CLASSIFICATION SYSTEMS FOR THE ASSESSMENT OF CARCASS MEAT CONTENT AND CONFORMATION

CHARLES R. SMITH

Marketing Manager – Henessy Grading Systems Ltd, Auckland, New Zealand & Hennesy Europe B.V., Rijswijk, The Netherlands

One may summarize this topic in three words THE GOLDEN LINK.

The act of Classification is the golden opportunity in the existance of the animal to acquire the maximum of information which has the most significance to the greatest number of people. The information derived from the act of Classification of a hot carcass on the slaughterline is, without doubt, the strongest link in the overall meat industry chain which stretches from the animal breeder to the retailer.

Discussions at all levels in the meat industries of approximately 20 countries over the last 3 years have invariably shown that every word in the title of this seminar has to be defined and agreed upon on each occasion before discussions may begin.

On this basis an attempt will be made to create a common understanding, if not an agreed definition of these terms before decribing the Hennesy family of Automatic Recording Probes and their advantages; whilst offering thanks to the Congress Organisers that the word "Quality" has not been included!

CLASSIFICATION

This term is frequently and falsely confused with both Grading since they both may mean "the arrangement in classes according to some system or principle", and Class which is "things grouped together because of certain likenesses". Grade as determined by a precision grading instrument such as the Hennesy "HGP" can only refer to a single parameter such as Lean-Meat content (despite the instrument being capable of delivering a wealth of information) whilst Class refers to "bands of values" such as the E-U-R-O-P scheme used by the member states of the European Community for pig carcasses having an estimated Lean-Meat content in steps of 5 percentage points. The same coding system is used for the Conformation of Beef and Sheep.

Classification in itself refers rather more to the act performed by an operator, be it a human or a robot, in the determination of two or more values – typically – Identification, Weight, Grade and Conformation, and in their recording, than it does to the coded information typically found on carcasses. Whatever the preferred case, the information is recorded in a document commonly called a "Classification Certificate".

SYSTEM

The physical equipment including Software where electronics are used, installed in the slaughterhouse for the purpose of determining and recording information on the (hot) carcass to meet both pricing and reporting needs and obligations. When used in the sense of a "National Classification System", the legislative and administrative frameworks are also included, just as are standardized carcass dressing and agreed hot-to-cold rebates.

ASSESSMENT

Defined as "the attribution of an estimated value to a product based on human expertise", it is therefore "Subjective" and so is markedly different from Grading which is an "Objective" machine-made estimation.

CARCASS MEAT CONTENT

This may be a factual or estimated percentage of the total carcass weight. Factual if the amount of meat is found by total dissection as performed during trials, or estimated when the amount of meat is found by partial dissection (commercial cutting) or from an automatic Grading Probe which uses measured values (predictors) in a yield equation.

When it is used for the factual lean (muscle) content of a given carcass, its definition as "the total red striated muscle from all parts of the carcass as far as separately by knife" seems the most suitable.

CONFORMATION

This refers to the structure of the carcass as determined by its parts and states how that structure relates (conforms) to certain norms.

Here in Europe, the previously mentioned five classes E-U-R-O-P are given to Beef and Sheep carcasses according to their shape or profile.

The correlation between pig muscle mass

measured by an automatic probe at the head of the last rib or between the 3rd /4th last rib, and the muscle mass in the leg (ham) area is, regrettably, too low. This shows itself in carcasses with identical backfat and muscle measurements, but considerable differences in lean meat content.

It is in the area of Conformation that one sees a move from "Subjective" to "Objective" criteria with the introduction of VIA (Video Image Analyses) equipment, albeit only for research use.

When Conformation joins Grade in being determined objectively, the overall accuracy of the predicted Meat Content will be improved quite significantly to the benefit of the whole industry.

Having established the limitation of Automatic Recording Probes as all-purpose Classification devices, we should examine their usefulness through the data they provide rapidly and inexpensively which contributes to the Classification.

Just before examining probe data and how it benifits the meat industry, it would be as well to remind ourselves of the features of a Grading Probe by a summary of the design criteria and operational functionality of the HGP.

Design

The criteria of accuracy and robustness endowed by Brian Hennesy at its conception have remained. Mechanical features have had to change but little since the first Hennesy Probe was used commercially in 1979 or since the GP2 was legislated as the grading standard for Sweden in 1984.

