Attachment 1 Amendment 6 - IS6/IAS6: Section 3.8: Amended New Zealand Standard for Spray Chilling – Large Mammals and Large Birds

February 2008

Contents

1 Scope

This amendment applies to all large mammals and large birds.

2 Background

New Zealand has allowed spray chilling for some time as per the requirements of IS6.

The intention of spray chilling is to reduce or compensate for the water loss of the carcass (including sides and quarters) that occurs during the chilling process. Spray chilling also has some microbiological effect in that it allows the surface of the carcass to cool down effectively. The National Microbiological Database (NMD) programme provides verification to this effect.

The current requirements specified in IS 6 apply to individual carcasses. All carcasses are weighed and non-complying carcasses are returned to the chiller to be reduced to the correct weight. As an alternative to the current requirements, an operator may replace this with a statistically based sampling plan and other performance-based monitoring. This is intended to give a high level of assurance that the “process lot “ will not be overweight by verifying that the collective weight of carcasses has not increased above their initial level.

Processes and facilities vary widely between premises. Beef sides and venison carcasses are typically held in a single chiller between slaughter and boning. Carcasses on many ovine slaughter plants move through continuous and batch chillers before boning or freezing. Some carcasses are loaded on transport vehicles to other sites for boning.

With multiple chiller arrangements, spray chilling may be deployed in the early stages of the chill cycle in one chiller with downstream chillers operated with no spray chilling to prevent weight gain and ensure that carcass surfaces are dry before boning. There is also a significant weight loss in carcass freezers such that any weight gain is unlikely. Therefore if operators elect to adopt a “processed lot” approach it is appropriate that validation and verification of spray chilling systems is carried out by considering the carcass weights for the entire process, rather than the weights in and out of a single room.

Operators meeting current IS6 spray chilling requirements, have weighing equipment installed at a suitable point for cold weight measurement such that every carcass can be weighed. Where such facilities are present, the operator may elect to continue weighing all carcasses for compliance purposes rather than electing to adopt a “process lot” approach. Where such facilities are not present and an operator elects to institute spray chilling, a spray chiller validation process with monitoring of the critical spray chilling parameters and a sampling plan for carcass weighing must be adopted.

3 Definitions

In this standard -

Cold weight: means weight of a unit at:

- the entry to an on-site or off-site boning room prior to pre-trimming; or
- the exit from a freezer prior to storage.

This does not preclude an operator from weighing units at any point upstream such as within a chiller. An upstream weigh point could be used if the operator elects to continue weighing all units or if the operator adopts a "process lot" approach to manage the process.
Units may not actually be "cold" in processes where they are boned or frozen while still warm.

Competent person: means a person who has the training, knowledge, skills and ability to perform an assigned task, and who is subject to requirements specified by NZFSA. This definition is synonymous with "suitably skilled person". A competent person must survey the chillers or freezers and must certify, for the named group of chillers, that they have been constructed and fitted in accordance with the common respective design specification.

Hot weight: means weight of a unit after final post-mortem examination prior to any water application (eg final carcass wash) and entry to a cooling floor or chiller.

Process lot: means a group of units which have been subjected to a common spray chilling process. A process lot may be produced within an individual chiller or group of chillers or be derived from a continuous chilling process.

Unit: means carcass, side or quarter.

Verification: means operator verification unless stated otherwise.

Note: Where units are transferred to another premises for boning or cutting –

a. the receiving premises must be operating under a registered risk management programme; and
b. the receiving premises must have sufficient written procedures and records to demonstrate the process lot has not increased in weight; and
c. the operators of both premises must have agreed documented procedures on how to deal with any non-compliances.

4 Procedure

4.1 Process Boundaries

The operator must define and document the cold weight measurement point for the unit and each process.

Weight loss due to trimming is not permitted to be compensated for by water absorption.

It is operator's responsibility to minimise weighing inaccuracies.

