

Examiners' Report/ Principal Examiner Feedback

June 2011

GCSE

Application of Technology in Engineering
and Manufacturing

Unit 5EM03 Paper 3A

Printing and Publishing, Paper and Board

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Chief Examiner's Report

There were two qualifications examined in this series at GCSE level.

GCSE Engineering (Double Award) 2EG02 and

GCSE Manufacturing (Double Award) 2MN02

Unit 3: Application of Technology in Engineering and Manufacturing (5EM03)

The award of this unit was split into six sectors with an individual paper for each;

5EM03/3A Printing and Publishing Paper and Board

5EM03/3B Food & Drink, Biological & Chemical

5EM03/3C Textiles and Clothing

5EM03/3D Engineering and Fabrication

5EM03/3E Electrical and Electronic, Process Control, Computers,
Telecommunications

5EM03/3F Mechanical, Automotive

All six papers were harmonised for structure and difficulty.

Each paper had two sections. Questions in Section A related generally to information about the chosen sector. Section B illustrated a product from the chosen sector and questions were related to that product. The product was pre-released in September/October 2010 and acted as a focus for research in preparation for the exam. Again this year a Support Paper was available to help centres prepare for the exam. This paper was attached to the pre-release material so every centre had access to this. Candidates were able to take their own research notes into the examination, but these were not to be submitted with the examination paper for marking. A very few centres did submit this work which caused problems for the processing of their scripts. This action may cause a delay in the marking and therefore issuing of results so centres are strongly warned not to include the pre-release work when submitting scripts. The question paper within both sections was ramped in difficulty throughout although in some papers an unusual pattern emerged where higher achievers failed to gain "easy" marks.

All Principal Examiners' reports indicate that all the questions within the respective paper were accessible to their intended candidature, although all indicated that lower achievers often gave generic answers throughout the paper. A feature of this year, different to the predecessor qualification, was that some sector papers (mainly sectors 3B and 3E) had a significant number of blank spaces. Also most Principal Examiners' reports indicate that marks could be obtained from questions 13 but question 14 which involved assessment of Quality of Written Communication (QWC) was difficult for most.

Generally speaking those candidates who had had opportunities to study and research the target product answered well. It was clear in their responses that they understood the process of manufacturing/engineering when applied to their product and sector. Good candidates were also able to give variety in their responses across the range of questions. Some responses led the examining team to suspect that in some centres candidates were allowed to take in information from previous examination papers or mark schemes as often their answers were duplicates from these previous mark schemes. In these cases often the answer was not in the context of the question and the candidate was not able to score high marks and therefore were disadvantaged by having this information within their pre-release notes and sketches. Candidates are not allowed to have these documents in the examination room as part of their pre-release work.

In general terms a typical grade F candidate was able to identify products from a given sector, name and describe, with some exceptions in some sectors, the use of components/equipment etc and in nearly all cases link applications of technology to key areas of technology. In a range of other questions where explanations and descriptions were required often candidates were only able to give one word if not simple answers. Variations in answers throughout the paper were limited. Application of technology was also limited throughout their responses. Often no responses were suitable for the latter questions in the paper particularly when the question asked for explanations of a term such as 'systems and control' and 'automation'. They showed limited recall and application of knowledge and understanding.

In general terms a typical grade C candidate was able to gain a range of marks from the same areas and aspects of the paper as a grade F candidate, but with further detail in their responses to those questions demanding an explanation or description. They were able to explain benefits of using CAD and CAM. Their responses when explaining the implications of the use of information and data handling were limited. Good responses were given when explaining the aspects of the product through sketches and notes. Some were still unsure of the stages in manufacture, particularly what happens in some of the stages of manufacturing.

In general terms a typical grade A candidate was able to access marks for many aspects of the paper including most of those achieved by grade C candidates. Their explanations and descriptions were complete and had many references to the "real" manufacturing and application of technology of their product. Throughout the papers candidate responses evidenced a variety of applications of technology. Many candidates at this level understood what SMART materials are and knew all about the application of automation. Often their evaluations on the use and impact of modern materials and processes were well presented.

All of these points were considered during the awarding of the results.

