An Oberon-based Rocket Engine Materials Testing System

O b e r o n D a y 2 0 1 1

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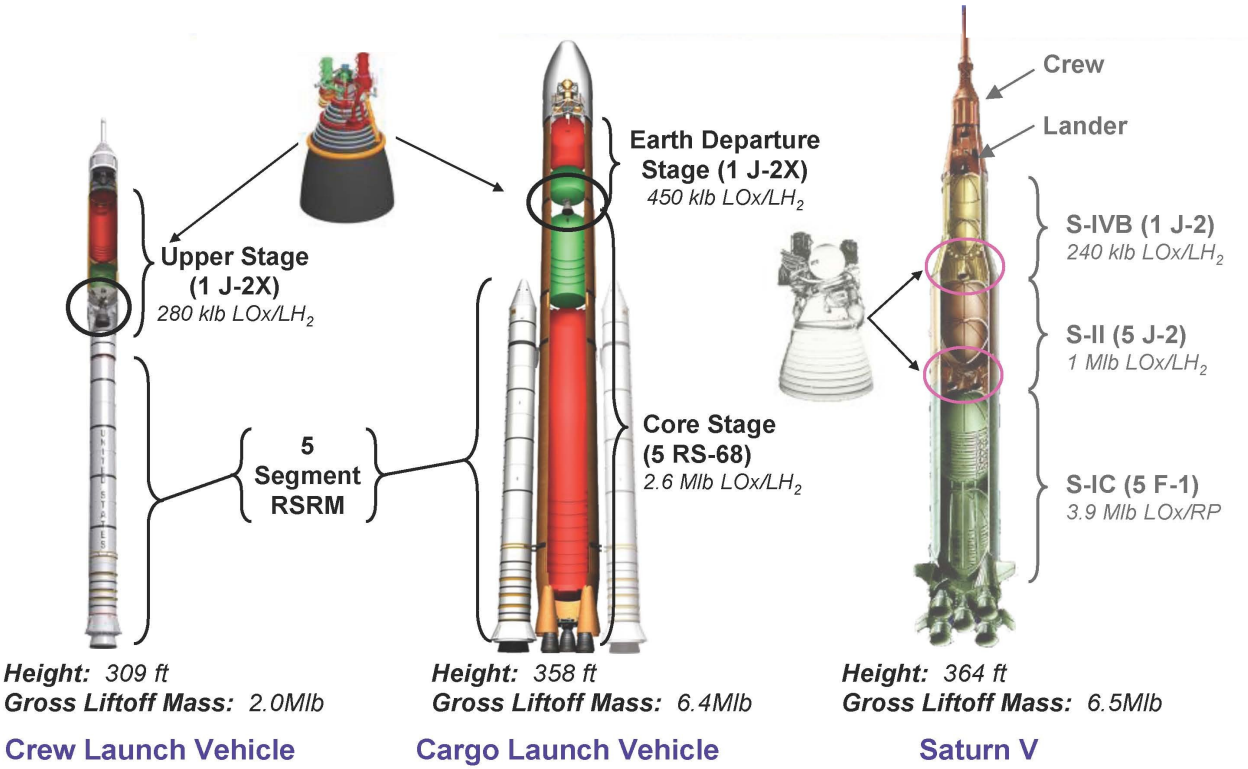
Motivation

- Constellation Project (NASA)
  - Shuttle Replacement
  - Family of launch vehicles (EO, Moon, Mars)
- Existing instrument required replacement
  - Early 1980's design
  - Expand capabilities
  - Improve serviceability

