LEO III/32 at Colvilles Ltd, Ravenscraig Works (Later part of BSC Strip Mills Division)

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Date 1965 – 1974

Principal Uses

- Production Tracking and Control
- Payroll

Background

In 1963, a decision was taken by ColvillesLtd, the Scottish steel manufacturer, to acquire a LEO III computer and the machine was installed in a custom-built facility at their Ravenscraig works in 1965. The first two projects were to be computerisation ofproduction planning and control and the works payroll system.

Staff to man the facility were recruited from within the company, their suitability for a new career in computing being assessed using the LEO 'Aptitude test'. The newly formed team was sent off to Hartree House in early 1965 for training in CLEO programming. On their return two groups were formed – one for the Production Control project, the other for the Payroll project. The two development teams numbered around a dozen personnel in total.

Production Tracking and Control System

In the nineteen fifties / sixties, Colvilles Ltd., iron and steel manufacturers in the West of Scotland, had built a fully integrated steel strip mill on a green-field site in Motherwell. The product was coils of steel or cut sheet which were of many grades, sizes and weights.

Iron ore and coal was fed into blast furnaces which produced iron. This was passed in bulk form to a steel-making plant where the steel output was transformed into ingots of varying sizesand steel qualities These were then processed in a slab mill which reduced the ingots to long slabs which were then sub-divided. From this point, where many slabs were produced from each ingot, product tracking became complex.

Each slab was allocated a unique identity together with its dimensions, weight,steel grade and whether it had been allocated to a customer order or to stock. Slabs were then scheduled for the next process where they were reheated and processed through the strip mill,the output being coils of steel.

Further processing wasthen carried out, as necessary, to meet customer requirements. This could involve processes such as pickling, tandem rolling, annealing, slitting and cutting coils into individual bundles of sheets. Cold finishing processes were carried out at Gartcosh Works some 15 miles away from Ravenscraig.

Tracking of individual pieces of material was vital. Most orders were comprised of many coils or bundles of sheet. For scheduling reasons it was not possible to keep the material for any one order together through all the processes. In the early sixties production had beenmonitored by Hollerith card systems and wall-mounted adjustable displays of customer orders givingdetails of their progress through the plant. Periodic stock-checks of material ahead of each process disclosed significant discrepancies and it was decided that a better production management system was required.

Given the complex movement of material and orders through the many processes along with constant transfers into and out of inter-process stocks it was vital that the production controllers had up-to-date information to keep abreast of a rapidly moving and ever-changing situation. Thus it was a prime target for the LEO system to deliver to the Production Control Department information which was as current as possible. This was defined as having the production status as at 6amavailable to the production control staff when they arrived to start work at 8.30am.

We were confronted with a major problem. We had just over 2 hours to collect the production information from the shop floor operatives, prepare it for input to the computer and produce the reports. Data preparation at that time was considered to be a task for women and the personnel rules dictated that females could not work outside dayshift hours. In any case the time required to prepare the data for input to the LEO using conventional data prep. methods was too long to meet our targets. So we turned our attention to Lector and optical mark sensing.

A body of opinion held that filling forms with marks was too complex for shop-floor operatives. However, the Ravenscraig development team felt that this was unjustified, and so it proved. With the elimination of data preparation delays we were able to meet our system performance targets. Clerks could now start their work at 8.30am and have on their desks the complete production details as at 6am that same morning. This allowed them to achievemuch tighter control. Inter-process stockswere reduced and delivery performance improved.

Appendix 1 gives some further information on how and why Lector OMR documents were used

Payroll System

In 1965 Ravenscraig and Gartcosh steel works employed around 5,500 personnel, a number which eventually rose to around 7,500. The pay structure was complex with around 900 differing pay rates and many local adjustments. Employees could be engaged in several different activities in any week, each attracting different pay rates. The majority of the employees were paid weekly, in cash.

It was considered that to be of real value the computer system should undertake not just the gross to net pay calculation but the considerably more complex calculation of gross pay from the pay rates and time worked for each individual. The main time-sheet information was input weekly using **Lector**. Again it was considered that getting the pay clerks used to completing Lector documents would be a ‘hard sell’ but with training it was successfully achieved.

At start up, employee payroll data, previously stored on a Hollerith Punch card system was input via a LEO installation in Birmingham which was equipped with a card reader. The system successfully went live in October 1965 - some 8 months after the implementation team had returned from their first programming course!

Some reflections

A principal feature of the Ravenscraig LEO III installation was the extensive use made of **Lector**. The somewhat contrived method of creating digits from a series of marks was easily mastered by plant and administrative personnel, contrary to general opinion. As noted above the benefit of directly inputting the collected data to the computer without the delays imposed by data preparation was key to the success of the system. We were greatly assisted by the printing industry in Edinburgh who had a reputation for high quality printing and rose to the challenge of producing Lector documents to the tight tolerances required. During the lifetime of the installation at least two dozen

different document formats were employed. Sadly no copies of these have been kept for the archives.

In hindsight, the speed with which the systems were implemented by an inexperienced team is astonishing. We were a young, enthusiastic and highly motivated team eager to prove ourselves in this new field of technology. Perhaps we were too naïve to appreciate the implications of trying to deliver large complex systems using somewhat experimental technologies in such a short timescale.

Finally a word of homage to CLEO. In the course of a long career in computing and exposure to many programming languages my admiration for the CLEO programming language has not diminished. Its blend of the best features of Cobol and Fortran rendered it a powerful, flexible and easy to master tool. I take my hat off to the pioneers who were responsible for creating such superb technology so far ahead of its time!.

Appendix 1 – Use of Lector OMR documents in the Production Planning & Control system (PPC)

The PPC system would require to be fed with all information as regards material movement and change of status from the slab mill output to despatch. Once updated, its output reports would provide schedulers with an accurate picture of what material was available for them to schedule to the next process. The system could only provide these reports once it had been run and it would be designed to present the updated information as at 6am – the end of the night shift. However, the data processing team was all female and females were not permitted to work outside the daytime working hours. When they started each morning, they would have to input at least half of the previous day's back shift (2 to 10) and the night shift (10 to 6) before the computer system could be updated. For the remainder of their day, they would input that day's day shift (6 to 2) and as much of that day's back shift as possible. This meant that it was unlikely that the system could be updated and output records produced before 2pm – a full 8 hours beyond the system updating point of 6am. It was felt that this was an unacceptable position.

This was in the days before the advent of on-line terminals but effective OMR machines were now becoming available. LEO Computers had recently merged with the English Electric company and the combined firm was now offering an OMR reader called Lector. Adoption of this technique could solve the delays caused by data preparation.

Trial OMR documents were printed and tested out on shop-floor production recorders. Most of the data to be collected was numeric; items such as material identity, any changes to dimensions, weight, grade or anything else that could change at any specific production unit. The test documents had the particular processing unit identity pre-printed on them. As most of the date to be collected was numeric, each character of a particular parameter to be input was represented by four, what we called, soup-bowls labelled 1, 2, 3 and 6. Thus, by filling in no more than 2 of these soup-bowls by pencil, any digit from 0 to 9 could be represented. Thus recording a material identity of 5 numeric characters would be represented on the pre-printed form by 5 groups of these 4 soup-bowls. We were advised that shop-floor personnel would not understand this. We argued that anyone who knew how to fill in a pools coupon would soon master it. Trials showed that we were right.Subsequently, once the system was implemented, we only had one failure – a person who was dyslexic.

