## Compact Air Cylinders Overview

### Features of Compact Air Cylinder Body
- The outer diameter of the cylinder body is selectable.
  - For selected shapes (with specified stroke), the bore can be specified in 1mm increments, and the rod type can be selected.
- The cylinder body can be fixed directly through the bore through holes.
  - In addition, additional parts can be selected accepting the shape bore, rod end, and flanges. Sensors can be installed at eight locations (BT32-locations), eight (BT55-locations).

### Selection of Cylinders
1. Define the requirements for the load.
2. Calculate the cylinder output (for Double Acting cylinder)
3. Determine the inner diameter of the tube.
4. Determine the theoretical reference speed based on the tube inner diameter and operating time (s).
5. Verify the cylinder design mechanism.
6. Verify the lateral load to be applied to the cylinder.
7. Provide safety measures against possible injuries and equipment damages by air cylinder malfunction.

### Compact Cylinder Basic Specifications
- Cylinder type: Double Acting
- Cylinder diameter is selectable from following 3 sizes: Ø20 (load factor: approx. 70%), Ø16 (load factor: approx. 80%), Ø12 (load factor: approx. 50%).

### Air Consumption and Required Amounts
#### Air Consumption of Double Acting Cylinder
1. Theoretical Air Consumption
   - Air consumption of an air cylinder depends on working pressure, cylinder diameter, and stroke. The air consumption is calculated by the following formula:
   - \( Q_{cp} = \frac{2 \cdot a \cdot \Delta P \cdot L}{P} \) [ℓ/min (ANR)]
   - \( Q_{cp} \) = Air consumption required for one reciprocating motion of air cylinder [ℓ (ANR)]
   - \( a \) = Inner Cross-sectional Area of Pipe [mm²]
   - \( \Delta P \) = Pressure Resistance [MPa]
   - \( P \) = Operating Pressure [MPa]
   - \( L \) = Stroke [mm]

#### Air Consumption of Double Acting Cylinder
2. Air Consumption of Cylinder in a Speed Range
   - Theoretical reference speed per cylinder stroke is calculated by the following formula:
   - \( \text{Theoretical Reference Speed} = \frac{2 \cdot a \cdot \Delta P \cdot L}{P} \times 0.1013 	imes 10^{-6} \) [m/s]
   - \( \Delta P \) = Pressure Resistance [MPa]
   - \( P \) = Operating Pressure [MPa]
   - \( L \) = Stroke [mm]

### Compact Cylinder Parts Details
- Part Number MD11L
- **Electrical Circuit**
  - Indicator Light LED (Lights when power is ON)
  - Connection: 3 Conductors, Outer dia. Ø2.6mm
  - Electrical Wiring Diagram: Refer to the "Electrical Wiring Diagram" of the sensor lead wires.

### Cylinder Sensor Specifications
- **Cylinders**
  - Sensor: Compact Cylinder (4-20mA, 1-5V, 1-10V, 0-5V, 0-10V, 0-20mA, 0-50mA)
  - Signal: 4-20mA
  - **Compact Cylinder Basic Specifications**
  - Cylinder Type: Double Acting
  - Cylinder Diameter: Ø20
  - Cylinder Stroke: 100mm
  - Operating Type: Double Acting
  - Lubrication: Category-1 turbine oil (ISO VG232)
  - Air Consumption: 0.0038 [ℓ/min (ANR)]
  - Air Consumption: 0.0114 [ℓ/min (ANR)]
  - Weight: 0.095 [kg]

### Cylinder Basic Structure Diagram
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### Compact Air Cylinders Overview
- MISUMI compact air cylinders are designed to be compact and safe to use.
  - The general purpose type is normally standard, and fixed-choke compact air cylinders can be shipped immediately, while those of selected shape (with specified stroke) can be dispatched within 2 days after receiving an order.
  - Each of the MISUMI standard type cylinders is equipped with a magnet rubber cushion.

### Compact Cylinders
- **Parts Details**
  - **Number Part Name**
  - **Theoretical Output**
  - **Load Calculations**
    - Calculate the cylinder output using the following formula:
    - \( F_{T} = \frac{W \cdot \Delta P}{P} \) [N]
    - \( F_{T} \) = Thrust force [N]
    - \( W \) = Weight of Object [kg]
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