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Gpo Box 1603, Hobart, Tasmania, 7001

Level 3, 65 Murray Street, Hobart, Tasmania, Australia 7000

Phone: 61 3 62319339

Fax: 61 3 62319625

www.gslm.com

Drilling

-Bellevue

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**CHAPTER 7
CASING**

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7.1 OBJECTIVES

The primary objective of casing operations is to run and subsequently cement a string of casing which is capable of meeting the subsequent pressure test and service requirements for the next hole section and to allow hydrocarbons to be produced and the well fracture stimulated if required.

To achieve this objective, the following must be avoided:

- Damage to the threads that may reduce the sealing capacity, in turn affecting the pressure rating of the string.
- Damage to the body of the casing that may reduce the collapse and burst rating and life expectancy due to ovality or gouges.
- Damage which may affect the drift of the casing due to buckling, crimping or ovality.
- Exceeding pressure test rating safety factors and so affecting the integrity of the casing or well head.
- Measurement or running errors that result in incorrect casing shoe depth.
- Poor hole or drilling fluid conditioning resulting in stuck casing or ultimately a poor cement job.
- Surging the formation by running too quickly, causing mud losses and formation damage.

Whilst handling and running casing personnel shall adhere to the following:

- All casing and handling strings shall be drifted (using a standard API drift, as per API 5CT) on the rig site and accurately measured prior to use.
- Two downhole non-return valves (NRVs) must be included on any casing string to be run through a hydrocarbon-bearing interval.
- Differential-fill float equipment shall not be used on casing strings that are to be run through potential hydrocarbon-bearing zones.
- Mud pit volumes must be monitored when running and cementing casing.
- Casing must be pressure tested prior to drilling out the casing shoetrack.
- The last joint of casing MUST be washed down.

Bottom will not be tagged unless the casing is being circulated..

7.2 RESPONSIBILITIES

Responsibilities for the preparation, execution and reporting of casing operations are tabulated below.

Task	Performed by	Verified by
Prepare the Casing Design for inclusion in the Drilling Programme	DM	DM
Ensure sufficient casing stocks available	DM	DM
Ensure sufficient casing accessories available	DM	DM
Order casing.	DSV / DM	DM
Order casing accessories.	DSV / DM	DM
Prepare casing for running (i.e. drift, clean and dope threads)	Drilling Contractor	DSV
Determine placement of centralisers	DM	DM
Prepare casing running program and send to DM prior to running casing	DSV	DM
Make an accurate record of the string as it is installed in the well	DSV	DM
Prepare casing running report	DSV	DM
Condition hole and drilling fluid	Drilling Contractor	DSV, Drilling Fluids Engineer
Conduct a Crew Safety Toolbox Meeting for all personnel involved in the job	Drilling Contractor	DSV
Run and land casing	Drilling Contractor	DSV
Confirm casing tally prior to landing including correct measurement of all joints.	Drilling Contractor	DSV
Inspect casing during running. Ensure it is made-up to the correct torque specifications and run as per running list	Drilling Contractor	DSV
Prepare Casing and Cementing Report Form	DSV	DM
Check that cement and additive shown on casing and cementing report are what was actually run	DSV	DM
Test casing	Drilling Contractor	DSV

Table 34. Responsibilities for the Preparation, Execution and Reporting of Casing Operations.

7.3 CASING STANDARDS

This section describes the casing standards and requirements to be adhered to by the Drilling Contractor and monitored by the DSV during drilling operations.

7.3.1 Casing Types and Functions

The table below illustrates standard nomenclature and functions used by GSLM with reference to casing classification.

Casing Type	Function
Conductor Pipe	<ul style="list-style-type: none"> Provides structural strength to cover unconsolidated surface formations Serves as a circulating system for the drilling fluid Guides the drilling and subsequent casing strings into the hole
Surface Casing	<ul style="list-style-type: none"> This string is normally cemented to surface Provides blow-out protection Seals off water aquifers Prevents loss of circulation
Intermediate Casing	<ul style="list-style-type: none"> Isolates weak formations (sloughing and caving) Cases off loss zones Cases off reservoir formations Provides blow-out protection by upgrading the strength of the well Cement fill is required to isolate hydrocarbon zones.
Production Casing	<ul style="list-style-type: none"> Separates/ isolates productive zones from other reservoir and non reservoir zones Cement fill is required to isolate hydrocarbon zones. On monoboires the entire open hole annulus should be cemented.
Liner	<ul style="list-style-type: none"> Separates/ isolates productive zones from other reservoir and non reservoir zones Tied back to previous casing string. Normally cemented back to liner hanger.