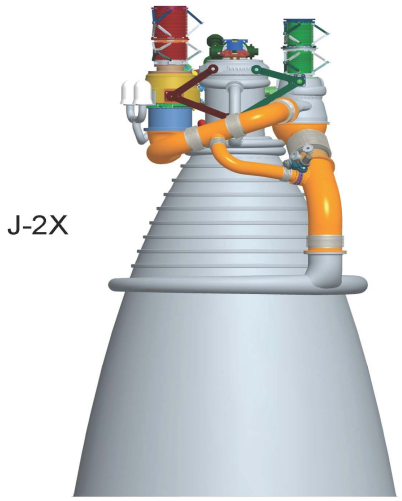
Ares Launch Vehicle Family



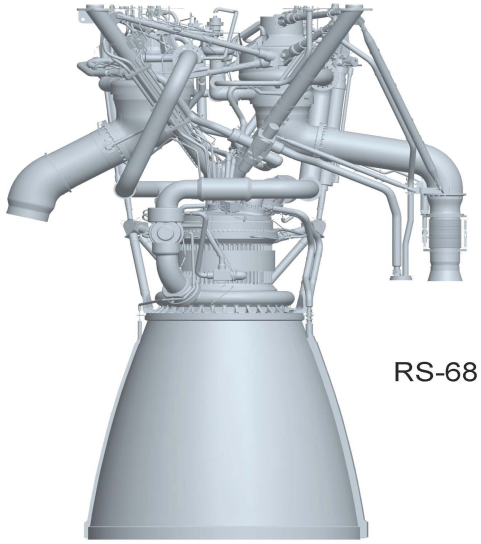
Ref: www.nasa.gov/pdf/214593main_Bouley(Lamm)2-26-08.pdf

