It is not possible to calculate repeatability and reproducibility (r&R) values across the full range of product designs due to the diversity in product styles, shape, and size. Thus, researchers testing products outside of the total particulate matter (TPM) loading and/or design characteristics included in this method should be mindful of this limitation in information.

1. FIELD OF APPLICATION

This Method:

- defines the smoking parameters and specifies the standard conditions to be provided for the routine analytical machine smoking of machine-made cigars;
- specifies requirements for a routine analytical smoking machine complying with the standard conditions.

2. NORMATIVE REFERENCES

2.1 CORESTA Recommended Method N° 46, *Atmosphere for conditioning and testing cigars of all sizes and shapes*

NOTE: the atmospheric conditions for testing are also referenced in ISO 3402

2.2 CORESTA Recommended Method N° 47, *Cigars – Sampling*

2.3 ISO 7210, *Routine analytical cigarette smoking machine —Additional test methods for machine verification*

2.4 ISO 2971, *Cigarettes and filter rods – Determination of nominal diameter – Method using a non-contact optical measuring apparatus*

3. TERMS AND DEFINITIONS

3.1 Test Atmosphere

The atmosphere to which a sample or test piece is exposed throughout the test

NOTE 1: It is characterized by specified values for one or more of the following parameters: temperature, relative humidity and atmospheric pressure, which are kept within the specified tolerances.

NOTE 2: The test may be carried out either in the laboratory or in a special chamber termed the "test chamber", or in the conditioning chamber, the choice depending on the nature of the test piece and on the test itself. For example, close control of the test atmosphere may not be necessary if the change in properties of the test piece is insignificant over the test period.

NOTE 3: Adapted from ISO 558:1980, definition 2.3.

3.2 Diameter

The measured diameter of the cigar at the indicated length from the mouth end of the cigar.

3.3 Butt Length

The length of unburnt cigar remaining at the moment when the smoking process is stopped (where applicable: including filter and/or mouthpiece).

3.4 Artificial Mouthpiece

A device attached to the mouth end of the cigar that is not consumed during smoking.

3.5 Insertion Depth

The length of cigar (or artificial mouthpiece) inserted into the cigar holder as measured from the mouth end of the cigar.

3.6 Restricted Smoking

The condition that exists when the mouth end of a cigar is closed to the atmosphere between successive puffs.

3.7 Pressure Drop

The difference in static pressure between any two points of the pneumatic circuit of a smoking machine which are passed by a current of air at a constant flow rate of 17,5 ml s^{-1}.

NOTE: The term draw resistance has a very similar meaning. To avoid any confusion the term draw resistance is used for cigars, whereas the term pressure drop is used by analogy in the case of the pneumatic circulation in a smoking machine.

3.8 Puff Duration

The interval of time during which the port is connected with the suction mechanism.

3.9 Puff Volume

The volume leaving the mouth end of a cigar and passing through the smoke trap.

3.10 Puff Number

The number of puffs necessary to smoke a cigar to a specified butt length.

3.11 Puff Period

Time between the start of one puff and the start of the subsequent puff.

3.12 Puff Termination

The termination of the connection of the port with the suction mechanism.

3.13 Puff Profile

The flow rate measured at the cigar holder and depicted graphically as a function of time.

3.14 Dead Volume

The volume which exists between the mouth end of a cigar and the suction mechanism.

3.15 Cigar Holder

The device for holding the mouth end of a cigar during smoking.

3.16 Smoke Trap

The device for collecting such part of the smoke from a sample of cigars as is necessary for the determination of specified smoke constituents.

3.17 Port

The aperture of the suction mechanism through which a puff is drawn and to which is attached a smoke trap.

3.18 Channel

An element of a smoking machine consisting of one or more cigar holders, one trap and a means of drawing a puff through the trap.

3.19 Cigar Position

The position of a cigar on the smoking machine.

NOTE: In particular it is determined by the angle made by the longitudinal axis of the cigar and the horizontal plane when a cigar is inserted into a cigar holder in an analytical smoking machine.

3.20 Mainstream Smoke

All smoke which leaves the mouth end of a cigar during the smoking process.

