Standardisation of switch actuation, locking and detection at INFRABEL

Ing. J. Reychler I-I.51

November 2012
Summary

1. Infrabel’s ALD-strategy & objectives

2. European standardisation of ALD-systems

3. Infrabel’s technical design criteria

4. Verification redesign with EN-approach

5. Future reliability, performance and cost reduction of standardised ALD

6. Conclusion
1. Infrabel’s ALD-strategy & objectives

1.1 Existing systems

- **Point machine:** Siemens S61
- **Detection system:** Internal detection in point machine
1. Infrabel’s ALD-strategy & objectives

➤ External locking system:

**Bussing locks:**
Old 50E2-turnouts till 2009

**Clamp locks:**
60E1-turnouts from 1990 till 2006

**Vertical clamp locks:**
60E1-turnouts since 2006 & 50E2-turnouts since 2006
1. Infrabel’s ALD-strategy & objectives

- “Non trailable ALD-system with trailing detection” → History

  - 1975 & 1976: two big accidents
    - Limited longitudinal movement (hot weather!)
    - Open switch blade was touched by wheels
    - Drive unlocked by dynamic movement
1. Infrabel’s ALD-strategy & objectives

- Till 1976: system was fully trailable ($V_{\text{max}}$ 140 à 160 km/h)

Safety measure:

- Since 1978:
  - Multiple attacks ($V \geq 40$kmh)
  - “Conditional trailability” ($V \geq 90$kmh)
1. Infrabel’s ALD-strategy & objectives

- Normal situation:
  - Machine remains trailable
- Planned route (by interlocking)
  - Drive rod is locked
  - Locking is detected
  - Detection of trailing (loss of internal detection)
1. Infrabel’s ALD-strategy & objectives

- **Advantages:**
  - Reliability and robustness of rodding system (MTBF=20 years)
  - Experience on the field

- **Disadvantages:**
  - Limited reliability of device to make ALD-system non-trailable with trailing detection (35% of reliability incidents)
  - Limited tampability
1. Infrabel’s ALD-strategy & objectives

1.2 Reliability and efficiency objectives

- Improved tampability
- Increased range for longitudinal displacement
- Reliable trailing detection
- Reduced maintenance activities
2. European standardisation of ALD-systems

2.1 Objective

- Description interface between operating equipment and S&C (EN13232)
- No European regulations for ALD-systems
2. European standardisation of ALD-systems

2.2 Approach

➢ Possibilities:
   • Starting from global system & functionalities + apportionment to sub-systems
     = Theoretical approach

   • Starting from experience with existing systems
     = Pragmatic approach

➢ Difficulties:

   Writing EU-standards for ex. stretcher bars (UK), components for “conditional trailability” (BE, IT), ...
   ➔ Same components – different requirement for different networks (depending on safety measures, history, …)
2. European standardisation of ALD-systems

**Conclusion:**

- High level requirements for ALD-systems are the same for all networks
- Apportionment of requirements is network depending
- Whole ALD-system determines if all risks are covered!

⇒ V-structure (EN50126)
2. European standardisation of ALD-systems

2.3 Objectives

- Generic on high level requirements for ALD-systems

- As specific as possible (values for locking force, maximum uplift tip of switch blade, maximum gap, …)

- Standardisation where possible (ex. system validation)

- Clarify requirements on ALD-system
  - Guidance for developing tender documents
  - Open up market
  - Euro-ALD-systems??
2. European standardisation of ALD-systems

- Permit clarifications of interface ALD <-> S&C
  - Specification requirements for locking/detection coming from S&C
    - Gaps (3 mm-check, studs, ..)
    - Forces (drive-, negative-, trailing-, …)
    - Number of drive points
    - Guidance on how to determine input values

- Future: Evaluation of existing systems
3. Infrabel’s technical design criteria

3.1 Redesign ALD-system for turnouts

- **Tampability:** Introduction hollow sleeper (according to EN16431)
- **Longitudinal displacement +/-35mm**
  - Redesign vertical clamp locking
  - Clearance/interference components
- **Point machine**
  - Reduced distance between drive rod and detection rods
  - Permanent system to guarantee detection of trailing
3. Infrabel’s technical design criteria

- Reduced maintenance activities
  - Switch point tamped by tamping machines (preventive maintenance ↓)
  - Low maintenance locking (preventive maintenance ↓)
  - Permanent system to guarantee detection of trailing (corrective maintenance ↓)

- Additional drives: abandoning rigid command
3. Infrabel’s technical design criteria

3.2 Redesign ALD-system for diamond crossings
4. Verification redesign with EN-approach

4.1 Redesign → Pragmatic approach

- Redesign process started before DG12
- Existing systems
- “At least as good as before”-principle (GAMAB)

4.2 To do: Verification design with ALD-standard

- Requirements
- Apportionment
- Risk analysis
5. Future reliability, performance and cost reduction of the standardised ALD

5.1 Reliability & performance

- Removal electro-mechanical device to make point machine non-trailable with trailing detection (35% ↓)

- Improvement tamping quality (reduction dynamic effects, shocks, …)

- Force reduction with new additional drive
5. Future reliability, performance and cost reduction of the standardised ALD

5.2 Cost reduction

→ LCC-analysis:
  - Infrabel reference
  - Infrabel upgrade
  - 4 potential ALD-suppliers

→ Cost categories:
  - Investment cost
  - Maintenance cost
  - Operational cost
  - Delay cost
5. Future reliability, performance and cost reduction of the standardised ALD

<table>
<thead>
<tr>
<th>Preventive maintenance:</th>
<th>Old design</th>
<th>Upgraded design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inspection ALD-system</td>
<td>12x/year</td>
<td>6x/year</td>
</tr>
<tr>
<td>2. Revision ALD-system</td>
<td>1.5x/year</td>
<td>1x/year</td>
</tr>
<tr>
<td>3. Tamping</td>
<td>0.5x/year</td>
<td>0.33x/year</td>
</tr>
<tr>
<td>Corrective maintenance (MTBF):</td>
<td>0.166667/year</td>
<td>0.133333/year</td>
</tr>
<tr>
<td>Intervention + disturbance traffic</td>
<td>(once every 6 years)</td>
<td>(once every 7.5 years)</td>
</tr>
</tbody>
</table>

**LCC result**

Gain (%)

- Infrabel reference: 0
- Suppl 1: -4.32
- Suppl 2: -5.7
- Suppl 3: -12.79
- Suppl 4: -11.36
- Infrabel upgrade: 11.2
6. Conclusion

➢ Currently: Pragmatic approach
  ▪ Only applicable method
  ▪ Different for every network

➢ Future: European ALD-standard
  ▪ Uniform method for ALD-system validation
  ▪ Standardisation of design process
Questions