Ares Engines

J-2X (LOX-H2), RS-68 (LOX-H2), SRBs



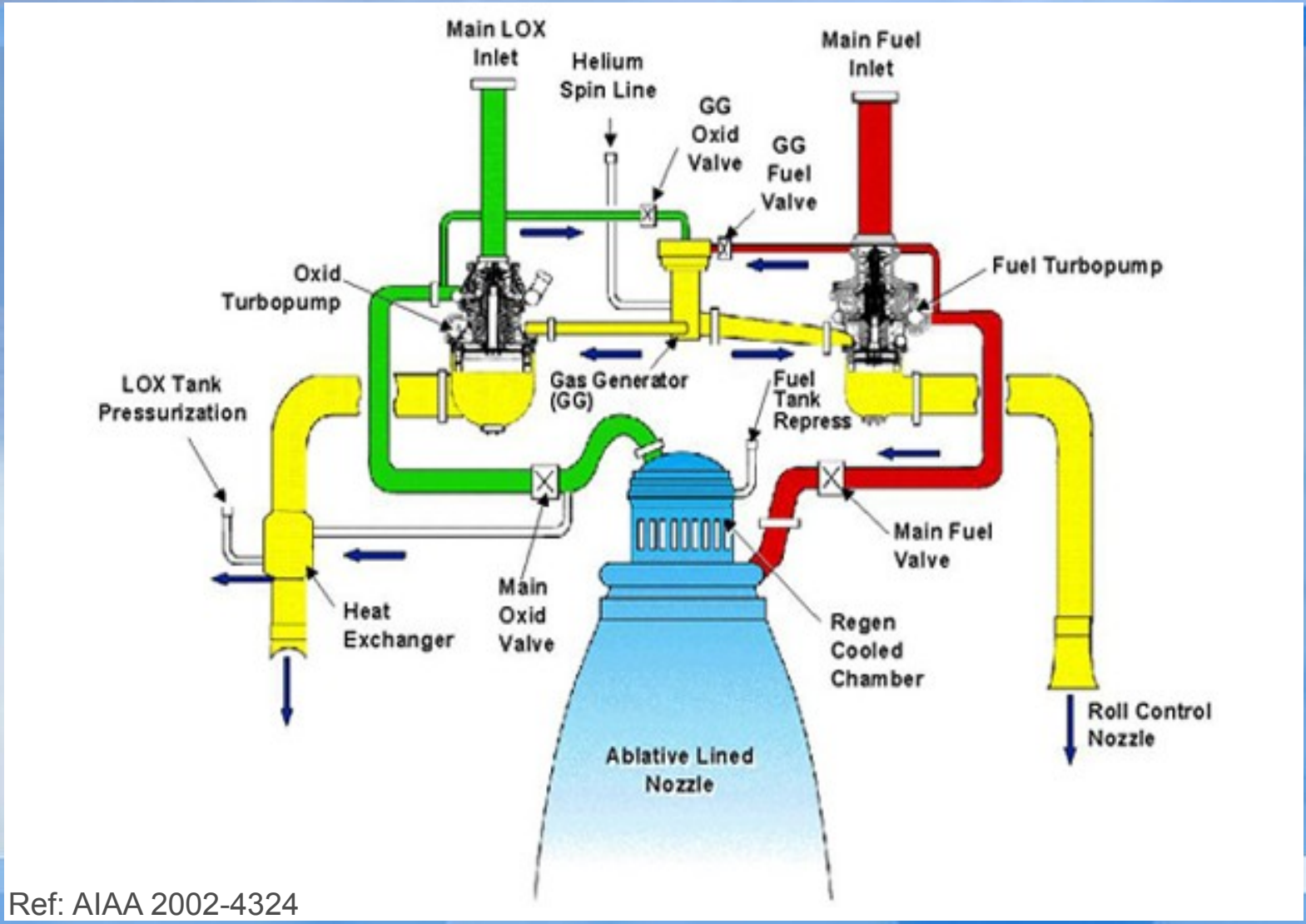
J-2X



