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Dear Brian

### **Climate Change Act – Geothermal Sampling Procedures**

This commentary is provided in response to discussion at the NZGA meeting on the 5<sup>th</sup> March 2010 with regard to appropriate methods for measuring CO<sub>2</sub> and CH<sub>4</sub> under the New Zealand Climate Change Act and Regulations promulgated in 2009. In the meeting minutes item 11 describes a subcommittee looking at emissions testing and possible formalising by way of a standard. Having reviewed the regulations I am of the view that a standard is not warranted because the regulations are quite prescriptive and methods included in the regulations enable sampling methods that have been developed in New Zealand to be used providing they are published.

The material that follows focuses on identification of appropriate sampling methods that can be used under the regulations. Other material is also discussed to put a context around the sampling methods.

Geothermal facilities supplying geothermal fluid for generating electricity or industrial heat are subject to the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009. These regulations consider fluid supply as either geothermal steam (Schedule 2, Table 6, Part A) or geothermal fluid (Schedule 2, Table 6, Part B) which is referred to variously in other parts of the regulations as *geothermal fluid that does not relate to steam production* and *2-phase geothermal fluid*.

Prescribed or default emission factors are defined in Schedule 2, Table 6 of the regulations. The measured annual fluid production is multiplied by the prescribed emissions factor to derive the annual emissions from a given facility.

There is an option for the prescribed emissions factor to be substituted with a unique emissions factor. The methodology to develop a unique emissions factor for a geothermal facility is covered in the Climate Change (Unique Emissions Factors) Regulations 2009, clauses 14 to 17. Appendix 3 contains a copy of Unique Emissions Factor Regulations.

There are several matters to be considered as part of developing a Unique Emissions Factor (UEF). In brief the:

- Difference between the UEF and the default factor has to be greater than the measurement uncertainty
- Two prescribed methods are set out for
  - (1) Geothermal Steam Production
  - (2) Geothermal fluid other than steam production
- Both CO<sub>2</sub> and CH<sub>4</sub> are accounted for
- An adjustment for fluid injected can be made
- UEF is to be submitted to a verifier for verification before adoption

To determine the CO<sub>2</sub> and CH<sub>4</sub> data the measurements required are identified in the Climate Change (Unique Emissions Factors) Regulations 2009, clause 16 for steam and clause 17 for geothermal fluid other than steam production.

#### **Clause 16 – Steam**

Flow measurements (if required) are to be made using equipment with the same accuracy as a venturi flow meter. (It is noted that orifice plates are used in the geothermal industry in New Zealand as the standard flow measurement method as opposed to venturi devices which are much less common – this may warrant representation for a change to the regulations at some future date).

Sampling of the steam is to be performed using procedures in ASTM E947-83, ASTM E1675-04 or other published geothermal fluid sampling methodology. For ease of reference published GNS methods for steam sampling are appended in appendix 1.

Analysis is to be performed by an ISO 17025:2005 accredited laboratory using gas chromatography for CH<sub>4</sub> and titration for CO<sub>2</sub>.

#### **Clause 17 – Other than Steam**

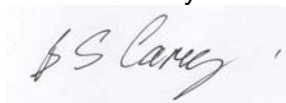
Flow measurements are not required for the prescribed calculations.

Sampling of the 2-phase fluid stream is to be undertaken using ASTM E1675-04 or other published geothermal fluid sampling methodology. For ease of reference published GNS methods for 2-phase fluid are appended in appendix 2.

Analysis is to be performed by an ISO 17025:2005 accredited laboratory using gas chromatography for CH<sub>4</sub> and titration for CO<sub>2</sub>.

I trust the letter answers the request by providing sampling procedures that can be used under the New Zealand Climate Change Act as it currently stands.

Yours faithfully



Brian Carey  
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## **Appendix 1   -   GNS Steam Sampling Procedures**

# **Sampling techniques for geothermal fluids**

**L E Klyen**

**Institute of Geological & Nuclear Sciences science report 96/29**

### **BIBLIOGRAPHIC REFERENCE**

Klyen, L.E., 1996. Sampling techniques for geothermal fluids. *Institute of Geological & Nuclear Sciences science report 96/29*. 157 p.

First published by the Chemistry Division of the Department of Scientific and Industrial Research, New Zealand, 1982.

This revised edition published by the Institute of Geological and Nuclear Sciences, New Zealand, 1996.

L E Klyen, Institute of Geological & Nuclear Sciences Limited, Wairakei Research Centre, Taupo

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## GAS SAMPLING TEE PIECE

### Function

To provide a suitable sampling adapter for separated steam line sample points.

### Use

- (i) For the collection of gas samples from separated steam lines.
- (ii) For the collection of steam condensates from separated steam lines.

### Description (refer Fig 4)

A separated dry steam and gas flow entering the tee piece at (A) is regulated by the valve at (B) before exiting through the two tee ports at (C). From the right-angled port a hose delivers dry steam and gas for collection into an evacuated pyrex flask, whilst the remaining port provides pressure relief.

### Method (refer Figs 4a, 4b)

- (i) The tee piece is screwed into a sampling point on a separated steam line. Gas and dry steam are directed from the right angled port through a butyl rubber hose into a water cooled, evacuated, pyrex flask containing a measured volume of sodium hydroxide (NaOH) solution. Where well gas fractions are low samples typically would be collected into an evacuated 5.0 litre flask containing 10ml of 16 N NaOH + 90ml H<sub>2</sub>O. Elsewhere, with higher gas concentrations, sample collection could take place in an evacuated 0.3 litre, "Rotoflo" type, flask containing 50 ml of 8 N NaOH solution. Where 5.0 litre flasks are used NaOH solutions, for a range of New Zealand conditions, are:

Field	mmoles CO <sub>2</sub> /100 moles in separated steam	mls 16N NaOH	mls H <sub>2</sub> O
Wairakei	50	20	80
Ohaaki	1300	100	100
Ngawha	4000	300	200

"Rotoflo" type flasks containing 50 ml of 8 N NaOH could advantageously be employed for gas collection at both Ohaaki and Ngawha above.

As gas and steam bubble through the NaOH solution the dominant gases - eg, hydrogen sulphide and carbon dioxide - are taken into solution. The suite of non-alkali soluble gases making up the minor gas fraction collect in the space above the NaOH and sample solution.

Cold water applied to the exterior of the collection flask condenses incoming dry steam thereby maintaining a partial vacuum and, thus, the continued entry of gases. Where applicable, "Rotoflo" type flasks may be used with their several advantages of smaller size and weight, significantly shorter sample collection times and modest cooling demands although they may incur the possible penalty of reduced gas volumes.

The necessary agitation of sample and NaOH is most easily accomplished by locating the sample input port at the lowest practical point and allowing the subsequent steam and gas entry to mix the flask's contents.

- (ii) A cooling coil is connected to the installed tee piece from which steam condensate may be withdrawn.

## **Operation**

- (1) (Refer Fig 4a) With the sample point valve closed screw the tee piece into the sample point on a separated steam line.
- (2) (Refer Fig 4) Shut the valve at (B).
- (3) (Refer Fig 4a) Attach sufficient length of 21mm OD x 7mm ID butyl rubber hose to the tee piece's right angled port.
- (4) Wear eye shields and protective gloves from this point onwards until sampling is completed.
- (5) Crack open the sample point valve and check for leaks.
- (6) If the system is leakage free completely open the sample point valve.
- (7) (Refer Fig 4) Note the pressure indicated by the gauge at (B).
- (8) (Refer Fig 4) Open the valve at (B) until a vapour plume of approximately 1 metre is attained. Note the sampling pressure.
- (9) (Refer Fig 4b) Securely connect the discharge hose to a prepared collection flask after purging all intermediate connections.
- (10) (Refer Fig 2c) Where 5 litre collection flasks are employed clamp shut the discharge hose with artery forceps immediately downstream of the flask sealing clip.
- (11) (Refer Figs 2c, 4b) Position the flask so that the sample input will bubble through the NaOH solution thus eliminating the need for continuous manual agitation.
- (12) (Refer Fig 2c) Fully release the flask sealing clip.
- (13) (Refer Fig 2c) Carefully release the artery forceps whilst observing that the tee piece discharge vapour plume is maintained at all times throughout the sampling period. If

the rate of sample discharge into the evacuated collection flask is too fast then internal pressure at the tee piece could be sufficiently reduced to allow atmospheric entry. Should this occur the sample immediately would be contaminated and must be discarded.

- (14) (Refer Fig 2c) Continue to control the flask input by manipulation of the forceps until manual control may be abandoned without loss of the tee piece discharge vapour plume.
- (15) (Refer Fig 2c, 4b) Apply cooling water to the walls of the collection flask whilst ensuring that the resultant internal pressure drop does not induce atmospheric contamination as in (13) above.
- (16) Exercise a close supervision throughout the sampling period to ensure that the tee piece discharge plume is maintained.
- (17) If the sample is required for only  $\text{H}_2\text{S}$  and/or  $\text{CO}_2$  determinations sampling may be terminated upon the collection of approximately 1 litre of total liquid (ie, NaOH solution plus condensate) where standard 5 litre flasks are used. But check with the analyst as to what volume is required. If the sample is required for non-alkali soluble gas, and/or  $\text{CH}_4$  and  $\text{CO}_2$  isotope determinations, allow sample collection to continue until input bubbling has almost ceased. Where stable isotope determinations such as  $^{18}\text{O}$  and D are called for collect not less than 50 mls of sample into a cooled, evacuated, 1 litre flask in the absence of NaOH solution. For  $\text{NH}_3$  determinations collect not less than 100 mls of sample into a cooled, evacuated, 5.0 litre flask in the absence of NaOH solution.
- (18) (Refer Fig 2c, 4b) Upon completion of sampling retighten the sealing clip with the flask remaining in the sampling position and with cooling maintained until the flask is fully sealed.
- (19) Where  $\text{H}_2\text{S}$  collection takes place in standard 5 litre flasks fitted with butyl rubber hoses analysis should be undertaken without delay. If collection is into teflon sealed "Rototflo" type flasks haste is unnecessary. But be sure always to gently retighten the valves after one hour following the completion of sampling.

### **Routine Maintenance**

1. Flush out with tap water followed by distilled water.
2. Check pressure gauge and recalibrate where necessary.



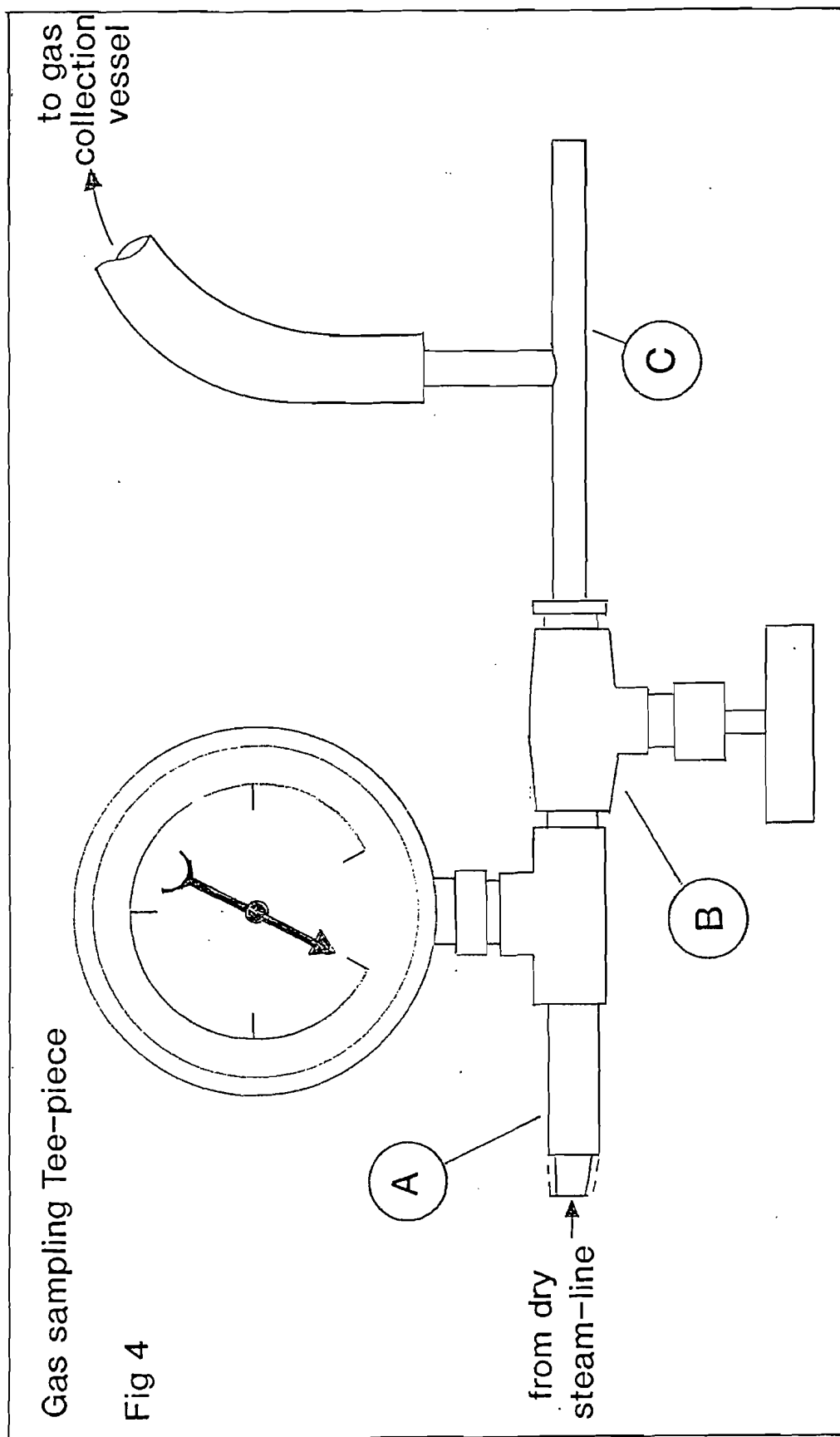
## Specimen Field Notes

Well No:              Date:              Time:              hrs

### Tee Piece Steam Sample:-

Flask No:	WHP	=	bar gauge
Flask No:      (duplicate)	CP	=	bar gauge
Ammonia Flask No:	SPP	=	bar gauge
	SP	=	bar gauge
Steam Mass Flow		=	tonne/hr