The HGP is a lightweight and compact hand-held instrument. It has no external switches or control buttons and is therefore simple and fast to operate. The power supply and communications are via a single 4-score spiral cable.

The green-yellow light source and detector (commonly called the "eye") are mounted in the tip of the stainless steel probe needle which extends from the body of the instrument. As the "eye" passes through the carcass, the reflected intensity is used to determine its presence in fat or muscle.

A transducer within the body of the HGP measures the distance that the "eye" has travelled relative to the carcass surface using a precision ladder-strip grating through which light is shone; the shadow of each "rung" registering 0.2 mm of needle travel.

These samples of reflected light intensity measured at precise intervals represents X-Y co-ordinates which are analysed by the microprocessor to determine the fat and muscle thicknesses.

From the beginning the use of potentiometers was eliminated in favour of the grating which has proved to be a wise decision. The Hennesy factory in Auckland New Zealand test run all HGP's for a minimum of 100 hours before despatch, simulating over 100,000 carcasses. The absence of bearings and brushes in the distance measuring mechanism is one of the the many factors which contribute to the long life and extended service intervals of the HGP.

Use

Studies by meat scientists have shown that there are certain sites on the carcass where fat and muscle measurements have the highest correlation to lean meat content. Such sites are: for pigs around the last rib or 3rd /4th last rib and the lumbar vertebra at distances between 4 and 10 cm from the midline, for sheep between the 11th and 12th rib at 11 to 12 cm from the midline, for beef 8 cm lateral to the prominence of the sacral crest.

Variations

The base probes GP2 & GP4 with a needle diameter of 5.95 mm have a nominal measuring range of 0 - 120 mm. For Heavy Hogs as found in Italy, and Beef cattle a 145 mm version is available. For Lamb the length is reduced to 80 mm being sufficient for ovine carcass thichnesses, while for measuring fat only on Beef a 55 mm version is made. The FD3 model called the Butchery Probe which is used by processors in de-boning halls has a 60 mm maximum reading range.

Operation

The HGP is aligned at the measuring site with the aid, where necessary, of an Aiming Plate and the needle is pushed into the carcass and immediately withdrawn which takes one second. Thicknesses to the required accuracy of 0.2, 0.4, or 1 mm, and other values, are shown on the upper display alpha-

numeric display. The maximum number of carcasses per hour that may be measured on the Kill-Line will vary according to whether one or two sites are probed. For pigs two site is approx. 300 and one site approx. 450 although 600 is achievable, and it has been tested in the US at 1,000+.

Alarms
Incorrect use such as not probing deep enough, withdrawing too fast or not keeping the contact plate against the surface are all drawn to the operators attention by flashing red warning lights. Errors such as measured values falling outside predetermined values are similarly evidenced.

After each succesful probing the acquired date is transfered to a recording device which may be the on-board memory, a printer or a computer. The totality of information (acquired data) provided by the HGP will be of interest to researchers who demand the fullest picture and for whom, through having relatively few carcasses in any given trial, the storage of data does not present a problem.

Individual slaughterers will not need or want to record all the available information if they handle several thousand carcasses per day, particularly data considered "useless" because it has no commercial value for them. Marketing Boards and similar bodies may only need the briefest of grading results, typically Meat Content to complement weight and numbers of carcasses.

AVAILABLE DATA
Table 1 shows the data available to researchers using an HGP with the Hennesy Grading Systems "Research System" (RSH) Software Package in its Reporting Mode.

The RSH software was evolved since its humble introduction in late 1983 when it was only available in monochrome giving a tabulated format, through Version 2 which added full profile reporting (digitized picture of what the "eye" sees) and selectable colours to take full advantage of today's Personal Computer technology. Version 3 improved "File Handling" and the soon-to-be-released Version 4, which in addition to not requiring an expansion card to be fitted to the PC, will permit total control of the grading data provided by the Hennesy GP4.

Table 2A shows the data available to researchers using an HGP with the Hennesy Grading Systems "Research System" (RSH) Software Package in its Profile Mode, the flatness in the muscle area indicates meat quality.

Table 2B shows the same available data, but for a PSE pig.

Table 3 shows the data which an HGP would transmit in "Computer Mode" when used with a Kill-Floor Data Collection System such as found at larger slaughterers.

