Ministry of Forests and Range

Cold Storage Procedures for Freezing, Storing and Thawing Nursery Seedlings

May 20, 2010

BC Timber Sales

Nursery Services

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1 INTRODUCTION

This document describes the responsibilities of a cold storage attendant, and provides information pertinent to the successful operation of a cold storage facility

Storing seedlings frozen (at -2ºC) reduces seedling respiration rates, carbohydrate losses and minimizes the incidence of storage moulds. Care must be taken not to expose seedlings to extremely cold temperatures as seedling roots are damaged at temperatures below -5ºC. The cold storage environment also helps maintain the integrity of storage cartons.

2 DEFINITIONS

Request Key: a registration number for tracking a specific volume of a Stock ID

Seedlot: a registration number allocated to a seed collection. It is a unique collection of seeds destined for site specific areas.

Stock ID: a unique combination of nursery/seedlot/stock type/age/planting season. A Stock ID may encompass one or more Request Key.

Stock type*:* a container type and size such as PCT410, and PSB412

Storage Mould: Botrytis or gray mould is a fungus which can be found on all seedling species. It is usually restricted to the foliage, but can infect the stem and kill the seedling. It is not found on roots. Given the 'right' conditions it can infect stored seedlings with varying degrees of severity.

3 RESPONSIBILITIES OF COLD STORAGE ATTENDANTS

This document forms Schedule A (*Services*) of your cold storage contract with the Ministry. The following points (1-8) summarize the responsibilities of the cold storage attendant accountable for BCTS and/or Ministry of Forest and Range stock. These responsibilities are further detailed in Sections 3.1 to 3.6 below:

1. Unload and load seedling shipments arriving/leaving the cold storage as required, including:
    a) Recording all stock movements in and out of the cold storage facilities by updating inventory sheets and stock location maps,
    b) Completing Planting Stock Shipping Orders (FS 1158 (Appendix 1)) when shipping or receiving stock, and
    c) Re-package seedlings if they arrive at the cold storage facility in damaged cartons and/or bags[1].

[1] Please contact either the shipping nursery or Nursery Services for

2. Maintain optimum storage conditions in the cold storage by monitoring and documenting:
    a) Temperature of all storage facilities and stock,
    b) Quality and condition of all stock;
3. Notify Nursery Services within 24 hours if problems:
    a) Occur in the functioning of any equipment that will impact stock quality, condition or the ability of the cold storage attendant to properly receive or ship stock from the facility, and/or
    b) Are discovered during routine temperature and stock quality monitoring.
4. Maintain a current inventory (stock balance report) for each request key in your cold storage:
    a) Send Inventory Reports to Nursery Services when requested to do so, and
    b) Map the location of each BCTS/Ministry request key stored in your facility.
5. Collect samples when required for:
    a) Root growth capacity (RGC) tests,
    b) Out-planting, and/or
    c) Quality assurance samples
6. Ensure cold storage facilities and equipment are kept in a neat and clean condition and serviced regularly.
7. Process thaw and shipping requests as received from planting contractors or Ministry representatives, which includes:
    a) Thawing stock completely within 7-10 days of receiving a thaw request,
    b) Providing adequate air circulation in the thaw area,
    c) Rotating and spacing cartons as necessary to achieve a uniform thaw, and
    d) Monitoring and documenting stock temperatures and stock condition daily during the thawing process.

Operating a cold storage facility can be logistically challenging; the following Gantt chart (Table 1) provides a reasonable guide for the timing of pertinent cold storage activities in the Interior of the Province while Table 2 provides the same for Coastal storage activities. An electronic copy of this chart can be provided upon request so that cold storage attendants can modify it to suit logistics at their locale.

Table 1: General timelines and expected activities for **interior** cold storage operations.