Gas Flask NaOH Vol =      ml,    Gas Flask H<sub>2</sub>O Vol =      ml



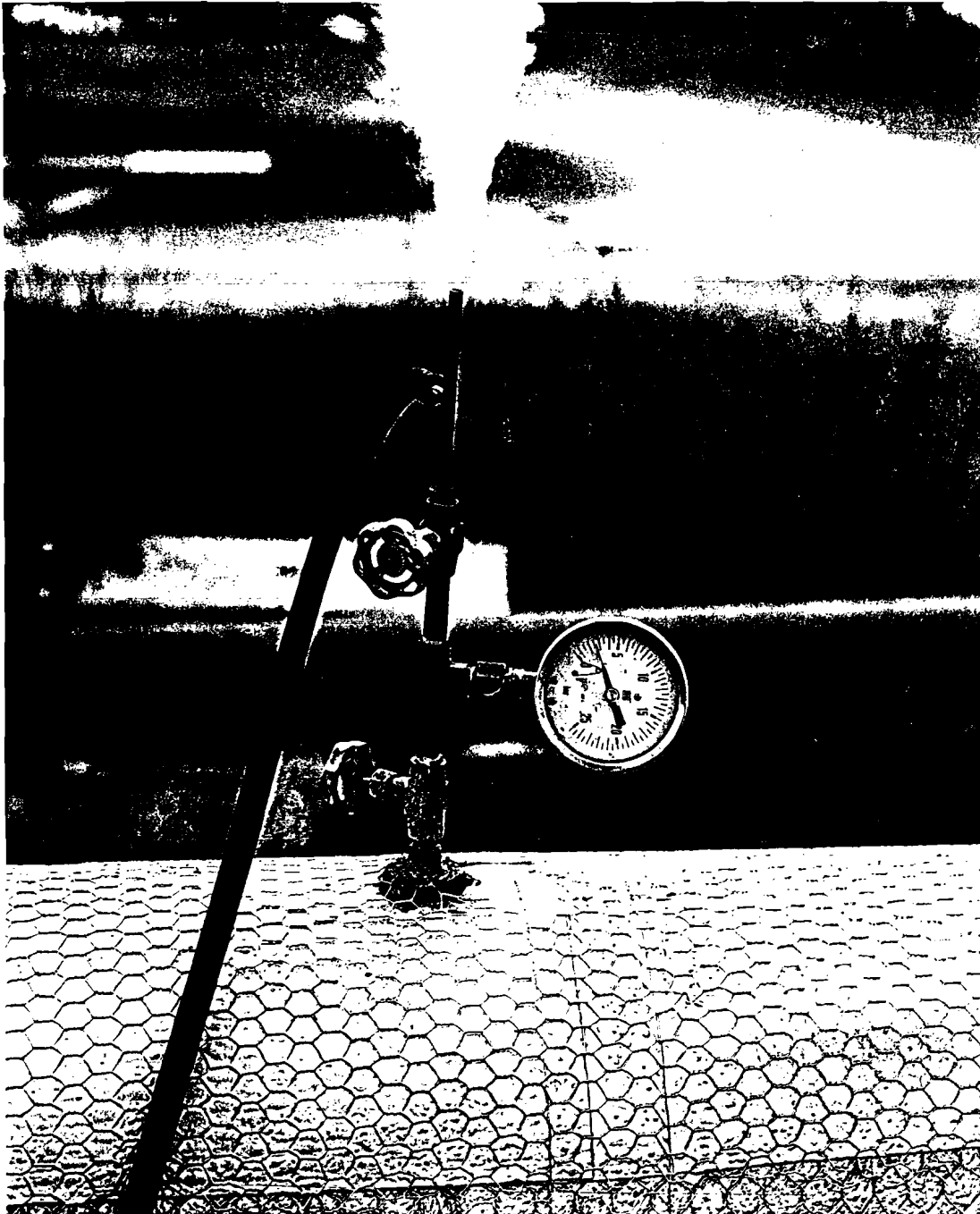


Fig 4a

Tee Piece attached to separated steam line

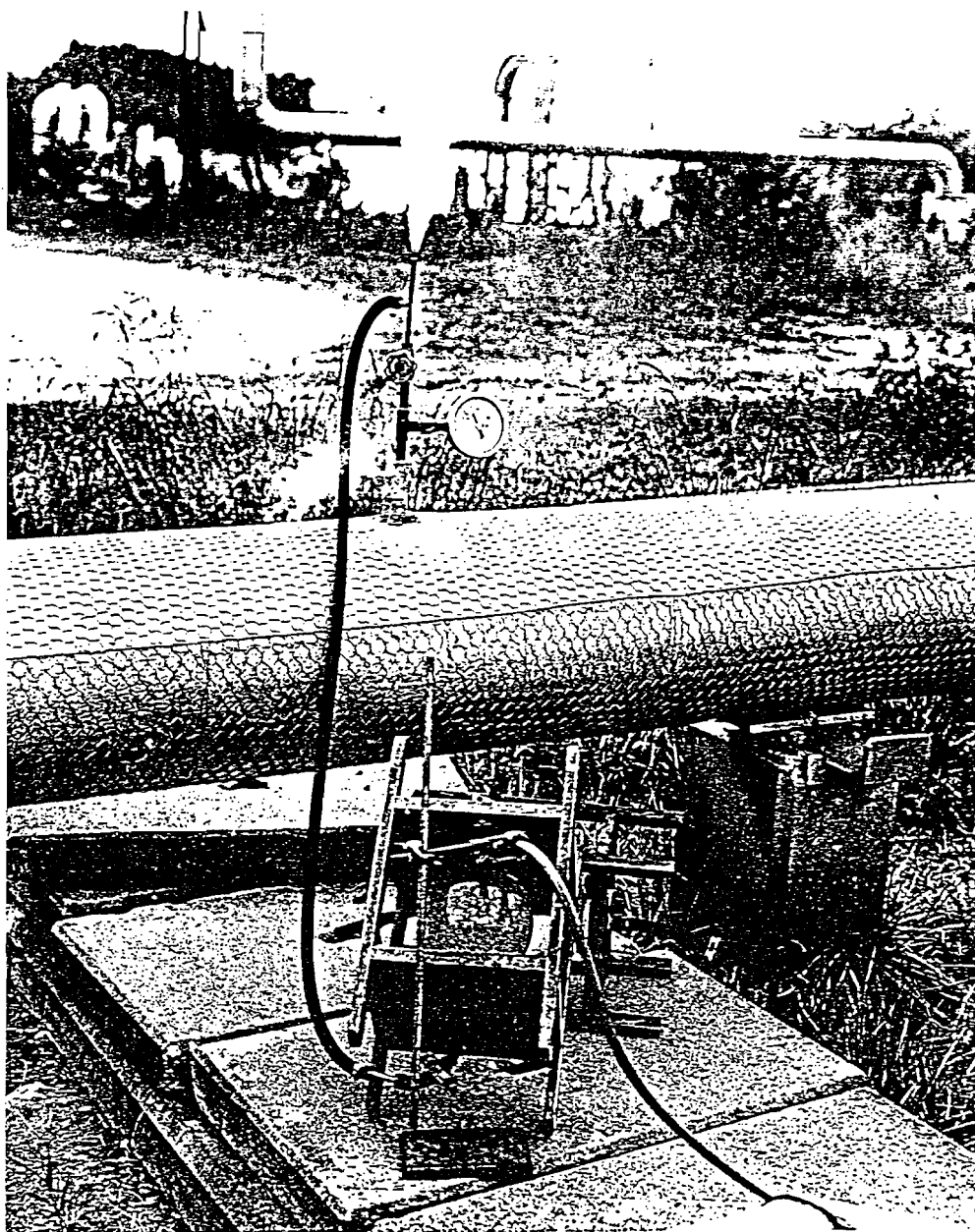


Fig 4b

Tee Piece attached to separated steam line with 5 litre collection flask

## GLOSSARY

<b>ALLEN KEY</b>	A driving tool, of hexagonal cross-section, designed to fit a socket in the head of an Allen screw.
<b>ALLEN SCREW</b>	A screw possessing an hexagonal recess into which an Allen key is fitted for purposes of tightening and loosening.
<b>BUTYL RUBBER</b>	A elastomer less permeable than most rubbers to gas diffusion. Butyl rubber tubing of: 21 mm OD x 7 mm ID, is suitable for gas collection flask connections and the dry steam hose of a Webre separator. 25 mm OD x 21 mm ID is suitable as an impermeable seal for water sample collection vessels.
<b>"CRACK" A VALVE</b>	To open a valve only the minimum amount necessary to allow the escape of a contained fluid.
<b>CYCLONE SEPARATOR</b>	A vertical cylinder into which a fluid mixture is tangentially injected. The heavier water fraction of the mixture, centrifugally separates and drains under gravity through a vent close to the base of the cylinder. The lighter components, steam and gas, escape through a vent communicating with the top of the cylinder's interior. See Figures 1 and 2.
<b>DRY STEAM</b>	Water free steam.
<b>DWANG</b>	A removable, usually adjustable, handle for the manual rotation of taps, dies, valve stems etc.
<b>DYNAMIC SEAL</b>	A component, such as a piston-ring, which maintains its seal over a distance of linear travel unlike a gasket which seals only statically.
<b>FLASHED WATER</b>	The liquid phase remaining from the separation of steam derived from single-step pressure drop of high temperature water or steam/water mixture.
<b>GLAND</b>	A device for sealing around cylindrical objects such as pump connecting rods, valve stems and, in the Klyen sub-surface sampler MkI, the glass break-off tubes.
<b>GLAND NUT</b>	A component part of a gland by which the seal is secured and/or compressed.
<b>HYDRAULIC DESCENT CONTROL OR HYDRAULIC DRAG</b>	A useful mechanism incorporated into many wireline winches where a variably throttled pump may be engaged at will to a ring-gear mounted on one of the wireline spool cheeks. As

instrument and wireline is paid off downhole the resultant rotation of the spool drives the closed pumping system. Adjustment of the throttle provides a smooth, controllable and, therefore, safe descent. The use of this device is strongly recommended wherever wireline borehole logging is undertaken.

**HYDROSTATIC PRESSURE**

The pressure exerted by an overlying liquid. Ten metres depth of cold water equals approximately 1 kilogram per sq. centimeter, or 0.98 bar.

**INERTIA MECHANISM**

A device incorporated in Klyen sub-surface samplers where a guided, spring-suspended, mass when jerked punctures a pressure seal.

**LOSS ZONE**

A zone encountered during well drilling where the fluids associated with drilling are lost into fissures and cavities in the immediate geological formations. Such zones often are the target of sub-surface sampling operations.

**SWIVEL UNION**

A pipe fitting normally consisting of a secured semi-ball and socket seal. It is a useful device providing an adjustable connection between the Webre separator and a sample point.

**NON-RETURN VALVE**

A valve admitting flow in one direction only. Such a valve allows a the sample vessel in a Klyen sub-surface sampler to fill but prevents subsequent leakage.

**O-RING**

A seal ring of solid, circular, cross-section, often of elastomeric material which, when correctly seated, provides a wide range of both static and dynamic sealing applications.

**PERMEABLE ZONES**

Geological formations through which fluids may move. Such zones often are the target of sub-surface sampling operations.

**RECOVERY GEAR**

(US = LUBRICATOR) Normally a flanged pipe bearing at its upper end a removable gland. Its purpose is to provide access for downhole instruments into pressurized wells. This is accomplished when the recovery gear is secured to the wellhead with the wireline threaded through the gland and shackled to an instrument contained within the recovery gear at which point the master valve may safely be opened and the instrument lowered. Upon retrieval of the instrument the master valve is closed and pressure within the recovery gear is exhausted through a valve to atmosphere. The instrument may then be recovered upon removal of the upper gland or by releasing the recovery gear from the wellhead. See Figure 8b.