The weighing equipment used must be trade certified in compliance with the requirements of the Weights and Measures Act 1987 and the Weights and Measures Regulations 1999. The required readabilities of trade certified scales are specified in the regulations. The trade certification will ensure that the scales are performing within specified limits in accordance with these regulations. Additionally processors will maintain a regular internal programme of scales calibration checks

Investigation of weighing inaccuracies should include the following:
- swinging of units
- unit to unit contact at weighing
- mass variability on rollers, gambrels and skids (where units are transferred to different hooks prior to reweighing)
- errors in recording

Weight loss or gain of individual units that differs considerably from that of other units should alert the processor to problems.

4.2 Freezing Weight Loss of Units

Where the process includes freezing of units (ie carcase, side or quarter), the operator must either:

- weigh the frozen unit bare or with a tare allowance for packaging, or
- provide sufficient data of the weight loss in the freezing process to be able to apply a freezing weight loss factor to a weigh point upstream (eg prior to bagging) such that a maximum weight gain is set for the weigh point.

The freezing weight loss factor is determined as follows:

- Weigh 300 units post freezing for each type of freezer operating at the shortest freezing time typically used for the freezer(s),
- Subtract the post-freeze weight from the post-spray weight for each unit,
- Determine the percentage weight loss for each unit during freezing,

• Determine the freezing factor at the 2.5%ile of the data set.

Validation of weight loss will require each different type of freezer or groups of freezers if the freezers are of a similar type to be individually assessed. Variations in airflows, temperatures and freezing times will affect weight loss during freezing.

Using the 2.5%ile value for the freezing factor is a reasonable indication of the lowest weight loss achieved and allows for elimination of outliers greater than 2 standard deviations (SD) below the mean weight loss.

See appendix 2 for procedure for determining packaging allowance

4.3 Spray Chill Options

The following options are available for determining spray chilling compliance:

- **Type 1:** All carcases must be weighed. Two options available:

  Option 1 The average cold weight of a process lot of units must not exceed the average hot weight.

  Option 2 The cold weight of each unit must not exceed the hot weight of that unit.
- **Type 2:** The average cold weight of a process lot of units must not exceed the average hot weight with monitoring by process control plus check cold weight measurements using the sampling plan(s) described in section 4.5.

4.4 Type 1 Procedure

Option 1

The average cold weight of a process lot must not exceed the average hot weight of that lot. 100% of all units are to be weighed to confirm compliance.

For each process, the operator must document:

- The process boundaries where cold weight is measured (section 4.1)
- The process lot description (section 3)
- The monitoring and corrective action procedures to be taken.

The operator must monitor and make available the weight records as both raw data and in summary statistics form including the statistics to allow the variance occurring within each process lot to be assessed.

If the average cold weight of a process lot exceeds the average hot weight for that lot, the operator must carry out an investigation of the reasons for the weight gain and determine corrective actions to be taken to prevent recurrence. Subsequent spray chilling for that process must cease until corrective action has been taken.

It is strongly recommended that a process control system with regular process monitoring checks is carried out to assist with any investigations that are required should the weight criteria not be met. Failure to do so is likely to have significant implications, ie failure of the process lot.

To minimise the risk of non-compliance, it is recommended that the operator apply statistical limits to warn of possible non-compliance before the completion of a process lot.

The non-complying process lot (cold weight mean greater than 0% of hot weight mean) is treated as a process failure; the product processed from the lot is retained and NZFSA VA contacted regarding product disposition. Product from any units that incur a weight loss may be released if this product can be identified and separated from non-complying product. The operator may elect to hold frozen units in store for a period prior to reweighing.

Option 2

The operator must weigh each individual unit and ensure that the cold weight of that unit does not exceed the hot weight of that unit.

Note: This is the current system. **Corrective action:** If the cold weight of any unit is greater than the hot weight, the unit must be held in a chiller until the cold weight is at or below the hot weight.

4.5 Type 2 Procedure

The average cold weight of a process lot of units must not exceed the average hot weight of that lot. As 100% weighing of units within any given process lot post spray chilling is not required, process control procedures must be in place to validate spray chill facilities and a weight verification programme used to monitor performance.