Table 4 shows the data which an HGP would transmit in "Printer Mode" which is a shortened version of "Computer Mode" and the format often preferred by smaller slaughterers.

CONTRIBUTION OF GRADING DATA TO THE MEAT INDUSTRY
The variety of complex and simple data provided by the HGP at the request of the world's leading researchers having been covered, we return to the evaluation of its contribution to the beneficiaries.

Using the hypothetical model of a totally fragmented meat industry characterized by the absence of integration, and without being specific to Pigs, Sheep or Cattle, we may isolate individual elements (beneficiaries) in the meat chain on either side of the GOLDEN LINK of Classification, and seek to quantify the benefits that each may derive from the use of a Hennesy Grading Probe- HGP- as the heart of the "System" previously defined.

MEAT INDUSTRY RESEARCHERS
It is to these few people in each country that we are indebted for their patience in working with us. Without their research we could not have the Yield Equations that make HGP's a commercially viable proposition for so many slaughterers.

By monitoring Classification results and the "Quality" information provided by HGP's they are able to analyse production trends.

BREEDERS
The breeding of livestock has today a strong scientific base in genetics, making research and development costly as well as time consuming. With profit coming from the sale of improved breeding stock several years

after its initial "design", monitoring of carcass traits is a necessity, not a luxury. Without the feedback form slaughter data, how are breeders guage or publicize their successes before offering to producers the "right" animal for the optimum economic return?

A word or two of caution should be noted by those who might contend that live animal assessment may be substituted for carcass classification. Taking as an axample the assessment of "carcass composition" on live pigs by the use of ultrasound or similar devices. These can at best be no more than a guide, and at worst a distraction, as demonstrated by recent events in the United Kingdom. The desire to produce leaner-and-leaner pigs has resulted in the combined Skin & Backfat thickness on certain carcasses being under 5 mm. Classed as extremely difficult to process, the outcome is an associated, but unexpected price penalty and loss of income to the producer.

PRODUCERS

The change from liveweight to deadweight settlement does quite naturally de-skill the trading of slaughterpigs. Ministry or privately organized graders often act as the "fair broker" between producer and slaughterer to certify the weight and classification. Most National Schemes take full advantage of probe data and register it completely, yet others only note the cold weight and meat content, which denies the producer information on fat depth and muscle thickness; so vital for a fuller picture.

It is only with full information that producers may gauge the effect of breed, environmental, feeding and husbandry changes and so take the corrective action necessary to ensure they send for slaughter those animals which most closely meet the market need, and command the best price.

SLAUGHTERERS

Private abattoirs in particular have the reputation for being the "bete-noire" and cheating the producers where possible. Objective grading, particularly when administered by an independant body, can improve their image at the same time as reducing their risks. They may devise producer price grids based on a new range of criteria extending beyond assessment, and learn from the probe data on the Kill-Line not only what the carcass is worth, but also decide its most profitable destination.

The current generation of HGP's, the GP2-Q and more particularly the GP4, in providing accurate and stable colour measurements enable an early assessment of final meat quality. Confirmed or suspect PSE carcasses may be identified and stored separately so they do not reduce the value of an otherwise homogenous consignment.

When used with the Hennesy HBP2 Battery Pack, any HGP may be taken into the chiller or other storage area for spot checks or quality change verification.

The use of Automatic Recording Probes for Classification does not only make life easier for the Grader who suffers less fatigue. The automatic transfer of data to the computer (which would normally also have the weigh-scale and a keyboard for tattoo marks and comments connected) means all the information on each individual animal may be viewed or printed on a signle line.

Labour-saving is possible on the Kill-Line through the elimination of a "scribe". In the administration there is no more need to copy hand-written sheets, with the transcription errors that inevitably occur.

When probe data is archived electronically, it may be reviewed with ease for the comparison of past and present producer lots. Price arranging with producers can have a factual basis to dispute-free negotiations.

GRADING ADMINISTRATION

Inspectors have ready access to printed data on every carcass, so that operator errors or suspect readings may be identified.

Countries such as Sweden and The Netherlands benefit from a unified system of grading and data capture, which has helped all sectors of their meat industries. The raising of the meat content of pig carcasses by one percentage point per annum has been registered with a resultant increase in industry incomes.