<b>"ROTOFLO" FLASKS</b>	These derive their name from commercially available "Rotoflo" teflon sealed, valves.
<b>SAMPLE POINT PRESSURE</b>	The pressure at the sample point in the absence of any discharge.
<b>SAMPLE PRESSURE</b>	The pressure at which sampling takes place.
<b>STEAM FRACTION</b>	The water vapour component of a steam/water two-phase flow.
<b>SHIM</b>	A thin metal plate such as those used as puncture seals in the Klyen sub-surface sampler MkII, MkIIa and MkIIb.
<b>TWO-PHASE FLOW</b>	Any simultaneous liquid and gas flow along a confined path: geothermally, a steam plus gas/water flow normally within a pipe.
<b>TOMMY BAR</b>	A lever designed to fit a matching recess.
<b>THIMBLE:</b>	A peripherally grooved, tear-drop shaped ring for forming eyelets at the ends of wires and ropes.
<b>VAPOUR PRESSURE</b>	The pressure of a vapour exerted either by itself or in a mixture of gases.
<b>WATER FRACTION</b>	The liquid water component of a steam/water two-phase flow.
<b>WEBRE SEPARATOR</b>	A miniature, twin-cyclone, separator. See "cyclone separator".
<b>WEIRBOX</b>	A compartment located at the base of a geothermal well silencer. It contains a small dam over which flashed water from the silencer drains. Its known dimensions, together with other criteria, provide a ready means of enthalpy and mass flow measurement. Useful water samples are collected from the weirbox.
<b>WHP = WELLHEAD PRESSURE</b>	The pressure existing within the wellhead assembly.
<b>WIRELINE</b>	Normally a single strand, stainless-steel, wire from which some downhole logging and sampling instruments are suspended.

## **Appendix 2   -   GNS 2-Phase Sampling Procedures**



# **Sampling techniques for geothermal fluids**

**L E Klyen**

**Institute of Geological & Nuclear Sciences science report 96/29**

### **BIBLIOGRAPHIC REFERENCE**

Klyen, L.E., 1996. Sampling techniques for geothermal fluids. *Institute of Geological & Nuclear Sciences science report 96/29*. 157 p.

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L E Klyen, Institute of Geological & Nuclear Sciences Limited, Wairakei Research Centre, Taupo

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## WEBRE CYCLONE SEPARATOR<sup>1</sup>

*"... and let it divide the waters from the waters."  
Genesis: 1.6*

### Function (refer Figs 2, 2a)

To separate the vapour and water fractions of a two-phase steam/water mixture discharged from a geothermal well. Working pressure: 0.7 - 40 bar gauge.

### Use

- (i) for the collection of geothermal well gas samples
- (ii) for the collection of geothermal well hot water samples.

### Description (refer Fig 2b)

Centrifugal separation takes place in Cyclone (A) from which dry steam and gas is discharged through the tee-piece at (A1). The tee-piece provides pressure relief before the the gas samples are directed, for collection, into evacuated pyrex flasks. Separated water is directed into Cyclone (B), which operates in a slightly flooded condition, and discharged together with any remaining traces of steam and gas at (B1). Water, free of gas and steam, from Cyclone (B) may be fed to the cooling system (C) and collected at atmospheric pressure from (C1), or, alternatively, it may be fed to an exterior and independent cooler.

### Method (refer Figs 2b, 2c, 2d, 2e, 2f, 2g)

- i) The separator is connected to a sampling point by means of a stainless steel, swivel-union, fitting on the two-phase discharge line of a geothermal well. Appropriate adjustment of valves (A1) and (B1) will yield, water free, dry steam and gas at (A1) and gas and steam free water at (C1). A steam/water residue is ejected at (B1). Gas and dry steam are directed through a butyl rubber hose into a water cooled, evacuated, pyrex flask containing a measured volume of sodium hydroxide (NaOH) solution. Where well gas fractions are low, samples typically would be collected into an evacuated 5.0 litre flask containing 10ml of 16 normal NaOH + 90ml H<sub>2</sub>O solution. Elsewhere, with higher gas concentrations, sample collection could take place in an evacuated 0.3 litre "Rotoflo" type flask, containing 50ml of 8 normal NaOH. If 5.0 litre flasks are used then NaOH solutions, for a range of New Zealand conditions, are:-

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<sup>1</sup>Manufactured to Institute of Geology & Nuclear Sciences specifications by Burns & Ferral Ltd, PO Box 12 030, 940 Great South Road, Penrose, Auckland, New Zealand

Field	mmoles CO <sub>2</sub> /100 moles in separated steam	mls 16N NaOH	mls H <sub>2</sub> O
Wairakei	50	20	80
Ohaaki	1300	100	100
Ngawha	4000	300	200

"Rotoflo" type flasks containing 50ml of 8 N NaOH could advantageously be employed for gas collection at both Ohaaki and Ngawha above.

Where 5.0 litre flasks are employed it is common practise to further dilute the 16 normal NaOH solution firstly to inhibit the precipitation of Na<sub>2</sub>CO<sub>3</sub> and, secondly, to reduce viscosity as an aid towards dispensing. As gas and steam bubble through the NaOH liquid the dominant gases, carbon dioxide and hydrogen sulphide, are taken into solution. The suite of non-alkali soluble gases making up the lesser fraction of the gas mix collect in the space above the NaOH + sample solution. Cold water applied to the exterior of the collection flask condenses incoming steam thereby maintaining a partial vacuum and, thus, the continued entry of gases. Where applicable, "Rotoflo" type flasks may be used with their several advantages of significantly reduced sampling times and modest cooling demands. Such use may, however, incur the penalty of only small non-condensable gas volumes. The necessary agitation of the NaOH/sample mixture is most readily accomplished by locating the sample flask input port at the lowest available point whereupon the resulting bubbling will ensure a thorough mixing of the contents.

- ii) a) separated water may be collected directly from (C1) after cooling through the water jacket (C)
- b) separated water may be collected indirectly after passing through an auxillary stainless steel cooling coil outside of the Webre separator. This offers an easier procedure when the unaided gravity flow of cooling water cannot reach the Webre's water jacket.

### Operation for gas collection

- (1) (Refer Figs 1, 1a, 1b) Attach separator to a correctly located sample point (Mahon, 1961, and item "Wellheads and Sample Points," p9 this pub.) by means of a stainless steel swivel union fitting and socket assembly fitted with a stainless steel mesh filter. Note well head pressure (WHP).
- (2) (Refer Fig 2f) Mount and secure separator with cyclones positioned vertically and control valves lowermost.
- (3) (Refer Fig 2b) Shut all separator valves.
- (4) Wear protective eye-glasses from here on until sample point valve is closed upon completion of sampling.

- (5) Crack open sample point valve and check for leaks.
- (6) If the system is leakage free open COMPLETELY the sample point valve.
- (7) (Refer Fig 2b) Crack open the separator valve (D) and note sample point pressure (SPP) on the gauge at (D). If gauge reading fluctuates excessively then progressively close valve (D) to throttle pressure until the fluctuation sufficiently is reduced to allow pressure measurement. Leave (D) open throughout sampling period.
- (8) (Refer Fig 2b) Open valve at (A1) until (ideally) a vapour plume of 1 to 2 metres is produced from the tee-piece discharge port at (A1).
- (9) (Refer Fig 2b) Open valve (B1) until the plume at (A1) goes dry. This condition may be recognized by:
  - i) briefly obstructing the (A1) discharge plume with an industrially-gloved hand and observing if water has been deposited. Little, or no, water will appear when optimum dry steam separation is achieved.
  - ii) closely observing the fringe of water adhering to the lip of the tee-piece discharge port at (A1). In most cases the fringe will disappear upon attainment of dry steam separation.
  - iii) a smokey-blue hue in the discharge plume and a transparent interval of dry steam at the (A1) tee-piece port will be observed under optimum separation conditions.
- (10) (Refer Fig 2b) Read sampling pressure (SP) on the gauge at (D) and continue to trim (A1) and (B1) settings until optimum separation with minimum pressure drop between the SPP and SP is achieved.
- (11) (Refer Fig 2c) Securely attach the dry steam discharge hose to a prepared collection flask after purging all intermediate connections.
- (12) (Refer Fig 2c) When the sample is collected in a 5 litre flask use self-locking artery forceps to clamp shut the flask input hose downstream of the flask sealing clip.
- (13) (Refer Fig 2c) Position flask so that the sample input will bubble through the NaOH solution thus eliminating the need for continuous manual agitation.
- (14) (Refer Fig 2c) Fully release the flask sealing clip.
- (15) (Refer Figs 2b, 2c) Carefully release the artery forceps whilst observing closely that the tee-piece discharge plume is maintained at all times throughout the sampling period. If sample discharge into the evacuated collection flask is too fast internal pressure at the tee-piece discharge point (A1) could be sufficiently reduced to allow atmospheric intrusion. Should this occur the sample is immediately contaminated and must be discarded.

- (16) (Refer Fig 2c) Continue to control the flask input by manipulation of the forceps until manual control may safely be abandoned without loss of the tee-piece plume.
- (17) (Refer Figs 2c, 2e) Apply cooling water to the walls of the collection flask whilst ensuring that the resultant internal pressure drop does not induce atmospheric contamination as discussed in (15)
- (18) (Refer Fig 2b) Exercise a close supervision throughout the sampling period to ensure that optimum separation is maintained together with a minimum difference between the sample point and sampling pressures.
- (19) Where 5.0 litre sampling flasks are used, and if the sample is required solely for H<sub>2</sub>S and/or CO<sub>2</sub> determinations, sampling may normally be terminated upon the collection of approximately 1.0 litre of total liquid: ie, NaOH solution plus condensate. But always check with analyst as to what volume is required. If the sample is for non-alkali soluble gas, and/or CH<sub>4</sub> and CO<sub>2</sub> isotope determinations, allow sample to accumulate until input bubbling has almost ceased. Where stable isotope determinations such as <sup>18</sup>O and D are required collect not less than 50ml of sample into a cooled, evacuated, 1.0 litre flask in the absence of NaOH solution. For NH<sub>3</sub> determinations collect not less than 100ml of sample into a cooled, evacuated, 5.0 litre flask in the absence of NaOH solution. Upon completion of sampling retighten the sealing clip with the flask remaining in the sampling position and with continued cooling until the flask is sealed.
- (20) Where H<sub>2</sub>S collection takes place in 5.0 litre flasks fitted with standard butyl rubber hoses, analysis should be undertaken without delay to avoid possible permeation of the hose by the sample gas.
- (21) Where "Rotoflo" type flasks are employed the only exceptions to the above instructions are:-
- i) there is no requirement for the use of artery forceps due to the fine tuning available from the flask's own teflon valve.
  - ii) cooling may take place, more conveniently, in a pail of cold water.
  - iii) all sampling continues, regardless of end use, until input bubbling has almost ceased
  - iv) before sampling is terminated the flask should several times be closed, vigorously shaken and reopened to ensure maximum sample input.
  - v) analytical urgency is unnecessary due to the impermeability of the "Rotoflo's" teflon seal which should gently be re-tightened approximately one hour following sampling completion.

#### **Operation for separated water collection**

- i)

- (1) (Refer Fig 2b, 2d) Attach to the valve outlet at (C1) sufficient a length of 12mm OD x 7mm ID butyl rubber tubing to reach from the installed position of the Webre separator to near the bottom of a transparent collection bottle.
- (2) (Refer Fig 2b) Apply cooling water to the lower water jacket connection of (C).
- (3) (Refer Fig 2b) Set up the Webre separator to deliver optimum separation as described above. Note WHP, SPP and SP. Having achieved the best separation conditions, slowly open (A1) whilst slowly closing (B1) until the dry steam discharge is seen to turn slightly wet.
- (4) (Refer Fig 2b) Open the valve at (C1) sufficiently to produce a small flow of cooled, separated water at a temperature not exceeding 30°C.
- (5) Allow to flow for five minutes then re-check discharge temperature.
- (6) (Refer Fig 2b) If the temperature of the separated water flow remains at, or below, 30°C begin sampling with the butyl rubber tubing located close to the bottom of the transparent sample collection bottle. If flow temperature increases during sampling reduce the flow rate at (C1). NB: always precede sample collection by twice rinsing the sample vessel with sample water.
- (7) (Refer Fig 2b) Be alert to gas bubbles emitted from the butyl rubber tubing throughout the sampling period. If bubbling persists, even when the sample flow is cool, check for poor separation and adjust accordingly. Any remaining bubbles will then most probably be due to dissolved gases coming out of solution and may safely be ignored.
- (8) Sample collection may be dictated by analytical requirements but a normal collection suite consist of:-
  - 1 x 1000 ml, or 500 ml, plastic bottle
  - 1 x 100 ml plastic bottle, filtered + 1.0 ml 1:1 nitric acid
  - 1 x 500 ml rubber sealed glass bottle

ii) (Refer Fig 2g)

Alternatively, connect to (C1) an independent, stainless steel, cooling coil immersed in a pail of constantly replenished cold water and/or ice and proceed as from (3) above.

### **Routine maintenance**

- (1) Flush thoroughly all steam and water flow paths, including connection fittings, with clean tap water after use.
- (2) Check pressure gauge and recalibrate when necessary.