When first implemented, we only had one machine and it was installed in the computer room at Ravenscraig Works. However, the daily operational run was still held up because there was no similar OMR facility at Gartcosh Works. Its data had to be collected by car after 6am and transported to Ravenscraig to go through data preparation from 8.30am. Nevertheless, the system provided its output mid morning. A second Lector reader was acquired for GartcoshWorks and a paper-tape to paper-tape link provided between the two Works. The system now produced all the output reports as at 6am ready for the schedulers when they started at 8.30am.

Instead of the predicted 8 hour delay in providing up to date information, this had reduced to two and a half hours. Routine stock-checks confirmed that the new system was extremely accurate compared to the old manual one. Any corrective updates to the computer stock database were minimal compared to the old system. Additionally, stock checks were completed considerably faster as checkers were provided with lists of material to check against the material in the various stock areas.

The team, with the help of the LEO aptitude test, was selected from existing Works staff. It was built up to about a dozen in 1964 and started work on system design. It received training in the CLEO high-level language in early 1965. Thereafter, it was split into two sections; one for the Production Planning and Control system and the other for the Payroll one.

Production Planning & control system

Perhaps a word is in order as to how I managed to get a little more detail. In 1967 I had just got married and was working on draft drawings of a house I planned to build. By pure chance, I recently found (in 2021) that one of these drawings had, on its reverse, most of a flow chart of the Production Planning & Control system that we had implemented. I think it is probably just missing 1 or 2 operations down one edge so it gives a good picture of the scope of the system. It is unfortunately very faded and not really suitable for adding to the LEO archives in its present state. However, I traced a copy of a Colvilles Ltd. Technical Offices progress report on the use of the LEO at Ravenscraig Works. It is undated but I estimate that it was probably produced in Spring 1967. It is held in the Peter Bird material at the Manchester University archives. The pages were poorly scanned with data missing or very difficult to read. However, I have managed to retype almost all of it. I was able to pick up additional detail of the use of Lector documents from it and it does contain Xerox copies of some of the Lector documents..

The primary requirement of the system was to provide information on orders and the location and present state of every piece of material across the works whether or not it was allocated to an order. This information allowed clerical staff to create production schedules for further processing. This information was required as at 6am by staff who started work at 8.30am and for production meetings at 9am. This was not possible to achieve using conventional data preparation staff who also started work at 8.30 and on-line terminals had yet to appear. English Electric LEO Computers had recently introduced its Lector Optical Mark Reading device. It was determined that this was the only feasible way of collecting the large amount of feedback in the short time available each morning .

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Lector documents were used to collect data on new orders, order amendments, order cancellations and order completions. These documents were completed by sales personnel in an office environment in normal

office hours. This information was input to the system run shortly after 6am daily thus providing an updated order file.

As Dr. Jack explained in his paper, for process scheduling reasons, it was not possible, unless an order was very small, to move all of the material for it through the plant together. However, by tracking the movement of every piece of material, whether or not allocated to an order, the system could provide the requirements of every order and the present progress towards order completion including whether there was a shortfall of material for it. Unlike order processing, material movement was a 24 hour, 7 days a week, operation. There was, therefore, a constant flow of Lector documents being collected from the shop-floor and processed to paper-tape by a Lector machine. This meant that, at the end of the night-shift at 6am, there was very little material still to be processed before the system could be run. Trials showed that there would be a delay whilst the final documents from Gartcosh Works, 15 miles away, were conveyed to Ravenscraig and processed. It proved necessary to install a second Lector reader at Gartcosh together with a paper-tape reader to paper-tape punch link to Ravenscraig.

Lector documents collected information on the creation of each steel slab, including dimensions, weight, grade or quality and allocation to an order. Thereafter, Lector documents were used to record every movement and change of status of the coils produced from the slabs. In later processing, a coil could be cut along its length into two or more narrower ones. Coils could also be cut into bundles of sheets and further processed. Lector documents were also used to track material through these processes. Where a coil was despatched by train to Gartcosh Works finishing processes, the tracking continued until despatch from there as either coils or bundles of sheets. The data recorded on each coil or bundle as it passed through the processes included a code for the process, any change to dimensions, weight or grade (which resulted in it being removed from its allocated order). A lector document was also used to collect information on surplus stock being allocated to suitable orders. The tracking of coil and sheet bundles movement thus covered all processes until the material was despatched. The Lector documents were completed by recorders on the shop floor (see Appendix 2). The data was collected through a 24 hour period and input to the Lector machines at Ravenscraig and Gartcosh.

The system produced production reports for morning progress and planning meetings at 9am. Additionally, order file reports were produced showing the present status of each order so that remedial action could be taken if it

was running late or short of material. Lists were produced of the stock ahead of each production unit to assist schedulers with their work and to greatly simplify periodic stock checks. Subsequent stock-checks showed the system to be highly accurate.

Analysis of the recovered flow chart indicates that there were 52 CLEO routines providing vetting and files updating together with about 50 printed reports. There were upwards of 30 sort routines. I do not have actual figures but there must have been many hundreds of order and stock changes every 24 hours.

Payroll System

The payroll system required much alpha information such as names and addresses. As the payroll was only run once a week there was plenty of time to collect this type of data using conventional data preparation. However, there was limited time between the end of the working week and the running of the payroll system. This would have required a large team of data preparation staff for a limited period each week. As it had already been decided to use Lector for the production system, this same facility was selected to collect the clock-card data. The complex nature of the payroll system would be handled by the system leaving the pay-clerks to fill in Lector documents from the clock-cards.

Further development

After the steel industry was nationalised, Ravenscraig and Gartcosh Works became part of the Strip Products Group of British Steel. The predominant computer supplier to this Group was IBM. The Group decided to adopt a policy of standard computer system as far as possible and it was decreed that the LEO III at Ravenscraig be replaced by an IBM360/40. It indicates how highly the LEO systems were regarded that both were rewritten almost unchanged in PL1 to run on the IBM machine. The rewritten systems which were implemented in 1973 still used Lector documents for several years until replaced by on-line terminals. The LEO III was decommissioned in 1974.

Acknowledgements

It was fortunate that 6 senior members of the original team were still available and the detail in this report would not have been possible without the help of Eric Halkett, Bill Jack, Stewart Logan, Bill Service, Allan

Watson and John Wolseley. I very much appreciate the encouragement of Frank Land to add to the LEO history.

