

EAR ***Workshop***

Analysis Tools



EAR Workshop

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June 2005

EAR vs. Delineation Testing

- **EAR for air void failures.**
 - ◆ **By EAR firm.**
- **Delineation testing for gradation, AC content and density failures.**
 - ◆ **Done by Contractor upon approval by the Engineer.**
- **EAR and delineation used to determine limits of defective material.**

Analyzing Data

- **What data is available?**
 - ◆ Production data: QC, VT, IV.
 - ◆ Plant reports.
 - ◆ Roadway reports.
 - ◆ Typical section – traffic data.
 - ◆ CPF sheets.
 - ◆ Forensic data – from roadway cores and field tests.

Summary Sheet

| Project Summary | | | | | | | | 9/13/2004 | 9/13/2004 | 9/13/2004 |
|---------------------|------------------------|-------------|--------|--------------------|--------|--------------|-------|---------------|---------------|---------------|
| Project No.: | 321456-1-52-01 | SR No.: | 121 | Date: | | | | 9/13/2004 | 9/13/2004 | 9/13/2004 |
| Contractor: | First American Asphalt | Gyrations | | Tested by: | | | | QC | QC | IV |
| Mix Design No.: | SP04-9999A | (mm): | 12.5 | @ N _i : | 7 | Lot / Sublot | | 8,1PC | 8,1 | 8,1 |
| Traffic Level: | C | Gmm: | | @ N _q : | 75 | Load #: | | 4 | 21 | 35 |
| VMA: | 14.0% MIN | VFA: | 65-75% | @ N _m : | 115 | Tons/day: | | | | |
| Design Temp: | Production: | Compaction: | | Cumulative tons: | | | | | | |
| Property | JMF | AVG | STD | MIN | MAX | RNG | CNT | | | |
| 25.0mm (1") | | 100.00 | 0.00 | 100.00 | 100.00 | 0.00 | 17.00 | 100.00 | 100.00 | 100.00 |
| 19.0mm (3/4") | | 100.00 | 0.00 | 100.00 | 100.00 | 0.00 | 17.00 | 100.00 | 100.00 | 100.00 |
| 12.5mm (1/2") | 95 | 93.82 | 1.65 | 90.14 | 96.26 | 6.12 | 17.00 | 96.08 | 93.13 | 94.36 |
| 9.5mm (3/8") | 89 | 87.42 | 1.83 | 84.34 | 91.26 | 6.92 | 17.00 | 89.45 | 86.73 | 87.26 |
| 4.75mm (#4) | 66 | 65.56 | 2.01 | 62.65 | 68.99 | 6.34 | 17.00 | 64.83 | 63.81 | 63.10 |
| 2.36mm (#8) | 45 | 45.11 | 1.81 | 42.64 | 48.38 | 5.74 | 17.00 | 42.81 | 43.37 | 43.00 |
| 1.18mm (#16) | 32 | 31.86 | 1.85 | 28.68 | 34.44 | 5.76 | 17.00 | 29.69 | 30.11 | 29.37 |
| 600um (#30) | 24 | 24.20 | 1.55 | 21.13 | 26.33 | 5.20 | 17.00 | 22.47 | 22.73 | 22.35 |