Unit 5EM03_3A

Printing and Publishing, Paper and Board

General Comments

Overall, the two sections within this paper produced a good range of responses. Lower ability candidates often gave generic responses to questions, such as 'Quick', 'Fast' or 'Cheap' etc which gained limited marks. Some candidates based their responses on an incorrect context and therefore did not gain marks. The more demanding questions, especially towards the end of Section A and Section B, were difficult for some candidates and consequently a significant proportion gave inappropriate responses.

It was extremely pleasing, however, to see that the majority of candidates attempted all questions and empty spaces were kept to a minimum throughout the paper.

Some candidates would benefit from being taught examination skills and techniques, as often they did not read the questions properly, and 'describe', 'explain' or 'discuss' questions were answered using single word statements and/or bullet points, as opposed to the 'It's...because...which means...' method.

Section A

Question 1

The vast majority of candidates correctly identified the products belonging to the Printing and Publishing sector in Q1(a) and Paper and Board sector in Q1(b). A small minority chose the response 'Hardwood decking board' for Q1(b), which was incorrect.

Question 2

For Q2(a), the majority of candidates correctly identified the two items used in the manufacture of paper or board products, namely the 'Staples' (although a significant minority wrote 'Paper clips', which was incorrect) and 'Stamp'. For Q2(b), most candidates only gained 1 mark for each part of the question or 2 marks for the meaning of 'Copyright' (generally, 'Copyright' was better understood than 'Trademark'). The meaning of 'Copyright' was normally explained as 'It can't be copied' with no extension, such as 'as it indicates ownership of a printed material'; similarly, the meaning of 'Trademark' was normally explained as 'Your logo/brand can't be copied', again with no extension, such as 'without permission from the owner'. Good responses for the meaning of 'Copyright' included 'It can't be copied or you will get sued by the owner', 'Only the people who own the copyright can distribute the product' and 'They must be in agreement before anyone makes their own version or they can take them to court'; similarly, good responses for 'Trademark' included 'It's theirs and is used on everything they make to show it', 'Their logo can't be copied without permission' and 'It certifies that their brand is lawfully protected against copying or plagiarism'.

Question 3

A straightforward and generally well answered question. However, a significant proportion of candidates confused Control terms with ICT terms. The terms 'Computer aided manufacture' and 'Robotics' were often identified as belonging to the ICT Key area, which is incorrect. Pleasingly, the vast majority of candidates correctly identified 'Coated card', 'Polypropylene' and 'Polyvinyl chloride' as belonging to the Modern materials key area.

Question 4

Good responses to Q4(a) included products used in the pre-release materials for examination papers from the previous specification, such as 'Cereal packaging' and 'Paperback books'. Other popular responses included 'Newspapers', 'Greeting cards', 'Street maps', 'Calendars' and 'Pizza boxes', and the vast majority of candidates gained 2 marks for this question.

Q4(b)(i) was also well answered, with a variety of types of board/card stated by the majority of candidates; however, 'Laminates' and smart materials, such as 'Phosphorescent pigments' were also popular and correct answers. For Q4(b)(ii), most candidates stated at least one generic benefit of the named modern material for the manufacturer, such as 'It is durable' or 'It is strong'. Fewer candidates then gained the second mark by explaining an identified benefit, ie 'It is a durable material which means the street map will last longer and this will increase customer satisfaction', 'It improves the aesthetics of the calendar as it will have a better surface finish which means it seems higher quality' or 'It has a high strength to weight ratio so packaging can be smaller and lighter and there is less to recycle'. A broad range of answers in the mark scheme meant that generally good marks were awarded for Q4(b) overall.

Q4(c)(i) was generally well answered, with many candidates gaining both marks for two smart materials. However, a significant proportion of candidates gave responses that are classed as modern rather than smart materials, ie 'Corrugated board' or 'Coated card', and if two modern materials were given, candidates could not access the marks for Q4(c)(ii). Centres are reminded that smart materials form an integral part of the unit specification and were explicitly noted in the pre-release materials for May 2011. When correct, 'Phosphorescent pigments', 'Thermochromic/Hydrochromic/Photochromic inks/dyes' or 'Holographic card' were the most popular, correct responses. Candidates that gave a smart material in Q4(b)(i) often scored highly on this question. Q4(c)(ii) was also generally well answered, especially by candidates that had gained both marks in Q4(c)(i). Some poor responses were very generic and focused on material benefits, such as 'It provides better aesthetics and makes a product more functional', when the actual characteristics of the chosen material were required, ie 'Thermochromic ink changes colour as the amount of heat in its environment changes' or 'Holographic materials can display several different images on the same piece of card or board'.