## **Fault finding**

- (1) Failure to achieve good separation at some point through the range of Webre settings will be due to the nature of the well's discharge: eg, sample point pressure below 0.7 bar gauge, very low enthalpy, or intermittent steam/water fluctuations. Nevertheless, it is a rare event when, with patience, satisfactory separation cannot finally be attained. Should such an adverse occasion arise the field technician must strive for the best results obtainable under the prevailing limitations. It is of the utmost importance that the section supervisor and analyst be notified of any departure from standard sampling procedures and that any such deviation is carefully recorded in the chemical data file.
- (2) Loss of separated water flow at (C1) usually arises from well debris blocking the Webre immediately upstream from (C1). To clear such a blockage attach the Webre separator, with all valves shut, to a closed sample point of pressure in excess of 1.0 bar gauge. Remove the valve at (C1) at the hexagonal nipple connection and momentarily open the sample point valve to discharge a two-phase flow through the Webre's water path thus clearing the blockage. Dismantle the valve at (C1), remove any debris, and re-assemble.



## Specimen Field Notes

Well No:                      Date:                      Time:      hrs

### Webre Separated Steam Sample:

Flask No:	WHP	=	bar gauge
Flask No:(duplicate)	SPP	=	bar gauge
Ammonia flask No:	SP	=	bar gauge
	Steam mass flow	=	tonne/hr

### Webre Separated Water Sample:

Plastic bottle,	1000 ml or 500 ml
Plastic bottle,	100 ml - filtered+1.0ml 1:1 nitric acid
Rubber seal glass bottle,	500 ml

### Weir Box Water sample:

Plastic bottle,	1000 ml or 500 ml
Plastic bottle,	100 ml - filtered+1.0ml 1:1 nitric acid
Rubber seal glass bottle,	500 ml*
	Temp =      °C

Gas Flask NaOH Vol =      ml,      Gas Flask H<sub>2</sub>O Vol =      ml

- \* a glass bottle to which is attached, at the neck, a 150mm length of 25mm OD x 19mm ID butyl rubber tubing. A seal clip is located close to the top of the butyl rubber extension. Separated water is collected until it overflows the butyl tubing whereupon the seal clip is closed on the column of collected water thus ensuring an atmosphere free sample. It is of crucial importance that no bubbles are entrapped during the closure of the seal clip. With a totally air-free sample H<sub>2</sub>S oxidization is delayed thereby maintaining a representative specimen for a useful period after collection. A rubber seal offers the further advantage of yielding without leakage as the bottle's internal pressure collapses upon cooling where a rigid seal would be vulnerable to atmospheric intrusion, or the partial vacuum created sucking the dissolved gases out of solution.

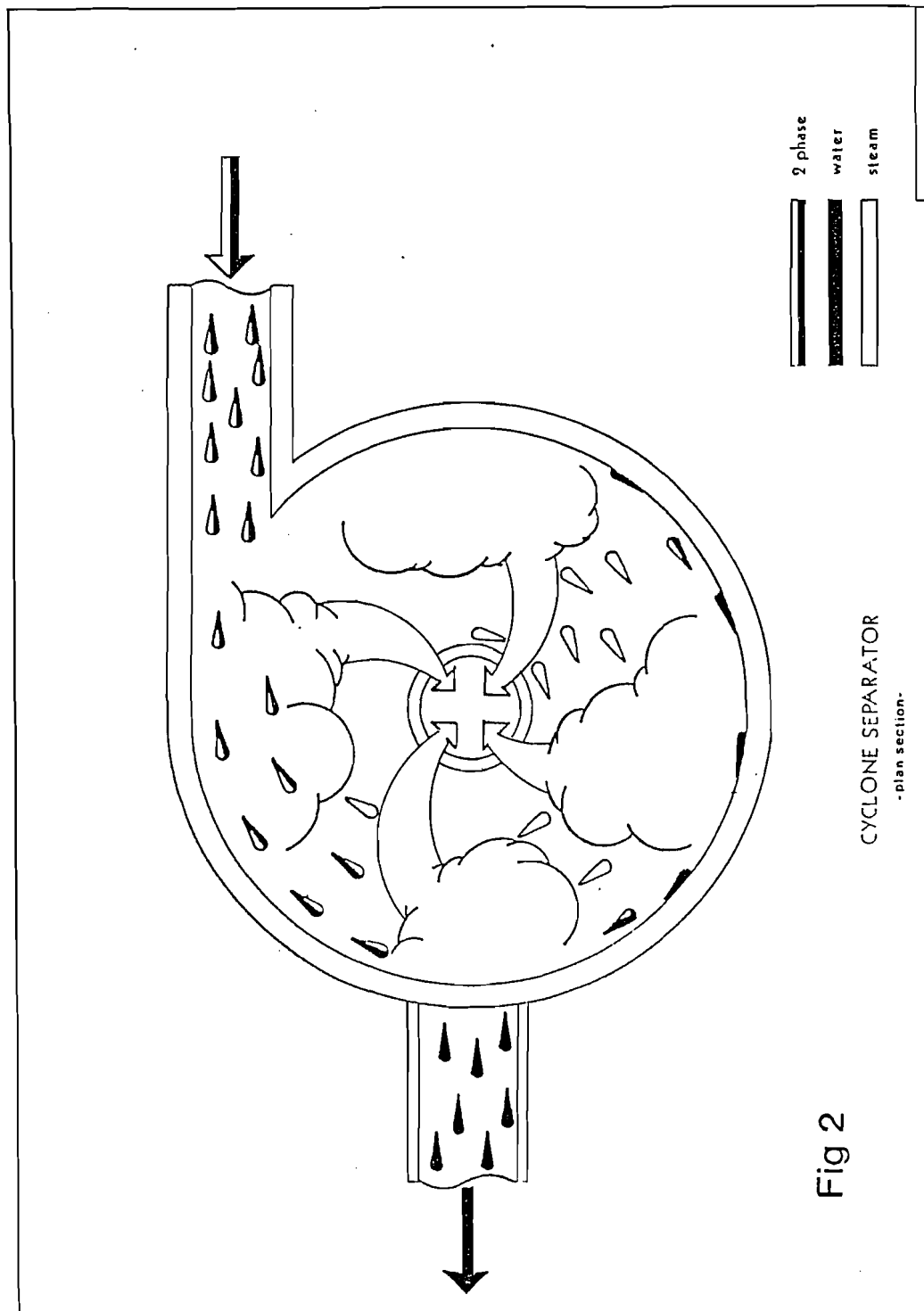
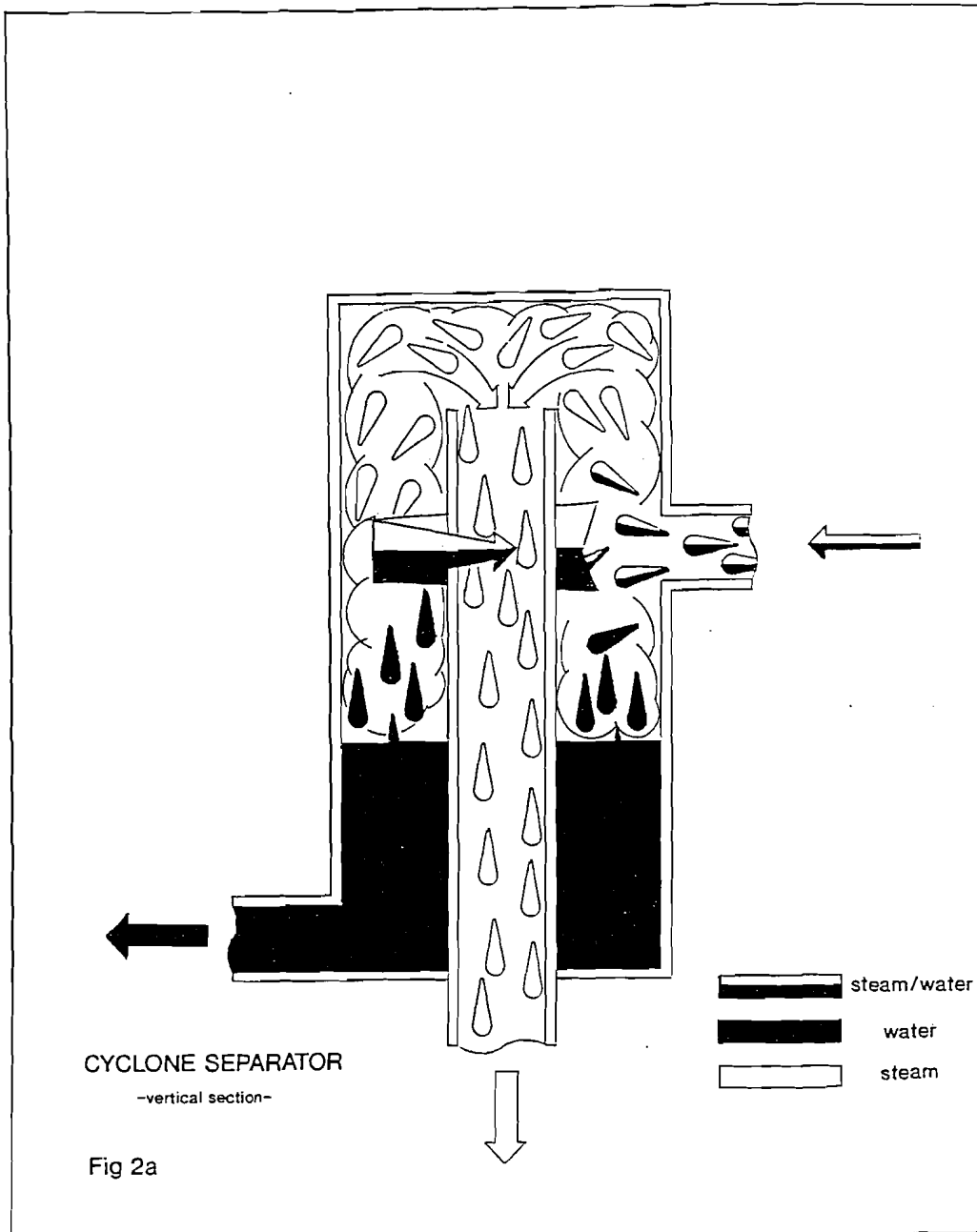
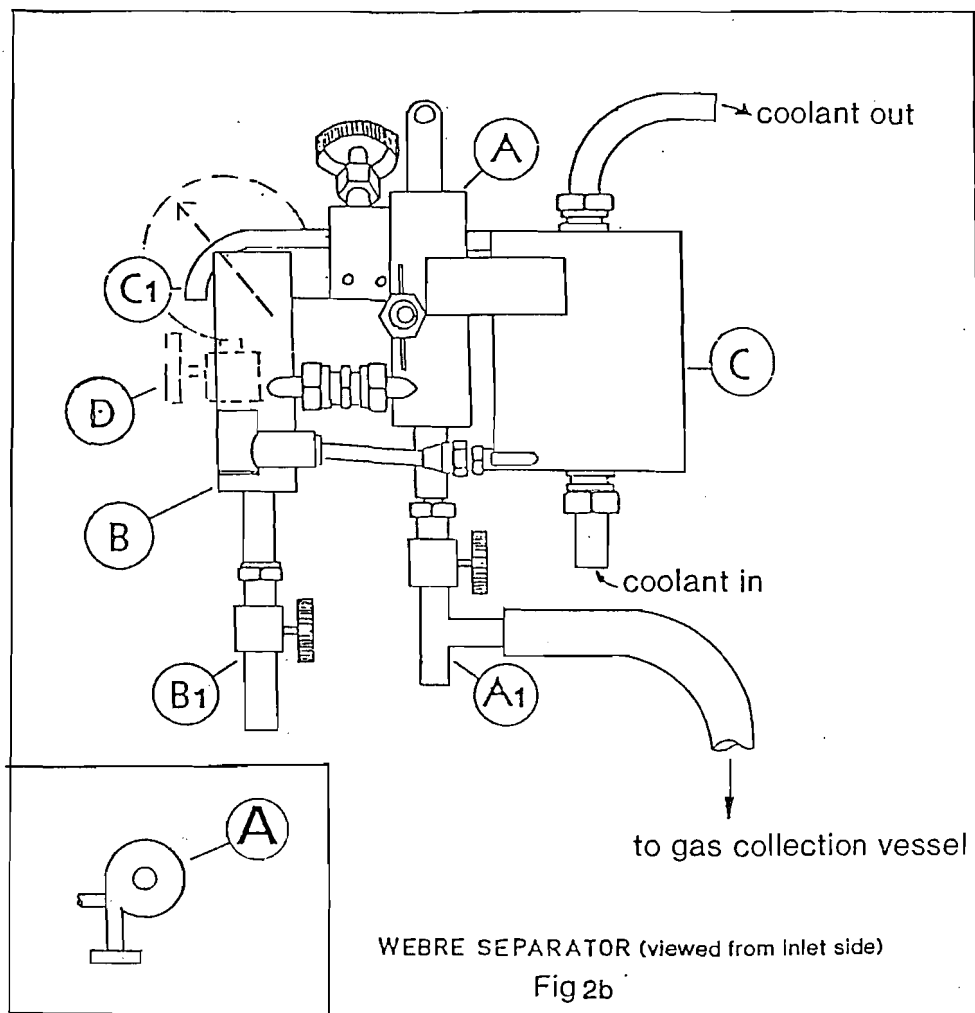
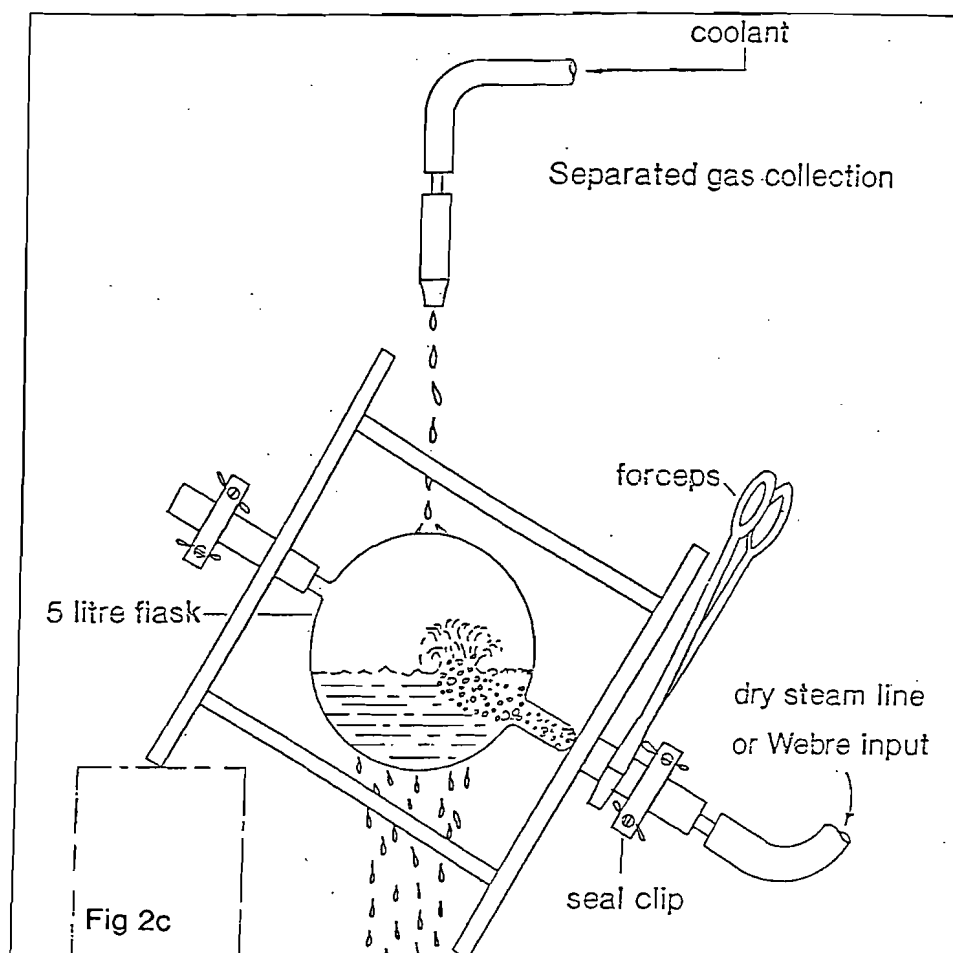