RS-68

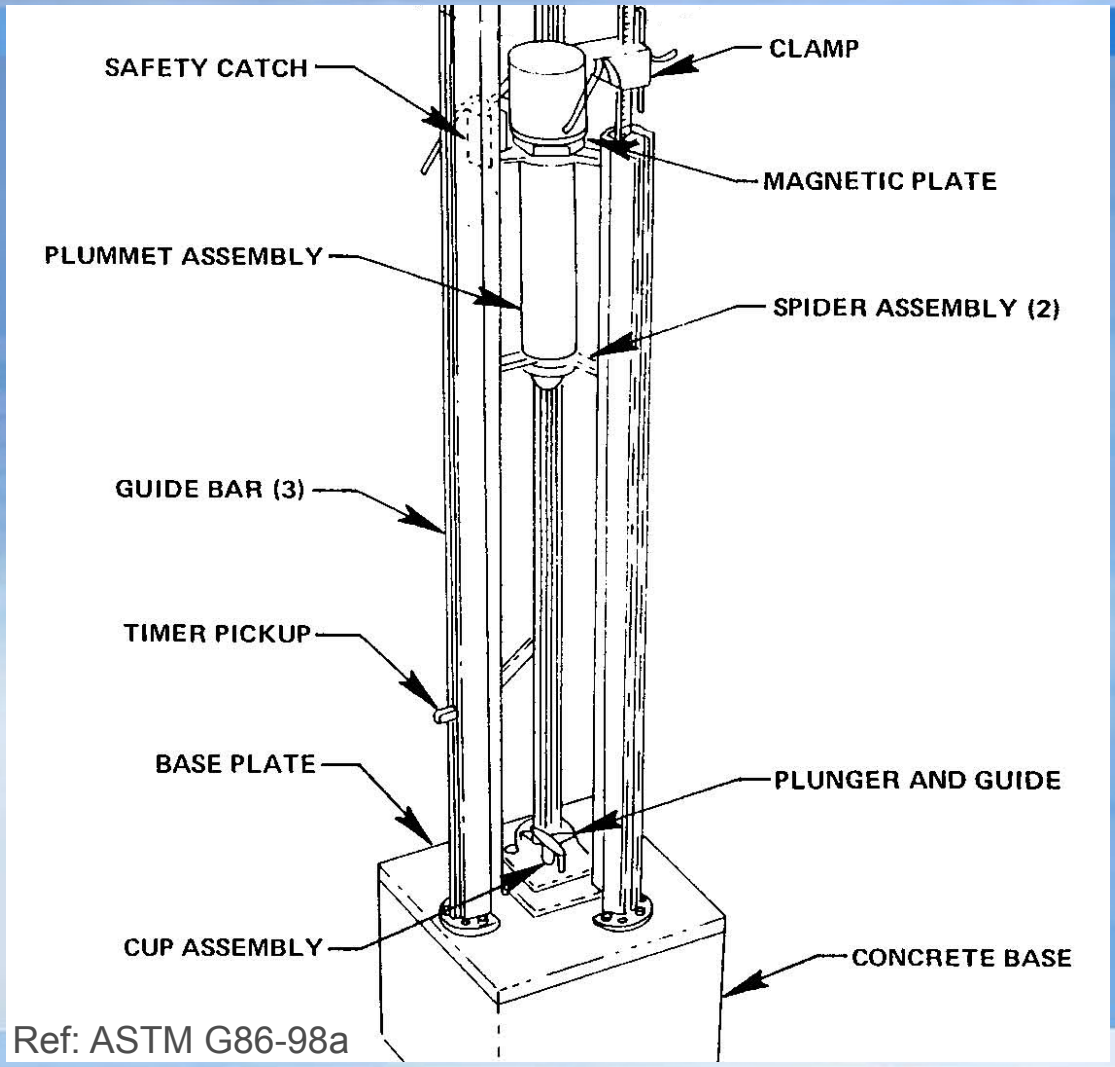
Ref: www.nasa.gov/pdf/214593main_Bouley(Lamm)2-26-08.pdf