PROCESSORS

Whether integrated with the slaughterline or autonomous, there are operational benefits from handling carcasses and primals which not only appear the same on the outside, but in fact have very similar fat and muscle

thicknesses. The measuring of factual cold carcass or primal fat depth and its addition, with information on meat quality, to a grade letter or number is the first step. The transfer of grading data from the Kill-Floor via machine-readable labels or other electronic means will be the refinement in their quest to more closely match the raw material to its end use.

WHOLESALERS
Grading Probes or Fat Depth Indicators such as the Hennesy FD3 permit fast and accurate verification of incoming or outgoing consignments.

Connection to even simple computer systems will allow rapid statistical analysis of lots of whole or half carcasses and primals.

Here one may mention, by way of example, that an importer was able to demonstrate and justify to a large exporter the rejection of a whole container-load of bacon sides that they were "out-of-specification" on fat depth. Previous trade had been marred by uncertainty, but the future satisfaction of both parties was guaranteed following the investment by the exporter in question of several FD3's.

RETAILERS
Multiple-retailers who specify their purchases by grade to meet seasonal and socio-economic merchandising needs can benefit from reduced handling costs. Independant retailers can buy on grade to meet their needs and avoid surprises when carcasses or primals arrive.

CONSUMERS
Not so much the end of the chain as was once thought. They now abandon red meat in favour of white meat or fish to follow healthy eating fads, but still remain the "King". It is the consumer in the shape of the housewife and her purse that determines the majority of meat purchasing decisions despite the many more meals now being taken outside the home. Quality and consistency are the watchwords that will command her attention and buying power; Classification makes this possible!

SUMMARY
The GOLDEN LINK of Classification remains invariable within a meat industry chain that expresses itself in many forms. However much these forms may vary with the different industry structures in each country and with the species of animal being classified, the Hennessy Grading System remains as much a necessity today as it has been over past years to researchers and slaughterers alike the whole world round.

H&S RESEARCH SYSTEM MEASUREMENT REPORTING Date : 17/08/88 Serial No. : 1234 Version : 0
Filename : RSH80817.DT2 Species : Pig Comment : This header was initialized by AGP4.NZ0101234

