

# IRSE

Institution of Railway Signal Engineers



## **IRSE Professional Examination**

---

### **2008 REVIEW**

**Date of Meeting:** 15 January 2009  
**Location of Meeting:** IRSE Headquarters

**Participants:**

John Alexander (JA), Andy Stringer (AS), and Daniel Woodland (DW).

DW opened the review and was pleased to say that there had been a slight improvement in overall exam results this year compared to the last couple of years. He said that there was however, still concern about pass rates generally and particularly those relating to Module 1. He said that the IRSE had launched a review to determine why the pass rates of candidates taking the Module 1 exam were so low. He said the review would include the consideration of the exam papers and how they may be improved. He went on to say that, in terms of Modules 4 and 6, because so few candidates sat these exams, it was difficult to get an accurate impression of what may be causing poor results. DW said the pass rate for Module 7 candidates was disappointing compared to last year.

	<b>M1</b>	<b>M2</b>	<b>M3</b>	<b>M4</b>	<b>M5</b>	<b>M6</b>	<b>M7</b>	<b>Totals</b>
<b>Distinction</b>	0	3	0	0	0	0	0	<b>3</b>
<b>Credit</b>	2	7	5	1	8	1	4	<b>28</b>
<b>Pass</b>	23	22	19	2	19	0	6	<b>91</b>
<b>Near miss</b>	10	5	9	1	4	0	1	<b>30</b>
<b>Fail</b>	29	15	21	2	8	6	12	<b>93</b>
<b>Total Candidates</b>	<b>64</b>	<b>52</b>	<b>54</b>	<b>6</b>	<b>39</b>	<b>7</b>	<b>23</b>	<b>245</b>
<b>2008 Pass Rate</b>	<b>39%</b>	<b>62%</b>	<b>44%</b>	<b>50%</b>	<b>69%</b>	<b>14%</b>	<b>43%</b>	<b>50%</b>
2007 pass rate	30%	54%	52%	50%	59%	60%	70%	<b>48%</b>
2006 pass rate	32%	56%	42%	44%	57%	60%	59%	<b>47%</b>
2005 pass rate	48%	55%	38%	50%	63%	63%	60%	<b>51%</b>
2004 pass rate	37%	63%	47%	33%	48%	60%	68%	<b>50%</b>
2003 pass rate	52%	48%	26%	40%	49%	100%	59%	<b>45%</b>
2002 pass rate	47%	57%	43%	100%	58%	67%	79%	<b>55%</b>
2001 pass rate	70%	46%	56%		52%		62%	<b>58%</b>
2000 pass rate	51%	67%	60%	50%	43%		83%	<b>57%</b>
1999 pass rate	50%	73%	55%		59%	100%	59%	<b>N/A</b>
1998 pass rate	63%	56%	43%	100%	36%	100%	61%	<b>N/A</b>
2007 total candidates	80	41	62	6	34	5	23	<b>251</b>
2006 total candidates	77	61	66	9	42	5	34	<b>294</b>
2005 total candidates	75	77	69	8	35	8	30	<b>302</b>
2004 total candidates	75	71	77	6	46	5	31	<b>311</b>
2003 total candidates	54	50	54	5	49	2	22	<b>236</b>
2002 total candidates	57	67	44	1	40	3	24	<b>236</b>
2001 total candidates	47	39	34	0	25	0	21	<b>166</b>
2000 total candidates	43	34	45	2	32	0	12	<b>168</b>
M1	Safety of railway signalling and communications							
M2	Signalling the layout							
M3	Signalling principles							
M4	Communication principles							
M5	Signalling applications							
M6	Communication applications							
M7	System management and engineering							

## Module 3

---

John Alexander said candidates need to explain why elements of any signalling arrangement are appropriate ie not just refer to them. He said that a number of candidates failed the aspect sequence chart question, which was clearly stated, and should have been fairly standard to most. He read the Part B Question 2 which asked the candidate to describe a signalling arrangement familiar to them. He said that some candidates gave more detail than the question required and therefore wasted precious time. He then read Question 4 regarding the upgrading of a user-worked level crossing. He said lots of detail was provided but the important issue of risk was not addressed adequately.