Stewart Logan

June 2022

Appendix 1 – Ravenscraig LEO3/32 and Lector Timeline

Colvilles Ltd. selects a LEO3 computer
1963

Development team selected & system design started
1964

LEO3 computer delivered and commissioned 1965

Development team trained in CLEO
Feb. 1965

Production Planning & Control system implemented at Gartcosh Oct. 1965

Payroll system implemented
Oct. 1965

Production Planning & Control system implemented at Ravenscraig
Apr. 1967

Ravenscraig/Gartcosh moved to British Steel Strip Products Group
July 1967

IBM360/40 delivered
c1969

PP&C system operational in PL/1 on IBM360/40 using Lector Docs.
c1973

Payroll system operational in PL/1on IBM360/40 using Lector Docs.
c1973

LEO3/32 decommissioned
Sept. 1974

IBM360/40 systems inputs moved from Lector to on-line terminals
c1975

Lector readers decommissioned c1975

Over 50 years after the IBM360/40 was brought in to replace the LEO3/32, we could not trace anyone who could be definite about the dates in the latter period when systems were converted to run on the IBM machine. However, these converted systems continued to use Lector documents for some years until replaced by on-line terminals..

Appendix 2 – Design of Lector forms

Trial OMR documents were printed and tested out on shop-floor production recorders. Most of the data to be collected was numeric; items such as material identity, any changes to dimensions, weight, grade or anything else that could change at any specific production unit. Alpha data was very limited and normally restricted to one of a small range of characters. The test documents had the particular processing unit identity pre-printed on them. As most of the date to be collected was numeric, each character of a particular parameter to be input was represented by four, what we called, soup-bowls labelled 1, 2, 3 and 6. By filling in no more than 2 of these soup-bowls by pencil, any digit from 0 to 9 could be represented. Thus recording a material identity of 6 numeric characters would be represented on the pre-printed form by 6 groups of these 4 soup-bowls. The choices of the limited acceptable alpha characters were all represented by individual soup-bowls. We were advised that shop-floor personnel would not understand this. We argued that anyone who knew how to fill in a pools coupon would soon master it. Trials showed that we were right. Subsequently, once the system was implemented, we only had one failure – a person who was dyslexic!

Logan R.S 1967 Colvilles Technical Office Report on Systems development on the LEO III/32

Ravenscraig Reports

Items in red are inferred from historic documents but not actually readable

Ito

This is the transcript of a Colvilles Ltd Technical Offices report on the development of systems on the LEO3/32 computer installed at Ravenscraig Works in Motherwell. The original copy is held in Peter Bird's material in the Manchester University Archives. It is undated but, based on the contents, must have been produced round about March 1967. It is a very poor copy of an original document with the bottom line missing on some pages and examples of print-outs being distorted and very faint. I have managed to retype the complete document with the exception of those lines that were missing from Peter Bird's copy. I have inserted in red the likely content of those missing lines. Despite the missing flow-chart, this report gives much detail of the computer's actual and planned workload. Due to the subsequent nationalisation of the steel industry, which resulted in the LEO computer being replaced by an IBM 360/40, much of the future plans to enhance the LEO systems were not implemented on that machine.
Stewart Logan (Chief Systems Analyst at that time)
June 2022

LEO III COMPUTER SYSTEMS
PRESENT DEVELOPMENT

Technical Offices
Motherwell
Mach 1967 (estimated)

1. INTRODUCTION

This report briefly outlines the projects at present being undertaken by the LEO III Computer. It indicates how far these systems have been developed and the form the ultimate systems will take. Wherever possible the savings and advantages of the computer systems are enumerated. Appendix 1 shows the information flow in the computer production control system and includes samples of the main reports.

The flow-chart is not in Peter Bird's material and cannot be traced.

2. PRODUCTION SYSTEMS

The Production System is being undertaken in three stages.

Phase 1 Production Recording

This involves the establishment of an effective recording and feedback system.

Phase 2 Computer assisted production control system

At this stage the Computer produces reports which enable the manual system to operate more effectively and with much reduced manpower.

Phase 3 Computer controlled production control sysyem

At this stage the computer will automatically control all aspects of production with manual interventions permitted for exceptions and emergencies.

Phases 1 and 2 are complete at Gartcosh and are in an advanced stage of implementation at Ravenscraig.

2.1. PRODUCTION RECORDING

Present

The object of this part of this project was to set up an effective method of recording the status of orders and coils as material moves through the Mills and the Finishing Units.

Accurate and speedy retrieval of data is the foundation of any computer system and most computer projects which have failed, (and there are many of these), have done so because this problem had not been adequately solved. Data retrieval is a special problem in steelworks where the area covered is large, conditions do not always favour clerical work and the quality of recording personnel is often poor. It was, therefore, thought that production recording should be tackled first as a project in its own right. The solution adopted was:

1. Use of Lector documents for direct retrieval of data from source.

2. Use of data links to transmit data rapidly between Ravenscraig and Gartcosh.
3. Adoption of 'exception' principle to limit the volume of recording.

The system has been in operation at Gartcosh for eighteen months and an effective recording system has been established there. The quality of recording by the Gartcosh Production Personnel is acceptable for the degree of control being sought. Data is collected at 2pm and 10pm and processing commences on the Computer within half an hour of the final collection of data at 6am.

Future

The recording system is being extended to the Ravenscraig Hot Strip Mill and Hot Sheet Finishing Department.

Because of the ease with which Production Personnel are coping with Lector recording, the 'exception' principle is being relaxed and the document is being extended to handle more information. All recording on production units will be done on Lector and the Computer will produce all relevant reports. The Lector documents have been redesigned and have been presented to the Production Management for approval.

2.2 SCHEDULING

Present

The Computer produces, daily, lists of material ready for processing ahead of each production unit at Gartcosh. These lists are in the schedule order dictated by the requirements of each unit (eg light, medium and heavy gauge rounds, in descending width order at Tandem Mill etc.). Most of the difficulties have now been overcome and all major production units at Gartcosh are scheduled from these listings.

Advantages

1. Clerical functions are simplified and the work load reduced.
2. When the correct criteria are established, the scheduling is more accurate and more efficient.
3. Delays between processes are reduced.

Future

The computer will produce schedules for direct use on the production units. These schedules will be manually scrutinised, minor adjustments made

and then issued directly to the units. The schedules could be in the form of Lector documents pre-printed by the computer. The unit personnel will record on these documents and return them to the Computer for further processing. Sufficient information will also be supplied so that emergency schedules can be prepared manually in the event of a breakdown or an occurrence outwith the scope of the Computer System, (eg roll breaking). An attempt will be made to move away from scheduling the next manufacturing unit to several production units. The Computer would reschedule continually as actual performance fell short of this plan,

2.3. PROGRESSING

Present

The Computer produces a summarised statement of the progress of each order, listing the tonnages ahead of each unit and the balance still to be despatched. It also indicates when an order is falling behind schedule and when insufficient material is in process to give a reasonable likelihood of completing the order. A further set of listings is produced giving details of the individual coils being processed against each order.

The progress report is available to Sales Department and to the Progressing and Expediting Departments.

Advantages

1. Considerable reduction in clerical effort.
2. Potential backlogs and shortfalls are highlighted much earlier, giving more time to take corrective action.
3. Sales Department can give customers accurate and up to date information on the status of their orders without reference to Production Departments.

Future

When confidence in the computer controlled system Has developed it is anticipated that the Computer will Report only on these orders that are not running to plan. This should have the effect of focussing the attention of the Progress Department on those orders where manual expediting is necessary

A statistics file will be set up on the Computer and development will be done into a method of accurately determining production overages and lead times. These Investigations will be continued and more sophisticated techniques developed for planning and evaluating progress.