Grd. time	Carcass number	Species type	Fat site 1	Meat site 1	INF	Carcass site 1	Dist. site 1	Meat %	Def. ind.	Class	Rc No	Prof XRef
9:02:23	1	Porker	20.0	48.0	10.0	78.0	122.0	56.2	..	1	1	1
9:02:36	2	Porker	10.0	48.4	20.0	78.0	122.0	63.3	..	0	2	2
9:08:01	3	Porker	16.0	22.8	3.6	42.0	46.8	55.2	..	1	3	3
9:08:18	4	Porker	7.2	23.6	0.0	30.4	30.4	61.5	..	0	4	4
9:08:25	5	Porker	7.6	82.8	13.6	104.0	122.0	70.1	..	0	5	5
9:08:53	6	Porker	10.0	44.0	22.0	78.4	122.0	62.2	..	0	6	6
9:09:21	7	Porker	10.4	43.2	19.2	72.4	122.0	62.2	..	0	7	7
9:10:26	9	Porker	5.2	24.0	10.0	47.6	122.0	63.0	..	0	8	8
9:10:44	10	Porker	11.6	44.0	11.2	67.2	122.0	61.6	..	0	9	9
9:11:00	11	Porker	11.6	46.0	10.0	68.4	122.0	61.9	..	0	10	10
9:12:05	12	Porker	13.2	35.2	7.2	55.2	122.0	59.0	..	0	11	11
9:12:26	13	Porker	0.4	85.2	12.4	105.6	122.0	69.9	..	0	12	12
9:12:52	14	Porker	12.0	55.6	11.2	78.0	122.0	62.9	..	0	13	13
9:13:17	15	Porker	0.4	16.0	0.0	24.4	24.4	59.5	..	0	14	14
9:13:22	16	Porker	7.2	72.0	10.0	90.0	122.0	60.9	..	0	15	15
9:13:45	17	Porker	6.0	50.4	14.0	70.0	122.0	65.0	..	0	16	16
9:15:25	18	Porker	11.2	10.0	0.0	30.0	30.0	50.0	..	1	17	17
9:15:31	19	Porker	12.0	87.2	13.2	112.0	122.0	67.7	..	0	10	10
9:16:07	20	Porker	16.0	46.0	0.4	70.0	122.0	50.7	..	1	19	19
9:16:40	21	Porker	0.0	01.6	10.0	99.6	122.0	69.6	..	0	20	20
9:17:20	22	Porker	12.0	20.0	0.0	32.4	32.4	57.0	..	1	21	21
9:17:35	23	Porker	12.4	46.4	19.2	70.0	122.0	61.3	..	0	22	22
9:10:40	24	Porker	10.4	22.4	0.0	40.0	40.0	53.5	..	2	23	23
9:10:46	25	Porker	10.4	16.0	9.6	43.6	43.6	52.5	..	2	24	24
9:10:53	26	Porker	10.0	46.0	11.6	75.6	122.0	57.3	..	1	25	25
9:19:23	27	Porker	0.4	37.6	10.4	56.0	122.0	62.0	..	0	26	26
9:20:03	20	Porker	13.2	55.6	3.6	72.0	122.0	62.1	..	0	27	27
9:20:29	29	Porker	16.0	20.4	7.6	44.0	44.0	54.9	..	1	20	20
9:20:34	30	Porker	19.2	7.6	20.0	46.4	46.4	50.7	..	2	29	29
9:20:39	31	Porker	10.0	50.0	26.0	95.2	122.0	57.3	..	1	30	30
9:21:19	32	Porker	14.0	21.2	0.0	36.0	36.0	55.0	..	1	31	31
9:21:33	33	Porker	13.2	20.0	29.2	70.4	122.0	50.0	..	1	32	32
9:23:15	35	Porker	12.0	40.0	11.2	72.4	122.0	61.4	..	0	33	33
9:23:36	36	Porker	17.6	44.0	10.0	72.0	122.0	57.4	..	1	34	34
9:24:39	37	Porker	12.0	40.0	10.0	64.0	122.0	60.2	..	0	35	35
9:24:55	38	Porker	12.0	36.4	0.0	57.2	122.0	60.1	..	0	36	36
9:25:14	39	Porker	13.2	43.2	10.0	66.0	122.0	60.2	..	0	37	37
9:25:20	40	Porker	14.4	29.6	0.0	44.0	44.0	57.4	..	1	30	30
9:25:36	41	Porker	16.4	69.6	6.0	92.0	122.0	62.0	..	0	39	39
9:25:45	42	Porker	16.4	14.0	0.0	30.4	30.4	53.6	..	2	40	40
9:25:52	43	Porker	6.0	46.4	23.2	75.2	122.0	65.0	..	0	41	41
9:26:25	44	Porker	10.0	45.2	11.2	66.0	122.0	62.2	..	0	42	42
9:26:39	45	Porker	11.6	13.6	0.0	24.0	24.0	56.9	..	1	43	43
9:27:40	40	Porker	20.0	40.4	10.0	70.0	122.0	56.3	..	1	44	44
9:20:10	49	Porker	9.6	39.2	0.0	40.4	122.0	62.2	..	0	45	45

Table 1.