Activities*	Month	SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST			
	Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Preparation of cold storage for storing season	CS																																															
Transportation of seedlings to cold storage	Nurseries/NS																																															
Receipt of seedlings at Cold Storage	CS																																															
Monitoring freeze down of stock	CS																																															
Bi Weekly Quality Inspections	CS																																															
Month End Reports: FS1158, inventory, temperature and quality inspections	CS																																															
CS 1st Invoicing	CS																																															
CS final reconciliation	NSI																																															
CS inspections	CS/NS																																															
Samples sent for RGC testing	CS																																															
RGC testing	NS																																															
Samples sent for secondary RGC if necessary	CS																																															
CS 2nd Invoicing	CS																																															
Second RGC testing	NS																																															
Preworks for spring planting*	CS/NS/TSOs & Contractors																																															
Spring thaw requests	Contractors																																															
Spring thawing, monitoring and shipping	CS																																															
Moving stock to the field	Contractors																																															
CS Final Billing	CS																																															

Key:
CS = Cold Storage
NS = Nursery Servies
TSO = Timber Sales Office

Table 2: General timelines and expected activities for **coastal** cold storage operations.

Activities*	Month	SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST			
	Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Preparation of cold storage for storing season	CS																																															
Transport of seedlings to cold storage	Nurseries/NSC																																															
Receipt of seedlings at Cold Storages	CS																																															
Monitoring freeze down of stock	CS																																															
Regular Stock Condition Inspections	CS																																															
Continuous Temperature monitoring	CS																																															
CS Shipment Invoicing(1158's) /Advices	CS																																															
CS inspections	NSC																																															
Samples sent for GHS testing	CS																																															
Samples sent for RGC testing(as requested)	CS/NSC																																															
RGC testing(as required)	NSC																																															
Samples sent for secondary RGC (if necessary)	CS																																															
Second RGC testing	NSC																																															
Prework for thaw and transport procedures	All Stakeholders																																															
Spring thaw requests	TSO or FT																																															
Spring thawing, monitoring and shipping	CS																																															
Moving stock to the field	TSO or FT																																															
CS Monthly Billing (for previous month)	CS																																															
CS Final Billing	CS																																															
CS final reconciliation	NSC																																															

Key:
CS = Cold Storage
NS = Nursery Servies
TSO = Timber Sales Office; FT = Field Team Office or Contractor

3.1 Receiving and Shipping

During the cold storage season (October - April), be available for receiving/shipping weekdays from 8:00 a.m. to 5:00 p.m. unless otherwise specified by BCTS Nursery Services. Given sufficient notice (48 hrs), other hours and days of work may be required.

The cold storage must provide suitable truck loading/unloading facilities including forklift for moving/loading cartons, and the labour necessary for the receiving, shipping, and movement of cartons. The Cold Storage Attendant must ensure, notwithstanding circumstances and events beyond the control of the Contractor, that all trailers are loaded/unloaded within a 2 hr hour period of the truck's pre arranged arrival time.

During Receiving

Seedlings and their packaging are to be inspected and the condition documented upon arrival at the cold storage and again when shipped. A Planting Stock Shipping Order (FS 1158 form (Appendix 1)) must accompany all stock shipments being received at, or being shipped from a cold storage facility. The shipping agency must be contacted immediately after receiving a shipment if:

- It arrives without an FS 1158 (shipping invoice/advice) form
- There are any discrepancies on the form, and/or
- The form is incomplete and does not contain all pertinent information.

Contact Nursery Services immediately if stock arrives in a condition that requires new packaging.

The receiving portion of the FS 1158 must be completed when the stock is received; the receiver (Cold Storage Attendant) also signs and dates the invoice. FS 1158s must be distributed as follows: (1) The cold storage retains a copy, and (2) Nursery Services is to be faxed or emailed a copy of the FS 1158 on the same day.

A random selection of cartons must be opened immediately upon receipt, and the condition of the plugs - degree of freezing as well as presence of any mould – must be noted on the shipping form. Upon receipt, seedling cartons must be placed immediately in the cold storage unit. They are not to be left in breezeways or other similar locations.

Always - Stock is to be handled carefully, do not throw or drop boxes, or lay on their side.