Fig 2







## Webre separated water collection

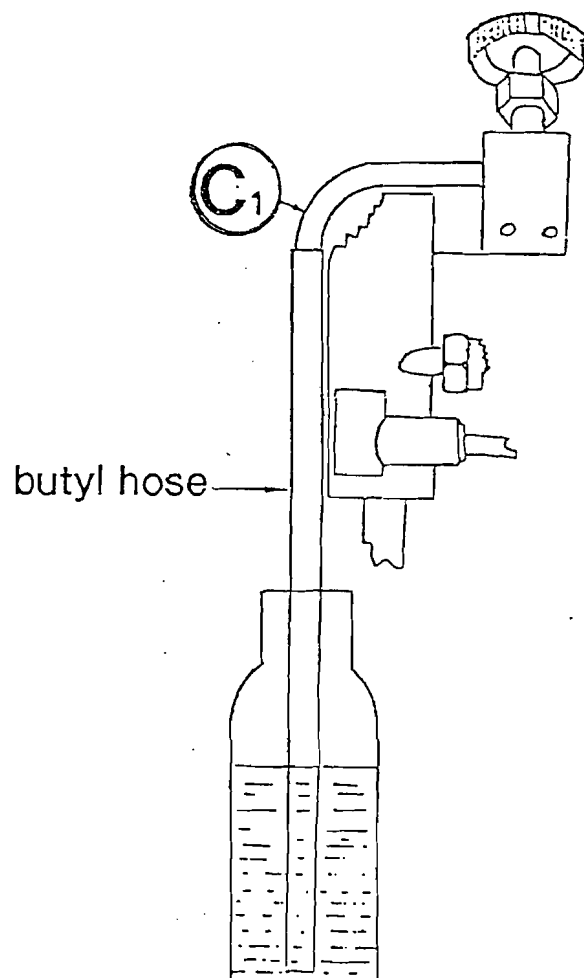


Fig 2d

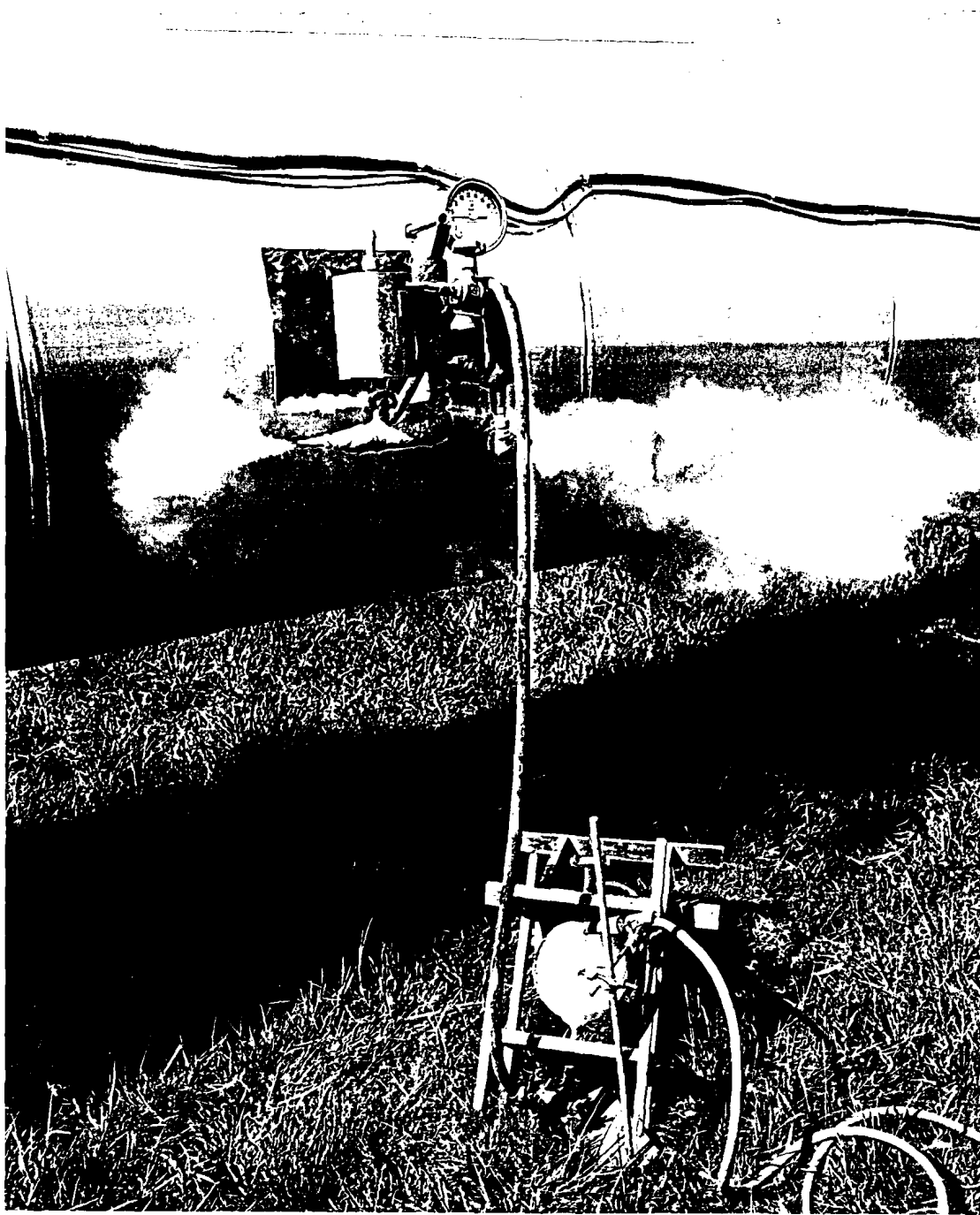


Fig 2e

Webre Separator connected to 2 phase steam/water line  
with 5 litre gas collection flask