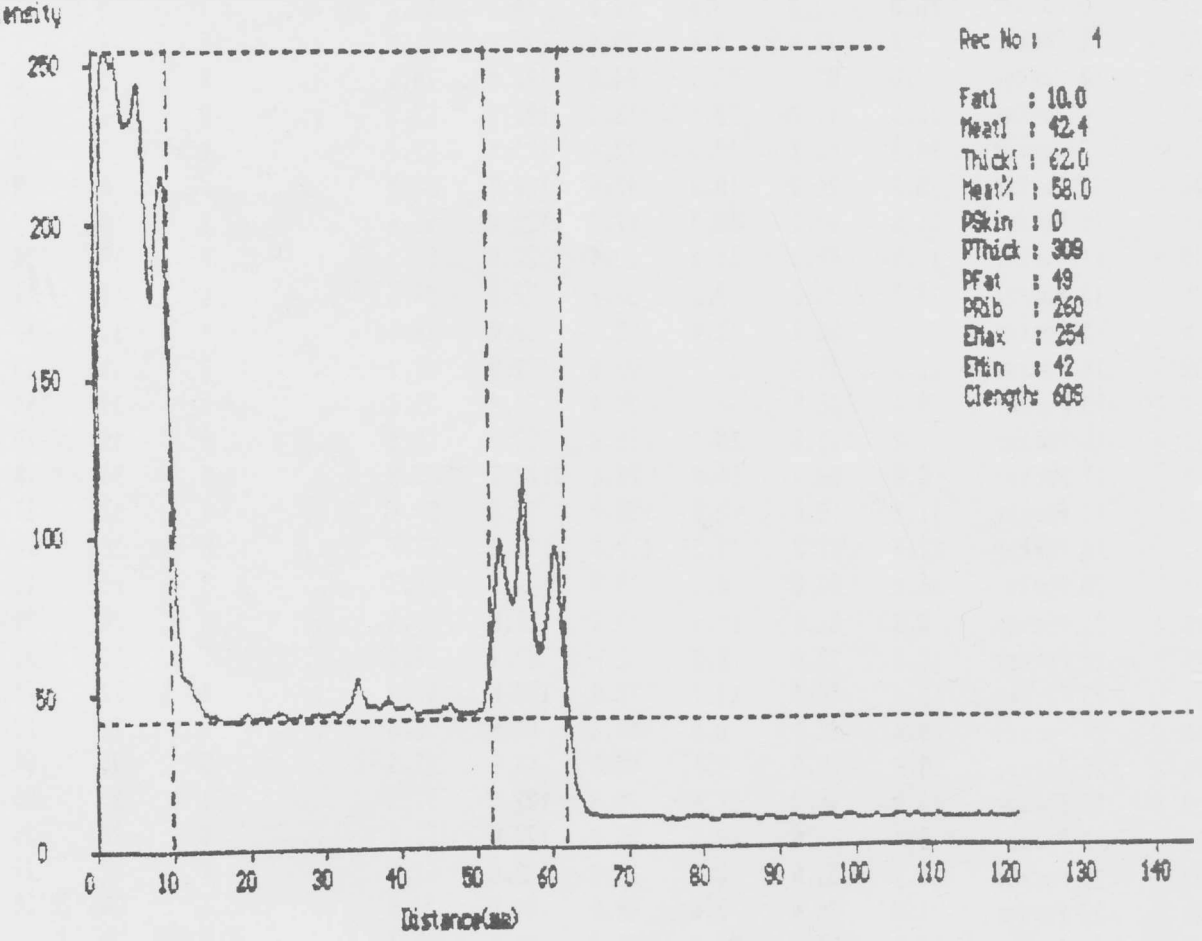
HENNESSY GRADING SYSTEMS PROFILE PLOTTING REPORT Profile Filename : RSHB0727.PF1 Date : 27/0

Grd. time	Carcass number	Animal type	Fat site 1	Meat site 1	IMF	Carcass site 1	Dist. site 1	Meat %	Def. ind.	Class	Rc No	Prof XRef
11:18:49	10001	Porker	10.0	42.4	10.0	62.0	121.6	58.0	..	E	5	

Comment :