During Shipping

When shipping, load all boxes with carton labels facing the rear doors for easy identification, and mark changes in seedlots appropriately with material such as flagging tape or spray paint.

During the spring shipping season, the Cold Storage Attendant must be available for shipping and thawing of seedlings during various hours to be specified by Nursery Services. The Cold Storage Attendant must also be available when given reasonable notice, as requested by the planting contractors.

Trailers leaving the cold storage must be properly loaded, with sufficient dunnage between box layers to prevent collapsing.

3.2 Storage Conditions

During the storage season (October - April), the Cold Storage Attendant must monitor and document the environmental conditions in both the cold storage facility and seedling cartons. The temperature of the cold storage rooms should be within ± 1°C of the temperatures specified in their contract (i.e. -2°C). At no time should the cold storage temperature be less than –5°C or greater than +5°C.

Stock must be frozen within two to three weeks of receipt. This may require rotating and/or spacing cartons to ensure freezing within the specified timeframe. If Nursery Services notifies the Cold Storage Attendant that the desired temperature range is not being maintained in the cold storage unit, the Cold Storage Attendant will, at no cost to the Province, **do whatever is necessary** to correct the problem. They will also provide, at no cost to the Province, accurate temperature monitoring devices for both ambient and carton air temperatures in quantities sufficient to satisfy requirement

Thermometers should be calibrated before the start of any cold storage season. Four to eight permanent **box temperature probes** should be distributed throughout the storage area. **Air temperature probes** should also be distributed throughout the facility to record ambient air temperature at the front and back of the unit and along the ceiling and floor. Ambient air temperatures should be recorded with a min/max thermometer to capture the temperature fluctuation between readings. Daily temperature readings must be taken until all stock is frozen. Once stock is frozen and the facility has reached a constant temperature of -2ºC ± ½ºC, readings are taken every second day. All temperatures should be entered on a Temperature Monitoring Record similar to the one in Appendix 2[2].Recommended temperatures are shown on the left hand side of Figure 1.

A copy of the Temperature Monitoring Record must be retained at the storage facility for reference, and a copy faxed or emailed to Nursery Services upon request. If a computer-based monitoring system is used, the pertinent daily information must be printed out once a week so an accurate daily temperature record is retained.

The liner inside each carton maintains seedling humidity levels. If cartons have open or torn bags, they should be closed or replaced respectively.

[2] Appendices 2 through 6 provide examples of record keeping documents which can be used as is or modified to suit a particular cold storage. If requested, Nursery Services will provide an electronic workbook of these forms.

Dial temperature probes are useful for quick checks of carton temperatures. Such checks should be made in cartons throughout the storage facility on a regular basis and information recorded and retained.