Table 35. Casing Types and Functions.

7.3.2 Casing Specifications

GSLM shall adopt the standards contained in API 5CT for all casing strings utilised in GSLM's wells. All casing and casing equipment procurements should be checked by the DSV for compliance with these standards.

Casing markings shall conform to API specifications that are detailed in the figure below.

API CASING GRADES IDENTIFICATION COLOUR CODES

	API GRADE	MARKINGS ONE PIPE BODY	MARKINGS ON COUPLING
A P I S P E C I F I C A T I O N S 5 C T	P-110 P-105	One White Band	White Coupling
	C-95	One Brown Band	Brown Coupling
	C-90 L-80 13Cr	One Purple Band One Red, One Brown and One Yellow Band	Purple Coupling Red Coupling with one Yellow Band
	L-80 9Cr	One Red, One Brown and Two Yellow Bands	Red Coupling with two Yellow Bands
	L-80	One Red Band and One Brown Band	Red Coupling with Brown Band or longitudinal stripe
	N-80	One Red Band	Red Coupling
	C-75 13Cr	One Blue Band and One Yellow Band	Blue Coupling with one Yellow Band
	C-75 9Cr	One Blue Band and Two Yellow Bands	Blue Coupling with Two Yellow Bands
	C-75	One Blue Band	Blue Coupling
	K-55 J-55 H-40	Two Green Bands One Green Band No Colour Marking or Block at Manufacturer's Option	Green Coupling Green Coupling No Colour Marking or At Manufacturer's Option

Note:

For pup joints shorter than 1.8 m in length, the entire surface except the threads shall be painted.

API Casing Grade Identification Colour Codes (API SPECIFICATION 5CT)

7.3.3 Casing Setting Depth

Unless otherwise stated in the Drilling Program the minimum surface and intermediate casing setting depth is determined by a minimum kick tolerance of **30bbls** of swabbed gas influx taken from the bottom of the open hole with the mud weight in use at the time.

The actual setting depth is determined by evaluating offset well data to make sure the proposed setting depth is in a competent formation and not a loose sand. The actual casing setting depth must also be in accordance with all applicable government regulations.

Suitability of these standard criteria should be assessed during the well design to ensure applicability for the well to be considered. Modifications to the standard should be technically justified and approved by the DM prior to implementation.

7.3.4 Casing Design Factors

The following general casing design loading and test criteria shall be used in the casing design for all GSLM wells.

Load Case		Design Factors		
		Burst	Collapse	Tension
Conventional wells	Surface, intermediate and production	1.1	1.0	1.6
Special cases (Air drilling, HPHT, liners etc.)	Case by case	Design assumptions shall be specified		

Table 37. Casing Design Loading Criteria.

7.3.5 Conductor Pipe

The conductor hole shall be augured and set a **minimum** of 8' below the cellar floor depending on the competency of the formation. If possible at least 3' of clay should be augured before setting the conductor. The conductor shall be cemented in place.

7.3.6 Shoe Track Configuration

Shoe track requirements:

- A float shoe shall be installed at the base of the bottom joint, with a float collar installed above either the first or second coupling. Surface and intermediate casing will normally have a two joint shoe track.
- Top and bottom plugs shall be used on all casing strings.
- The float shoe, shoetrack and float collar shall be threadlocked.
- Float equipment shall not be welded on to the casing at any time.

7.3.7 Centralisation

The standard centralisation program is shown in the table below. The actual centralisation program will be shown in the drilling program.

Casing String	Centralisation Programme
Surface Casing	<ul style="list-style-type: none"> • 3 m from shoe • Centrally on the second joint • Across the third coupling • First coupling below the conductor.
Intermediate Casing	<ul style="list-style-type: none"> • 3 m from shoe • Centrally on the second joint • Across the third coupling • One over every fourth casing coupling over water sands • One over every second casing coupling across an interval from 15 m (50') below to 15 m above any potential pay zone
Production Casing	<ul style="list-style-type: none"> • 3 m from shoe • One over next two casing couplings • One over every second casing coupling across an interval from 15 m (50') below to 15 m above any potential pay zone • One over every second casing coupling over any good porous sand with 15 m overlap • One over the 1st, 3rd and 5th coupling above the intermediate or surface casing shoe

Table 38. Minimum Standard Centralisation Program

Bowstring type centralisers will normally be used. For special projects additional centralisation should be run according to DM instructions..

