

Design of a recorder flute

Goal

Design a recorder flute dimensioning the bore, the last two finger holes, the flue channel and the instrument mouth.

First component: resonator

The resonator is shaped as a cone whose conical semiangle is 0.75° . The instrument is aimed at being a treble recorder, with a length of 0.45m. For the sake of simplicity, we consider that only two finger holes are present.

Question 1

Find the diameter of the cone at the resonator head and foot so that the note produced when all the finger holes are closed is E4 (329.63 Hz).

Question 2

Find the position of the last finger hole (i.e. the one closest to the resonator foot) in order to produce the note F4[#] (369.99 Hz) when it is open. Consider the finger hole diameter to be equal to the bore diameter at the resonator foot (simplification).

Question 3

Find the position of the second last finger hole in order to produce the note G4[#] (415.3 Hz) when the two finger holes are open. Consider the finger hole diameter to be equal to the bore diameter at the resonator foot (simplification).

Second component: flue channel

The instrument is aimed at producing a spectrum whose centroid is at 1.7 kHz when the pressure difference between the player mouth and the flue channel entrance is 55 Pa.

Question 4

Find the flue channel thickness that complies with the above specifications. For this pair of thickness and jet velocity, compute the Reynolds number Re and assess the jet regime that is undergoing at the flue channel exit and in the instrument mouth (laminar, turbulent, etc).

Question 5

Consider that the flue channel length is 25 mm. Find the thickness of the boundary layer at the flue channel exit for the specifications defined above (Question 4).

Important information

Deadline: send the report by January 13, 2023.