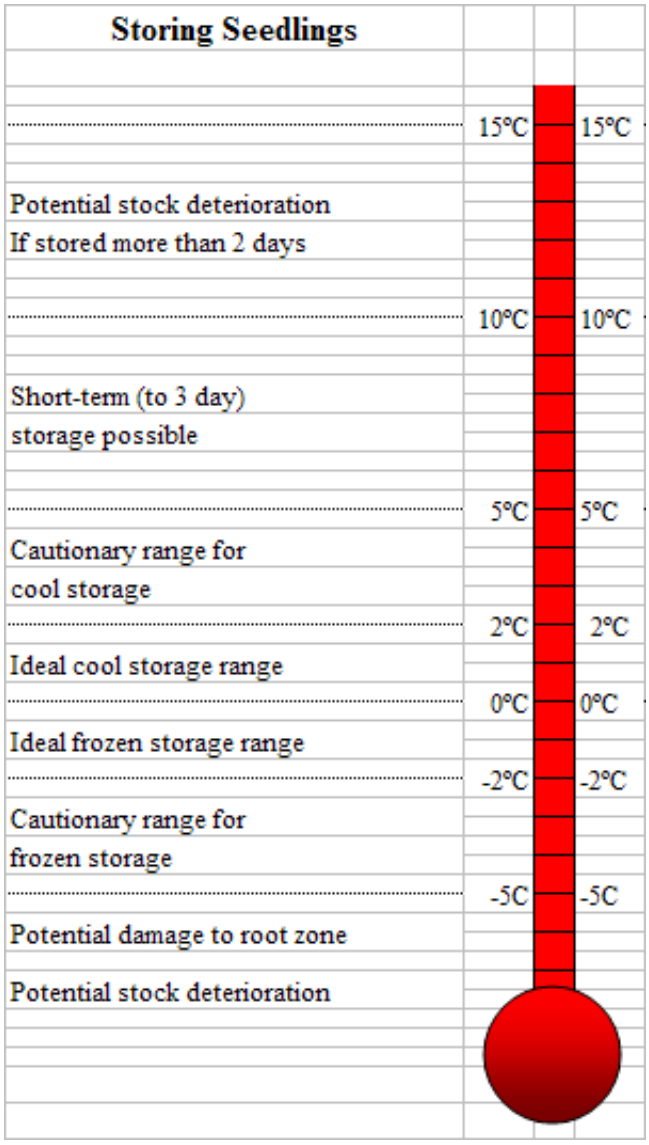


Figure 1: Recommended internal carton temperature ranges for various storage and thawing treatments.

Humidity is difficult to control in the cold storage environment. The humidity level is generally above 70%, but will drop when the outdoor temperature is extremely cold. During these cold snaps it is important to keep the doors to the cold storage facility closed as much as possible to reduce moisture loss.

3.3 Stock Quality

The condition of stock for each request key is checked every week until the stock is completely frozen, and the frequency of monitoring can be reduced to bi-weekly as long as a frozen state with sub-zero temperatures has been maintained within the cold storage facility. Do not always check the same cartons; randomly select the cartons each time. Stock quality checks are recorded on a Quality Control and Inspection document (Appendix 3). This allows tracking of individual shipments and documentation of any potential problems or changes in stock quality.

Open at least two cartons for every 200 cartons of a request key and check for:

- Unfrozen bundles or degree of freezing
- Gray mould on foliage
- Open or damaged liners/bags
- Damaged cartons
- Light (dry) bundles

Report any discrepancies or concerns about the above conditions to Nursery Services immediately.

3.4 Inventory

A record of inventory is required to track stock that is received, stored and shipped. An example form to be used for an inventory record (Appendix 4) is filled out after each FS 1158 has been reconciled and signed off. The FS 1158 can be used to document the initial inspection of the stock.

Periodically throughout the season, you may be asked to send a stock inventory balance of the cold storage inventory to Nursery Services to assist with the reconciliation process of the Nursery Services data base..

3.5 Sample Collection

There are three types of samples that the Cold Storage Attendant may be required to collect and send to Nursery Services or other locations: Greenhouse Screening (GHS) and Root Growth Capacity(RGC), out-plant, and inspection samples for quality assurance or stock condition analysis.

3.5.1 Greenhouse Screening (GHS) and Root Growth Capacity Test (RGC) Samples

Root growth capacity samples are typically requested in February, and consist of 20 seedlings. The following information must accompany the RGC samples: request key, nursery name, seedlot number, species, stock type and age. Each bundle must be labelled appropriately. An example RGC record used for this purpose is shown in Appendix 5. Shipping instructions will be provided each year.

3.5.2 Out-plant Samples

Nursery Services may request a sample of seedlings for out-planting. Bundles selected should be labelled as such and tagged with the seedlot number, nursery of origin, request key, stock type, seedling age, species, and cold storage unit. When multiple bundles have been collected for a seedlot, label the bundles accordingly – 1 of 3, 2 of 3, and 3 of 3 etc.

3.5.3 Inspection Samples

Nursery Services may request an inspection sample for quality assurance purposes. This is a minimum of 120 seedlings or 10 bundles, whichever comprises the most seedlings. General stock condition samples may be a variety of amounts depending on the purpose but Nursery Services will provide instructions for collection upon making the request.