3.21 Sidestream Smoke

All smoke which leaves a cigar during the smoking process other than from the mouth end.

3.22 Ashtray

The device positioned under the cigars in their holders to collect ash falling from the cigars during smoking.

3.23 Clearing Puff

Any puff taken after the cigar has been extinguished or removed from the cigar holder.

4. STANDARD CONDITIONS

4.1 Machine Pressure Drop

The whole of the flow path between the mouth end of the cigar and the suction mechanism shall offer the least possible resistance and its pressure drop (see 3.4) shall not exceed 300 Pa.

4.2 Insertion Depth

The typical insertion depth of the cigar or artificial mouthpiece shall be (28,0 ± 1,0) mm.

4.3 Puff Duration

The standard puff duration shall be (1,5 ± 0,05) s.

4.4 Puff Volume

The standard puff volume (V) measured in series with a pressure drop device of 1 x (1 ± 5 %) kPa shall be V ml, as determined using the table below, with a standard deviation for individual puffs not greater than 0,30 ml.

The puff volume, V, is dependent on the diameter of the cigar (d) as follows:

Cigar diameter x (mm)	Puff volume y (ml)
≤12,0	20
>12,0	$V = 0{,}139 \cdot d^2$

where: V = puff volume, in ml (to the nearest 1 ml)
d = cigar diameter, in mm (to the nearest 0,1 mm), measured 33 mm from mouth end, after cutting if cutting is required.

NOTE: The formula [$V = 0{,}139 \cdot d^2$] is based on the principle of a constant airspeed of 11,8 cm/s.

4.5 Puff Period

The standard puff period shall be one puff every (40,0 ± 0,5) s.

4.6 Puff Profile

The puff profile (see 3.10) shall be measured with an impedance of 1 × (1 ± 5 %) kPa as specified in 4.3. It shall be bell-shaped with a maximum between 0,6 s and 0,9 s from the start of the puff. The increasing and decreasing parts of the profile shall not have more than one point of inflection each.

The maximum flow rate shall be such that, measured with a draw resistance of

$$1 \times (1 \pm 5\ \%)\ \text{kPa:}$$

$$\text{Maximum Flow} = \text{Puff Volume} * 1{,}05 \text{ with a tolerance of } \pm 15\ \%$$

4.7 Restricted Smoking

An analytical smoking machine shall be a restricted smoker [i.e. fulfil the conditions for restricted smoking (see 3.3)].

4.8 Puff Number

Each individual puff shall be counted and recorded and the puff number (see 3.7) rounded off to the nearest one-tenth of a puff, based on the puff duration.

4.9 Cigar Holders

4.9.1 General Specifications

The design of the cigar holder and smoke trap is such that they shall connect the cigar to the port of the machine in a leak free manner and shall be impermeable to smoke constituents and air. The axis of the cigar holder and smoke trap shall be within 0° to +5° of the horizontal and ensure that the cigar is held within -10° to +5° of the cigar holder and smoke trap axis. For heavy or long cigars an additional support might be required. Any necessary support should not touch the coal of the cigar during the smoking process. If the cigar holder is connected to a smoke trap for glass fibre filters as specified in 5.3.6, the distance between the mouth end of the cigar and the surface of the filter pad facing the cigar should be set to (12,0 ± 1,0) mm with an insertion depth of (28,0 ± 1,0) mm.

The cigar holder should be designed in a way that the cigar is sealed and supported in accordance with the statements above. An example of a suitable design that is available commercially is shown in Annex A1. Acceptable positions for sealing and support have been demonstrated between 10,0 mm and 20,0 mm measured from the mouth end of the cigar. Other ranges have been found suitable to provide the necessary sealing and support. The dimensions shown in Figure 1 have been shown to be acceptable and avoid damage to the cigar. Any wrinkling of the cigars must be avoided, as to prevent leakage during machine smoking.

NOTE: Specific cigars may have ventilation holes located in the sealing zone. If the study objective requires open ventilation, the sealing area may need to be adjusted and the deviation reported with the results.