Advantages

1. Reduction in clerical effort.
2. Better control of backlogs and shortfalls.
3. More accurate production plans and progress reports.

2.4. STOCK CONTROL

Present

The Computer produces daily lists of unallocated material with all relevant parameters and, where applicable, the reason why the material was put to stock. This material appears in gauge/width order and is grouped according to the stock areas. This report is used in conjunction with a daily list of orders requiring tonnage to be allocated to them. It is a simple task to match the two listings and reapply stock to orders.

Advantages

1. Reduced clerical effort.
2. More effective reallocation of stock to orders leading to reduced stock levels and the utilisation of a larger percentage of stock for prime orders.

Future

A system has been specified for automatic reapplication of stock to orders by the Computer.

Advantages

1. No clerical effort.
2. Reduced stocks.
3. More economic use made of stocks by considering the costs involved.

2.5. ORDER HANDLING SYSTEM

Present

The Sales Department return to the Computer selected information about each order received. This is stored on an order file in the Computer and used to progress the orders through the plant. The computer order book can be listed in any form required, giving details of order parameters and balance of tonnages

to be met. The amount of data recorded is not sufficient to set up an effective computer control in this area at present.

Future

Phase 1 – A Lector document has been designed to record additional information for each order. This information will permit the Computer to carry out the analysis required by the Market Research Department and produce all the B.I.S.F. statistics. The additional information will also enable the Computer to perform all the calculations at present done by the Figuring Section.

Advantages

1. Considerable reduction in clerical effort.
2. Better and more extensive market research analysis.
3. Reduction in the loading of the De La Rue Bull Punch Card installation.

Phase 2 – This involves the complete computer control of the order handling system through Sales, Quality Control to Scheduling and Planning. A detailed feasibility study has been carried out and the findings passed to Sales, Quality Control and Production Planning. (unable to suggest next missing words) and Quality Control details are typed on these machines and the paper tape produced is fed to the Computer.

As 70% of all orders handled are completely or in some part standard, the Computer will add this standard information, figure the order, produce the master order form, calculate the plant loading and produce the Melting Shop Schedules completely automatically.

Advantages

1. Greatly reduced clerical effort.
2. More accurate and speedy handling of the order.
3. More legible Mill documentation would be produced, thus reducing the chance of mistakes in processing.

2.6. MANAGEMENT REPORTING

Present

The computer produces daily, reports of plant performance and stock tonnages, weekly summaries of performance and monthly tabulations of stock values. Plant loading summaries are produced on the basis of the order book.

Future

As the Computer extends its control into the various aspects of the production system the reports produced for Management will increase in scope. The setting up of a statistics file will enable Management to have statistical information about the production system in any form they request.

A major extension envisaged will be the Incorporation of costing information into the system. This would mean that Management would be supplied with costing reports as a by-product of the computer production control system and thus the effects of policy decisions could more easily be evaluated in terms of these costs.

3. PAYROLL SYSTEM

Present

Each week the Computer processes the pay- roll of weekly paid employees at Ravenscraig and Gartcosh. From the input data of gross hours and jobs worked for each employee it produces the following information:-

Payroll

Pay Envelopes

Schedules of Deductions

Cash Dissections

B.I.S.F. Statistical Returns

National Insurance Schedules.

Advantages

1. The payroll is produced 24 hours earlier.
2. Much less manual preparation of input data is required.
3. Many of the clerical functions of the Pay Department have been taken over.

Future

A Collectadata time and attendance record- Ing system is being introduced to record directly to the Computer, the clocking in and out times of each employee at Ravenscraig and Gartcosh.

Used in conjunction with Lector documents for recording the various jobs worked on by each

employee. This will permit the preparation of the payroll to be completely automatic.

Advantages

1. Greatly reduced manpower.
2. A very closely controlled payroll system.

Possibly another advantage missed at bottom of page

4. INVENTORY CONTROL SYSTEM

Present

The Computer produces a monthly statement of all issues from the Ravenscraig and Gartcosh Stores. These are tabulated against bin numbers, account numbers and job numbers for the Cost Department and Plant Maintenance Department.

Advantages

1. Gartcosh Hollerith equipment abolished.
2. Operating staff for this equipment freed.

Future

A Collectadata recording system is being introduced into the Ravenscraig and Gartcosh Stores. This system will record all stores receipts and issue quantities. The Computer will eventually:-

Produce cost reports

Maintain stock records

Control perpetual inventory system

Control stock levels

Prepare purchase requisitions

Produce order progress reports

Produce financial returns

Advantages

1. Considerable saving in clerical effort.
2. Reduction in levels of consumable stocks.
3. More accurate control of stores system.
4. Prompt financial returns.

5. OTHER SYSTEMS

In addition to the main systems discussed , the Computer is also used for work of a scientific and statistical nature. The computer has also been used to analyse the

performance of coils through the production processes to set up more accurate tables of production overages and lead times.

Scientific

The Computer is being used to assist research into heat transfer in the slab reheat furnaces and in the evaluation of titration values for the Central Research Laboratories.

Critical Path Methods

Computer time has been sold to local building firms to do critical path analysis of large building projects. The Computer Department has liaised closely with the planning engineers of these companies in order to gain a working familiarity with this technique as it has some very definite applications in the steel industry, eg building and development projects, implementation of computer systems, shutdown maintenance projects, roll changing etc.

Process Control

A set of programs has been written for the LEO Computer to handle directly, data logged by the KDF7 which is linked on-line to the Hot Strip Mill. From this data mathematical models are being constructed in preparation for computer control of the Hot Strip Mill.

Budgetary Control

Linear programming techniques are being used on the Computer to develop an accurate economic model for the Ravenscraig and Gartcosh Works.

Appendix 1

This appendix contains samples of the major items of documentation in the production system. These documents should be studied in conjunction with the diagrammatic illustration of the production system.

Diagrammatic illustration not included and could not be traced.

BALANCE OF ORDERS TO DESPATCH – COLD REDUCED

MOTOR TRADE	GEN. HOME	EXPORT	PICKLE & OIL	GALVANISED	TOTAL BACKLOG
862	386	**335**	185	11	**1779**
197	711	280	114	14	1316
377	97	219	184	26	903
126	55	841	122	31	1175
125	103	8	22	4	262
187	47	91	12	3	340
15	676	163	182	381	1417
1889	2075	1937	821	470	**7192**

TONNAGE AHEAD OF DESPATCH

MOTOR TRADE	827 TONS
GENERAL HOME	1307 TONS
EXPORT	3458 TONS
PICKLE & OIL	336 TONS
GALV. – HOME	55 TONS
EXPORT	6 TONS
TOTAL	5983 TONS

