Casting Specifications and Quality Assurance
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Presented by:

Association of American Railroads
Coupling System and Truck Casting Committee

and

Truck Manufacturers Engineering Committee

MARTS 2005 Technical Conference
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Casting Specifications and Quality Assurance

- Panel Introductions, Today’s Discussion, Formation of CSTCC -- Cackovic
- Why is this Effort so Important? -- Iden
- What has been Improved in the Specifications (to date)
  - M-201 -- Clark
  - M-202/203 -- Moseng
  - M-210/211 progress -- Stephens
- Other Improvements
  - CSTCC Meetings - Participation in Foundry Audits -- Cackovic
  - Technical Checklists for QA Audits -- Cackovic
- Future Initiatives -- RFID -- Moseng
- Questions and Answers
Casting Specifications and Quality Assurance

◆ AAR Coupling System and Truck Castings Committee
  ● Mike Iden, Union Pacific Railroad Company
  ● Daniel Moseng, Jr. BNSF Railway
  ● Chuck Stevens, CSX Transportation
  ● Tim Ward, NS Corporation (absent)

◆ AAR Staff
  ● David L. Cackovic, Transportation Technology Center

◆ TMEC
  ● Mickey Clark, ASF
In 2002 the AAR was made aware of several derailments caused by broken truck bolsters. The AAR Equipment Engineering Committee began an investigation, and a tremendous effort ensued.

The bolsters were failing due to a combination of inclusions, hot tears and improper heat-treating. Testing showed that there was at least 100,000 miles between initial and complete failure.

The AAR EEC targeted over 24,000 cars for inspection and bolster replacement. The research in Pueblo led to a managed, safe plan of inspection and replacement program, an effort which is still underway under the direct management of the AAR in Washington, DC.

Radiographic Sensitivity (Contrast and Definition Demonstrated by Three Shot Radiographic Technique)
Why is This Effort so Critical to the Industry?

EXAMPLE:

- Safety
  - derailment prevention,
  - hazmat shipments
- Operating velocity
- Customer service
- Industry success ... castings mfrs., car builders/owners/maintainers, railroads, shippers and the public
M-201 Steel Castings -- Improvements

- **Section 3 – Records**
  - Added requirement for heat treatment records
  - Added requirement for traceability from individual casting serial numbers to chemical, mechanical and heat treat records
  - Reduced record retention period from 15 yrs to 3 yrs.

- **Section 5 – Heat Treatment**
  - Added Draft Sill End Castings
  - Added requirement that manufacturers must document inspector qualifications and inspection procedures regarding the removal and inspection of test lugs. These are used to verify that individual castings have been heat treated.
M-201 Steel Castings -- Improvements

- **Section 6 – Chemical Properties and Tests**
  - Added a requirement to monitor “tramp” elements which can affect impact properties and weldability. A carbon equivalency formula and acceptance criteria were added. This formula considers carbon, manganese, silicon, chrome, molybdenum, vanadium, nickel and copper content of cast steels.

- **Section 7 – Mechanical Properties and Tests**
  - Added requirement that results of mechanical tests must be found to be in compliance prior to shipment of finished castings.
  - Added requirement that a hardness test shall be completed for each heat either from a casting or a test coupon.
**M-201 Steel Castings -- Improvements**

**Section 12 – Weld Repair**

- Added requirement that manufacturer’s must have specific procedures for weld repairs to castings. These procedures must include restrictions to the amount of weld repair allowed in critical and non-critical areas.
- Added E9015, E9016 and E9018 weld wire for Grade E castings
Added test loading scenarios for 286K bolsters and side frames.

Updated design requirements to utilize best practice modern techniques.

Increased the number of bolsters required to be tested dynamically.

A detailed record of crack growth is to be maintained for all tests for later analysis.

Clarification of what constitutes a failure for a side frame in dynamic test.

Test reports to include:
- Metal thickness readings related to drawings.
- Internal solidity assessment.
- Chemistry, Mechanical properties including impact.
- Radiographs of spring seat and bottom tension member.
**M-210 Truck Bolster and Side Frame Purchase and Acceptance -- Improvements**

- Will soon go out for comment with:
  - Strengthened purchaser and AAR rights to enter and inspect foundries at any time.
  - Restricted time allowed when not manufacturing AAR approved castings to no more than 90 days.
  - Clarified approval requirements and durations.
  - Added B+ Steel per M-201.
  - Tied the metallurgical properties requirements to M-201.
  - Added the requirement for statistical sampling techniques to be applied to gaging, and maintained in auditable form.
Will soon go out for comment with:
- Required auditable, written weld repair procedures to be maintained.
- Added American Welding Society requirements for welder qualification.
- Replaced superficial finishing requirements section with 4 ½ pages of detail, including SCRATA surface condition requirements.
- Requires product distribution information to be sent quarterly to the AAR for archiving.
- Outlines required process control plan requirement for critical foundry processes.
- Has placeholder for possible future foundry NDT requirements based on AAR research.
Considering adding:

- Articulated connectors.
- Best practice, modern design techniques, including FEA.
- Revised definitions for design groups.
- Auditable:
  - Critical process control plans.
  - Gaging statistics.
- Requires product distribution information to be sent quarterly to the AAR for archiving.
Casting Specifications Other Improvements

- Other Improvements
  - CSTCC Meetings - Participation in Foundry Audits
  - Coordination with Quality Assurance Committee
  - Technical Checklists for QA Audits
All quality systems require that you “document what you do”

All Quality system audits then compare what you have documented with what is being done

M-1003 is the North American Interchange Railway System Quality Specification and the only quality system that requires reference to AAR criteria within the quality program
Quality audits are conducted with a checklist.
- To maintain consistency between audits.
- To ensure all requirements are met.

M-1003 uses the Quality Assurance System Evaluation (QASE) Checklist.
In addition to the QASE – M-1003 requires the use of “supplemental audit checklists” if appropriate.

- Supplemental Audit Checklists give an auditor additional information to look for concerning specific requirements based on technical requirements.
- Supplemental checklists are used in conjunction with the QASE and do not replace technical inspections.
Casting Specifications Other
Improvements – Technical Checklists

- M-101, Axles
- **M-201, Castings**
- M-210, Side Frames and Bolsters
- M-211, Couplers
- M-601, M-618, M-619, M-620, Hoses
- M-921, Cushioning Devices
- M-1002, Tank Cars
- S-2034, Freight Cars
Casting Specifications and Quality Assurance – Future Initiatives

- NDT research at TTC to determine feasibility for in-foundry use.
- Failure database development.
- Load spectra testing by TTCl and others in support of the Freight Car Fatigue Task Force, which is made up of AAR members and industry associations including ARCl and TMEC.
- RFID tags for castings.
Casting Specifications
and Quality Assurance – RFID Tags
Casting Specifications and Quality Assurance

Questions ??