This is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement of this product. Other cigar holders and smoke traps may be suitable for use with this method; however, laboratories must verify that alternative designs are fit for purpose.[1]

4.9.2 Cylindrical Cigars

A support disk (also referred to as an 'end seal'), if needed, may be positioned in the area 3 mm to 8 mm from the mouth end of the cigar. The diameter of the support disk shall be selected to accommodate the specific head shape of the cigar. A support disk with orifice diameter of approximately 1 mm to 2 mm less than the measured cigar diameter at the seal position has been found to be suitable.

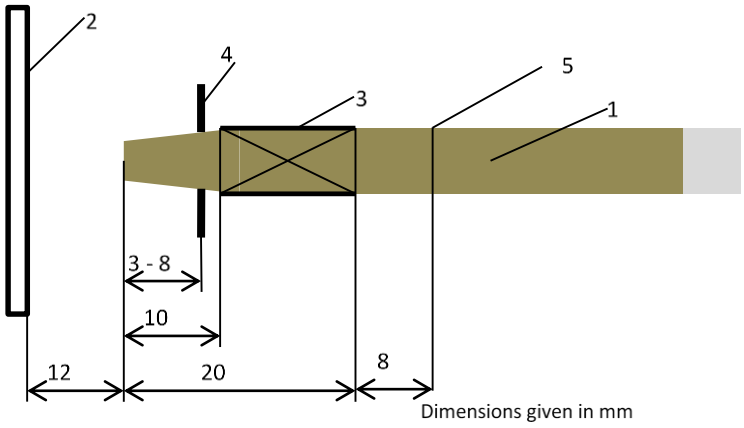
A sealing device using bobbins equipped with latex sleeves has been found to be a suitable solution. The dimension of the bobbins should be 1 mm to 2 mm bigger in diameter than the cigar measured at 15 mm from the mouth end. The sleeve used should be 1 mm to 2 mm smaller in diameter than the cigar at the above position.

For cylindrical products with smooth surfaces and a diameter between 4,5 mm and 9 mm, labyrinth seals as defined in ISO 3308 are found to be suitable. Labyrinth seals with orifices larger than those stipulated in ISO 3308 have been found to be suitable for larger cigars. The seal orifice is typically 1 mm to 2 mm smaller than the diameter of the test piece. The specifications in section 4.9.1 also apply.

4.9.3 Non-Cylindrical and Other Cigars

Cigars with an artificial mouthpiece or cigars with non-cylindrical mouth-ends may not be amenable to the holder designs described above. These products may require product specific solutions. These solutions should still meet the requirements in section 4.9.1.

Figure 1: Requirements for Cigar Holder Distance, Coverage, and Support Dimensions



Key

1 Cigar
2 Filterpad
3 Sealing area
4 Support disk / „end seal" (optional)
5 Insertion Depth

4.10 Ashtray Position

The ashtray shall be placed in a horizontal plane between 30 mm and 60 mm below the plane of the axes of the cigars.

5. SPECIFICATION FOR THE ROUTINE ANALYTICAL SMOKING MACHINE

The smoking machine shall comply with the standard conditions (see Section 4) and the following special conditions.

5.1 Operating Principle and Puff Profile

The machine shall include a device to draw a fixed volume of air (puff) through a cigar.

5.1.1 The machine shall produce a bell-shaped puff profile (see 4.6).

5.1.2 The machine shall be a restricted smoker (3.6).

5.2 Reliability

The machine shall control the puff duration, the puff volume, and the puff period to the tolerances specified in this document.

5.2.1 The machine shall possess the mechanical and electrical reliability necessary to meet the standard conditions regarding these parameters (see 4.3, 4.4 and 4.5) for prolonged periods.

5.2.2 The connecting piping between the smoke trap and the suction source shall offer the least possible resistance to air flow. The pressure drop of the total flow path between the mouth end of the cigar and the suction source shall not exceed 300 Pa before smoking (see 4.1).

5.2.3 The total dead volume (3.15), on any channel, shall not exceed 125 ml.

5.3 Cigar Holders and Smoke Traps

The machine shall contain devices for holding the cigar and for trapping the smoke produced.