3.6 Thawing

A 'rapid thaw' method is used to thaw Ministry seedlings; if an alternative method is required, contact Nursery Services to discuss thawing logistics.

When thawing, the seedlings must be protected from stresses caused by temperature extremes, moisture loss, and physical damage. Cartons must be handled with care at all times.

The temperature range of the thawing area must be maintained between 10-15°C ambient air and 5-10°C inside the cartons (Figure 2).

To facilitate even thawing, space the cartons on the pallets to permit airflow between them. Depending upon the thaw schedule, and the facility, boxes may need to be rotated from top to bottom and cartons turned so that inward box-edge is then outward on each pallet. Sufficient uniform and sustained air flow must be provided to assist with uniform thawing.

During the thaw, the temperature of the seedlings must be monitored and recorded; inspect thawing seedlings daily for storage mould, dryness, physical damage, odour and thaw progression. See Table 3.

Table 3: Recommended monitoring frequencies

What to monitor	Frequency
a) Temperature (room and carton)	Continuous
b) Degree of thaw	1 time per day
c) Root and shoot activity (flushing, new growth)	Observe changes
d) Mould development	1 time per day
e) Root moisture content (bareroot especially)	1 time per day
f) Foliage colour / discolouration	Observe changes

Record the inspection information on a thaw record (Appendix 6) the day before or on the day that a shipment is ready to leave the facility, and provide the report to Nursery Services and the receiving Agency, so the appropriate measures can be put in place upon the receipt of stock.

A thaw inspection report is to be carried out, recorded and forwarded to Nursery Services at anytime there are changes to the stock condition or problems in meeting the anticipated schedule are realized.

When thawed, and stock shipments are delayed, cartons are to be returned to a refrigerated storage where internal box temperatures can be maintained at 2°C, ± 1°C.The main environmental variables to consider during the thaw are temperature, sunlight, humidity, and air movement.

Temperature

Internal carton temperatures must be carefully monitored and controlled. If thawing inside a cold storage facility, all doors and windows should remain closed to ensure a constant temperature.

Ideal thawing temperatures are provided in (Figure 2). The internal carton temperature should be continually monitored, and not exceed 10°C. If temperatures get this warm, the seedlings should be cooled by reducing the temperature and/or opening the cartons and bags. The seedlings should be thoroughly examined for disease and heat damage and should be planted as soon as possible. **Seedlings must not be re-frozen**.

Rapid temperature fluctuations (> 4°C) should be avoided during and after the thawing process. If damage to the seedlings is suspected, report the circumstances to Nursery Services as testing may be required before they are planted.

Thawed stock not shipped to the field immediately should be stored at 1 to 2°C. If poor air circulation has resulted in varying carton temperatures, special attention must be given to ensure that all cartons are re-cooled to +2°C. However, do not allow the internal carton temperature to fall below 0°C. If a temperature drop to -5°C occurs, the incident must be reported to Nursery Services as roots are vulnerable to damage at low temperatures, particularly after being thawed; this is especially important for most coastal species. Bud tissue can also be damaged if it starts to swell or become active during the thaw.