| 300um (#50) | 18 | 18.22 | 1.38 | 15.36 | 20.30 | 4.94 | 17.00 | 16.66 | 16.98 | 16.75 |
| 150um (#100) | 7 | 6.94 | 0.84 | 5.38 | 8.28 | 2.90 | 17.00 | 5.38 | 5.95 | 5.83 |
| 75um (#200) | 2.9 | 2.42 | 0.24 | 2.15 | 3.10 | 0.95 | 17.00 | 2.15 | 2.24 | 3.10 |
| Ext. AC %: | 6.1 | 6.04 | 0.18 | 5.81 | 6.55 | 0.74 | 17.00 | 6.10 | 6.00 | 6.55 |
| Rice MSG (Gmm): | 2.399 | 2.399 | 0.01 | 2.385 | 2.412 | 0.03 | 17.00 | 2.396 | 2.397 | 2.385 |
| Avg. Bulk (Gmb): | 2.303 | 2.311 | 0.01 | 2.300 | 2.333 | 0.03 | 17.00 | 2.315 | 2.305 | 2.333 |
| Agg. Sp. Gr. (Gsb): | 2.557 | 2.557 | 0.00 | 2.557 | 2.557 | 0.00 | 17.00 | 2.557 | 2.557 | 2.557 |
| Hgt.@N int.: | | 123.9 | 1.21 | 122.5 | 126.3 | 3.80 | 17.00 | 126.3 | 124.4 | 126.0 |
| Hgt.@N des.: | | 115.9 | 0.57 | 115.2 | 117.3 | 2.10 | 17.00 | 117.3 | 116.0 | 117.0 |
| %Gmm @ Ni | ≤ 89.0 | 90.2 | 0.55 | 88.9 | 91.0 | 2.09 | 17.00 | 89.73 | 89.67 | 90.83 |
| % Gmm @ Nd | 96.0 | 96.4 | 0.45 | 95.9 | 97.8 | 1.95 | 17.00 | 96.62 | 96.16 | 97.82 |
| % Air Voids @ Nd | 4 | 3.65 | 0.45 | 2.18 | 4.13 | 1.95 | 17.00 | 3.38 | 3.84 | 2.18 |
| % VMA @ Nd | | 15.07 | 0.23 | 14.74 | 15.74 | 1.00 | 17.00 | 14.99 | 15.27 | 14.74 |
| % VFA @ Nd | | 75.83 | 2.82 | 72.28 | 85.21 | 12.93 | 17.00 | 77.45 | 74.85 | 85.21 |
| Dust/Asphalt | | 0.48 | 0.04 | 0.41 | 0.56 | 0.15 | 17.00 | 0.41 | 0.44 | 0.56 |
| Gmb @ Nd | | 2.311 | 0.01 | 2.30 | 2.333 | 0.03 | 17.00 | 2.315 | 2.305 | 2.333 |
| Density lbs/cf | | 144.2 | 0.46 | 143.52 | 145.6 | 2.060 | 17.00 | 144.46 | 143.83 | 145.58 |
| Gse | | 2.6 | 0.01 | 2.62 | 2.6 | 0.02 | 17.00 | 2.62 | 2.62 | 2.63 |
| Pba | | 1.02 | 0.09 | 0.97 | 1.27 | 0.30 | 17.00 | 0.97 | 0.97 | 1.12 |
| Pbe | | 5.08 | 0.15 | 4.76 | 5.50 | 0.74 | 17.00 | 5.19 | 5.09 | 5.50 |
| Roadway Core 1 Gmb | | | | | | | | | 2.234 | |
| Roadway Core 2 Gmb | | | | | | | | | 2.223 | |
| Roadway Core 3 Gmb | | | | | | | | | 2.228 | |
| Roadway Core 4 Gmb | | | | | | | | | 2.212 | |
| Roadway Core 5 Gmb | | | | | | | | | 2.226 | |
| Average Core Gmb | | 2.21 | 0.01 | 2.20 | 2.23 | 0.03 | 11.00 | | 2.225 | |
| Sublot Gmm | | 2.40 | 0.01 | 2.39 | 2.41 | 0.03 | 17.00 | 2.391 | 2.397 | 2.385 |
| % of Sublot Gmm | | 92.15 | 0.42 | 91.63 | 92.83 | 1.20 | 11.00 | | 92.81 | |