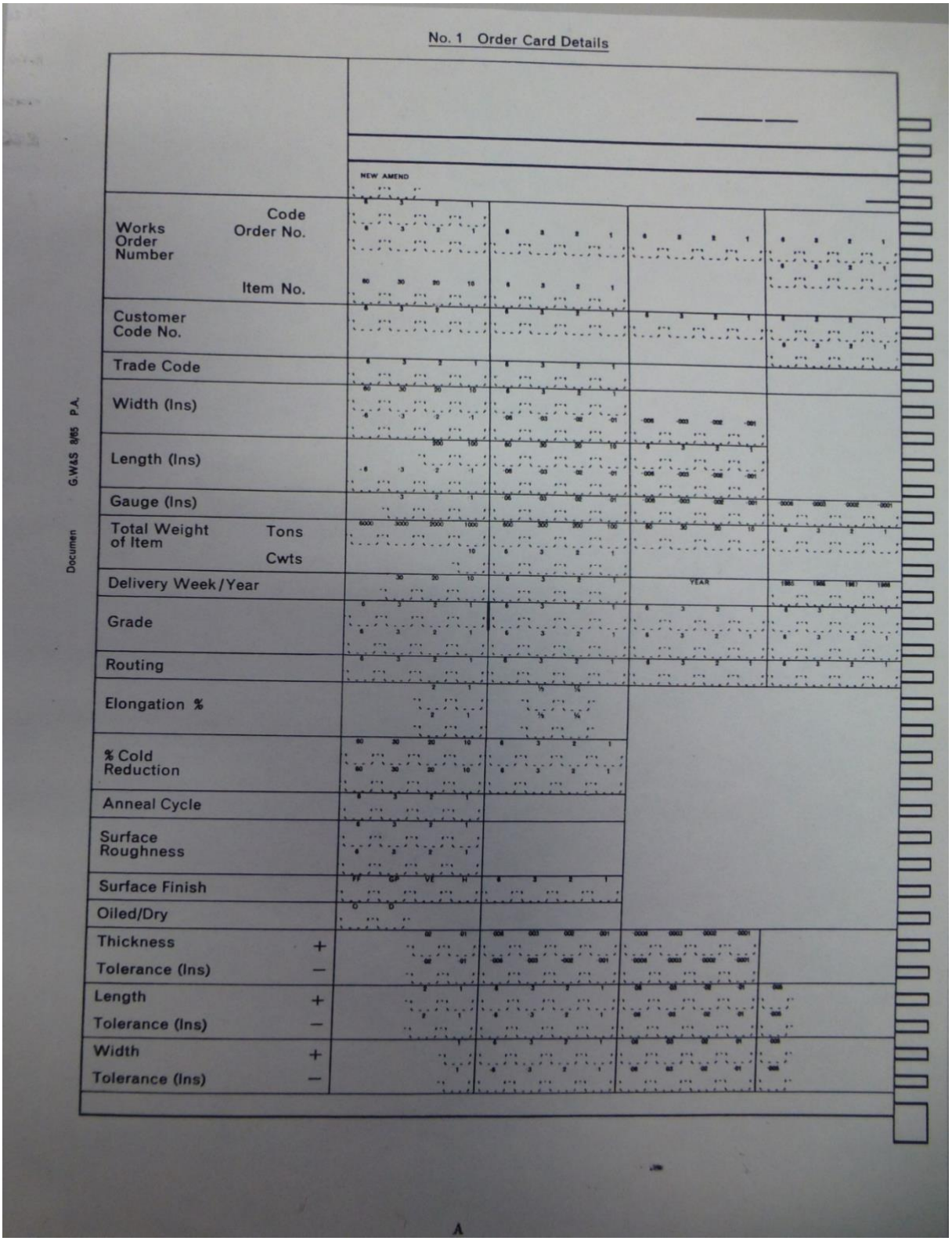
GARTCOSH SHIFT PRODUCTION REPORT FOR 24 HOURS ENDING AT 10PM ON FRIDAY 17/03/67

	10 – 6			6 – 2			2 - 10		
PROCESS	TONNAGE IN	TONNAGE OUT	YIELD	TONNAGE IN	TONNAGE OUT	YIELD	TONNAGE IN	TONNAGE OUT	YIELD
STRIP MILL	0.00	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00%
PICKLE TRIM & OIL	14.11	11.72	78.57%	0.00	0.00	0.00%	0.00	0.00	0.00%
PICKLE LINE	228.75	208.57	91.23%	357.59	336.16	94.12%	475.33	442.23	93.05%
TANDEM MILL	733.10	732.88	99.86%	905.25	904.42	99.89%	612.86	621.65	101.47%
ANNEALERS	0.00	0.00	0.00%	343.37	485.40	141 40%	370.20	180.56	48.65%
NO 1 TEMPER MILL	307.88	302.23	98.37%	452.68	452.05	100.00%	321.50	311.31	96.88%
NO 2 TEMPER MILL	0.00	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00%
SLITTER LINE	0.00	0.00	0.00%	94.59	79.28	84.04%	211.96	195.83	92.42%
NO 1 SHEAR LINE	0.00	0.00	0.00%	100.89	98.14	98.00%	164.78	161.67	95.17%
NO 2 SHEAR LINE	0.00	0.00	0.00%	76.47	63.00	82.89%	64.72	62.29	96.88%
RESHEAR	0.00	0.00	0.00%	4.71	4.71	100.00%	5.36	5.36	100.00%
ROLLER LEVELLER	0.00	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00%
HAND INSPECTION	0.00	0.00	0.00%	11.10	11.10	100.00%	0.00	0.00	0.00%
SHEET PACKING	33.98	33.98	100.00%	76.82	76.82	100.00%	9.19	9.19	0.00%
COIL PACKING	119.75	120.20	100.84%	216.42	225.00	104.17%	332.05	334.13	100.60%
DESPATCH	0,00	0.00	0.00%	0.00	350.83	0.00%	0.00	303.83	0.00%

DAILY STOCK REPORT FOR GARTCOSH AS AT 10PM ON SATURDAY 18/03/67

STOCK AREA	COIL BACK LOGS	COIL CURR ORDS	COIL ADV ORDS	COIL AWAIT ORDS	COIL TOTAL	SHEET BACK LOGS	SHEET CURR ORDS	SHEET ADV ORDS	SHEET AWAIT ORDS	SHEET TOTAL	N.T.R CURR	RESERVE ADV	STOCK TOTAL
PRIME													
A/H PICKLE (Rav & Gart)		467	1605	6156	434 (8662)						562	9224	
A/H TANDEM		139	1077	409	113						187	1925	
A/H ANNEAL		1522	3488	217	71						735	6033	
IN ANNEAL	690	1662	29	11	(2392)	666	77	406	6	(1155)	230	3777	
A/H OF COOLING	21	316	1094	46	(1477)	115	249	586	30	(980)	90 323 178	3047	
TEMPER – READY ROLL		2244	3932	1345	392 (7913)		918	193	488	214 (1813)	402 120	672	10920
A/H SLITTER	254	953	672	132	(2011)	40	15	7	13	(75)	22	2108	
A/H CUT UP LINES		2	23	210	(235)	152	198	151	250	(751)	8	994	
A/H FINISH & PACK			HOME					EXPORT					
AT SHEET STOCK	51	14	4	408	(477)	85		4	90	(179)		656	
AT ROLLER LEVEL	2			2	(4)							4	
AT RESHEAR		44			(44)		-1			1			44
AT HAND INSPECTION		31	-6	4	31 (58)		-4			-1 5			58
AT SHEET PACKING		32	61	-2	6 (97)		271		3	13 (287)		11	395
H/R PICKLE & OIL AT SHEET DESPATCH		298	320	278	145 (1041)		792			4 (796)		25	1862
H/R PICKLE & OIL AT COIL PACKING		162	108	215	234 (719)		419	485	410	46 (1360)		4	2083
H/R PICKLE & OIL	17												
AT COIL DESPATCH		708	427	149	210 (1494)		1649	677	276	4 (2606)			4100
H/R PICKLE & OIL	87												
GALVANISED A/H DESP.	75	10	26								111		
NON-PRIME											47341		
RAVENSCRAIG COBBLE										PLATE			
GARTCOSH PICKLE										TANDEM 28			28

