NTSB National Transportation Safety Board

Office of Highway Safety

Hazardous Materials

Oxygen Cylinders

- 7 cylinders in luggage bay had minimal fire damage
- 11 cylinders in passenger compartment had extensive fire damage

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Cylinder Design

- Cylinder contains large quantities of oxygen compressed to 2,015 psig
- Valve assembly pressure relief device (burst disk)

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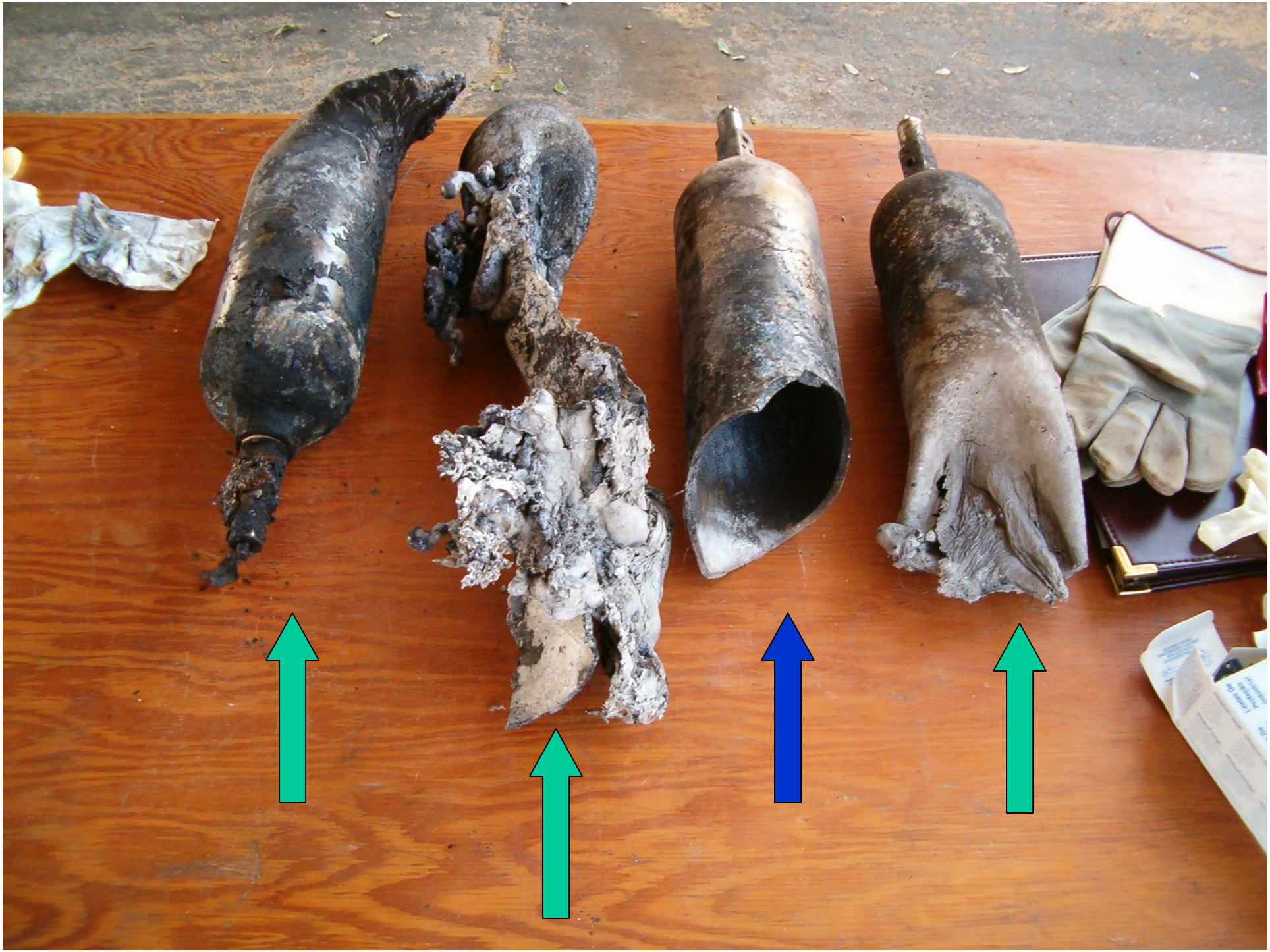
Burst Disk

- Actuates between 3,025–3,360 psig
- Fully pressurized cylinder reaches this range between 260º–315º F



Aluminum Cylinder Failure

- Aluminum melting range between 1,020º–1,206º F
- Aluminum begins to lose its strength when heated
- Without a burst disk, internal cylinder pressure rapidly causes failure above 600º F

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Valve Examination

- One burst disk actuated, relieving pressure as designed
- Two burst disks did not actuate, indicating cylinder failure

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Aluminum Cylinder Pressurization

- Compressed Gas Association tests
  - ***Fully pressurized*** cylinder in fire
  - Burst disk actuates
  - Prevents failure
- NTSB study
  - ***Partially pressurized*** cylinder <78% gas
  - Heated in excess of 400° F
  - Cylinder fails
  - Burst disk does not actuate

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Rescue Efforts

- Burst of fire due to cylinder failure
- Temperatures in excess of 400° F
- Conditions in motorcoach quickly became overwhelming
- Cylinders failed after successful rescue no longer possible

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Aluminum Cylinder Hazards

- Significant pressure
- Fire exposure may result in cylinder failure, pressure surge, and projectiles
- Danger to public and responders
- DOT regulations do not address partially pressurized cylinders exposed to heat

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Summary

- Standards needed for safe transportation of partially pressurized aluminum cylinders to prevent failure
- Guidance necessary for protection of emergency personnel and public responding to vehicle fires

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