RS-68 Engine Cycle



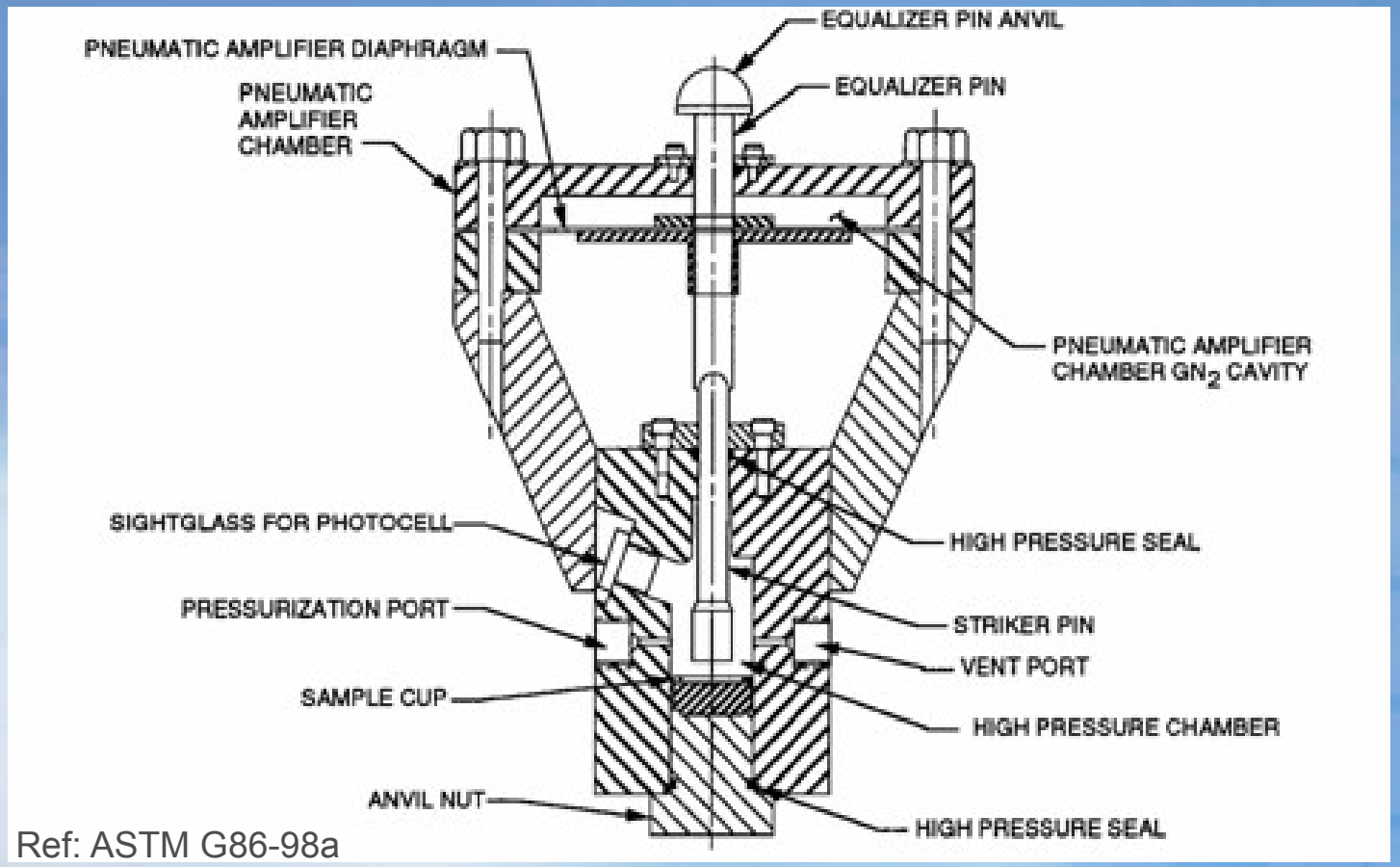
Ref: AIAA 2002-4324

O2 Impact Test System



Ref: ASTM G86-98a

O2 Impact Test System



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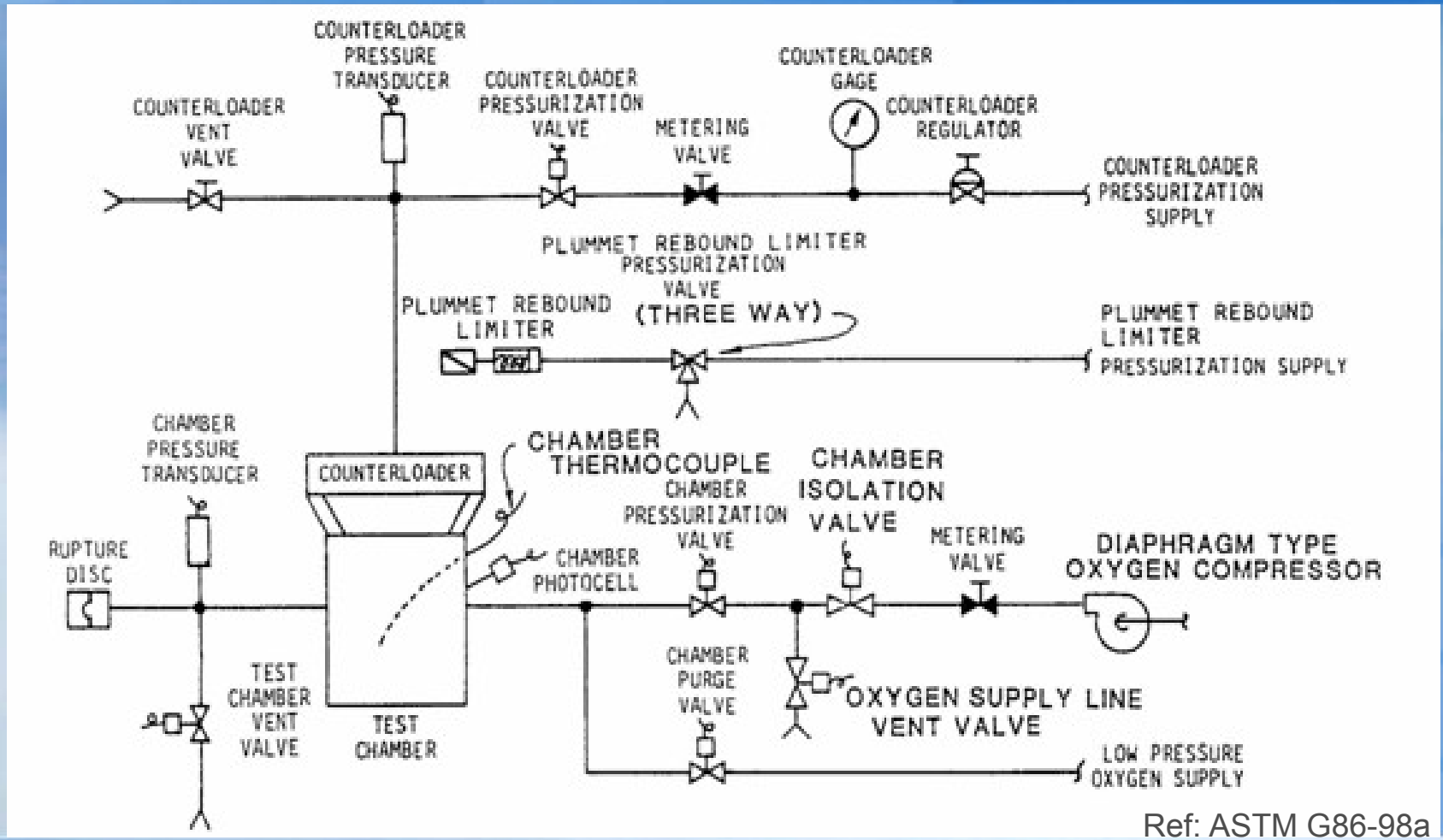
Typical Media Requirements