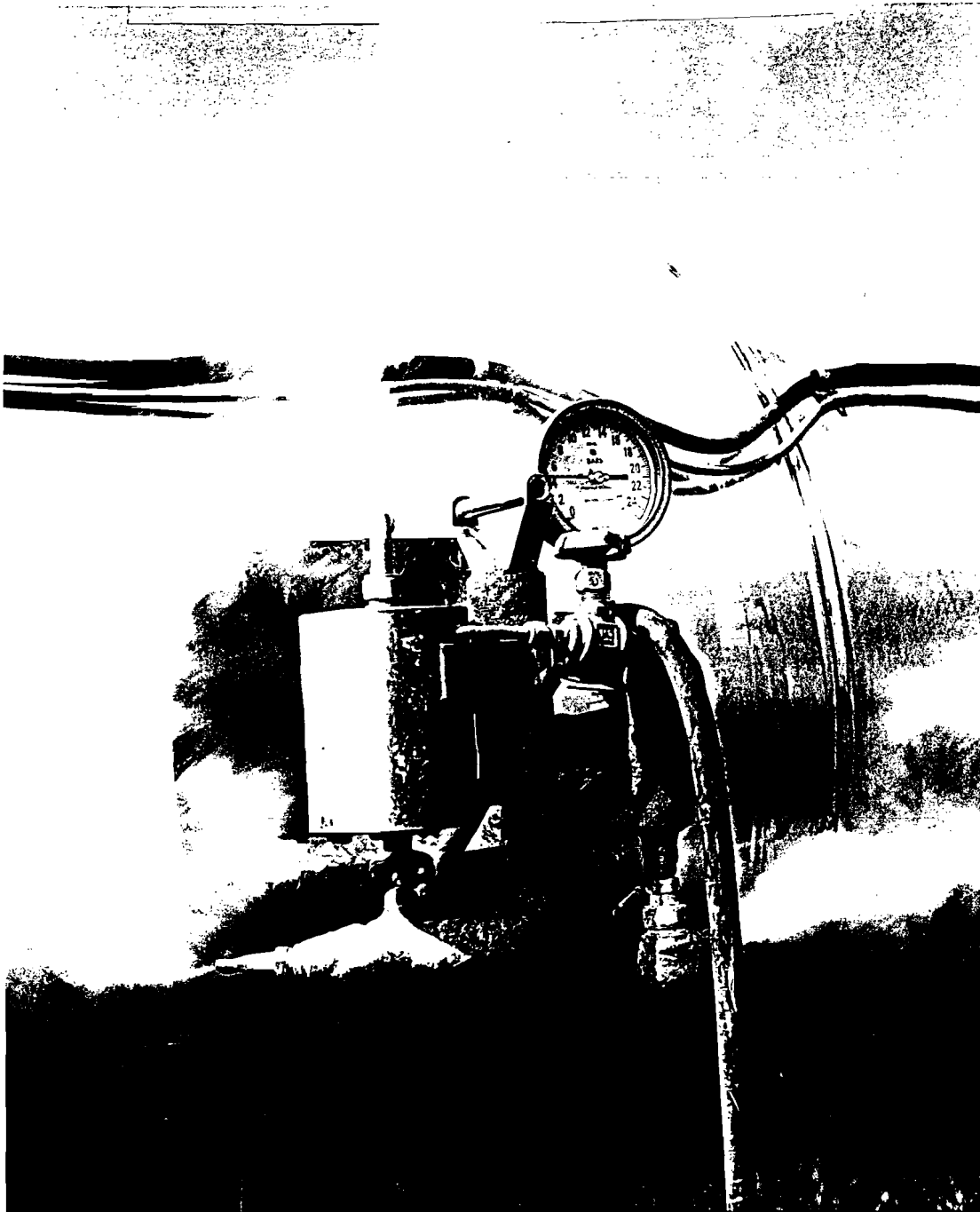


Fig 2f

Webre Separator connected to 2 phase steam/water line



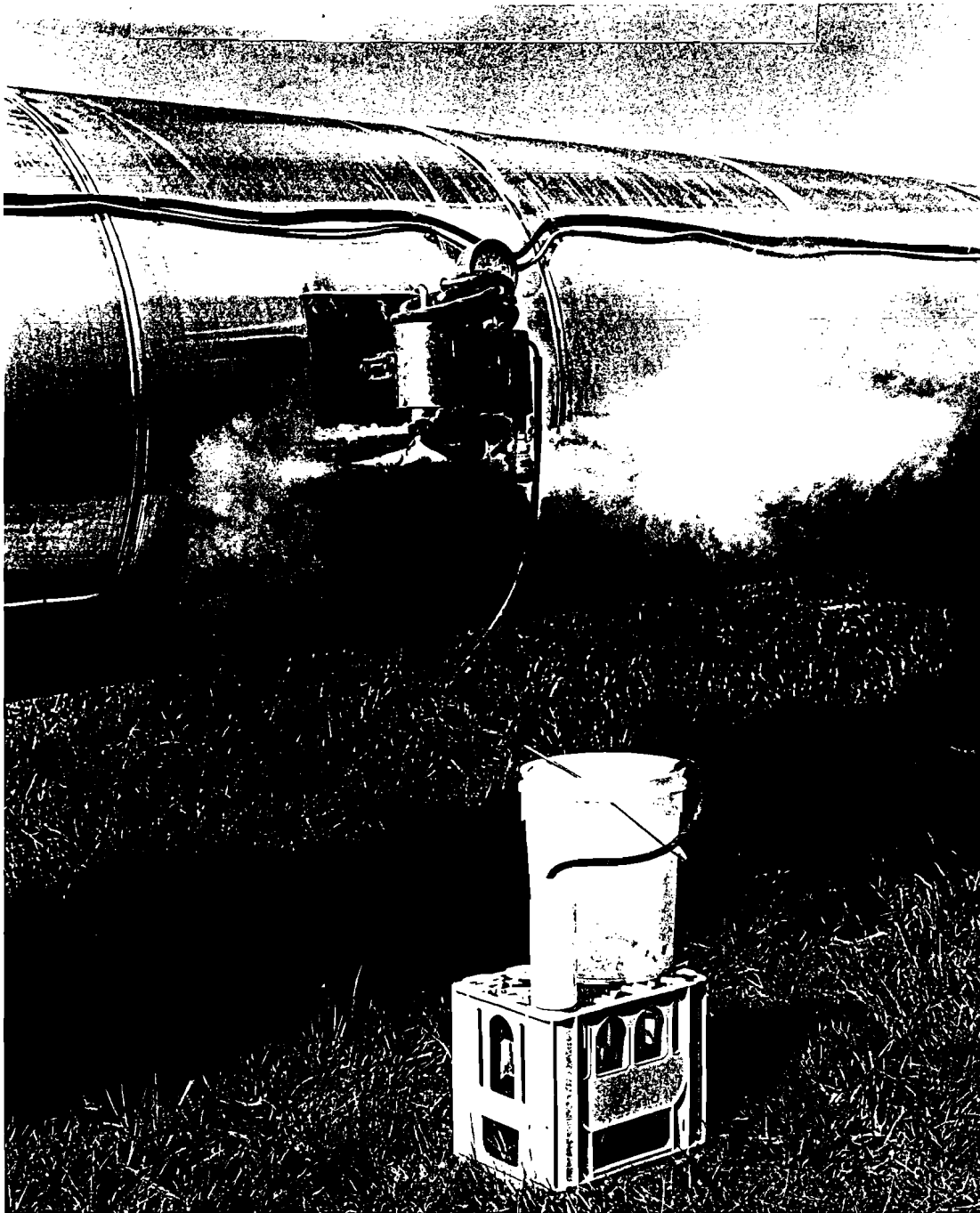


Fig 2g

Webre Separator connected to 2 phase steam/water line  
with separated water cooler and collection bottle

## **HIGH PRESSURE HOT WATER COOLER**

### **Function**

To cool separated, high pressure, geothermal hot water to a temperature at which it may be extracted without evaporation. This device duplicates one of the Webre separator functions but is often more readily adaptable to the close to ground level location of most hot water sampling points. It also may, if required, perform as a simple high pressure condenser.

### **Use**

- (i) for the collection of separated, high pressure, geothermal hot water samples.
- (ii) for the collection of geothermal dry steam condensates.

### **Description** (refer Figs 3)

Separated, high pressure, hot water enters the stainless steel tube (A) upon opening the sample point valve. Cooling water flows freely through the water jacket (B) which encloses the pressure tube (A). Cooled sample water may be collected at atmospheric pressure from (C).

### **Method**

- (i) (Refer Fig 1, 1a, 3, 3a, 3b) The cooler is connected to a sampling point on a separated hot water line. Cooling water is fed into the water jacket (B). Appropriate adjustment of the valve at (C) will deliver sample water at a temperature, say 30°C, at which significant evaporation does not occur.
- (ii) Dry steam condensation is achieved by connecting the cooler downstream from, a dry steam source: eg, a Webre separator or by direct connection to a separated dry steam line.
- (iii) (Refer Fig 3c) For gas collection free from steam and condensate a trap is interposed between the cooler and the gas collection vessel.

### **Operation for high pressure hot water collection**

- (1) (Refer Fig 3, 3a, 3b) Attach the cooler to a closed sample point by means of a stainless steel swivel union fitting. Note WHP and WH Separator pressure where applicable.
- (2) (Refer Fig 3, 3a, 3b) Mount and secure the cooler in an inclined attitude with the sample discharge port highest to ensure that the water jacket is full of water.
- (3) (Refer Fig 3) Shut the valve at (C).

- (4) (Refer Fig 3, 3a, 3b) Attach sufficient a length of 12mm OD x 7mm ID butyl rubber tubing to the sample discharge port at (C) to reach the bottom of the sample collection vessel.
- (5) (Refer Fig 3, 3a, 3b) Apply cooling water to the lower water jacket connection.
- (6) Crack open sample point valve and check for leakage.
- (7) (Refer Fig 3) If system is leakage free completely open the valve at (C) and purge the cooler pressure tube until vapour appears.
- (8) (Refer Fig 3) Shut valve at (C)
- (9) (Refer Fig 3) Fully open sample point valve. Note SPP on gauge at (C)
- (10) (Refer Fig 3) Open valve at (C) until a small discharge, of not greater than 30°C, flows from the the butyl rubber tubing.
- (11) Allow to flow for five minutes then check discharge temperature.
- (12) (Refer Fig 3, 3a, 3b) If the discharge temperature remains at less than 30°C sample collection may proceed with the butyl rubber tubing located close to the bottom of a collection vessel. If the discharge temperature rises above 30°C discontinue sample collection and reduce the flow rate by manipulating the valve at (C). Recommence sampling two minutes after the discharge temperature falls to below 30°C. Note SP. NB: Always precede sample collection by twice rinsing the collection vessel with sample water.
- (13) Throughout the entire period of sampling be watchful for bubble emission from the butyl rubber tubing. Bubbling may be an indication of insufficient cooling and/or too rapid a collection rate. If bubbling persists even when the discharge remains cool it will be attributable to excess steam and gas entering the separated hot water line and should be recorded and reported to the section supervisor.
- (14) Sample volume may be dictated by analytical requirements but a normal collection suite consist of:
  - 1 x 1000 ml or 500 ml plastic bottle
  - 1 x 100 ml plastic bottle, filtered + 1.0ml 1:1 nitric acid
  - 1 x 500 ml rubber sealed glass bottle

### **Operation for dry steam condensate collection and steam-free gas collection**

(refer Fig 3c)

- (1) Secure a short length of 21mm OD x 7mm ID butyl rubber hose to the upstream end of the cooler's swivel union fitting.

- (2) Attach sufficient a length of similar sized hose to the dry steam source through a pressure relief tee-piece (Figs 4, 4a) or, where applicable, set the Webre separator up for optimum separation discharge.
- (3) Connect the dry steam discharge hose to the cooler's swivel union fitting per the rubber extension.
- (4) For dry steam condensate collection proceed according to the instructions for hot water sampling above. Distinguish between unacceptable steam bubbles and normally attendant gas bubbles by observing a strict control over discharge temperature.
- (5) For gas collection free of steam and condensate a trap is interposed between the cooler and the gas collection vessel which separates the desired gas from the unwanted condensate.
- (6) Sample volume will be dictated by current analytical requirements in the absence of any "normal" specification for this comparatively rare procedure.

#### **Routine Maintenance**

- (1) Thoroughly flush out pressure tube with clean tap water.
- (2) Check pressure gauge and recalibrate where necessary.

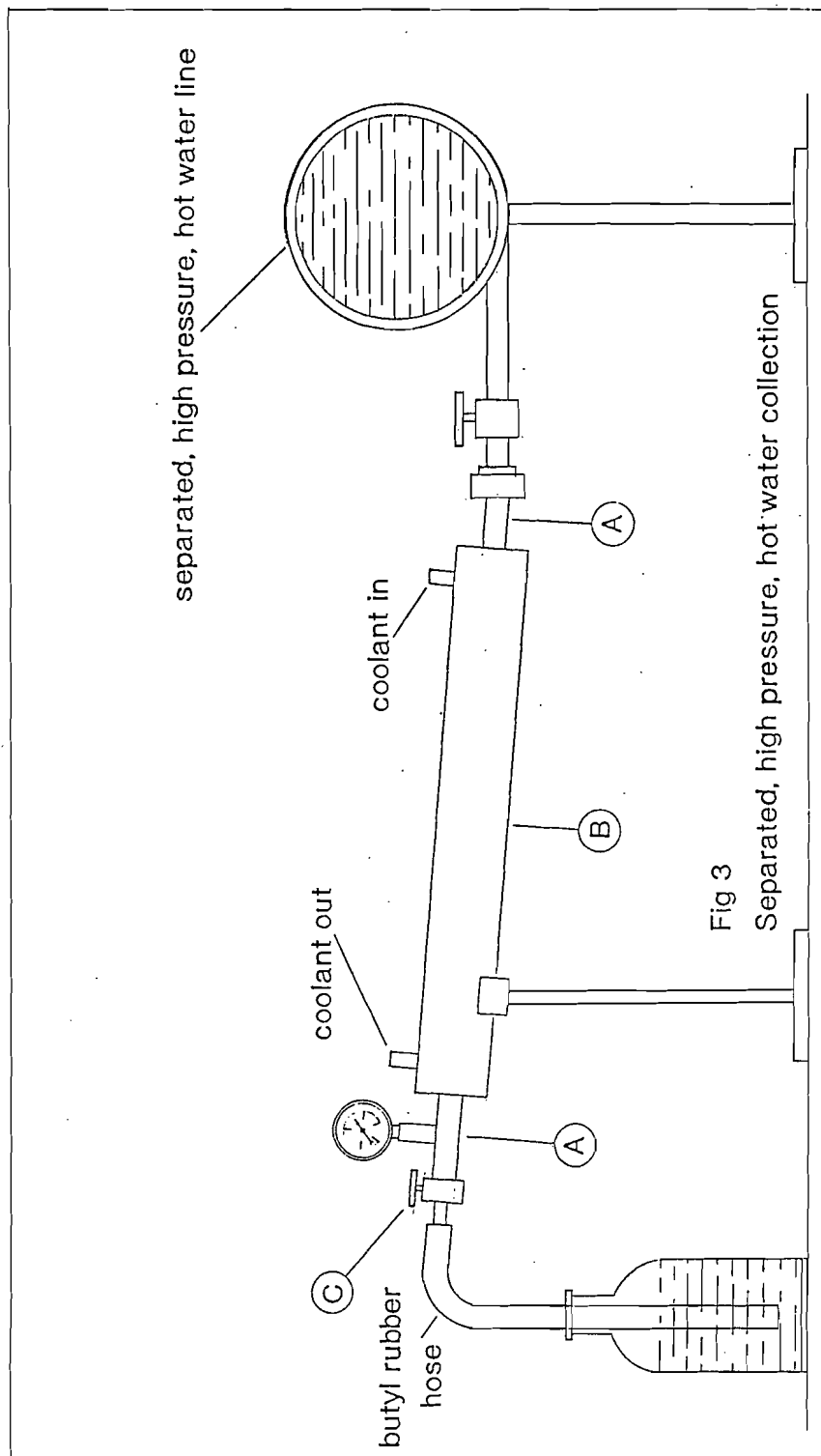
## Specimen Field Notes

**Well No:**                      **Date:**                      **Time:**                      **Hrs**

WHP =           bar gauge  
CP    =           bar gauge  
SPP   =           bar gauge  
SP    =           bar gauge

## Separated Water (or condensate) Sample per Cooler

Plastic bottle	1000 ml or 500 ml
Plastic bottle	100 ml - filtered+1.0ml 1:1 nitric acid
Rubber seal glass bottle	500 ml



