

**Project Design Specifications**  
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Expandable Nasogastric Tube

**Team Members**

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**Problem Statement**

Nasogastric tubes (NG tubes) are commonly used for aspiration of gastric contents and gastric decompression in patients with small bowel obstruction. Placement of a NG tube causes discomfort and pain during insertion due in part to the large diameter of the tube. The project requires a nasogastric tube which is small enough to reduce discomfort, while still being functional. Secondary design specifications include pH sensitivity, to allow visual confirmation of when the tube reaches the stomach, and recyclability.

**Client Requirements**

The developed nasogastric tube must:

- minimize patient discomfort upon insertion by reducing tube diameter and/or incorporating an anesthetic or lubricating agent
- increase ease of insertion for the physician
- enable aspiration of stomach/small bowel contents without collapsing or harming patient
- be visible on x-rays used to confirm proper tube positioning
- incorporate a color indicator that confirms when tube is in the low pH environment of the stomach
- contain materials that are recyclable or made from recycled materials

**Design Requirements**

**1. Physical and Operational Characteristics**

a. *Performance requirements:* Currently, tubes are used once and thrown away, but if ours is recyclable, the tube must be able to withstand sterilization so it can be reused multiple times. The tube must withstand pressures up to 40 mmHg without collapse and acidity down to a pH of 2 to account with the harsh conditions of the stomach. Must be flexible to be manipulated through the nose down through the esophagus and into the stomach.

b. *Safety:* The tube must be hypoallergenic. It also must not have any sharp ends so it does not puncture or cut any vessels in the body.

c. *Accuracy and Reliability:* Has not been determined at this time.

d. *Life in Service:* The tube must last about a week in the environment of the stomach and esophagus.

e. *Shelf Life:* The tube must last at least 3 months on the shelf.

f. *Operating Environment:* The nasogastric tube is currently used in hospitals and medical clinics. It will be stored at room temperature with little exposure to humidity and pressure. This device will be inside the body, touching visceral organs, so while it is in use, it will have to withstand core body temperatures, ~100°F, and the acidity of the stomach, ~2pH. The device can be in the body for up to one week so it will have to be completely resistant to corrosion at these temperature and acidity conditions.

g. *Ergonomics:* There are many restrictions since the device will be used inside the human body. The nasogastric tube will be guided through the nasopharynx into the esophagus, so torque to bend the tube will be limited so tissue damage won't result. The diameter of the tube has to be

small enough to fit inside of the nose. The average length of a typical nasogastric tube is 90-100cm which will be used in our design. The suction of the typical hospital wall vacuum used will be between 80-120mmHg.

*h. Size:* The device will be 90-100cm long, and under 18Fr (~6mm) in diameter.

*i. Weight:* The device should be under 2kg.

*j. Materials:* All materials must be non-allergenic and non-irritable. Tube materials will most likely be made of polyurethane or polyvinylchloride.

*k. Aesthetics, Appearance, and Finish:* The device should look professional, the finish and appearance is not a factor, since function is 100% of the focus.

## **2. Production Characteristics**

*a. Quantity:* One prototype is needed at this time. There is the possibility of mass production in the future.

*b. Target Product Cost:* Target cost for device is kept to a minimum. Budget for prototype and design is \$1000.

## **3. Miscellaneous**

*a. Standards and Specifications:* FDA approval is required for the device for mass production.

*b. Customer:* The device must be expandable and start out in a small diameter. Would like for the tube to have an acid detector to ensure it is placed in the stomach. Recyclability would be ideal.

*c. Patient-related concerns:* Device will more than likely be one-time use. There is no patient data storage or other safeguards necessary.

*d. Competition:* Current competition is simple tubes constructed of PVC that are large and cause discomfort to the patient. There are a variety of models created by a large number of companies. Models vary in gauges and lengths. Average cost between \$12-\$20.