No. 1 Order Card Details Lector document



PROGRESS REPORTS – ALLOCATED STOCK

DEPARTMENT 1 ROUTES PRESSINGS 14/11/66

ORDER NO. GAUGE G/C TONS BAL	A/H	A/H PCLE	A/H TAND	A/H ANEL	IN ANEL	IN COOL	A/H TEMP	COIL PACK	A/H SLIT	A/H CUL	A/H RLV	A/H RHO	A/H CINN	A/H INSP	A/H SPAK	A/H DESP	IN PROC	ORD DESP
2/32827/1 0048 0 0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	17	0	10 `10
		L <-																
2/32826/1 0048 0 0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	11	0	10 10
		L <-																
2/32839/1 0048 0 0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	16	0	12 12
		L <-																
2/32840/1 0048 0 0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	13	0	10 10
						L <-												
2/32841/1 0048 0 0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	9	0	10 10
		L <-																
2/32842/1 0048 0 0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	22	0	20 20
		L <-																
2/33210/1 0048 0 0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	8	0	5 5
						L <-												
2/33211/1 0048 0 0	0	0	29	10	0	0	0	0	0	0	0	0	0	0	0	39	0	29 29
						L <-												
2/33462/1 0048 0 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10 10
		L <-																
2/29970/4 0048 0 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	15 15
		L <-																
2/29977/1 0048 0 0	0	0	0	0	0	59	0	0	0	0	0	0	0	0	0	58	0	94 94
		L <-																
2/32732/1 0048 0 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	10 10
		L <-																

TOTALS FOR DELIVERY WEEK 601

	ORDDBAL	TEMPR	ROLLD	NON T	ROLD	PRESS	FISH	FORD
	VAUX	OTHER						
	TONS	26	26	26	26	STEEL	LUD	HALL
COIL ORDERS	721	721	578	0	143	0	646	0	0	0	0

	ORDDBAL	UNDER	OVER	FLAT R&RDOILED	PRESS	FISH	FORD
	VAUX	OTHER					
	TONS	020	0 20		STEEL	LUD	HALL
SHEET ORDERS	314	314	11	303	0	1	254	215	0	0	0	0

	ORDDBAL	PLATE	MPLTE	SHEET	PRESS	FISH	FORD
	VAUX	OTHER					
	TONS				STEEL	LUD	HALL
PICKLE & OIL ORDERS	32	32	0	17	15	0	0	0	0	0

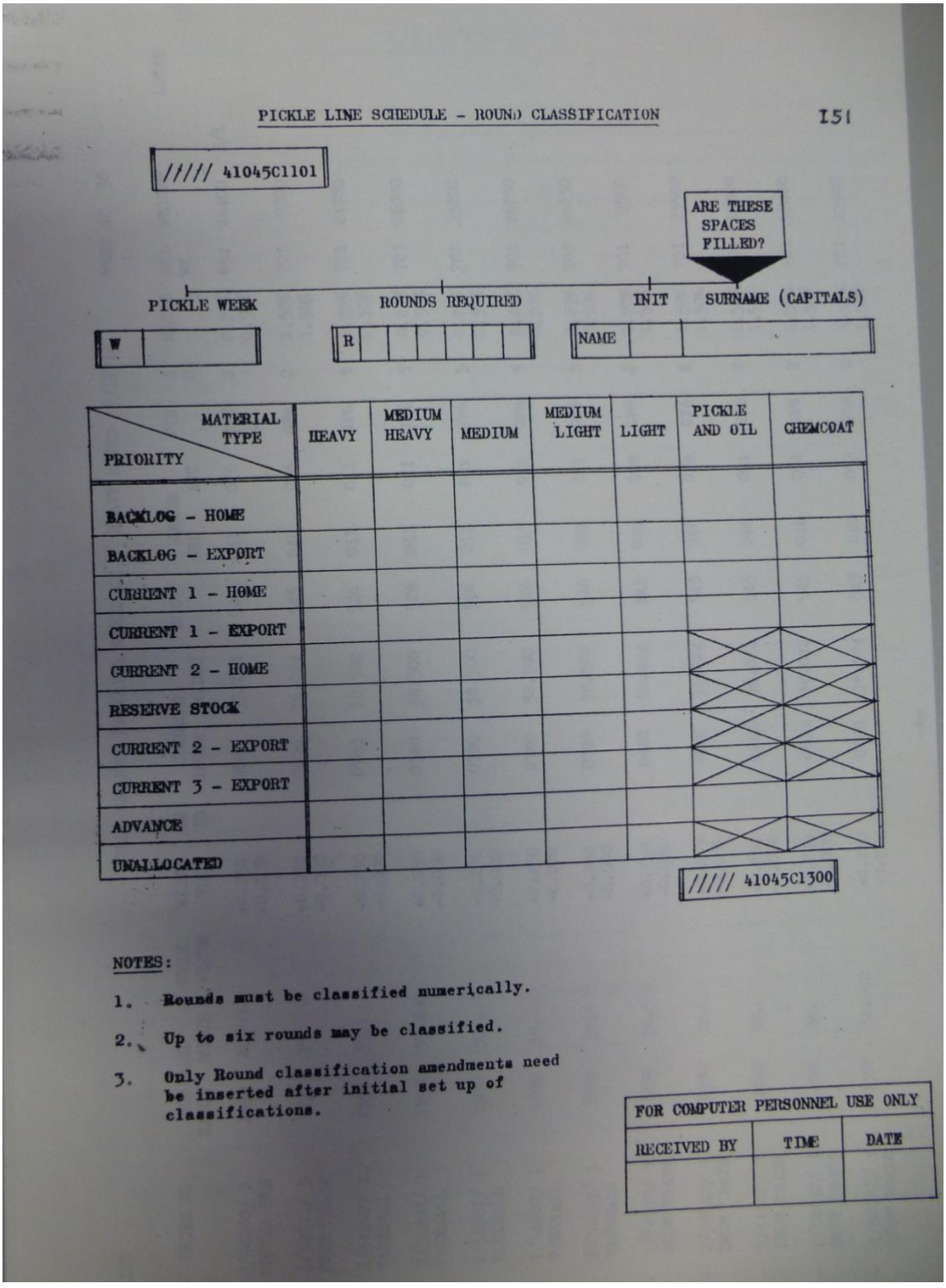
TOTALS FOR DELIVERY WEEK 602

	ORDDBAL	TEMPR	ROLLD	NON T	ROLD	PRESS	FISH	FORD
	VAUX	OTHER						
	TONS 26	26	26	26	26	STEEL	LUD	HALL
COIL ORDERS	2800	2800	1550	420	830	0	689	823	268	0	20