5.3.1 The cigar holders shall be capable of holding the mouth end of the cigar during smoking. The standard conditions relative to the length of butt covered by this device and the air tightness of the seal are given in 4.9.

5.3.2 Devices shall be provided for attaching cigar holders to the machine, so that the cigar holders are held rigidly. A screwed fitting or "O" ring seal is recommended.

5.3.3 The cigars to be smoked shall be attached to the ports or the smoke traps by cigar holders meeting the specifications in section 4.9.

5.3.4 The machine shall be designed to hold the cigars in the standard position (see 4.9).

The system shall be designed to prevent losses of smoke constituents between the mouth end of the cigar and the smoke trap.

5.3.5 The cigar holders shall be arranged so that the sidestream smoke does not affect cigars smoked in adjacent holders. The distance between the centres of adjacent burning zones shall be at least 50 mm.

5.3.6 When the smoking machine is used for collecting particulate matter it shall be fitted with a glass fibre filter smoke trap, comprising:

Filter holders made of an airtight, non-hygroscopic and chemically inert material, fitted with end cap seals of the same material, able to contain a filter disc of glass fibre material l mm to 2 mm thick. The rough filter surface shall face the oncoming smoke. Different designs of smoke trap can meet this requirement. The diameter of the filter pad disc shall be selected based on the expected total particulate matter yield. Typically 44 mm, 55 mm and 92 mm diameter filter pads are suitable for smoking 1 or 2 cigars per pad based on TPM loading.

NOTE: Filter material which shall retain at least 99,9 % of all particles having a diameter equal to or greater than 0,3 µm of a dioctyl phthalate aerosol at a linear air velocity of 140 mm s^{-1}. The pressure drop of the filter assembly shall not exceed 900 Pa at this air velocity. The content of binder shall not exceed 5% as mass factor. Polyacrylate and polyvinyl alcohol (PVA) have been found to be suitable binders for this material.

The filter assembly shall be capable of quantitatively retaining all of the particulate matter in the mainstream smoke produced by the cigar without loss. In addition, the filter assembly shall be chosen so that the increase in pressure drop of the assembly does not exceed 250 Pa when measured after the smoking run.

5.3.7 Each channel shall have a puff termination device linked to a butt length (mark) sensor and a puff counter. When activated by the sensor the device shall prevent any further drawing of air through the cigar.

Examples of suitable sensors are as follows:

a) a micro-switch activated by the burning through of a 100 % cotton, (48 ± 4) tex thread, placed on the butt mark;

b) a specially shielded infrared detector. The shielding defines a detection border plane perpendicular to the cigarette. The crossing of that plane by the burning cone terminates the puff.

Alternatively, when the shape of the cigar does not allow the use of a puff termination device, the smoking shall be stopped manually when the coal reaches the butt mark, preventing any further drawing of air through the cigar.

5.4 The machine shall be capable of making at minimum one clearing puff after the termination of smoking an individual replicate.

5.5 Test Atmosphere

The temperature and relative humidity of the ambient conditions shall correspond to those specified in CORESTA Recommended Method N° 46.

5.6 Puff Counting

Each port shall have its own puff counter capable of counting to the nearest 0,1 puff.

5.7 Ignition

Flameless ignition shall be used where possible. The lighters shall light the cigars without either touching or pre-charring the cigar. Lighting of each cigar must be done in such a way that the whole surface of the fire-end of the cigar is burning. It is the operator's decision whether a 2^{nd} or 3^{rd} or … n^{th} lighting puff is required.

Where flameless ignition of the cigar is not possible by the standard lighters fitted on the smoking machine, lighting shall be done by means of a handheld electrical lighter or by a conventional gas lighter or torch.

5.8 Smoking Enclosure

The smoking process shall be carried out in an environment that allows the removal of sidestream smoke by extraction, in a manner that allows for a straight vertical smoke plume for approximately 10 cm between puffs.