Question 5

Q5(a) was answered well, with many candidates gaining both marks. Popular and correct responses focused around: 1) the speed with which modifications can be undertaken, ie 'You can easily change things as you can select one part of a drawing and change that quickly, instead of having to redraw the whole thing again on paper' and 2) modelling in 3D, ie 'The manipulation capabilities allows designers to preview and test a virtual product before its made'. Poor responses were often very generic, ie 'It's easier than using a pencil and paper'. Q5(b)(i) was also answered well with the award of 2 marks prevalent; most sound responses centred around answers such as 'It can work 24/7', 'You get consistent quality/less likelihood of human error' or 'It's cheaper as you don't have to pay lots of skilled workers'. Good responses often noted that the high set up cost of CAM is offset by production efficiencies at high volumes; in contrast, poor responses were highly generic, ie 'It's quicker' or 'It's easier'. A small proportion of candidates read the question as CAD and answered accordingly, which was incorrect. Many candidates gained at least 2 marks on part Q5(b)(ii), but a lot of repetition was seen between the first and second benefit, and some candidates did not structure their response with the retailer in mind, which restricted the marks that could be awarded. Good responses included 'The product will have been made more efficiently, so the retailer can sell it more cheaply', 'Using CAD and CAM means that the product will be made more accurately and consistently, so the retailer will have fewer returns to deal with' or 'Involving CAD and CAM means the whole manufacturing process becomes faster, resulting in shorter ordering and delivery times so the retailer can get stock quickly if it runs out'.

Question 6

The majority of candidates gained one mark for Q6(a), with a generic response that normally mentioned 'automation', 'using an automated method' or 'input, process and output' in some form. Better responses referred to: 1) the monitoring and feedback capabilities of systems and control technologies, ie 'Systems and control technology monitors the automatic equipment that makes the products and the accuracy of the products themselves. The results are fed back to an operator who can make changes if things are going wrong' or 2) examples of systems and control technologies, ie 'This is where process control can be used to monitor and control production, through technologies such as PLCs'.

Q6(b)(i) and Q6(b)(ii), taken together, were generally well answered, with most candidates gaining at least one mark, and very few giving the answer 'Robotics' for Q6(b)(i), which was excluded due to the content of the question. In some cases, this one mark was for Q6(b)(ii) rather than Q6(b)(i), as some candidates seemed able to name the traditional method that a systems and control technology has replaced, but not a specific example of a systems and control technology itself, which is perhaps understandable. Popular and correct responses were normally 'CAM' for Q6(b)(i) and 'Hand building' for Q6(b)(ii), 'Sensors' for Q6(b)(i) and 'Humans were measuring it themselves' for Q6(b)(ii) or 'Automation' for Q6(b)(i) and 'Humans were doing all the making activities' for Q6(b)(ii). Poor responses for Q6(b)(i) were often 'CAD' or 'Databases' (not systems and control technologies), but invariably a mark was still awarded for

Q6(b)(ii) if the answer involved the replacement of manual activity. Many candidates gained at least 2 marks on Q6(b)(iii), but a lot of repetition was seen between the first and second benefit, which restricted the marks. Poor responses for this question often gave the general benefits of robotics, rather than the specific benefits of robotics in hazardous conditions, ie 'Very consistent and accurate products' or 'They can make things a lot quicker once programmed' as opposed to 'It means humans don't need to be in some dangerous conditions and so they don't get injured' or 'They don't get tired so they won't make dangerous mistakes'.

Question 7

Centres are reminded that the paper is ramped in difficulty and the latter questions in each section are aimed at the more able candidates; as a result, this question required an ability to provide specific responses, by drawing upon specialist knowledge. Q7(a) elicited a mixed response, as expected; good answers, for 3 marks, included 'It has made information on sales more accurate as the manufacturer can get instant feedback. This means that they can see how many products will be needed (customer demand) and find out how much profit they will make from each type of product, so they can advertise those that are most profitable. They will also get information on the customers so they can change the products if they want too' or 'They contain detailed customer information, therefore products can be tailored for the market and suitable marketing strategies can be devised'. Less able candidates often mentioned using the internet for advertising, promoting products or customer questionnaires, as they concentrated on the 'marketing' aspect of the question, when what was actually required was an implication of information and data handling systems (for marketing).