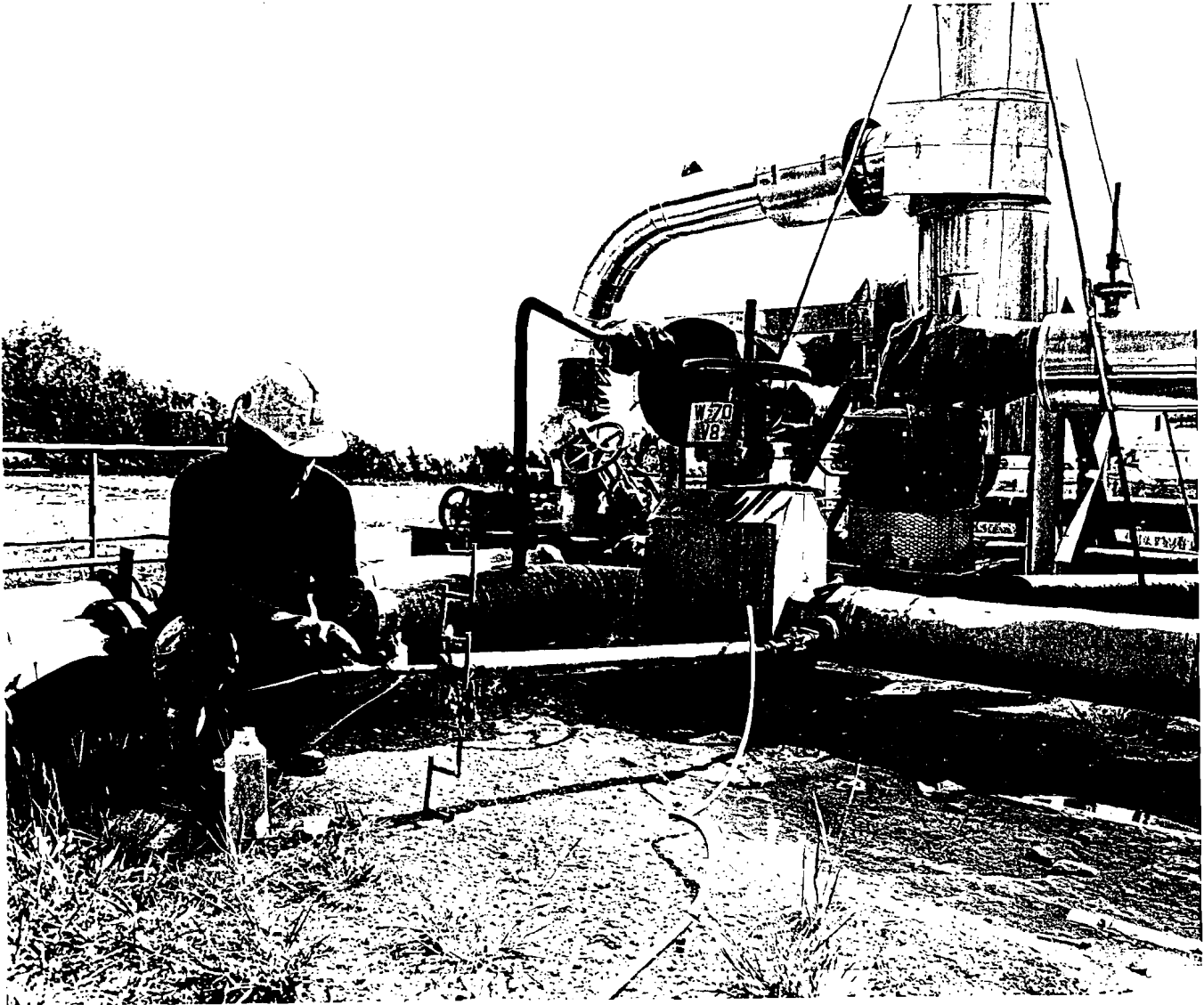


Fig 3a

High pressure Hot Water Cooler attached to separated water line

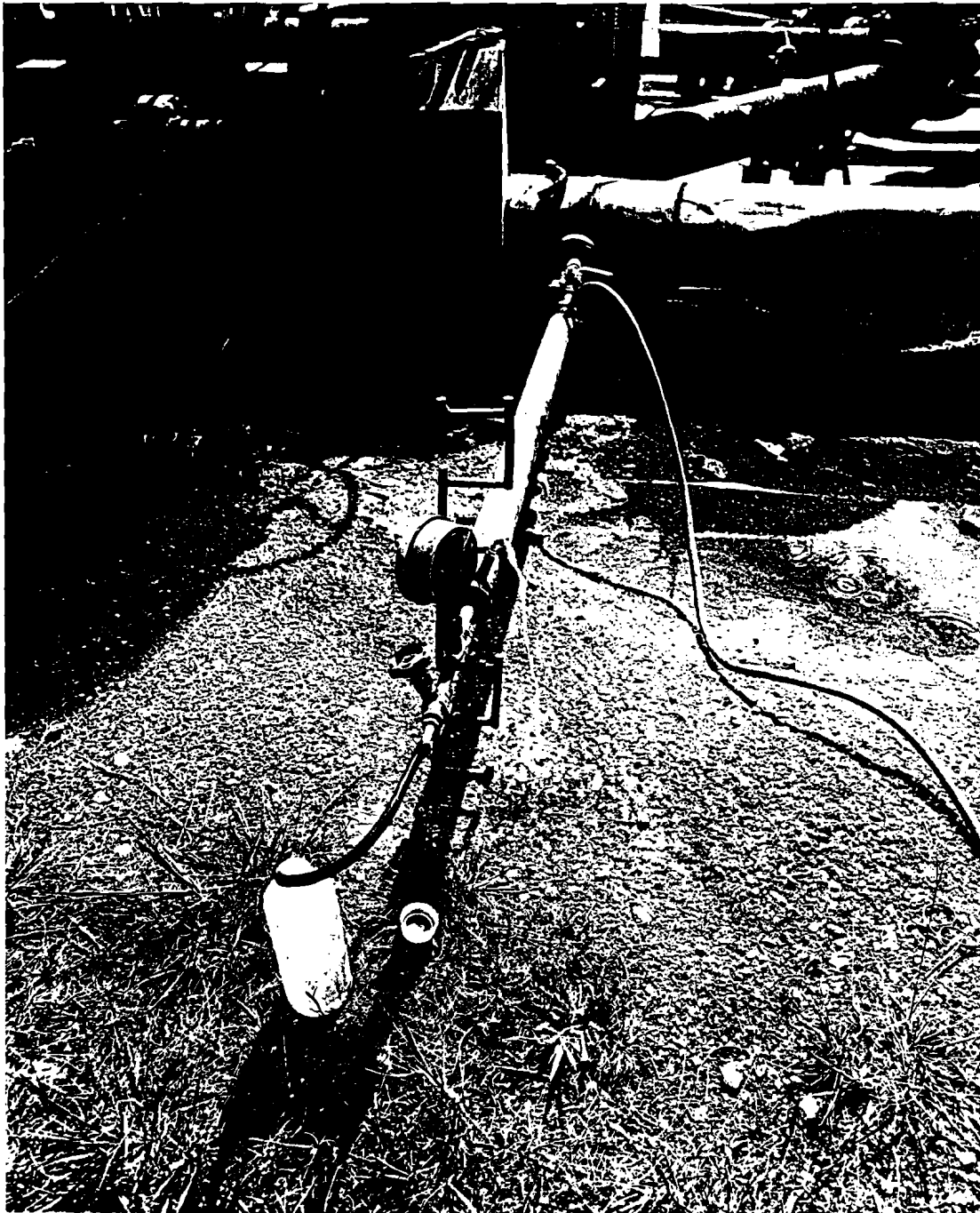


Fig 3b

High pressure Hot Water Cooler attached to separated water line



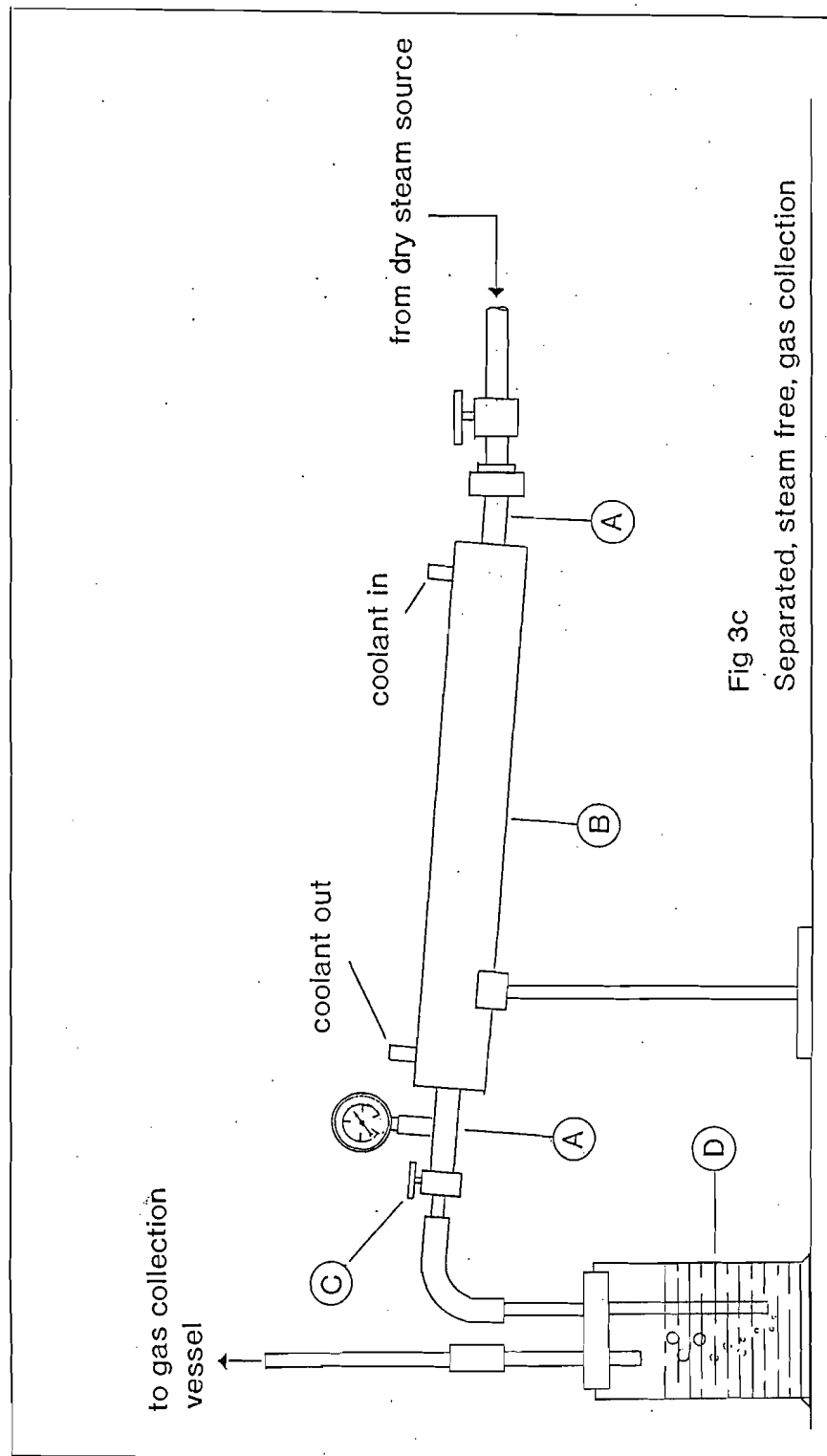


Fig 3c  
Separated, steam free, gas collection

## INTERMEDIATE AND LOW PRESSURE HOT WATER COOLER

### Function

To cool separated intermediate and low pressure geothermal hot water (ie, pressures at which unsecured rubber hose connections safely are compatible, say  $\leq 6.0$  bar) to a temperature at which it may be extracted without excessive evaporation. This device duplicates one of the functions of the Webre separator but is more readily adaptable to the location of most hot water sample points. It is, furthermore, quicker and more easily set up than either the Webre separator, (which it may serve in an ancillary role) or the High Pressure Hot Water Cooler. It also may, if required, perform as a simple condenser.

### Use

- (i) For the collection of separated, intermediate to low pressure, geothermal hot water samples.
- (ii) For the collection of separated geothermal, dry steam, condensate samples.

### Description (refer Figs. 3d, 3e)

A stainless steel tube, wound into a spiral, is immersed in a pail of constantly replenished cold water and/or ice. Both ends of the spiral are fitted with butyl rubber hose connections. The upstream hose connects the spiral to the sample source whilst the downstream hose delivers a cooled sample. NB: the spiral commonly is made from specification 316 stainless steel.

### Method (refer Figs 3d, 3e)

- (i) With the upstream hose attached to the sample point the spiral is immersed in a pail through which a continuous supply of cold water is passed. Sampling rates will be enhanced by the addition of ice to the pail while situations yet more demanding may more speedily be dealt with by linking in series two spirals, each in its own bucket. For other, less rigorous, conditions a single pail of unreplenished cold water may suffice. Cooled sample water is discharged at the downstream hose.
- (ii) Dry steam condensate sampling is achieved by connecting the cooler downstream from a dry steam source: eg: Webre separator, steam line. Again, individually cooled, tandem spirals, often are an asset to this method of sample collection where cooling demands are high. Cooled sample condensate is discharged at the downstream hose.
- (iii) For steam and condensate free gas collection a trap is interposed between the cooler and the sample collection vessel.

