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Supersonic (Engine) Inlets

- For air-breathing engines on supersonic vehicles, usually want to slow flow down to subsonic speeds inside engine
  - need supersonic diffuser ($M > 1 \rightarrow M < 1$) for engine inlet
  - exception: SCRAM jets
- **Goals**
  - produce desired M_{exit}
  - meet $\dot{m}_a$ requirement (thrust)
  - lowest p_o loss (highest thrust)
    - for flight M range
  - stable operation
    - no drastic inlet property changes for small flight condition changes


NASA.gov


Airbus


Lockheed Martin

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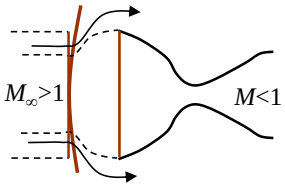
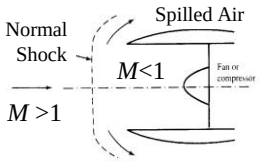
Supersonic Inlet Types

- **Conv.-div. diffuser**
  - lowest potential p_o loss
  - but starting problem (overspeeding) and single design M_{flight} (or variable area throat)
  - ***not used***



- **Normal shock diffuser**
  - uses external compression
  - highest p_o loss (strong shock)
  - also generally ***not used***



from Mattingly, *Elements of Gas Turbine Propulsion*

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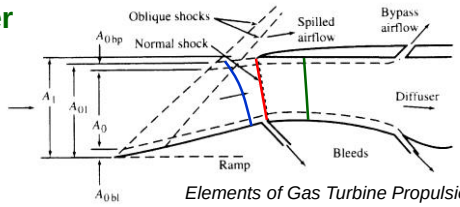
Supersonic Inlet Types

- **Oblique shock diffuser**
  - also uses external compression
  - lower p_o loss
  - works for large range of M_{flight}
  - heavier
  - ***most used***



Elements of Gas Turbine Propulsion

Subcritical: spillage, buzz

Critical: min p_0 loss, but not stable

Supercritical: higher p_0 loss, stable

Axisymmetric

NASA.gov

2-D

heritageconcorde.com

Diverterless

Lockheed Martin

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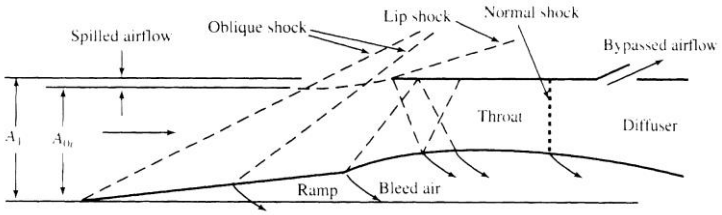
Two-D Mixed Compression Inlets



Mattingly, *Elements of Gas Turbine Propulsion*

FIGURE 10-30

- Needs fast reacting bypass doors
- Axisymmetric version (central spike) has weight advantage, but 2-d simpler and gives more variation in air flow

Supersonic Inlets - 4
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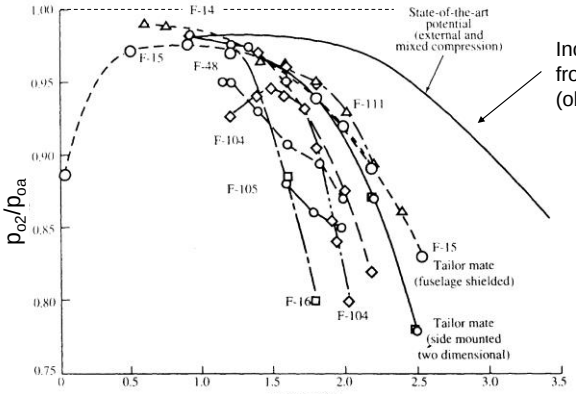
Pressure Recovery Performance



Increasing p_o loss from external (oblique) shocks

FIGURE 10-31

Mattingly, *Elements of Gas Turbine Propulsion*

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