Production Data

- **Look for trends and changes in data.**
 - ◆ AC increases, air voids decrease.
 - ◆ Gmm decreases, air voids decrease.
- **If available, see if IV data follows same trends.**

Forensic Data

■ Types of data:

- ◆ Properties of field cores.
- ◆ Laboratory tests from extra mix (if available).
- ◆ Laboratory performance tests on field cores.
- ◆ Performance tests at the roadway.
- ◆ Core reconstitution.

Properties of Field Cores

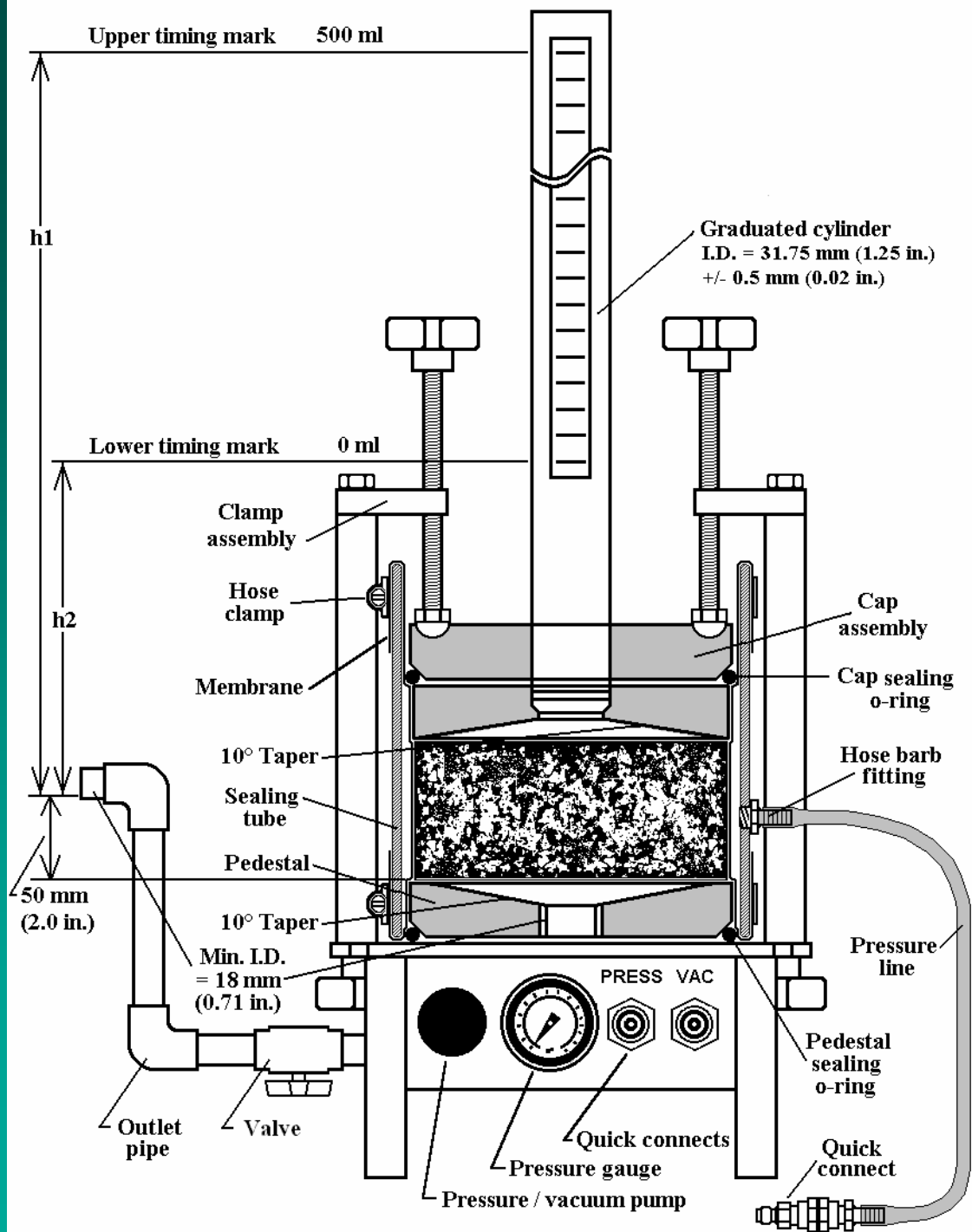
- Density (Gmb).
 - ◆ Sample in the WP and BWP.
- Maximum specific gravity (Gmm).
- Asphalt content and gradation.
- Frequency: 4 cores per 500 ft. 2 WP, 2 BWP. More cores if performance tests are needed.
- Gmb on all cores (wash cores well).
- Gmm on two cores.
- AC and gradation on two cores.
- Cut cores in good section ?