7.3.8 Marker Joint

On intermediate or production casing strings, a marker or pup joint of either equal or greater weight and grade to the highest weight and grade casing used in the string, shall be run no more than 15 m above the pay zone. The position of the marker joints must be shown on the casing tally. Only one marker joint is required if pay zones are within 60 m of each other.

7.4 CASING PREPARATION

This section describes the safety, transportation and handling of casing before running.

7.4.1 Safety

All personnel must be informed of, and observe the following safety and environmental requirements for handling casing:

- Hold a pre job safety meeting before running any casing string.
- Never walk under loads suspended in the elevators or high line.
- Always wear gloves and eye protection when cleaning joints.
- Never get between loads and another object.
- Be careful when rolling casing across racks ensuring that feet do not get trapped.
- **Diesel oil MUST NOT be used for cleaning threads.** The preferred method is to use a high pressure wash system..

7.4.2 Transportation of Casing

Tubulars shall only be moved and transported with both thread protectors correctly installed. Road transportation and casing handling are described below.

7.4.2.1 Road Transportation

- GSLM require that all casing loads must conform to all road regulations at all times. This includes both load limits (weight, size etc) and drivers hours. If casing is needed urgently then two drivers may be required. GSLM also require that all trucks must be roadworthy.
- Pipe shall be loaded on bolsters and chained down at each end (and middle for long tubulars).
- Tubulars shall be loaded with all couplings at one end of the truck.
- Pipes shall be loaded to prevent chafing of adjacent couplings.
- After a short distance traveled, chains loosened by load settling must be re-tightened.

7.4.2.2 Handling Practices

- Casing ends should all be easily accessible. This is a primary requirement for the thread-cleaning crew. Move casing only when thread protectors are in place.
- If pipes are to be unloaded by hand via ramps, they shall be rolled in a controlled manner using rope slings to prevent them from gaining momentum. Thread damage can easily occur if pipes strike each other end to end, even with thread protectors installed.
- Use a spreader-bar and choker-chain arrangement near each end of a joint to prevent crushing when handling bundles of casing joints with a crane.
- Store or rack casing only on wooden or metal surfaces free of rocks, sand or other debris.
- Pipe rack arrangements should allow for any programmed wellsite casing inspection. An extra pipe rack may be needed to achieve this.

7.4.3 Surface Preparation of Casing

It is the responsibility of the DSV to ensure that all casing and equipment is ordered and is at the wellsite prior to the casing job. It is the responsibility of the DSV to ensure all casing and casing equipment has the correct threads.

The following generic procedure should be followed for preparing casing:

1. Back off the protectors sufficiently to obtain the proper measuring point after each row is laid out.
2. Measure the casing. Write the numbers and lengths clearly in white or yellow on each joint.
3. Count the total number of joints and compare this number with the pipe tally and shipping manifest. As an additional check, calculate the average joint length.
4. Calculate if there is enough casing by checking the pipe tally. Where a mixed string is to be run, the DSV shall verify that sufficient casing of each type is at the wellsite.

Note: In general there should be a minimum of five excess joints of surface casing, and ten of production casing in each weight and grade available on the location.

5. Check the weight, grade, and connections of all pipe and accessories are correct as specified in the Drilling Program (see colour coding in Section 7.3.2).

Note: All threaded accessories shall be made up on casing pin ends to ease fishing operations in case the casing should fall into the hole.

6. Thoroughly clean, check and lubricate all threads. **Diesel oil must not be used.** A high pressure (fresh) water gun should be used to clean the threads. Connections must be thoroughly dried to prevent subsequent corrosion.
7. Drift with the appropriate API drift. (API 5CT Section 6.9). Mark any failures clearly with red paint.
8. Ensure the thread protectors are clean and reinstall on the pin and box ends (hand tight).
9. Make up the final Casing Tally and Running sheets and send to the DM
The running list must show:
 - The top and bottom depth of each joint.
 - Where centralisers are to be attached.
 - Where cement basket, if required, is to be attached.
 - Exactly which joints shall be run and which joints shall be left out of the string.
 - The placement of shoe and collar, and special casing equipment.
 - The appropriate length of landing joint to be calculated to ensure a safe working height for the cement head.