4.5.1 New Facilities

Where a new spray chilling facility is constructed, operators are required to have a competent person acceptable to NZFSA to certify that the spray chilling facility and critical spray chilling parameters and controls will meet the required outcomes.

A competent person will have demonstrated competence in the design and operation of spray chilling facilities. Factors to be considered in the written report would include those set out in section 4.5.2 (Factors to be considered during validation)

4.5.2 Factors to be considered during validation of the spray chilling process

Operators using TD00/811 section 2.2 (a) or 2.2 (b) will not be eligible for spray chilling. All chillers to be used in spray chilling processes must have been validated for unit cooling and evaporative capacity.
Processes that use a chiller (s) that has been validated for air cooling without spray chilling, should be suitable for spray chilling providing there are no significant structural alterations to the chiller and/or the operating parameters (temperature, air velocity, heat load or unit mass) for the chiller are not altered. As a consequence, revalidation of cooling in the chiller would not be required. In these cases, further validation is limited to the spray chilling parameters.

The operator must document the factors affecting their chilling process(es) and identify and document the critical spray chilling parameters that achieve the outcome of this standard.

Factors that must be considered because they affect the amount of water retained by units, include:

- the management and performance of the spraying system, including monitoring the functionality of spray heads, noting any difference between spraying cycles applied to different process lots;
- the management and performance of the refrigeration / air flow systems, throughout the chiller (s);
- the amount of meat (number of units) in the chiller (s);
- loading (opening of doors etc.) of the chiller (s);
- position of units within the chiller (s);
- process time including drying time;
- time interval between sprays, length of spray, volume of spray, number of sprays;
- spray nozzle - type (fan, hollow cone, full cone), pressure and flow rate.

Given a process lot, the critical spray chilling parameters for monitoring purposes are considered to be:

- Unit type;
- Number of units of that type;
- Interval between sprays;
- Spray duration;
- Number of sprays per cycle;
- Chiller temperature regimes;
- Fan speed setting;

• Time from last spray to point of weighing (drying time).

A record of these critical spray chilling parameters must be kept to permit a regular check that the correct process is being used.

Each installation must have a process control programme prepared, taking into account site-specific features.

Given the process would be documented; an example of a typical process control plan would be as follows.

Daily:

- Maintain records for each chiller to record the number of units of each process lot.

Weekly:

- Check the nozzle pressure and water temperature is in the normal range
- Check for blocked or leaking nozzles
- Check the records for at least one chiller to confirm that the spray settings, fan speeds and air temperature conform to the set process
- Check the records for at least 10% of chiller batches to confirm that the correct process was applied.

Annual:

- Flow checks on a sample of nozzles in each chiller.

As required:
- Record any changes to nozzle types and re-validation work carried out

See Appendix 4 for further information.

Ongoing monitoring checks of the critical spray chilling parameters must occur and the findings recorded. Since the amount of water retained may be influenced by various factors that relate to the position of units within the chiller, spatial issues need to be considered in the design of the process and addressed as necessary to ensure compliance.

It is permitted that some units increase in weight. However this should not be a common occurrence for units in certain positions in the chiller. For instance it may be that units that are in the middle of a chiller consistently absorb water to such a degree that they are more prone to increase their cold weight above their hot weight. This is the reason for recording the position of sampled units in the chiller. Once such an issue has been identified chiller management should be amended to ensure this problem is corrected. Targeted sampling of units in these areas over and above the required random sampling should then be performed to check that the amended procedures are effective. Unit weights should be mapped for each chiller and trends analysed.

An operator can validate a process to include a group of similar chillers.

Where similar chillers are grouped within a common process

a. The chillers must be of similar construction and must have been fitted with rails, spray chilling equipment and other fittings that have been constructed to similar respective specification, as certified by a competent person (eg a refrigeration engineer).
b. All chillers must be loaded to at least 90% capacity.

4.5.2.1 Sampling Units

The sampling units will be randomly selected from the process lot.

In the case where an individual chiller is used, the sites within the chiller or the units could be randomly selected while for continuous processes the units should be randomly selected.