He then spoke about Question 8 and gave advice on appropriate answers (see italics):

- a) Under what circumstances is it appropriate to provide track circuit interrupters (TCIs)? (5 marks) - *A list of the circumstances where one might provide would address this, eg trap points, sand drag, sliding buffer stop, ...*
- b) For the circumstances you have described in a), list the risks being addressed and describe how the provision of the TCI addresses these risks. (10 marks) - *Note the number of marks! You are expected to explain the risks being managed in each of the scenarios and how detection helps to mitigate those risks*
- c) What happen when, and after, a TCI is operated? (5 marks) - *A brief description of how a TCI works and the impact it has on the signalling. Also the need for it to be repaired rather than a simple reset.*
- d) What difference would it make if the area was fitted with axle counters rather than track circuits? (5 marks) - *An axle counter head could be used in place of a TCI, but you need to be careful that the train detection section cannot be reset.*

JA then showed slides of a sample route; points in the route and overlap; protecting the flanks; and other routes. He then talked about control tables and said that more candidates do these rather than the written questions and often achieve better results. He acknowledged the time involved in producing control tables but said that around 80% get good marks and 20% do not do all routes or run out of time.

He stressed the importance of creating logical control tables; annotating with reasons for using controls or not using them; and reading the route boxes, which contain useful information.

JA talked about 'Keeping it Simple' as below points:

- Availability
  - The route (points)
  - The overlaps (points – remember alternative overlaps)
  - Opposing routes

- Call and lock
  - The route (points)
  - The overlap (points)
- The destination (lit)
- Route and overlap clear (tracks)
- Protecting the route
  - Trapping protection (points)
  - Flank protection (points)
  - Foul tracks
- Other routes
  - From entrance signal
  - Within route
  - Entering at destination
  - Opposing route joining in route
  - Time to a stand options
- Aspect Controls
  - Approach controls
  - Better aspects
  - Specials (eg preset or preceded by)
- Replacement
- Approach Locking
- Route Release

He concluded by answering the below questions:

**Are two completed routes better than a number of incomplete routes?**

JA: Markers look at the overall effort made by the candidate.

**What is to be gained by getting people to fill in column titles? Why can't that already be provided on the form?**

JA: A blank form encourages candidates to think about what columns should be provided and increases understanding. The less standard information added, the more chances of getting greater marks.

## Module 5

---

Andy Stringer acknowledged that the pass rate this year for Module 5 candidates was good but felt that a number of candidates failed because they did not read the questions properly and added that answers were often irrelevant. He made the following points.

Look at the marks allocated for each question and use that as a gauge for the length of answer required. Candidates have sometimes written answers using 10 sheets of paper when they would have achieved the same result using three. The quicker you can get your knowledge across, the better. Rather like a presentation, it can be useful to give the markers a brief summary of your answer before you launch into it. Quoting standards takes up time and doesn't show you actually have knowledge. Avoid acronyms – these were used by a number of candidates whose marks were jeopardised because they failed to provide a key. If appropriate, answers in the form of bullet points can be provided and full marks achieved; good drawing can also score marks. Remember that handwriting needs to be legible! Track circuit questions come up nearly every year – OHMS law knowledge can help achieve good marks.

JA said that the Examination Committee try to keep the questions fresh every year. Although they must work within the area of the syllabus, they try to offer a good balance of questions. DW added that candidates have a choice of ten questions but only have to answer three. This broad choice of questions caters for those with different backgrounds. JA advised that it is worth practicing exam technique and attempting past papers in exam time.

## Module 7

---

DW showed slides of the following questions and made the listed points.

Question 6:

**There is a project to build a new railway. The Signalling and Telecommunications systems are to be designed and supplied by multiple organisations, with further suppliers responsible for enabling works (such as power supplies and equipment rooms) and for rolling stock provision.**

**What activities are required during the design, installation and commissioning phases of the project in order to ensure that the individual sub-systems integrate with each other to provide a safe and reliable railway? [20 marks]**

- There was one good answer (78%) – the remainder of the candidates achieved very low marks.
- In general, candidates answered as though this were a question about project lifecycle phases and stages, not about integration of multiple sub-projects. Hence few marks could be awarded.
- Read and answer the question, not a related one that you know more about!