When preparing the running list of this type, it is important to specify the position of accessories separately from the joints to which they are attached to avoid confusion over exact location.

A copy of the API Specification 5CT should be available on all drilling rigs and in the GSLM office for reference.

 API Specification 5CT

7.4.4 Equipment Preparation

The following checks must be made to ensure that all the required equipment is at the wellsite, that it is certified (if applicable) and in good working/mechanical order.

Casing Equipment Checklist	Check
Dates of all lifting gear certificates checked.	
Single joint and side door elevators tested on several joints of casing to ensure their fit.	
Side door elevators checked for uneven wear on the bearing surface and for correct operation of the door latch.	
Spider and elevator slips and guides checked for size, condition, and the ability to operate evenly.	
Drilling line condition and load capabilities checked (slip and cut whilst out at the shoe on the last out if required).	
Mud pumps fitted with the proper size liners and in good mechanical condition.	
The mud pump relief valves tested and set.	
Low pressure mud fill line rigged up with a quick opening valve for high rate casing fill requirements	
Power and conventional casing tongs checked for condition of dies and operation	
Stabbing board safety checks carried out according to the Drilling Contractors safety checklist.	
Cementing accessories, shoe, float, stage equipment, cementing stinger, etc. checked for compatibility and suitability.	
Cementing crews and cement is correct before running casing.	
Pipe rams dressed with the correct size casing rams and BOP bonnet seals pressure tested.	

Table 39. Generic Casing Equipment Checklist.

7.5 RUNNING CASING

The following information is general and should be used by the DSV and Drilling Contractor in preparation of the work instructions for running casing.

7.5.1 Conditioning the Hole

Before running casing the hole shall be conditioned as shown in the procedure below:

1. Before pulling out of the hole for casing, the hole must be circulated clean and the drilling fluid parameters checked.
2. The hole depth should be checked by strapping out of the hole and checked against the Casing Tally and Running sheets.
3. A wiper trip may be necessary before running casing if there are indications of hole problems.

7.5.2 Running Casing Pre-Job Check List

The following list identifies the key points to be checked by the DSV prior to running casing.

Running Casing Pre-job Checklist	Check
Bradenhead	
<ul style="list-style-type: none"> • Check wellhead threads are compatible with the casing being run. • Check condition of wellhead threads regardless of new or reconditioned wellhead 	
Casing and cement calculations completed and checked	
<ul style="list-style-type: none"> • Correct number of joints of the correct weight and grade included • Shoe track and rat hole as per program • Casing tally and running list prepared. Running list faxed to DM. 	
Landing string drifted and checked	
Cement equipment as follows checked by Cementing Contractor	
<ul style="list-style-type: none"> • Cement head casing connection • Top and bottom plugs installed as appropriate,. Note a ball may be used below the top plug in 3 ½" tubing • Installation witnessed and checked by DSV • Float shoe and float collar installed and checked 	
Centralisers, cement basket, stop collars and pins on rig floor	
Casing running equipment rigged up / on rig floor	
<ul style="list-style-type: none"> • Power tongs • Pick up elevators • Casing elevators • Hand slips • Klampons • Circulating head for all types of casing being run. Check threads compatible with casing • Spider slips (if required) • Spider elevators (if required) • Torque turn equipment (if required) 	
Thread lock and casing compound on rig floor	
Snub and back up lines correctly installed and checked	
Stabbing board checked by stabber	
Drill floor cleared of unnecessary equipment	
Crew safety toolbox meeting conducted	
Surge / swab calculations completed as required	

Table 40. Running Casing Pre-job Checklist.

7.5.3 Picking-Up and Running

The following generic checklist should be used by the DSV for running casing, and for writing and checking specific work procedures to be issued to the Drilling Contractor.

Casing Running Checklist Generic	Check
Visually check all joints of casing to ensure that all joints are clear of foreign matter. Ensure 'auto fill' equipment not fitted	
Check casing float equipment after the shoetrack is run in to ensure the float is holding and that circulation is possible.	
Install centralisers in accordance with requirements	
Partially fill each joint and completely fill every five joints	
Make up the connections in accordance with API 5CT.	
If required install a short joint in the intermediate or production casing just above the hydrocarbon zone to assist later correlation	
Before landing the casing, count the joints of casing remaining on location	
Install cement basket approximately 60' below the rotary table on surface casing jobs (if required)	
The last joint must be circulated down – do not tag bottom.	
Set the casing such that it is at a safe height for installing the cementing head, i.e. 4 - 6' above the rig floor if possible	
Circulate a minimum of twice the annular volume prior to cementing. The Yield Point may be lowered if required as to enhance mud displacement efficiency during the cement job. This will be specified in the Drilling Program .	
Reciprocate casing while circulating and cementing if possible	
Landing joint (where run) shall be backed off in the presence of the Toolpusher and Drilling Supervisor.	
Ensure that the next joint is not backing off with the landing joint.	
Ensure that the last collar is soft broken prior to running, unless a double pin crossover is to be used to install the bradenhead.	