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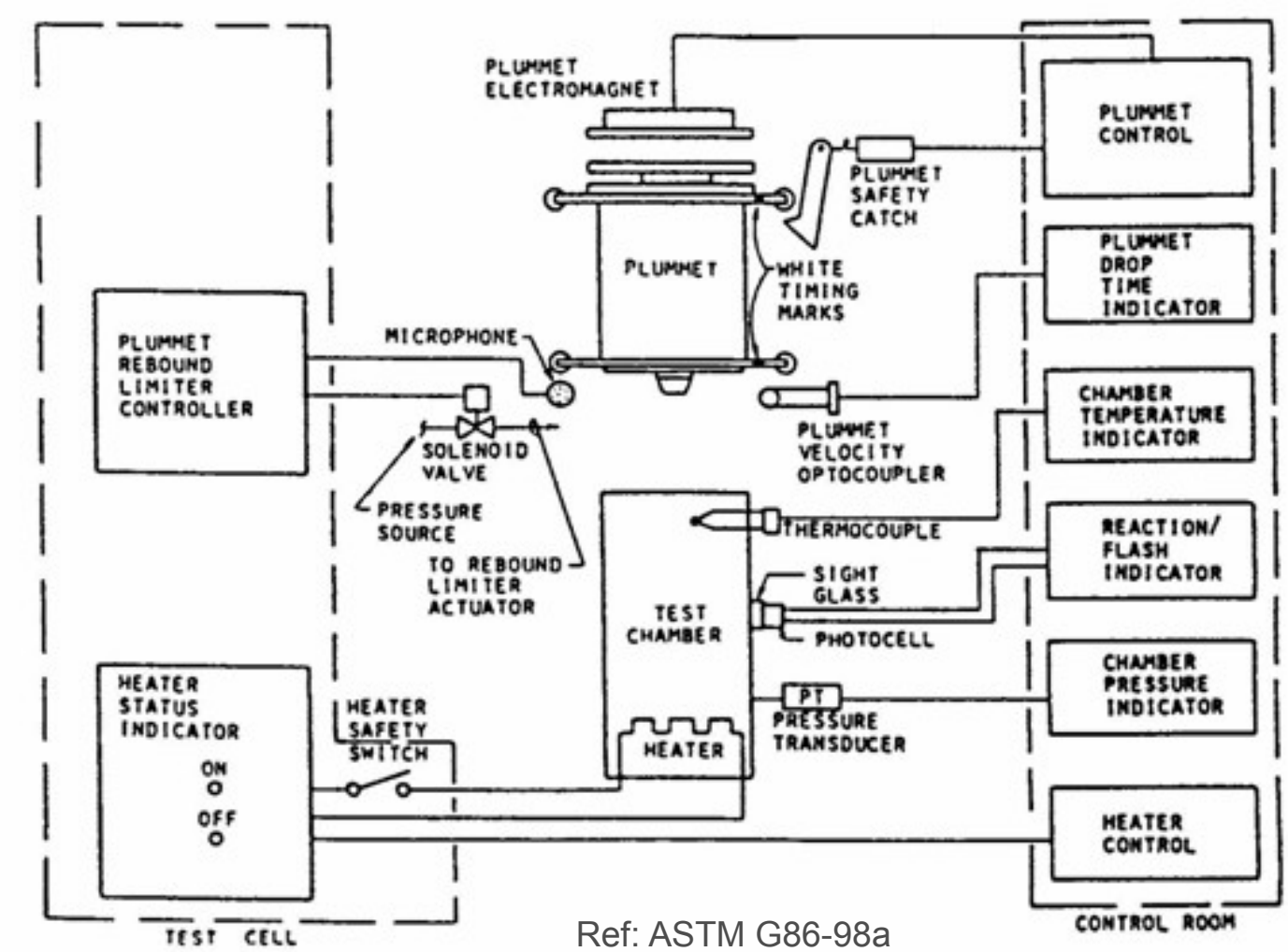
Instrumentation Requirements