	ORDDBAL	UNDER	OVER	FLAT R&RDOILED	PRESS	FISH	FORD
	VAUX	OTHER					
	TONS	020	0 20		STEEL	LUD	HALL
SHEET ORDERS	2926	2926	119	2807	13	43	2374	265	0	93	205	691

		ORDD	BAL	PLATE		MPLTE		SHEET					PRESS		FISH		FORD		
		VAUX		OTHER															
		TONS										STEEL		LUD				HALL	
PICKLE & OIL ORDERS		515	515		100	202	2	13					42	0		0		0	5 0

PICKLE LINE SCHEDULE ROUND CLASSIFICATION



PICKLE LINE SCHEDULE - ROUND CLASSIFICATION 151

///// 41045C1101

ARE THESE SPACES FILLED?

PICKLE WEEK W | ROUNDS REQUIRED R | INIT NAME | SURNAME (CAPITALS)

PRIORITY \ MATERIAL TYPE	HEAVY	MEDIUM HEAVY	MEDIUM	MEDIUM LIGHT	LIGHT	PICKLE AND OIL	CHEMCOAT
BACKLOG - HOME							
BACKLOG - EXPORT							
CURRENT 1 - HOME							
CURRENT 1 - EXPORT							
CURRENT 2 - HOME							
RESERVE STOCK							
CURRENT 2 - EXPORT							
CURRENT 3 - EXPORT							
ADVANCE							
UNALLOCATED							

///// 41045C1300

NOTES:

1. Rounds must be classified numerically.
2. Up to six rounds may be classified.
3. Only Round classification amendments need be inserted after initial set up of classifications.

FOR COMPUTER PERSONNEL USE ONLY		
RECEIVED BY	TIME	DATE

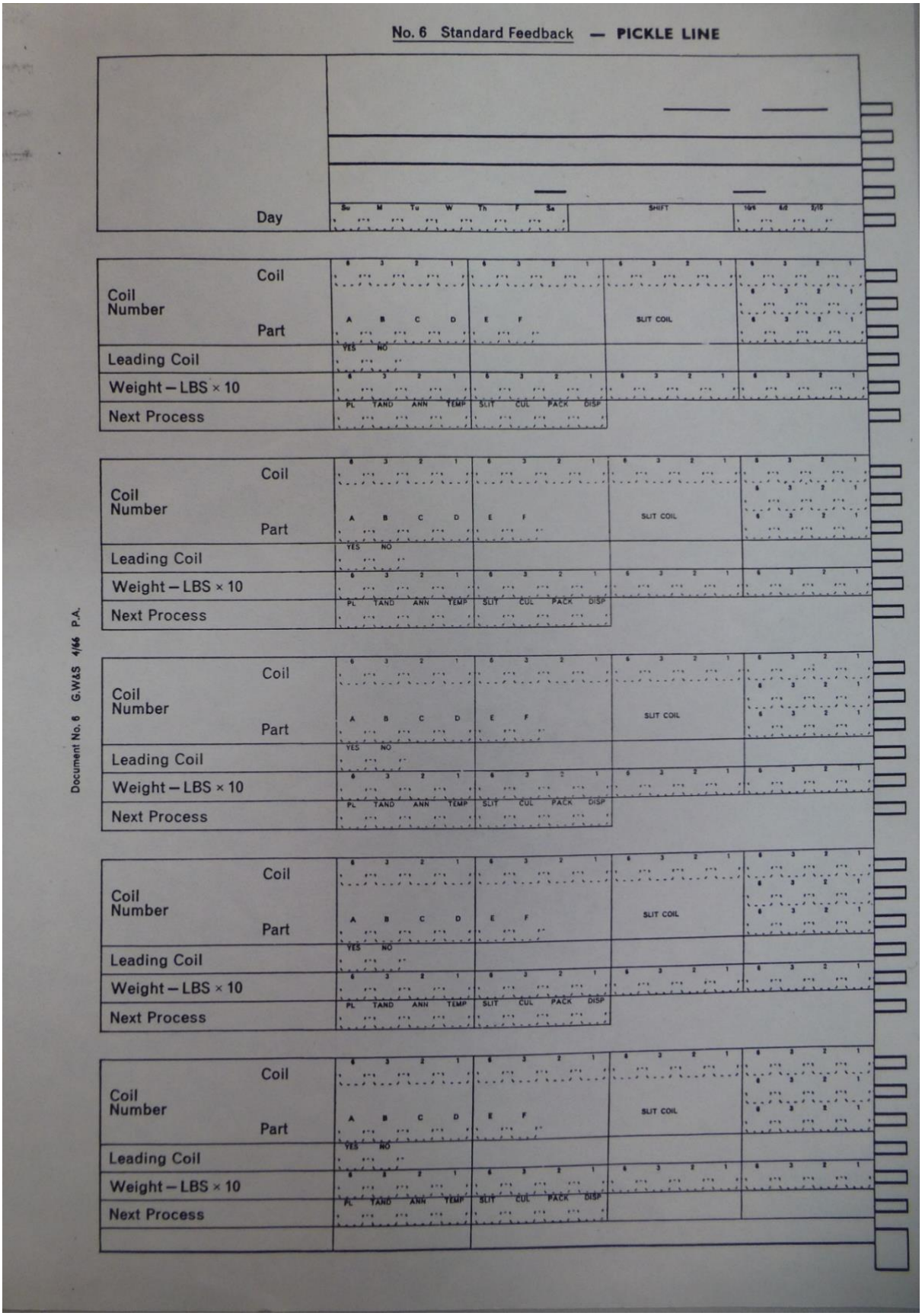
PICKLE LINE **COLD REDUCED MATERIAL SCHEDULE** **HEAVY ROUND** **9/12/66**

WEEK NO 50

ORDER NO	HOT BAND WEIGHT	GAUGE	WIDTH	TRIM WIDTH	WE TOL	ORDERED LD	GAUGE	WIDTH	ROUT	GRADE	FIN ORD	A ACT	ELONG C	DEL WK
2/34280/1	1590	40.60		+0.250	0620	39.750	846	041	026	GP6	2	0.25%	652	26400 b/l
ROOTES PRE				-0.000								0.50%		
2/34042/3	1590	39.00		+0.250	0600	36.024	545	048	036	GP6	2	1.50%	701	9700
DRUM TRADE				-0.000								1.50%		
2/34207/1	1590	39.40		+0.250	0780	38.500	526	011	011	GP6	5	0.25%	701	24700
VAUXHALL				-0.000								0.50%		
2/34207/1	1590	39.40		+0.250	0780	38.500	526	011	011	GP6	5	0.25%	701	26000
VAUXHALL				-0.000								0.50%		
2/34207/1	1590	39.40		+0.250	0780	38.500	526	011	011	GP6	5	0.25%	701	25200
VAUXHALL				-0.000								0.50%		
2/34207/1	1590	39.40		+0.250	0780	38.500	526	011	011	GP6	5	0.25%	701	26950
VAUXHALL				-0.000								0.50%		
2/34207/1	1590	39.40		+0.250	0780	38.500	526	011	011	GP6	5	0.25%	701	26250
VAUXHALL				-0.000								0.50%		
2/34042/3	1590	38.50		+0.250	0600	36.024	545	048	048	GP6	2	1.50%	701	9500
DRUM TRADE				-0.000								1.50%		
2/34042/3	1590	38.00		+0.250	0600	36.024	545	048	028	GP6	2	1.50%	701	23500
DRUM TRADE				-0.000								1.50%		
2/34042/3	1590	38.00		+0.250	0600	36.024	545	048	001	GP6	2	1.50%	701	13300
DRUM TRADE				-0.000								1.50%		
2/34042/3	1590	38.00		+0.250	0600	36.024	545	048	001	GP6	2	1.50%	701	12400