Reflected Intensity

Type 'T' - Text, 'P' - Print, 'X' to eXit, Any to continue



Pointers Site 1 EMax : 254 PSkin : 0 PRib : 260
EMin : 42 PFat : 49 PThick: 309

Table 2A

Hennessy Research System in Profile Mode

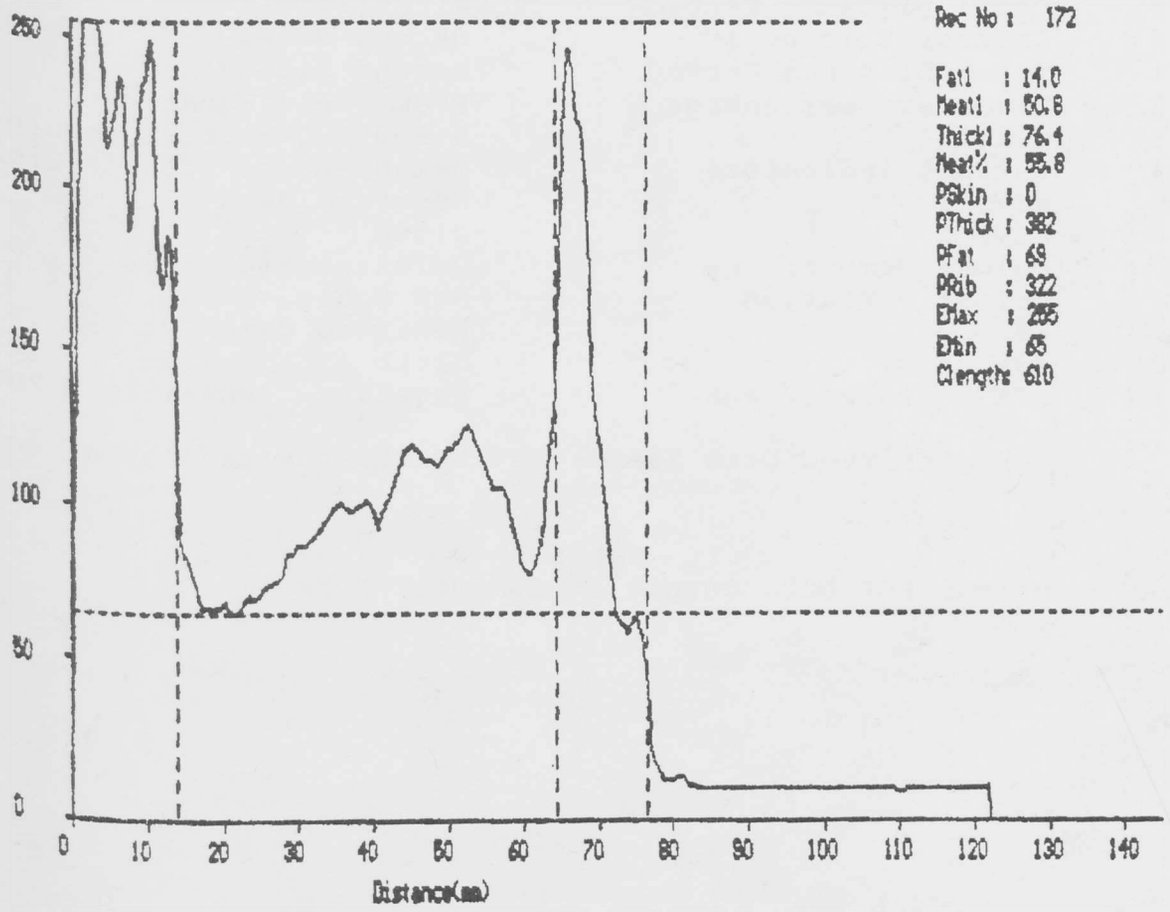
HENNESSY GRADING SYSTEMS PROFILE PLOTTING REPORT Profile Filename : RSH80727.PF1 Date : 27/07/

Grd. time	Carcass number	Animal type	Fat site 1	Meat site 1	IMF	Carcass site 1	Dist. site 1	Meat %	Def. ind.	Class	Rc No	Prof XRef
11:45:16	156	Porker	14.0	50.8	12.0	76.4	122.0	55.8	..	E	173	

Cosant :

Reflected Intensity

Type "T" - Text, "P" - Print, "X" to eXit, Any to continue



Pointers Site 1 EMax : 255 PSkin : 0 PRib : 322
EMin : 65 PFat : 69 PThick: 382

Table 2B

Hennessy Research System in Profile Mode

Muscle area exhibits PSE

Field #	Column Header	Comment
1	Animal Type Code	Multi-species / Types
2	Carcass Counter	000001 - 999999
3	Time	24 hour Clock
4	Fat Thickness	First Site
5	Fat Thickness	Second Site
6	Muscle Thickness	Second Site
7	Intercostal Fat Thickness	Second Site
8	Carcass Thickness	First Site
9	Total Distance Probed	First Site
10	Carcass Thickness	Second Site
11	Total Distance Probed	Second Site
12	Lean Meat percentage	From Yield Equation
13	Class	S-E-U-R-O-P or as required
14	Default indicators	Measurements outside Limit
15	RSVD 1	Reserved data
16	RSVD 2	ditto
17	Colour Number	Paleness of muscle
18	Colour Variation	PSE Scale
19	RSVD 3	Reserved data
20	RSVD 4	ditto
21	PSE Decision Flags	Negative . Possible ? Posi

N.B. Reserved Data Fields may be 'Customized' by arrange

Table 3
Normal HGP Data Output in Computer Mode

Field #	
2	Carcass Counter
3	Time
4	Fat Thickness 1
5	Fat Thickness 2
6	Muscle Thickness
12	Lean Meat percentage
13	Class
14	Default Indicators
17	Colour Number
18	Colour Variation

Table 4
Typical HGP Data Output in Printer Mode