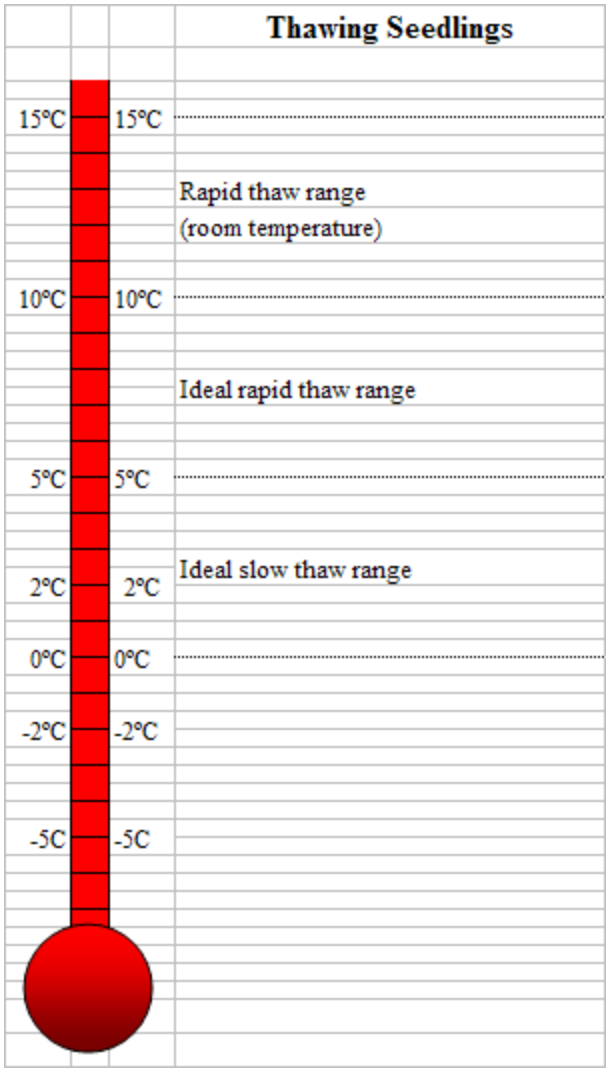


Figure 2: Recommended internal carton temperature ranges for thawing treatments.

Sunlight

Never thaw cartons directly in the sun, as cartons will absorb heat rapidly. The heat will initiate rapid physiological activity with increased respiration. This will seriously compromise the health of the seedlings.

Humidity

Never allow seedlings to dry out. The liner inside the cartons acts as a vapour barrier to retain moisture around the seedlings. Condensed moisture on the inside of the bag is acceptable as it indicates that the seedlings are being kept in an environment with high humidity.

After seedling inspection the bags and cartons should be properly closed. It is important to keep the bag closed to prevent excessive moisture loss. The exception to this is if significant amounts of storage mould are detected.

Air Movement

The speed and uniformity of thawing depends on the volume and ease of air flow. Large portable floor and ceiling fans are very useful for creating adequate air circulation.

To promote an even thaw, cartons should be placed at least 5 to 10 cm apart on pallets, and the pallets spaced at least 15 cm apart. Loaded pallets can be stacked on each other assuming there is no crushing of cartons. If cartons are thawing unevenly on a pallet, they may have to be rotated to achieve a more uniform thaw. If the seedlings are not thawing uniformly, the cartons or pallets may require rotating.

Thawing Times

The rate of thaw depends on a number of factors, including:

- Thaw facility
- thawing method
- stock type – seedling age and size
- species
- packaging arrangement (see Table 4)
- seedling density - cartons that are tightly packed with seedlings will thaw slower than cartons with fewer seedlings.
- moisture content of the root plug - plugs that were very moist when placed in frozen storage will have more ice to thaw and therefore will thaw at a slower rate.

Table 4: Estimated thaw times for different packaging conditions

Stock Condition	Estimated Thaw Time
Container seedlings packaged horizontally	5 to 8 days
Container seedlings packaged vertically	6 to 10 days
Bareroot seedlings	1 to 3 days

Individually wrapped (I-WRAP) stock is not thawed as it will be planted frozen. Cartons containing this type of stock are labelled I-WRAP. If necessary, contact Nursery Services regarding information about I-WRAP stock.

Nursery Services should be notified immediately if:

- **storage mould** is discovered on the seedlings,

- thawed seedlings **are held for more than one or two weeks**, and/or
- seedlings become **physically active** (bud flush and/or new root growth) during the thaw.

4 CONTACT INFORMATION

Should you have any questions regarding the proper storage and handling of seedlings or the activities involved in maintaining a cold storage facility please contact Nursery Services. Contact information for Provincial Nursery Services staff is provided in Table 5.