He then provided outline answer ideas:

- Clear contractual responsibilities and reporting lines for integration
- Requirements capture – overall system requirements and functional decomposition first, including verification / validation assigned. Formal capture / documentation
- Architecture and system / sub-system scope definitions
- Requirements capture – consistent sub-system apportionment, complete with verification / validation and captured links to system requirements and other sub-systems
- Interface identification / specification / definitions (including constraints, formats, information exchange methods, etc.) and common interface register
- Shared assumptions and issues, dependencies and caveats
- Hazard analysis, risk register and mitigations across system (not isolated sub-systems only)
- Overall system ALARP case and safety case – including input from individual systems and cross-system mitigation consideration
- Integrated design reviews, etc.... including preliminary stages
- Co-ordinated programme and Co-ordination meetings
- Change management and configuration control within and across sub-systems
- Prototyping / off site trials of individual sub-systems to show correct function and response to designated interfaces
- Prototyping / off-site trials of multiple sub-system elements together
- Full testing of all installed sub-systems as used before commissioning / verification
- Trials of multiple sub-system elements in use together on site
- Training of users and maintainers in FULL system, not just some sub-systems in isolation
- Validate requirements met by overall system performance

DW said that the above answers idea would have been what the examiners were looking for and if candidates had used all of them, they would have achieved a Distinction; if they had used half of them, with adequate explanation, they would have been heading towards a Pass.

Question 3:

**A railway is equipped with multiple aspect lineside signalling and a comprehensive ATP system. As the signalling member of an inquiry team investigating the causes of a derailment at a junction on this railway, what evidence would you look for to establish whether the signalling system had contributed to the accident in any way? [20 marks]**

Outline answer ideas:

- What were the operating conditions at the time (was the system in use, under RM, ...)

- Obtain juridical recorder units – any evidence of system failure, incorrect usage / operator error?
- Signal box register entries
- Review working time records for driver / signaller
- D&A test on driver
- Signal selection working correctly now
- Correspondence of signal selections and ATP codes
- Signal sighting conditions
- Wire count on relays matches design
- Point machine working (does push against stock rail and lock, stretcher bars in place, ...)
- Point detection working (and detecting correctly)
- Indications to the signaller correspond with the physical infrastructure and interlocking
- Were there signalling works ongoing in the area at (or near) the time?
- Train detection systems correctly functioning (within set up parameters and actually working)
- Any record of recent failures in the area that could be related?
- Statements from staff involved
- Condition of track / point tips
- Speed restrictions in place & correctly signed
- Condition of wiring
- photograph everything

DW said the examiners would be looking for a mixture of these answer ideas to determine whether the candidate has a well-rounded knowledge of the subject.

Question 8:

**A new railway control centre is being built which will centralise control of a complex line. A voice communication system is to be provided to allow control staff to communicate with drivers.**

**Describe the process you should adopt in order to identify the system requirements. [10 marks]**

**Briefly explain how each of the following issues could impact on the design and operation of the voice communication system:**

- a) **Human machine interface**  
**AND**
- b) **Environmental factors**  
**AND**
- c) **Interaction with other railway control systems**  
**AND**
- d) **Maintenance and installation** **[10 marks]**

Outline answer ideas:

- Identify / procure resources
- Business requirements (high level objectives based on corporate need, policies, plans, etc.)
- Survey of market (what is possible / good practice)
- Scope definition (e.g. system architecture - intended usage, limits of what will be done, high level functionality to be included, users, ...)
- Identify system context (interfaces and constraints - including physical environment, EMC, railway access)
- User requirements capture (operators – driver and signaller - maintenance staff and general engineering expertise for good practice and integration)
- Analysis of applicable standards (company and international )for applicability
- Performance requirements (RAMS, etc.)
- Risk analysis (QRA, HAZID / Hazard Log, ...) and development of mitigations
- Develop requirements set based on above. Document, link and provide traceability to source
- Identify must have, nice to have and gold plating. Assign criteria for value
- Assign verification / validation criteria.
- Peer review