There was also a mixed response to Q7(b), although responses were generally better than those provided for Q7(a). Good answers, for 3 marks, included 'Data handling systems mean that when stock levels fall to a certain level they are automatically reordered. This means the company doesn't run out of the materials they need and they can keep making things so the workers are kept occupied' or 'They can use a database to keep a real time check of the material they require. This will allow for JIT ordering, which means they won't need as much space for stock and can use the space for machines that are making things'. Less able candidates often mentioned researching on the internet when trying to find suppliers, or issues with the quality of material sent by suppliers, as again they concentrated on the 'materials supply' aspect of the question [similar to Q7(a)], when what was actually required was an implication of information and data handling systems (for materials supply).

SECTION B – based upon the mass produced shoe box packaging pre-release material

Question 8

A well answered question for all three parts. Candidates were able to effectively explain, using notes and sketches, the function of the Base, Attached lid and Lid 'cut out'. The vast majority of candidates had clearly undertaken research based upon the pre-release material; those that provided incorrect responses often described a manufacturing process for the part in question, rather than the function. However, it should be noted that full marks can only be attained with both notes and sketches; a significant number of candidates omitted one or the other, or just labelled a sketch without describing the function of the part. For Q8(a), the majority of candidates gained 2/3 marks, with a sound 3D sketch and written answers associated with protection of the shoes, easier stacking, simple transportation, information for the customer/retailer etc. For Q8(b), the majority of candidates gained 3 marks, with a sound 3D sketch and written answers associated with protection of the shoes, preventing separation of/damage to the shoes, ensuring the lid isn't lost etc. For Q8(c), the majority of candidates again gained 2/3 marks, with a sound 3D sketch and answers associated with picking the box up, carrying it easily, removing it from a stack easily/safely, allowing air into the box etc.

Question 9

For Q9(a)(i), a number of candidates were unable to correctly identify the missing stages in the list (Materials supply and control and Assembly and finishing). Many gave 'Quality control' as a missing stage, and 'Scheduling', 'Buying' or 'Planning' were popular, but incorrect responses. The correct sequence of stages is clearly outlined in the unit specification and centres should refer to it; however, the vast majority of candidates correctly identified 'Marketing' as the stage where the shoe box packaging would be advertised on websites [Q9(a)(ii)].

Q9(b) was generally well answered, with many candidates gaining three plus marks. There was a somewhat mixed response to the Production planning aspect of the question [Q9(b)(i)], with some very good responses, ie 'Scheduling production and detailing material, machine and labour requirements. Deadlines will also have to be set and any health and safety issues will need to be considered' and some poor responses, where candidates often described activities associated with the Design or Production stages. Responses for Q9(b)(ii) were of a higher standard than those for Q9(b)(i), with many candidates gaining at least 2 marks. Good responses considered more than just the manual activities at the Packaging and dispatch stage, ie 'Invoices will be sent out and the products will be packaged into large boxes with safety symbols to try to avoid damage, and then they are stored or sent to the shops. After that they create a stock inventory for the confirmation of recipient parties'. Less valid responses often suggested that Quality Control is only required at the packaging and dispatch stage. It was rare that fully developed answers, and hence a score of 6 marks, were seen for both parts of Q9(b), as most of the descriptive responses were quite brief.

Question 10

Q10(a) was very well answered, with 'Corrugated cardboard' the most popular correct answer. Q10(b)(i) elicited a mixed response, which was surprising; answers that gained the full 3 marks were not as frequent as expected, with many candidates stating other printing processes, such as 'Gravure'/'Letter press'/'Lithography', or other manufacturing stages/aspects of manufacturing, such as 'Quality control', 'Health and safety,' or sometimes even 'Materials'. 'Die cutting', 'Scoring', 'Folding' and 'Gluing' were the most popular correct responses, with 'Embossing' seen very rarely. For Q10(b)(ii), some candidates that had studied the pre-release material were able to offer detailed responses in relation to why flexography is a suitable process for printing onto the surface of shoe box packaging; however, in general Q10(b)(ii) was not well answered, with many candidates gaining only one mark with simplistic responses such as 'It's cheap and fast'. Good answers included 'Flexography uses fast drying inks and can print on different materials, which makes it suitable for shoe boxes as they are made in high volumes but can be made from different materials, ie expensive shoes have glossy boxes' or 'Flexography is very flexible as the inks are ready mixed and do not run, which makes the process very fast and economical'. It is surprising that many candidates were unable to gain higher marks on this question, by providing responses with some specificity to flexography, as the pre-release material referred to 'high volume printing processes', of which there are few.