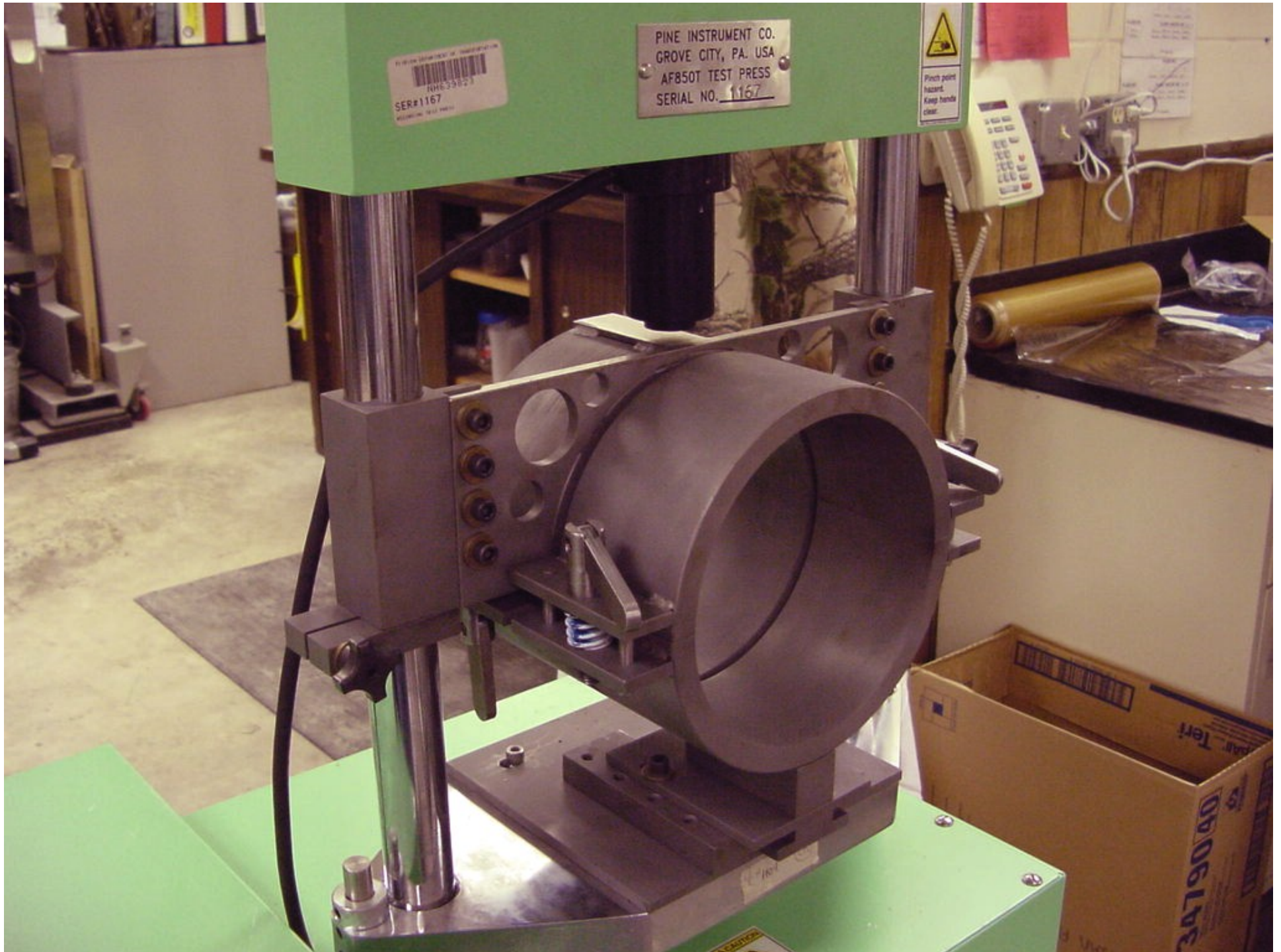
Lab Tests of Extra Mix

- Mix not always available.
- Used to check other results....
 - ◆ Gmb
 - ◆ Gmm
 - ◆ Air voids
 - ◆ AC and gradation