DRUM TRADE			**-0.000**								**1.50%**			
2/34042/3	**1590**	**38.00**	**+0.250**	**0600**	**36.024**	**545**	**048**	**053**	**GP6**	**2**	**1.50%**	**701**	**24900**	
DRUM TRADE			**-0.000**								**1.5**			

PICKLE LINE LECTOR DOCUMENT



No. 6 Standard Feedback — PICKLE LINE

Day

Su M Tu W Th F Sa SHIFT

Coil Number — Coil / Part

A B C D E F SLIT COIL

Leading Coil — YES NO

Weight – LBS × 10

Next Process — PL TAND ANN TEMP SLIT CUL PACK DISP

Document No. 6 G.W&S 4/66 P.A.

RUN 286 PROGRESS REPORTS IN ORDER NUMBER ORDER 4/ 5/67

DEL WEEK	ORDER NO	GAUGE	G/C	A/H PCLE	A/H TAND	A/H ANEL	A/H COOL	A/H COOL	AN & TEMP	DATE PACK	A/H SLIT	COIL CUL	A/H RLV	A/H R&CS	A/H INSP	A/H SPAK	A/H DESP	A/H PROC	A/H DESP	IN TONS	BAL
720	2/38237/1	0490	0	0	0	0	12	10/05 L<-	0	0	0	0	0	0	0	0	0	12	0	10	10
720	2/38237/2 25	0360		9	0	0	22	28	7/05	0	0	0	0	0	0	0	0	0	50	0	25
720	2/38237/3	0360	0	0	34	0	0	L<-	0	0	0	0	0	0	0	0	0	34	0	30	30
720	2/38237/4	0390	0	0	0	24	0	L<-	0	0	0	0	0	0	0	0	0	24	0	35	35
720	2/35238/1 10	0395		0	0	0	0	15 L<-	10/05	7	0	0	0	0	0	0	0	0	22	0	10
720	2/35238/2	0360	0	0	0	18	0	L<-	0	0	0	0	0	0	0	0	0	18	0	10	10
720	2/35239/1	0360	0	0	0	0	38	30/05 L<-	0	0	0	0	0	0	0	0	0	38	0	31	31
720	2/38210/1	0360	0	0	0	0	0	L<-	31	0	23	0	0	0	0	0	0	54	0	25	25
720	2/38210/2	0360	0	0	0	0	56	10/05 L<-	0	0	0	0	0	0	0	0	0	56	0	56	56
720	2/38211/1	0360	0	0	0	54	0	L<-	0	0	0	0	0	0	0	0	0	54	0	50	50
720	2/38212/1	0360	0	0	0	10	5	6/05 L<-	11	0	0	0	0	0	0	0	0	27	0	25	25
721	2/38213/1	0360	0	1	0	0	0	L<-	0	0	0	0	0	0	0	0	0	1	0	14	14
721	2/28214/1	0390	0	0	0	0	0	L<-	0	0	0	0	0	0	0	0	0	0	0	10	10
721	2/38214/2	0360	0	0	0	0	13	09/05	16	0	0	0	0	0	0	0	30	59	0	25	25

721	2/38214/3	0490	0	14	0	L<- 0 L<-	0		0	0	0	0	0	0	0	0	0	14	0	10	10

STOCK LIST (COILS AGAINST EACH ORDER) SHEET 93 RUN 185 6/01/66

ORDER NO	T/C	DEL WK	GAUGE	WIDTH	LENGTH	GRADE	ORDERED TONS	BALANCE CW	BALANCE TONS	ROUT CW	SUR	O	%	A	S	TOLERANCES FIN	D	CR	C	R
2/34356/2	8	652	.0625	27.250	67.500	048	5	5	2 12	540	GP5	*	45	2	3	+0020	0.125	0.500		
GNRL-LONDON															65	6	-0080	0.000	0.000	
49943/-/			.0625	27.230		048	3860		364	SHEET DESP					MOVED		32/12			
54588/-/			.0625	27.250		078	11860		183	ROLL/LEVEL					MOVED		22/12			
2/34356/3	8	652	.0625	46.025	76.000	048	10	0	6 0	540	GP5	*	45	2	3	+0020	0.250	0.500		
GNRL-LONDON															65	6	-0080	0.000	0.000	
36847/A/			.0000	00.000		008	15100	(1)		TEMPER					MOVED		29/12			
54186/A/			.0625	46.625		021	13540		218	ROLL/LEVEL					MOVED		28/12			
2/34356/4	8	652	.0247	28.250	90.750	048	6	5	6 5	540	GP5	*	45	2	3	+0020	0.125	0.500		
GNRL-LONDON															68	6	-0080	0.000	0.000	
37931/-/			.0780	29.529		048	16700	(1)		TANDEM					MOVED		8/12			
55100/-/			.0247	28.230		034	13800		760	ROLL/LEVEL					MOVED		5/01			
2/34356/5	8	652	.0313	36.750	72.500	048	42	0	1 14	540	GP5	*	45	2	3	+0010	0.250	0.500		
GNRL-LONDON															65	6	-0080	0.000	0.000	
55299/-/			.0313	36.750		041	250		-1	SPEC PACK					MOVED		6/01			
							8531		400	SHEET DESP										
2/34357/1	17	705	.0394	32.290	0.000	111	22	13		816	GP6	*	45	6	3	+0030	0.125	0.000		
EXPORT ORDER															55	6	-0030	0.000	0.000	
58630/-/			.0394	32.290		111	29050	(1)		A/H ANNEAL					MOVED		5/01			
58632/-/			.0394	32.290		111	27900	(1)		A/H ANNEAL					MOVED		5/01			
58638/-/			.0394	32.290		111	28400	(1)		A/H ANNEAL					MOVED		5/01			
2/34357/2	17	705	.0394	33.560	0.000	111	66	3		816	GP6	*	45	6	3	+0030	0.125	0.000		
EXPORT ORDER															55	6	-0030	0.000	0.000	
58630/-/			.0394	33.560		111	28100	(1)		A/H ANNEAL					MOVED		4/01			
58632/-/			.0394	33.560		111	28950	(1)		A/H ANNEAL					MOVED		4/01			