Conversely, good responses were often seen for Q10(c), with the award of three marks prevalent, for example 'Certain modern materials are used to great effect on shoe box designs to create an aesthetically appealing product, such as lacquer. The use of lacquer also makes the product more durable, which means it will last longer on the shelves' or 'Modern materials can be processed very quickly, which increases production efficiency and this means sales can be increased as they can be sold more cheaply'. Sound responses associated with the environmental benefits of modern materials were also evident. Where candidates gained lower marks their responses were sometimes focused on the production process or marketing stage rather than the modern materials, ie 'Sales can be increased by reducing delivery times/improving advertising', or their responses were simplistic and unqualified, ie 'They cost less'.

Question 11

Q11(a) was generally well answered; the majority of candidates gained at least one mark for this question, normally with a generic response such as 'Making things without humans' (not strictly true but some understanding demonstrated). Many candidates gave good responses, for two marks, for example 'A system that automatically controls an operation or task and replaces human workers', 'Everything is controlled electronically resulting in a process where things are done automatically' or 'The wide use of machines and control technology to make products without large amounts of human intervention'. Poor responses often stated the benefits of automation ('Quicker', 'Cheaper' etc) or gave examples of automation (PLCs, robotics etc) without any explanation of what the term 'automation' actually means.

Most candidates gained at least 2 marks for Q11(b) overall, but answers to Q11(b)(i) were very generic in the majority of cases, ie 'Die cutting the net' or 'Scoring for the folds' with no automation technology link. As a result, most candidates only had access to one mark for each of Q11(b)(ii) and Q11(b)(iii), and this is where the two marks were often gained, as both these questions were normally answered well. Good responses to Q11(b)(i) included 'Automated die cutting using a PLC to cut out the net fed by a printed web' (2 marks) or 'Conveyor systems which move the cardboard, boxes and nets around to the correct place in the plant'. Good responses to Q11(b)(ii) included 'It is safer to cut using automation, as the workers don't need to be near so less injuries will occur', and good responses to Q11(b)(iii) included 'The quality of the product is increased as there is less human error, so the consumer gets a product that is more consistent and reliable'. Poor responses to Q11(b)(ii) and Q11(b)(iii) often mixed up the benefits for the manufacturer and the consumer and/or negative impacts of automation were stated. Furthermore, several candidates repeated responses from Q11(b)(ii) in Q11(b)(iii) and benefits were written in simple terms such as 'Quicker production' or 'More accurate' for Q11(b)(ii) and 'Higher quality product' or 'Receive product more quickly' for Q11(b)(iii), without further explanation.

The majority of candidates gained at least one mark for part Q11(c); correct responses, for 2 marks, included 'Automation is where the machinery repeats over and over again without humans, whereas mechanisation is using machinery operated by people', 'Automation is where the machines keep working and are monitored by computers and stop if there is a problem but mechanisation means the person operating the machine must realise there is a problem' or 'Mechanisation is the inclusion of machines to do the hard work with a human operator, but automation involves computers to control the mechanisation'. Poor responses often confused the definitive characteristics of mechanisation and automation, or gave the benefits of either or both, rather than an explanation of the difference between the two.

Question 12

Q12(a)(i) was answered well, with the majority of candidates gaining 2 marks for responses such as 'Email' (most popular), 'Video conferencing', 'Telephone', 'Internet' or 'Bluetooth', although some incorrect responses were seen frequently, including 'CAD/M', 'Databases' and 'Spreadsheets'. Q12(a)(ii) was often well answered if both responses to Q12(a)(i) were correct; however, generic answers associated with speed or accuracy were prevalent, which only gained only one mark. From Q12(a)(i), most candidates chose 'Email' when considering a benefit for Q12(a)(ii). Good responses were specific to the design stage, and included 'Using attachments means that other workers anywhere can modify the designs quickly without having to wait for the post' or 'Both people will have a copy of the email, so if you change a design you still have the original version'. Other good responses for Q12(a)(ii) included 'You can use all of the information on the Internet as a resource to think of good ideas, and then you can order the materials you need online' or 'Because travelling takes a lot of time and money, video conferencing provides the tool to talk face to face with a camera link over the internet exchanging views about ideas'.