Laboratory Performance Tests on Field Cores

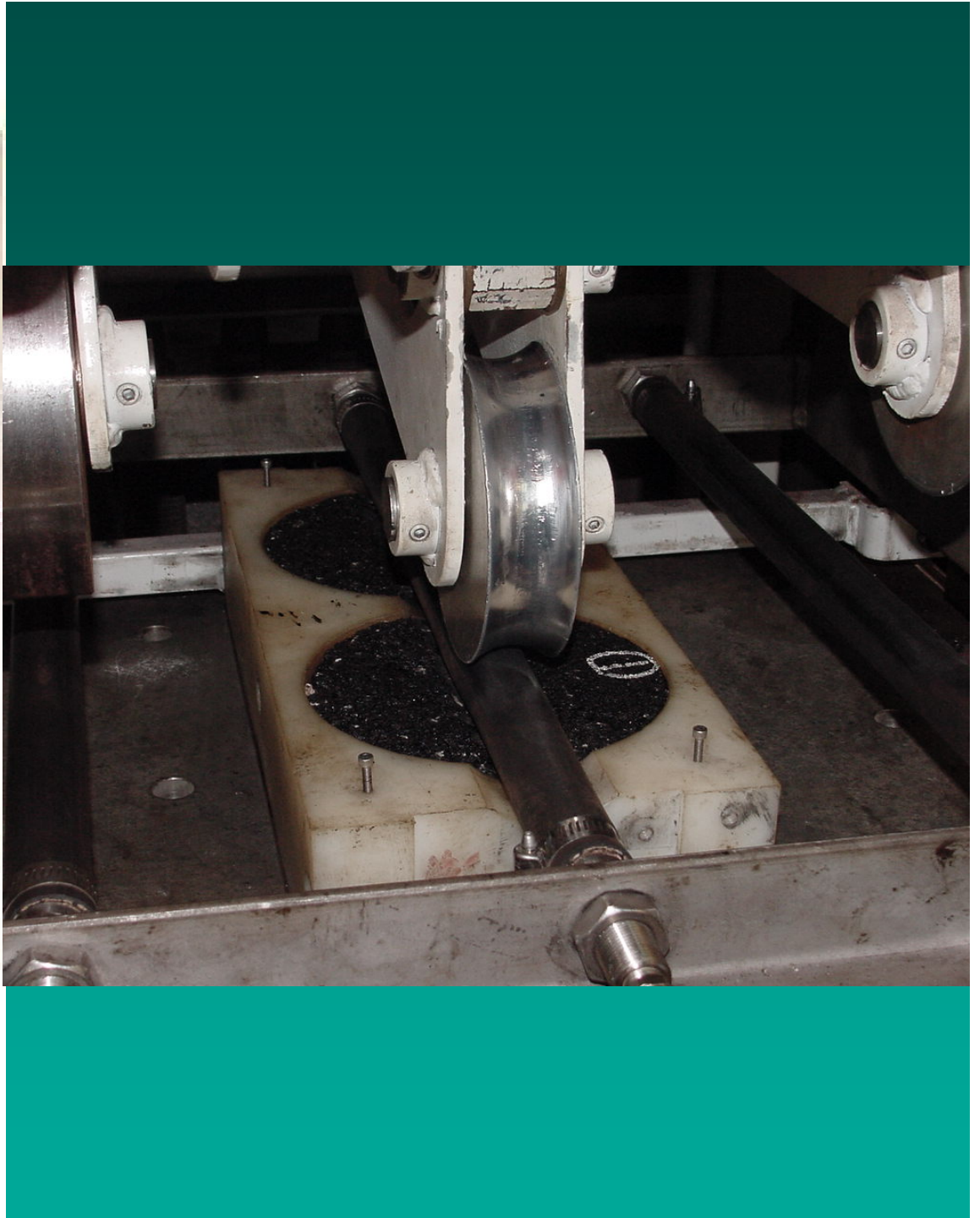
- Dense graded mixtures only.
 - ◆ Permeability.
 - ◆ Shear test – bond strength between two asphalt layers.





Future

- **Laboratory rutting test.**
 - ◆ Asphalt Pavement Analyzer.
 - ◆ Hamburg rut device.
 - ◆ Good for lab or field specimens.



Performance Tests at Roadway

- Field permeability – OGFC only.
- Longitudinal and transverse density profiles with density gauge (like PQI).
 - ◆ Use in conjunction with lesser frequency core data.



Core Reconstitution

- **Make gyratory pills from roadway cores.**
- **Measure Gmb. Calculate air voids.**
- **Used as a tool to evaluate mix with out-of-tolerance air voids.**
- **Evaluated method in research lab.**

Comments / Questions?