6. ANNEX A

Figure 1: Basic Dimensions of Cigar Holder Arrangements

Table 1 : Recommended Bobbins, Sleeves and Buffer Washers

Figure 2 : Example of Holder Assembly for Cigars ∅ 6.5 to 16.49 mm (Construction Type 2 for ventilated cigars)

Figure 3 : Example of Holder assembly for Cigars ∅ 16.5 to 22.49 mm (Construction Type 2 for ventilated cigars)

Figure 4 : Example of Trap Assemblies for Cigars ∅ 6.5 to 16.49 mm and ∅ 16.5 to 22.5 mm

Figure 5 : Example of Trap & Holder Assemblies for Cigars ∅ 6.5 mm to 16.49 mm and ∅ 16.5 to 22.5 mm (Construction Type 2 for ventilated cigars)

Holder Construction Types:

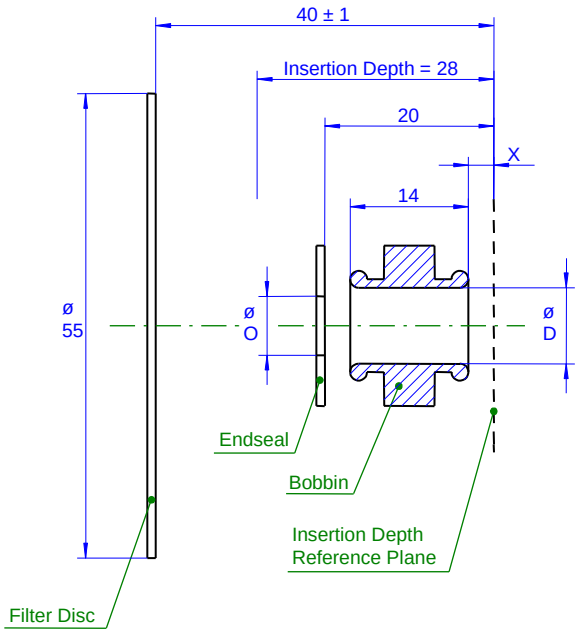
Cigar Holder Construction <u>Type 1</u> (1 seal / bobbin / 2 seals / endseal) is to be used for unventilated cigars.

Cigar Holder Construction <u>Type 2</u> (2 seals / bobbin / 1 seal / endseal) is to be used for ventilated cigars (see figures 2, 3 and 5)

Transcription of some references used in figures 2 and 3:

Nº 1 = Bobbin
Nº 4 = Seal
Nº 6 = Endseal
Nº 8 = Sleeve

Figure 1 - Basic Dimensions of Cigar Holder Arrangements



All Dimensions in [mm]

Diameter D and O and
Dimension X according to Table 1

Table 1 : Recommended Bobbins, Sleeves and Buffer Washers

Cigar Diameter [mm]			Recommended Bobbin internal Diameter (Ref. D) [mm]			Recommended Sleeve Diameter [mm]			Endseal internal Diameter (Ref. O)
6,5	-	7,5	8,5	or	9,5	4,5	or	5,0	to be selected by the operator to accomodate the headshape of the cigar
7,5	-	8,5	9,5	or	10,5	5,0	or	5,5	
8,5	-	9,5	10,5	or	11,5	5,5	or	6,0	
9,5	-	10,5	11,5	or	12,5	6,0	or	7,0	
10,5	-	11,5	12,5	or	13,5	7,0	or	8,0	
11,5	-	12,5	13,5	or	14,5	8,0	or	9,0	
12,5	-	13,5	14,5	or	15,5	9,0	or	10,0	
13,5	-	14,5	15,5	or	16,5	10,0	or	11,0	
14,5	-	15,5	16,5	or	17,5	11,0	or	12,0	
15,5	-	16,5	17,5	or	18,5	12,0	or	13,0	
16,5	-	17,5	18,5	or	19,5	13,0	or	14,0	
17,5	-	18,5	19,5	or	20,5	14,0	or	15,0	
18,5	-	19,5	20,5	or	21,5	15,0	or	16,0	
19,5	-	20,5	21,5	or	22,5	16,0	or	17,0	
20,5	-	21,5	22,5	or	23,5	17,0	or	18,0	
21,5	-	22,5	23,5	or	24,5	18,0	or	19,0	