For Q12(b)(i) the majority of candidates gave correct responses such as 'Size check', 'Tolerance check', 'Position check' or 'Colour check' for one mark; however, the responses for Q12(b)(ii) were often simplistic and not suitable for quantity manufacturing, with answers such as 'Measuring with a ruler' seen frequently. Good responses to Q12(b)(ii) included 'The product will be measured with a gauge to check it is between two sizes', 'Using crop marks and registration marks to make sure prints are in the right place' or 'Colour bars and densitometers would be used to check whether the colour is right and consistent on all the shoe boxes' [all of which were related to the check given in Q12(b)(i)]. Few candidates gained the third mark on Q12(b)(iii), with repetition evident in many responses; however, most candidates gained at least one mark, with simple answers such as 'The shoes will be sold at a lower price'. Good responses included 'The shoe box will always be made to the correct standard so the end user can read the information on the box at the point of sale and they know the shoes inside will have been protected properly', 'It ensures the quality of the box is up to standard and safe so the end user will have confidence in the company and will buy from them again' or 'The product is safe to use, reliable and there will be confidence in the product as they will have ensured standards are met. It would also be sold at a lower price as there will have been less waste and efficient methods used'. In general, poor responses did not consider the end user, and often stated benefits that are more applicable to a manufacturer, such as 'It means you check them as they go along so you know they are right when you have finished making them'.

Question 13

Candidate responses to this question were mixed, and it was generally answered very well or very poorly. Popular responses focused around 'Less jobs for workers', 'Smaller workforce', 'Retraining required', 'More skilled workers', 'Safer environment', 'Cleaner environment', 'More noisy because of machines' etc. Those candidates that gained full marks recognised that their response had to cover both the workforce and the working environment. Good answers included responses such as 'The workforce has become smaller and less people are needed and involved in the production processes, the workforce must also have a higher level of skill, as they must have the ability to retrain often and cope with constant change. The working environment is now safer as workers do not have to intervene in dangerous procedures, however there is more noise pollution as the machines are very noisy'. Poor responses often discussed the effect of modern technology on the global environment, rather than the working environment, or the benefits of modern technology without reference to the workforce or the working environment.

Question 14

The latter questions in each section are written to challenge the most able candidates, and consequently candidate responses to this question were again mixed, as it was generally answered very well or very poorly, with a significant proportion of candidates not attempting the question. This was somewhat surprising, as candidates' exposure to questions associated with sustainability, across a variety of subjects, has increased in recent years. For the highest marks, candidates needed to show a good understanding of the conflict between efficient/modern technologies and sustainability; further, the 'quality of written

response' was taken into account when awarding marks, and therefore accurate spelling, punctuation and grammar was required (please see the mark scheme for further details). Good answers included responses such as 'Firstly, because of the energy needs that are required to power automation in shoe box packaging, the process is unsustainable as it takes a lot of finite resources to generate the electricity. Secondly, the pollution that can potentially be involved in using new technologies for shoe box packaging is massive, due to the excretion of CO₂ gas. This contributes to climate change and again negatively impacts on the sustainable manufacture of shoe box packaging. Thirdly, vast amounts of paper are used in manufacturing shoe box packaging with modern technologies, meaning that more deforestation occurs. In order to counteract this, much work is needed replacing trees that are cut down and used for pulp so the process becomes sustainable. Having said all this, most processes for producing shoe box packaging are only efficient at very high volumes, so if they were made in a more sustainable way the packaging would be much more expensive and this is another problem with modern technologies'. Other candidate responses focused around the more positive aspects of modern technologies, such as 'Less waste', 'Less polluting gases', 'Lower carbon emissions', 'Easier recycling' etc; these answers were equally valid and marked as such. Poor responses often discussed the benefits of/problems with modern technology with no reference to sustainable manufacture, and very few candidates mentioned issues associated with the impact of consumer demand.

Grade Boundaries

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