Table 5: Contact Information for Nursery Services staff

Nursery Services Interior	Contact/Title	Phone/Fax	Email
Ministry of Forests Nursery Services Interior 2501 14th Ave Vernon, BC V1T 8Z1	Stephen Joyce Manager	250-260-4617/ 250-260-4219 Cell: 250-503-8430	Stephen.Joyce@gov.bc.ca
	Art Moeller Technician - South	250-260-4618 Cell: 604-250-5956	Art.Moeller@gov.bc.ca
	Alan Rasmussen Seedling and Reforestation Specialist - South	250-558-1740	Alan.Rasmussen@gov.bc.ca
	Leanne Hildebrand Nursery Services Interior Coordinator	250 558-1712/ 250-260-4619	Leanne.Hildebrand@gov.bc.ca
Ministry of Forests Nursery Services Interior 1st Floor, 1011 4th Avenue Prince George, BC V2L 3H9	Patience Rakochy Technician - North	250 565-6093 / 250-565-6671 Cell: 250-614-9690	Patience.Rakochy@gov.bc.ca
	Steven Kiiskila Seedling and Reforestation Specialist - North	250-565-4344/ 250-565-6161 Cell: 250-614-7716	Steven.Kiiskila@gov.bc.ca
Ministry of Forests Nursery Services Coast 14275 96th Street Surrey, B.C. V3V 7Z2	Bob Merrell Manager	604-586-4347/ 604-586-4353	Bob.Merrell@gov.bc.ca
	Lauchlan Glen Seedling and Reforestation Specialist - Coast	604-586-4342/ 604-586-4353	Lauchlan.Glen@gov.bc.ca
	Leanne DeSousa Nursery Services Coast Coordinator	604-586-4346/ 604-586-4353	Leanne.DeSousa@gov.bc.ca

APPENDIX 1 – FS 1158 PLANTING STOCK SHIPPING ORDER FORM

BRITISH COLUMBIA

PLANTING STOCK SHIPPING ORDER

INVOICE NO.	PAGE

SHIPPER		RECEIVER	
FROM CODE / DESCRIPTION		TO CODE / DESCRIPTION	
CONTACT NAME	PHONE NO.	CONTACT NAME	PHONE NO.
SHIPPER'S SIGNATURE	DATE SHIPPED YYYY - MM - DD	RECEIVER'S SIGNATURE	DATE RECEIVED YYYY - MM - DD
LOAD START TIME :	LOAD FINISH TIME :	UNLOAD START TIME :	UNLOAD FINISH TIME :
TRANSPORT COMPANY	SHIPPING INSTRUCTIONS	TRUCKER'S SIGNATURE	

REQUEST KEY	AGENCY	SPECIES	NURSERY	SEEDLOT
STOCK TYPE	AGE	ACCEPTING AGENCY	REQUEST AMT.	LIFT STATUS (C/I)
COMMENTS				

CARTON SIZE	TREES/ CARTON	CTNS SHIPPED	TREES SHIPPED	CTNS RECEIVED	Overrun
TOTAL					

REQUEST KEY	AGENCY	SPECIES	NURSERY	SEEDLOT
STOCK TYPE	AGE	ACCEPTING AGENCY	REQUEST AMT.	LIFT STATUS (C/I)
COMMENTS				

CARTON SIZE	TREES/ CARTON	CTNS SHIPPED	TREES SHIPPED	CTNS RECEIVED	Overrun
TOTAL					

REQUEST KEY	AGENCY	SPECIES	NURSERY	SEEDLOT
STOCK TYPE	AGE	ACCEPTING AGENCY	REQUEST AMT.	LIFT STATUS (C/I)
COMMENTS				

CARTON SIZE	TREES/ CARTON	CTNS SHIPPED	TREES SHIPPED	CTNS RECEIVED	Overrun
TOTAL					

REQUEST KEY	AGENCY	SPECIES	NURSERY	SEEDLOT
STOCK TYPE	AGE	ACCEPTING AGENCY	REQUEST AMT.	LIFT STATUS (C/I)
COMMENTS				

CARTON SIZE	TREES/ CARTON	CTNS SHIPPED	TREES SHIPPED	CTNS RECEIVED	Overrun
TOTAL					

REQUEST KEY	AGENCY	SPECIES	NURSERY	SEEDLOT
STOCK TYPE	AGE	ACCEPTING AGENCY	REQUEST AMT.	LIFT STATUS (C/I)
COMMENTS				

CARTON SIZE	TREES/ CARTON	CTNS SHIPPED	TREES SHIPPED	CTNS RECEIVED	Overrun
TOTAL					

FS 1158 HBT (2006)