X = 5,5 ± 0,5 mm for ventilated cigars (see Figure 1)

X = 2,0 ± 0,5 mm for non-ventilated cigars (see Figure 1)

Figure 2 - Example of Holder Assembly for Cigars ∅ 6.5 to 16.49 mm (Construction Type 2 for ventilated cigars)

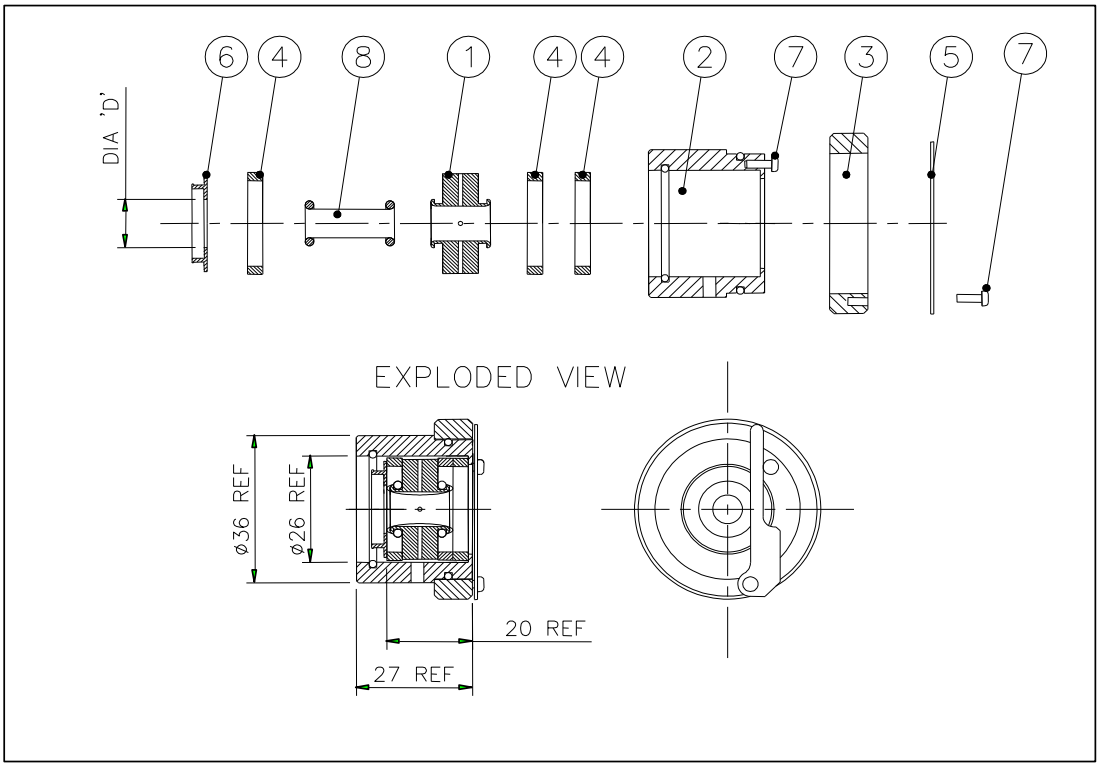


Figure 3 - Example of Holder assembly for Cigars ∅ 16.5 to 22.49 mm (Construction Type 2 for ventilated cigars)