Table 41. Generic Casing Running Checklist

Note*: Use a casing cover where appropriate to prevent foreign matter entering whilst running the casing. Casing dope shall be applied while the casing is on the V-Door.

Note:** When threadlocking is carried out care must be taken to ensure that both pin and box are clean and dry. The thread lock compound shall only be placed on the pin of the connection.

Casing should be run smoothly, in accordance with the running list, avoiding high acceleration and deceleration that could cause unnecessary surge/swab pressures causing the well to swab in or the formation to break down.

Regulate the casing lowering speed to 30 sec/joint or to the optimum speed as dictated by pressure surge/swab calculations. Returns must be monitored constantly.

Note:

- Returns should be made to the same tank as is used for filling and a trip sheet filled in.
- When using side door elevators, avoid impact loading which can open the elevator.

 API Specification 5CT.

7.5.4 Stuck Casing

7.5.4.1 Setting the Casing High

If the casing string becomes stuck during running in and cannot be freed, the safety of the well and casing string design become adversely affected and the following possibilities must be considered:

- a. If the shoe is near the intended setting depth and is located in a suitable formation, the casing can usually be cemented in place and serve its original purpose. The cementing proposals and subsequent casing depths shall be amended and approved by the DM. Emergency hanger and seal assemblies may have to be employed.
- b. There is a possibility that an extra casing string may have to be run to serve the intended purpose of the stuck casing.
- c. Where a casing string contains different weights and grades, the casing design factors must be checked for the new setting depth. A re-evaluation of the design applicability must be performed by the DM.
- d. A non-planned position of the casing collars with respect to the well head slip profiles may be critical. Procedures for installing a (standard) slip and seal assembly are complicated in the following cases:
 - i. There is a collar in the way between the rotary table and the wellhead.
In this case, after cementing the casing, the BOP can be lifted and the slip and seal assembly installed around the pipe below the obstructing collar.
 - ii. There is a collar located in the landing area of the wellhead.
In this case, the pipe may either have to be slacked off allowing the slip and seal assembly to be lowered through the BOP stack. Alternatively the pipe may have to be stretched and the BOP stack lifted to install the slip and seal assembly after the casing has been cemented.

In both cases, the pipe will have to be mechanically cut at the proper height to ensure that there is sufficient length of casing above the hanger to allow normal installation of the seal assembly and that the casing stub is sufficiently long to provide sealing into the next wellhead or tubing spool.

If losses have been observed during the cement job and there could be hydrocarbons present, the BOP shall not be lifted without first establishing there is an annular barrier, or by lowering the slip and seal assembly through the BOP stack.

7.5.4.2 Allowable Pull on Casing

When pulling on casing, the maximum total surface load on the casing shall not exceed the lesser of either:

- a. The lesser of pipe body yield strength or thread yield strength (of top pipe)
1.6
- or:
- b. The lesser of the weakest pipe or thread + Weight in air of casing above it
1.6.

The following reports are to be submitted to the DM by the first reporting day after completion of cementation:

- Casing and Cementing Report. Casing landing weights must be shown on this form.
- Casing Tally and Running sheets (these should be sent to the DM for checking prior to the casing being run).
- Wellhead Installation Report.

Additional reports as required to explain abnormal or unusual events.

7.6 CASING PRESSURE TESTS

All components of a casing/wellhead system shall be pressure tested in compliance with the standards in Chapter 10 of this Manual. The casing string shall be tested to the **lowest** value dictated by the following:

- The casing design pressure or 80% of the casing burst.
- The wellhead design pressure (3000 psi or 5000 psi).
- The working rating of the BOP.
- Cement head working pressure rating.
- Float equipment manufacturers test pressure limitation.
- Maximum anticipated surface pressure.

The test pressure and the justification for this pressure shall be clearly indicated in the Drilling Program.

CHAPTER 8 CEMENTATION

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