Outline answer ideas:

Impact of issues:

- a) HMI Human factors (location, viewing angles, size of display, layout of display, layout of controls, length of phone cord / hands free, colour usage, need to co-ordinate with other systems with same user both before and after the project, alarm identification, noise levels, lighting conditions, ...)
- b) Environment Light, heat, noise, vibration, EMC, space, cable routings, impact of materials, power usage, heat generation, neighbours concerns (such as mobile masts), materials fire performance
- c) Interaction with other control systems, distraction, use of similar symbols etc. for like functions, EMC, interfaces, common log on, integration, design consents for changes to other systems (wiring, etc.)
- d) Maintenance and Installation: Easily accessible to maintenance staff, not accessible to unauthorised people, spares holding for standard parts, modular units, central or trainborne locations (not trackside), fault tolerant, fault reporting / alarms, minimal disruption to services, integration with existing

The examiners were flexible on correct answers given in wrong parts of the question and gave marks anyway if appropriate concerns were highlighted (but it is easier to spot good answers if they fall in the right sections).

Question 10:

**Explain the human factors to be taken into consideration (from a passenger perspective), when developing the information systems, both visual and audio, for a major surface or underground station.**

Outline answer ideas:

- Customer vision: Clear, crisp, uncluttered, unambiguous, unrestricted view, big enough to read from required distance, meaningful use of symbols not just colour (colour blind users), anti-glare surphases, etc., bright enough, but not glaring
- Customer hearing; distinctive, unambiguous / clear, Noise pollution, ambient noise; heavy accents
- Not causing obstruction (space availability; people flow; crowd control)
- DDA regulations (use both sound and vision);
- Use of standard symbols, etc. to avoid confusion.
- Avoid unnecessary announcements and information

Question 2:

**What features should be included in the product selection, application design and location of each of the following types of signalling equipment in order to ensure the safety of maintenance staff.**

- **Colour light signals**
  - **Point machines**
  - **Track circuits**
  - **Lineside power distribution**
- **You should take into account the possible effects of electric traction. [20 marks]**

Outline answer ideas:

- Colour light signals: Earthing, access in position (ladders, shields), electrification (location and shields), manual handling (holds and weight), walkways to access, high reliability (LED bulbs?), modular units (low wiring)
- Point machines: manual handling, touch potentials, trapping potential, location with respect to other lines, high reliability, modular units, remote condition monitoring to enable safe maintenance out of traffic before failure, point heating method, local disconnection to prevent throw.
- Track circuits: location of equipment relative to power rails, location of disc boxes, touch potential protection, overvoltage (explosion) protection, high reliability
- Lineside power distribution: keep separate, warning signs, isolation arrangements

DW said that, when studying for the IRSE examinations, he learned a great deal by going to study groups. He added that those on training schemes would possibly be in a better position to succeed in the exam early in their careers because of their broader knowledge that would otherwise take much longer to acquire.

Questions:

**Are there any red herrings within the exam questions?**

DW: No - the examiners avoid questions which could mislead the candidate.

JA: Questions are drafted several times to make sure they are not misleading.

**Are there any statistics regarding age profiles?**

DW: There are no stats at the moment. He added that the exam paper marking process involves complete anonymity.

**Was there any feedback on the N feedback?**

DW: He said not - despite contacting all study groups and each candidate who achieved a Model 1 N grade. He added that the examiners had spent a lot of time putting the feedback detail together.

**Why isn't N feedback provided for all modules?**

DW: Because it would be a huge administrative task, it would not be easy for the markers to find the time for this. The lack of feedback obtained from the trials has also brought into question whether the effort is actually providing useful information to candidates.

DW said that model answers for many questions are available and encouraged prospective exam candidates to use the exam forum as a source of exchanging information. JA reminded people that the exam was a tough, professional qualification and successful candidates would likely be industry leaders of the future.

**End of review**

---

Olga Wisniewska acknowledged the useful feedback provided by the markers and said she hoped future candidates would follow their advice. She thanked everyone for their contribution and brought the review to a close.