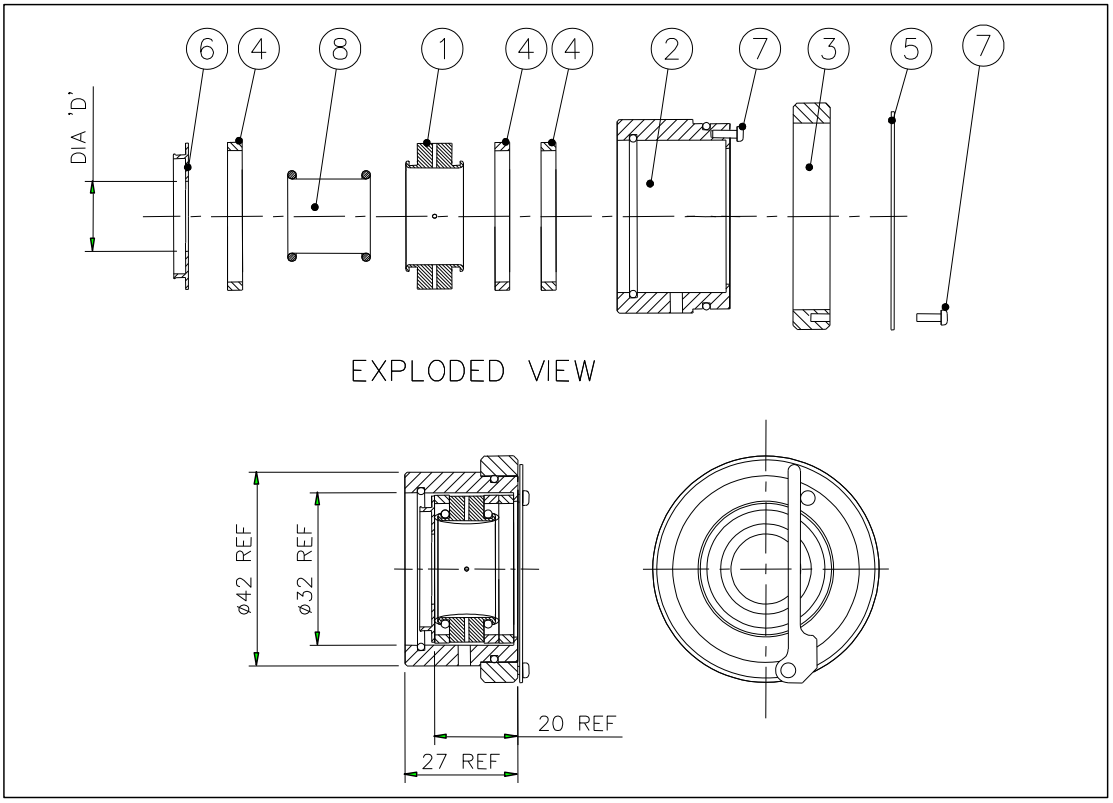


Figure 4 - Example of Trap Assemblies for Cigars ∅ 6.5 to 16.49 mm and ∅ 16.5 to 22.5 mm