APPENDIX 2 – TEMPERATURE MONITORING RECORD

Cold Storage Location: ____________________

Ministry of Forests and Range

BCTS Nursery Services

Temperature Monitoring Record

Storage Unit: ____________

			Probe Locations													Condition Comments
			Inside Cartons								Storage Area*				Stock Frozen	
Probe #	Min	Max	1	2	3	4	5	6	7	8	1	2	3	4	yes/no %	
Date ↓																

Temperature monitoring occurs everyday until all stock is frozen and the cold storage has reached the appropriate temperatures.
Temperature Monitoring Records are then completed every other day while stock remains in the cold storage facility;
Typically every Monday, Wednesday and Friday.

Additional Monthly Comments: ____________________

APPENDIX 3 – STOCK QUALITY MONITORING RECORD

Cold Storage Location: _____

Ministry of Forests and Range

Monitoring/Sampling Date: _____

BCTS Nursery Services

Quality Control & Inspection

Storage Unit: _____

Request Key	Species	Seedlot	Nursery	Stock Type	Lift Date	Packaging		Overall State			Stock Condition			Storage Mold				Quality/Condition Comments
						Bags Closed	Box Damage	Frozen	Semi-Frozen	Not Frozen	Good	Fair	Poor	None	Slight	Moderate	Extensive	

Quality Control and Inspection Reports are completed bi-weekly.
Quality Control and Inspection Reports are also completed as stock is prepared to leave the facility.

APPENDIX 4 – INVENTORY RECORD

Cold Storage Location:

Ministry of Forests and Range — Date:

BCTS Nursery Services

Cold Storage Inventory Report

Load #	Date In	Request Key	# of Cartons IN	Trees/ Carton	Date Out	# of Cartons OUT	Trees/ Carton	Species	Seedlot	Stock Type	Age	Nursery	Comments
											_ + _		
		Total											
											_ + _		
		Total											
											_ + _		
		Total											
											_ + _		
		Total											
											_ + _		
		Total											
											_ + _		
		Total											
											_ + _		
		Total											

APPENDIX 5 – RGC SAMPLE RECORD

Cold Storage:

Ministry of Forests and Range — Date:

BCTS Nursery Services — Sent to:

Root Growth Capacity Record

Request Key	Nursery	Seedlot	Species	Stock Type	Age	# Seedlings

Note: Nursery Services will provide the details for RGC samples prior to collection.

APPENDIX 6 – COLD STORAGE/ THAWING INSPECTION REPORT

Ministry of Forests and Range

BCTS Nursery Services

Cold Storage Location: _____

Inspected by: _____

Cold Storage/ Thawing Inspection Report

Storage Unit: _____ **Date INTO Thaw:** _____

Ambient Temperature (^{0}C): _____ **Anticipated OUT Date:** _____

Agency Shipped to: _____

Request key	Species/ Seedlot	Nursery	Stocktype	Stock Condition Code	% Frozen	°C in box	No. of Boxes	Foliage condition	Root condition	Bundle Orientation	Descriptor Comments

Code	Description
1	No visual problems
2	Less than 15% of bundles of seedlings have slight presence of active foliar mould (ie. botrytis)
3	15 – 30% of bundles of seedlings have slight presence of active foliar mould
4	>30+%+ of bundles of seedlings have slight presence of active foliar mould
5	Roots and/or buds becoming active
6	Foliar mould significant & High Potential for mould to enter shoots &/or main stems
7	Code + Percentage(%) of Seedling mortality visibly apparent
8	Other – specify condition.
**	If condition code accompanied by ** symbol; consult Nursery Services as corrective action required.