

# Master Specification

## Part ST-SC-S4

### Low Pressure Steam Curing of Precast Units

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**Government of South Australia**  
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## ST-SC-S4 Low Pressure Steam Curing of Precast Units

### 1 General

- a) This Master Specification Part specifies the requirements for the low pressure steam curing of precast concrete units manufactured in accordance with ST-SC-S3 "Precast Concrete Units", including:
  - i) the documentation requirements, as set out in section 2;
  - ii) the temperature record requirements, as set out in section 3;
  - iii) the steam delivery requirements, as set out in section 4;
  - iv) the steam curing cycle requirements, as set out in section 5;
  - v) the steam cured test specimen requirements, as set out in section 6;
  - vi) the removal of steam cover requirements, as set out in section 7;
  - vii) the additional moist curing requirements, as set out in section 8; and
  - viii) the verification requirements and records, as set out in section 9.
- b) The low pressure steam curing of precast concrete units must comply with the Reference Documents, including:
  - i) AS 1379 Specification and supply of concrete; and
  - ii) T41 Guide to Concrete Construction.
- c) For the purposes of this Master Specification Part:
  - i) "concrete mass" is defined as the concrete product, member or part of a structure, or the concrete in the products on a pre-tensioning bed or in a group of similar products made within the one casting period, to which steam curing is applied;
  - ii) "initial maturity" is defined as the product of temperature of the concrete in °C and time in hours (h), where:
    - A. the temperature is that of the concrete mass at the completion of placement; and
    - B. the time is measured from the time of completion of placement of the concrete mass to the first introduction of steam;
  - iii) "recording thermometer" is defined as an instrument capable of continuously recording and printing a permanent record of temperature versus time. The report must be accurate to within 2°C;
  - iv) "steam covers" is defined as flexible or rigid barriers that retain heat and moisture around the concrete mass and test specimens during steam curing;
  - v) "temperature probe" is defined as a probe with a thermometer which can be inserted under the steam covers to check the steam temperature. The thermometer must be accurate to within 1°C; and
  - vi) "test specimen" is defined as any compression, flexural or other test specimen which is to be tested for the purpose of determining a property of the concrete mass following steam curing.

## 2 Documentation

### 2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) detailed procedures and documentation for curing of precast units by the controlled application of wet steam at atmospheric pressure into an enclosure containing the units; and
- b) details of any proposal by the Contractor to include mineral additions for steam curing, in accordance with section 5b).

### 2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include the verification records required by Table ST-SC-S4 9-1.

## 3 Temperature record

In relation to temperature records for low pressure steam curing of precast concrete units:

- a) a sufficient number of temperature probes and recording thermometers must be used to ensure that any temperature differences between any 2 points under the steam covers is detected;
- b) a printed continuous record of temperature variation with time must be obtained;
- c) the Contractor must record the following information:
  - i) description of concrete mass (e.g. pile, girder, etc., with identifying element number);
  - ii) time of completion of concrete placement;
  - iii) temperature of the concrete at completion of placement (measured in the member);
  - iv) time of commencement of steaming;
  - v) variation of air temperature under steam covers with time;
  - vi) time of shutting off steam;
  - vii) time of removing covers;
  - viii) ambient air temperature at the time of removal of steam covers; and
  - ix) name of Contractor and date of operation; and
- d) the records required in sections 3b) and 3c) must be kept until the Date of Completion and must be made available both upon request and as part of the Quality Management Records.

## 4 Steam delivery

In relation to steam delivery for low pressure steam curing of precast concrete units:

- a) sufficient steam jets or steam entry points must be provided to ensure that the temperature between any 2 points adjacent to the concrete mass is not more than 10°C. The Contractor must provide evidence that this requirement is met as part of the Quality Management Records;
- b) steam jets must not be allowed to impinge upon any part of the concrete mass, test specimens, formwork, or moulds. Steam delivery piping must not be attached directly to any formwork or moulds in such a manner that may cause localised overheating of the concrete mass;

- c) steam covers must be placed over the concrete mass immediately following the concrete finishing operations to minimise evaporation from the surface of the concrete mass; and
- d) the steam covers must be placed in such a manner that they will allow free circulation of steam around the concrete mass and the test specimens.

## 5 Steam curing cycle

In relation to the steam curing cycle for low pressure steam curing of precast concrete units:

- a) low pressure steam curing must:
  - i) involve heating of precast units, after an initial maturing period, by the controlled application of wet steam at atmospheric pressure into an enclosure containing the units:
  - ii) be of a sufficient duration as part of the curing regime to obtain the required compressive strength as noted in the Design Documentation: and
  - iii) maintain the relative humidity under the steam covers at 100% during steam application;
- b) steam curing must not include mineral additions unless this has been clearly specified as part of the Construction Documentation;
- c) concrete must have an initial maturity of not less than 40°C/h and must be more than 2 hours old before steam may be admitted to the steam covers, except where necessary a small amount of steam may be used to maintain the concrete at the temperature at which it was placed. During this period the temperature at the surface of the concrete mass must not exceed 30°C;
- d) the maximum rate of air temperature rise / fall under the steam covers must be 24°C/h; and
- e) the maximum air temperature within the steam enclosure must not exceed 70°C.

## 6 Steam cured test specimens

### 6.1 General

- a) The sampling and testing of specimens for steam cured concrete must conform to the requirements of AS 1379 Specification and supply of concrete, as applied to not-steam cured concrete.
- b) The test specimens referred to in section 6.1a) must be subjected to the same curing procedure adopted for the elements they represent, including any subsequent moist curing. The test specimens must be located under the steam covers such that they are not subjected to overheating from the steam points.
- c) The Contractor must ensure that sufficient cylinders are provided to enable the required testing by section 6.1a) to be undertaken.
- d) The test results of the test specimens required in this section 6 must be submitted as part of the Quality Management Records.

### 6.2 Testing for transfer or handling

- a) Where an assessment of transfer strength is required, an additional sample with a minimum of 2 cylinders must be taken from the last batch of concrete in the element. The transfer strength must be assessed in accordance with the sampling and testing clauses of AS 1379 Specification and supply of concrete.
- b) If, on testing at the end of the steaming cycle, compressive strength test specimens made for the purpose of determining the time of transfer of prestressing force or handling do not achieve the required strength, further curing must be carried out until the required strength is achieved.

### 6.3 Curing time

If 75% of the target 28-day compressive strength (calculated as the average of the test specimens) has not been achieved by the test specimens referred to in section 6.1a) at the end of the curing cycle, curing by either moist or steam methods must continue until that strength is reached.

## 7 Removal of steam covers

Steam covers must not be removed until the surface temperature of the concrete has fallen to within 25°C of the ambient air temperature outside the steam covers. Steam covers must remain in place longer if the concrete product shows signs of damage due to thermal shock or differential cooling.

## 8 Additional moist curing

Additional moist curing, if required, must not be applied until the concrete mass has cooled to the ambient air temperature, nor can it be delayed beyond this time.

## 9 Verification requirements and records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table ST-SC-S4 9-1 been complied with.

**Table ST-SC-S4 9-1 Verification records**

Section reference	Subject	Record to be provided
3d)	Ambient, concrete and water temperature records	Temperature records, in accordance with section 3d)
4a)	Sufficient steam jets or steam entry points	Evidence that sufficient steam jets or steam entry points, in accordance with section 4a)
6	Test specimen testing results	Test specimen testing results, in accordance with section 6