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Control Requirements

- On/Off solenoid valve control
- Pressure, Balance Control (Servo'd)
  - Compressor control
- Temperature Control
- Transient Data Capture
  - Pressures, temperatures, photo intensity
  - ~250 ms sweep
  - Measurement of drop time
  - Impact velocity

Software Design

- Manual Overrides for all valves, major functions
- State Machine Approach
  - Drop Sequencer
  - Pressure Control
  - Balance Control
- Machines located in an ISR
  - Predictable
  - High rate

Approach

- Host-Target Design
  - Windows interface
  - Industrial PC running Oberon
  - Dedicated Ethernet Connection
- Signal Conditioning
  - Digitally adjustable Gain, Excitation
  - High resolution, good bandwidth
- Safety Interlocks

Why Oberon?

- Clear, concise language
  - Type safe, cycle free import, predictable 'straight' code, unambiguous behavior
- Very lightweight system
  - Fast, dynamic module loading/unloading
  - M.P commands
  - Knowable by one person
- In short...
  - Speed, safety, clarity, maintainability
  - Shaping force for problem solution

Results

- System Acceptance late in 2009
- Very Reliable operation
  - Minor adjustments (reporting, tuning)
- Much more capable system

Oberon- Looking Backward

- Rich language legacy
  - Algol, Pascal, Modula-2, Oberon
- Influential implementations, remarkable systems
  - P-Code, M-Code
  - Lilith, Oberon
- Modula-2 exceptionally powerful for RT work
- Emergence of NO enabled realization of Oberon for much RT work

"All knowledge is but remembrance" -Plato

Oberon- Looking Forward

- An alternative vision
  - We work with enormous languages, libraries, and systems, at great cost, much with little or no value added
  - We accept this; 'it is the way things are'
  - Really?
  - Oberon and its philosophical basis more important today than possibly at any earlier time

"...all novelty is but oblivion" - Solomon

Oberon- Suggestion

- Consider creating an archive of early implementation sources, build scripts, etc.
  - Missing links between PO and Last S3, V4
  - Literature surrounding these, including semester works
  - Captures evolutionary steps, decisions taken, implementations made
  - Preserves a formidable intellectual legacy

Oberon: a Proposal

- Consider an implementation targeting a VM
  - Portability, longevity, not speed, are the main concerns
  - Fixed backend, module format, loader, GC, etc.
  - VM can be easily re-targeted
  - An updated M-Code VM?
  - Wishes: HUGEINT

"And at the end of all our searching, we shall be returned to the place where we started, and know the place for the first time."

-T.S.Eliot