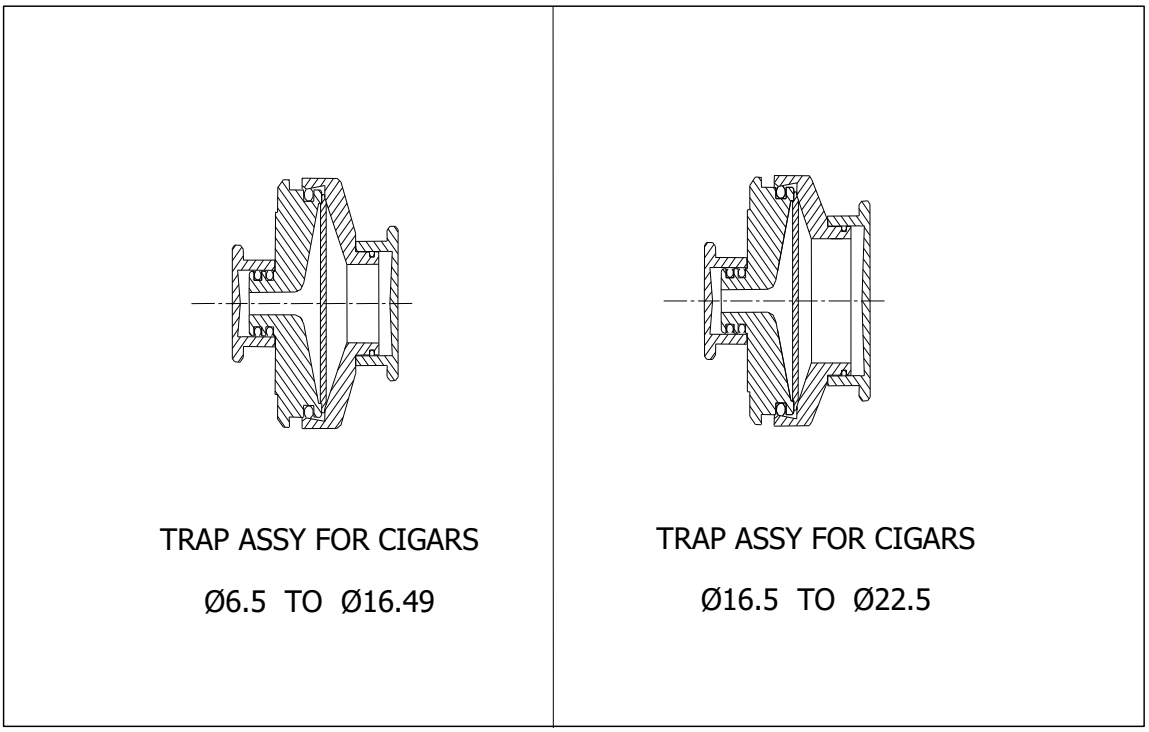
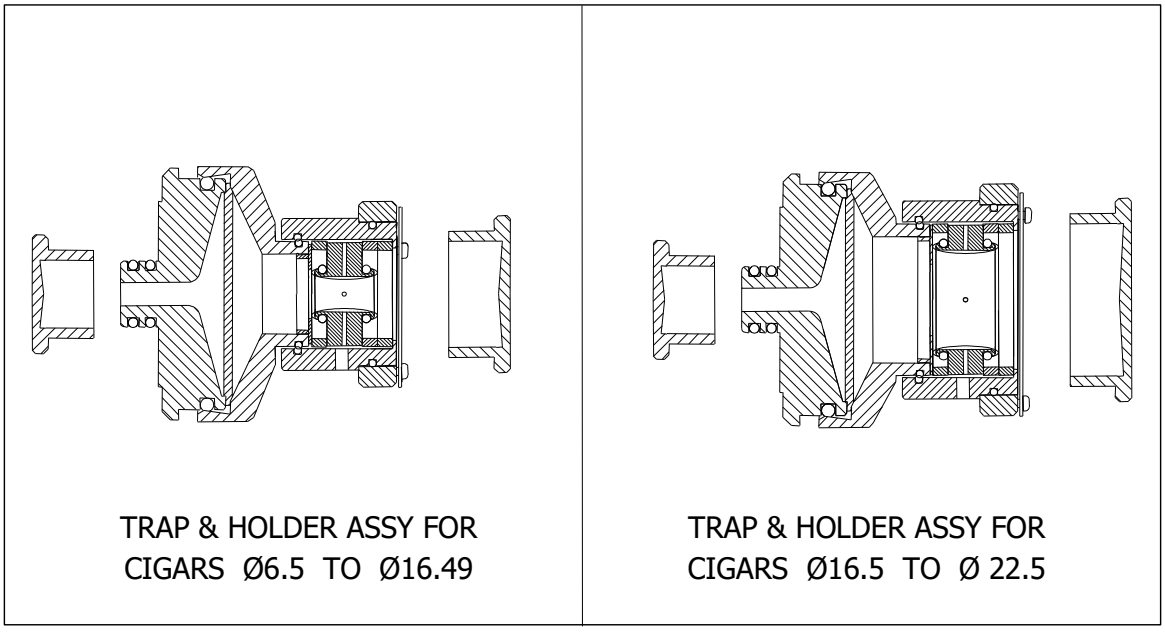


Figure 5 - Example of Trap & Holder Assemblies for Cigars ∅ 6.5 mm to 16.49 mm and ∅ 16.5 to 22.5 mm (Construction Type 2 for ventilated cigars)



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ISO 3308 *Annex A (Ambient air flow around cigarettes in routine analytical smoking machines: Control and monitoring), Annex B (Description of the puffing mechanism of a piston-type smoking machine), Annex C (Diagrammatic representation of a puff profile)*

ISO 558:1980 *Conditioning and testing — Standard atmospheres — Definitions*