4.5.2.2 Weighing of Samples

The sampling of hot and cold weights for each process lot must commence on a daily basis at Level 1, during start up and validation of the spray chilling as set out below. Subject to satisfactory performance, the sampling size can be reduced at Level 2 and the sampling frequency at Level 2 (fortnightly), Level 3 (monthly) and Level 4 (quarterly).

If any critical spray chilling parameter is changed that results in more water retention, then the operator must return that process to Level 1 to re-validate achievement of the spray chilling requirements.

4.5.2.3 Level 1 – Start up and Validation of Spray Chilling

Critical spray chilling parameters must be recorded for each spray chilling process before further processing. The following information must be recorded for each sample and it must be possible to relate the information back to individual units:

- Date of sampling;
- Unit identifier;
- Position of unit in chiller;
- Hot weight of unit;
- Cold weight of unit;
- Mean of the difference in hot and cold weights of the units sampled;
- Standard deviation of the mean of the difference in hot and cold weights of units sampled.

The total weight of all sampled units prior and post chilling is to be calculated.

If the sample has not increased in weight, ie the sample mean is 0% (or a weight loss), then the process lot is passed.

If the sample has increased in weight, non-compliance has occurred and corrective action will be taken (see section 4.5.2.7).

The process control procedures are:

a. Data must be obtained for 300 units over 5 production days (60 units per day).
b. The units for cold weighing must be selected within the chiller(s) from a spatial distribution grid that covers the full chiller volume(s). The grid positions must be recorded.
c. Hot and cold weights must be measured.
d. Chillers must be loaded to at least 90% capacity.
e. Critical spray chilling parameters must remain within defined limits for each production day and are to be recorded.

Processes that have days where the chillers are operating at less than 90% of normal capacity are not eligible for the 5 day processing period.

For units to be frozen

a. The operator must nominate whether cold weight measurement is pre-freeze or post-freeze.
b. If cold weight measurement is pre-freeze and an allowance must be made for freezing weight loss, the freezing factor must be determined (see section 4.2).

Critical spray chilling parameters for validation:

- Time units are in chiller/s;
- Number of units in the chiller/s;

- Unit type;
- Number of sprays, spray duration;
- Time after last spray to point of weighing (drying time);
- Chiller temperature regimes;
- Fan speed setting.

If these parameters are changed to an extent that they vary significantly from those used during validation (eg resulting in weight gain) then re-validation must be undertaken.

Operators should validate their processes using the widest set of critical spray chilling parameters possible providing these are delivering consistent outcomes.

Data from each unit for the whole process lot must be collected and the mean and standard deviation of the difference between the hot weights and the cold weights[2] recorded for each process lot. At the end of the 5 days, an overall mean and standard deviation of the hot/cold weight difference must be determined for each chilling process representing the chiller population of units for that class, type and identified critical spray chilling parameters. (See statistical background section – Appendix 1)

Weight loss should be recorded as a negative (–ve) entry and weight gain as a positive (+ve) entry

When 5 days of consecutive complying process lots of spray chilled units have been achieved for the specific process, then **Level 2** sampling may be undertaken for that process.

Operators currently using IS6 spray chilling requirements may use their existing data to meet Type 2, Level 1 requirements provided they have also:

a) Documented the factors and critical spray chilling parameters for each process.

b) Recorded all weights in and out of the chiller(s) being proposed for the process. This includes the initial weights of overweight units that have been returned for further drying. Operators must be able to demonstrate that there has been 0% weight gain for that process lot for 5 consecutive processing days based on the weights in and initial weights out as described in the previous sentence.

c) Data must be available to demonstrate the mean and standard deviation of the mean of the population of units for each chilling process for 5 days.

4.5.2.4 Level 2 – Process Control and Sampling

At Level 2, process control procedures are the same as at Level 1 but the cold weight measurement is reduced to a fortnightly check with the sample size of 32 units per day for 5 days (ie 160 units). Compliance of an individual process lot is based on compliance of the 32 unit sample for that day.

Sampling procedure:

a. Carry out and record checks of critical spray chilling parameters as set out in the approved process control programme.
b. Carry out check cold weights for the 32 unit sample with units randomly selected from the chiller or chillers each day over a 5 day processing period each fortnight for a month.

Determining compliance:

The average cold weight in the sample of units from that process lot must not exceed the average hot weight in the sample of units from that process lot.

If compliant, then move to Level 3.

If not compliant, determine cause; implement corrective actions, repeat Level 2, but increase to sample size of 60 units.

4.5.2.5 Level 3 – Process Control and Sampling

At Level 3, the process control procedures are the same as for Level 1, but the sample size is as for Level 2 and the sampling frequency is monthly for a period of 3 months. The sampling procedure followed is as for Level 2.

The average cold weight in the sample of units from that process lot must not exceed the average hot weight in the sample of units from that process lot.

If compliant, then move to Level 4.

If not compliant, determine cause, implement corrective actions and move back to Level 2.

4.5.2.6 Level 4 – Process Control and Sampling

At Level 4, the process control procedures are the same as for Level 1, but the sample size is as for Level 2 and the sampling frequency is quarterly for a period of 12 months. This is the minimum sampling frequency for a Type 2 process.

The average cold weight in the sample of units from that process lot must not exceed the average hot weight in the sample of units from that process lot.

If not compliant, determine cause, implement corrective actions and move back to Level 3.

4.5.2.7 Corrective actions

Non-compliance in the Type 2 spray chilling process can result from a failure of process control where a critical spray chilling parameter is not met, or from the average cold weight exceeding the average hot weight on a day when sample weighing is being carried out.

Due to the nature of the sampling plan, the acceptability of a process lot may only be known with the last unit to be weighed. This could be at the end of the unloading of the chiller (ie depends on the location of the last sample unit). As a result, returning all units to the chiller (to reduce weight) is not practical. This means that some affected units could be processed. Process failure requirements apply and the disposition of the affected process lot will be decided by NZFSA VA.

If the failure is the result of a critical spray chilling parameter not being met, the operator can elect to hold units in the chiller for an additional drying period to ensure that there is a net weight loss for the process lot. Check weighing will be required to verify this.

The operator must reassess the process (factors and critical spray chilling parameters) each time a process lot does not comply.

Where a process is shown not to be in control, eg non-compliance at Level 1, repeated non-compliances, spray chilling is to cease or be carried out in accordance with Type 1.

Record the findings.

4.6 Records

Records must be kept for validation data, all samples, statistical analysis, critical spray chilling parameter monitoring checks and verification so that the ongoing performance of the process can be demonstrated and be verified by NZFSA.

Note: Operators may continue to weigh in/weigh out units as per the current IS6 requirements.

4.7 External Verification

NZFSA VA must carry out verification of the process in accordance with the Verification Statement of Policy

Spray Chilling Appendix 1: Statistical Analysis

The sample size of 300 for the chilling process Type 2, Level 1 is based on the table of probabilities used by NZFSA. To ensure the critical spray chilling parameters are controllable the data needs to be collected over a series of 5 days. 300 units is a statistically significant sample size.

If a process is under perfect control, the mean and the standard deviation will be constant over time. It is recommended that the mean is plotted to evaluate whether any patterns become obvious over time. For instance the mean might increase over time. By evaluating the control chart the operator will be alerted to a possible problem.

Computer spreadsheets (eg Excel) have functions for calculating the mean and standard deviation. They can also be used for plotting the results. Statistical software, such as Minitab, have control charts with tests to alert when a process is likely to be out of (statistical) control.

Spray Chilling Appendix 2: Determination of Packaging Allowance

Determination of packaging allowance for frozen units (refer section 4.2)

Randomly select 15 wrappings or packaging and determine the average weight to be used for the tare allowance.

The average weight is to be checked:

- Every 12 months
- After any change to wrapping or packaging specifications
- After changes to wrapping or packaging suppliers
- At any time where the operator believes the weight of wrapping or packaging may have changed.

Spray Chilling Appendix 3: Summary of Requirements

Type	Level	Sample Numbers	Frequency of Sampling	Criteria for compliance	Criteria to move a level	Corrective Actions
Type 1	Option 1	100% reweigh	Each unit	The mean weight of units in the lot post spray chilling is </= the mean weight of the lot ex slaughter	N/A	Process failure
	Option 2	100% reweigh	Each unit	The individual weight of each unit in the lot post spray chilling is </= mean weight of the unit ex slaughter	N/A	Redry until post spray weight < pre spray weight
	L1 (entry)	N = 60 for 5 days (300 samples)	Daily	Spray chilling monitoring parameters met each day The mean of the sample units post spray is </= to the mean of sample units ex slaughter.	5 days compliant	Process failure
Type 2	L2	N = 32 for 5 days (160 samples)	Fortnightly	As L1	4 weeks compliant Non compliant repeat with N = 60	Process failure

	L3	N = 32 for 5 days (160 samples)	Monthly	As L1	3 months compliant Non compliant return to L2	Process failure
	L4	N = 32 for 5 days (160 samples)	3 Monthly	As L1	12 months compliant Non compliant return to L3	Process failure

Spray Chilling Appendix 4: Critical Spray Chilling Parameters

Critical spray chilling parameters	Chiller Checks
Nozzle Type	Should not change on a day-to-day level. Replacement of blocked or worn nozzles with the same type or one with a lower discharge rate should be recorded in chiller maintenance logs. Where the nozzle is changed, the new type and nozzle location should be recorded. Where a higher capacity nozzle is adopted and the spray duration not reduced to ensure that no more water is applied per spray event, check weighing of units should be carried out to assess the significance of the change.
Nozzle Pressure Assuming good pump pressure and design this should be fairly constant	Log the pressure of the water going to the chiller. Should be checked weekly or alarmed to notify if greater than 10% fluctuation from setpoint.
Nozzle Flow Rate Should be constant and even across chiller. Most likely cause of a drop in flowrate is detritus blocking the nozzle. An increase would be a nozzle failure or breakage.	Weekly check of each chiller while empty to see if all sprays form a cone evenly. Annual check of flow rates for a distribution of nozzles in each chiller plus any nozzles that visually appear to have a higher flow rate than others. If flow rates have increased by more than 10%, these nozzles should be replaced or the spray duration reduced to maintain the same volume of application in each cycle.

Interval Between Sprays **Spray Duration** **Number of Sprays** These are usually PLC controlled. Only validated processes allowed.	Carry out a weekly check of a sample of chiller records to confirm that the timing settings match the documented settings for the process that was used.	
Water Temperature This may be stable enough to not need monitoring. If part of validation then it will need to be monitored.	Log the temperature of the water going to the chiller. Make available for inspection on request. Check the log weekly to confirm the water temperature is approximately that specified for the process.	
Chiller Relative Humidity (RH) Assume that RH is even throughout the chiller. (in reality RH will be lowest ex the evaporators and highest on return air). Direct measurement of RH is difficult at close to saturation. Also variable through each cycle. Monitoring of return air temperatures can provide some indication of RH changes.	Log the temperature of the [return] air onto the evaporators and make available for inspection on request.	
	Batch Chiller Checks Should see rises during sprays (so have a cross-check on the PLC logs) and gradual falls during intervals between sprays. Comparison between process lots should be fairly consistent.	**Continuous Chiller Checks** For this type- the sprays activate as each unit moves into the spray zone so the RH change should be less noticeable.

Fans Off and On or Reduced Speed It is usually a good idea to turn the fans off during a spray as this minimises droplet entrainment and the ability of drops to get up on to the rails and supports etc. Usually PLC controlled (if controlled at all).	Log the fan speed from the PLC. Carry out a weekly check to confirm that the correct process was used.
Unit Information	Maintain a log of each process lot, detailing the date/time, chiller, stock class, number of units and the process used. This information should be able to be matched to other recorded data (room temperatures, fan speeds, spray timings, etc). Carry out a weekly check of a sample of the process lot to confirm that the correct process has been used.

1 TD outlines conditions for operating un-validated refrigeration rooms or processes.
2 Cold weight is the first cold weight for the individual carcass (i.e. pre-corrective action).