### **Operation for intermediate and low pressure hot water collection (refer Fig 3d)**

- (1) Note SPP and connect the cooling coil to a closed separated hot water sample point by means of a butyl rubber hose.
- (2) Immerse the coil in a pail of constantly replenished cold water or, where cooling demands are high, ice and cold water.
- (3) Attach sufficient a length of 12mm OD x 6mm ID butyl tubing to the downstream end of the spiral to reach the bottom of the sample collection vessel.
- (4) Crack open the sample point valve sufficiently to establish a modest flow at the downstream butyl tubing.
- (5) Allow the spiral to discharge to waste three times its own (pre-measured) volume.
- (6) If the discharge water is at a temperature greater than 30°C then reduce flow at the sample point valve.
- (7) With a discharge temperature of  $\leq 30^{\circ}\text{C}$  and the downstream butyl tubing located close to the bottom of the sample collection vessel sampling may proceed.
- (8) Throughout the sampling period be alert to bubble emission from the butyl rubber tubing. Bubbling may be an indication of insufficient cooling and/or too rapid a collection rate. If bubbling persists even when the discharge remains cool it will be attributable to excess steam/gas present in the separated hot water line and should be recorded and reported to the section supervisor.
- (9) Sample volume may be dictated by analytical requirements but a normal collection suite consists:

- 1 x 1000 ml or 500 ml plastic bottle
- 1 x 100 ml plastic bottle, filtered + 1.0ml 1:1 nitric acid
- 1 x 500 ml rubber sealed glass bottle

### **Operation for dry steam condensate and steam-free gas collection (refer Fig 3e)**

- (1) Secure a pressure relief tee-piece (refer Fig 4) to a closed separated dry steam line sample point or, alternatively, set up the Webre separator for optimum dry steam separation.
- (2) Close tee-piece valve (B)
- (3) Secure a 21mm OD x 7mm ID butyl rubber hose to the dry steam source and connect to the upstream end of the cooling spiral.

- (4) Open sample point valve and note SPP
- (5) For separated steam condensate collection proceed according to the hot water sampling instructions above. Distinguish between unacceptable steam bubbles and normally attendant gas bubbles by exercising a strict control over discharge temperature.
- (6) For steam and condensate-free gas collection separate the desired gas from the unwanted fraction by interposing a trap between the cooler and the gas collection vessel. (refer Fig 3e)
- (7) Sample volume for steam condensate collection may be dictated by analytical requirements but a normal suite consists:
  - 1 x 1000 ml, or 500 ml plastic bottle
  - 1 x 100 ml plastic bottle, filtered+1.0ml 1:1 nitric acid
  - 1 x 500 ml rubber sealed glass bottle
- (8) Sample volume for steam and condensate-free gas collection will be entirely dictated by current analytical requirements due to the rarity of this procedure.

## Specimen Field Notes

**Well No:**                      **Date:**                      **Time:**                      **hrs**

WHP =                      bar gauge

CP =                      bar gauge

SPP =                      bar gauge

## Separated Water (or condensate) Sample per Cooler

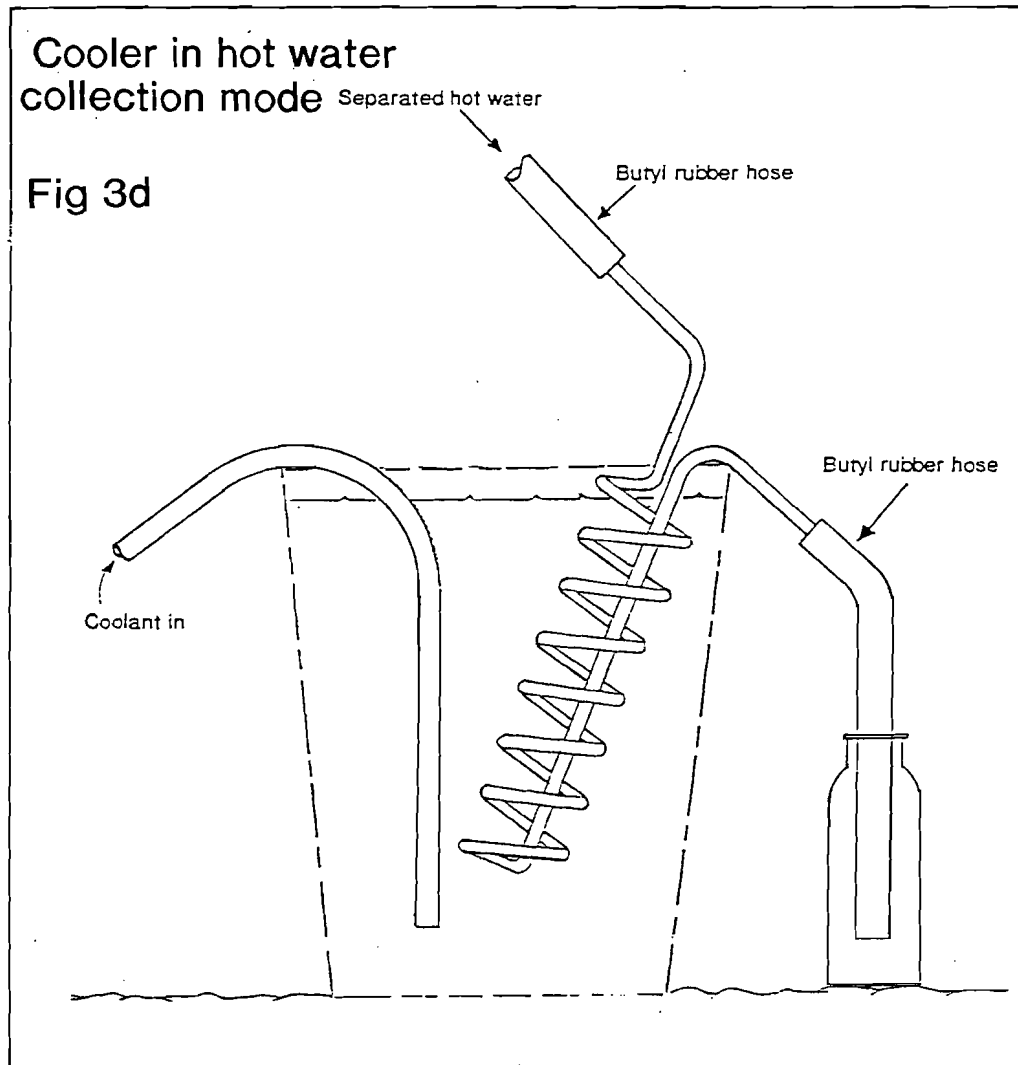
Plastic bottle                      1000 ml or 500 ml

Plastic bottle                      100 ml - filtered+1.0ml 1:1 nitric acid

Rubber seal glass bottle                      500 ml

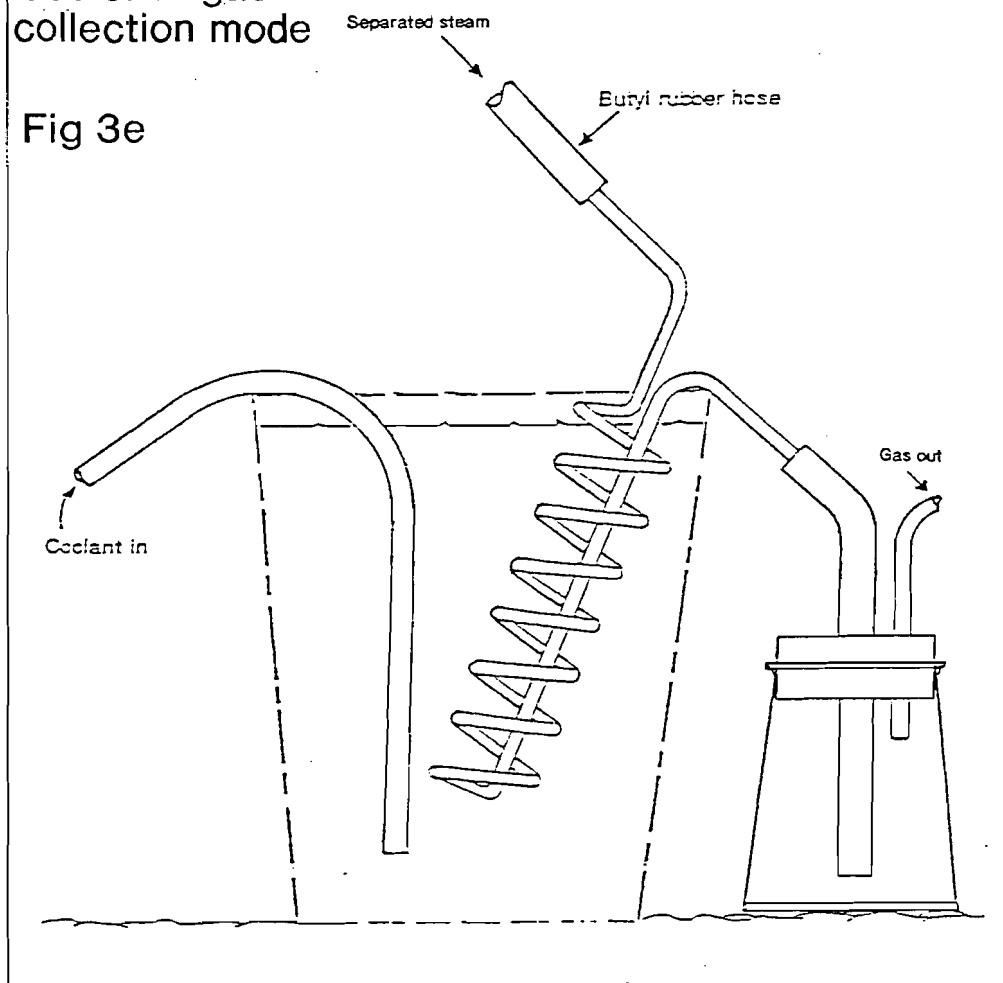
Cooler in hot water  
collection mode

Fig 3d



Cooler in gas  
collection mode

Fig 3e



## GLOSSARY

<b>ALLEN KEY</b>	A driving tool, of hexagonal cross-section, designed to fit a socket in the head of an Allen screw.
<b>ALLEN SCREW</b>	A screw possessing an hexagonal recess into which an Allen key is fitted for purposes of tightening and loosening.
<b>BUTYL RUBBER</b>	A elastomer less permeable than most rubbers to gas diffusion. Butyl rubber tubing of: 21 mm OD x 7 mm ID, is suitable for gas collection flask connections and the dry steam hose of a Webre separator. 25 mm OD x 21 mm ID is suitable as an impermeable seal for water sample collection vessels.
<b>"CRACK" A VALVE</b>	To open a valve only the minimum amount necessary to allow the escape of a contained fluid.
<b>CYCLONE SEPARATOR</b>	A vertical cylinder into which a fluid mixture is tangentially injected. The heavier water fraction of the mixture, centrifugally separates and drains under gravity through a vent close to the base of the cylinder. The lighter components, steam and gas, escape through a vent communicating with the top of the cylinder's interior. See Figures 1 and 2.
<b>DRY STEAM</b>	Water free steam.
<b>DWANG</b>	A removable, usually adjustable, handle for the manual rotation of taps, dies, valve stems etc.
<b>DYNAMIC SEAL</b>	A component, such as a piston-ring, which maintains its seal over a distance of linear travel unlike a gasket which seals only statically.
<b>FLASHED WATER</b>	The liquid phase remaining from the separation of steam derived from single-step pressure drop of high temperature water or steam/water mixture.
<b>GLAND</b>	A device for sealing around cylindrical objects such as pump connecting rods, valve stems and, in the Klyen sub-surface sampler MkI, the glass break-off tubes.
<b>GLAND NUT</b>	A component part of a gland by which the seal is secured and/or compressed.
<b>HYDRAULIC DESCENT CONTROL OR HYDRAULIC DRAG</b>	A useful mechanism incorporated into many wireline winches where a variably throttled pump may be engaged at will to a ring-gear mounted on one of the wireline spool cheeks. As



instrument and wireline is paid off downhole the resultant rotation of the spool drives the closed pumping system. Adjustment of the throttle provides a smooth, controllable and, therefore, safe descent. The use of this device is strongly recommended wherever wireline borehole logging is undertaken.

**HYDROSTATIC PRESSURE**

The pressure exerted by an overlying liquid. Ten metres depth of cold water equals approximately 1 kilogram per sq. centimeter, or 0.98 bar.

**INERTIA MECHANISM**

A device incorporated in Klyen sub-surface samplers where a guided, spring-suspended, mass when jerked punctures a pressure seal.

**LOSS ZONE**

A zone encountered during well drilling where the fluids associated with drilling are lost into fissures and cavities in the immediate geological formations. Such zones often are the target of sub-surface sampling operations.

**SWIVEL UNION**

A pipe fitting normally consisting of a secured semi-ball and socket seal. It is a useful device providing an adjustable connection between the Webre separator and a sample point.

**NON-RETURN VALVE**

A valve admitting flow in one direction only. Such a valve allows a the sample vessel in a Klyen sub-surface sampler to fill but prevents subsequent leakage.

**O-RING**

A seal ring of solid, circular, cross-section, often of elastomeric material which, when correctly seated, provides a wide range of both static and dynamic sealing applications.

**PERMEABLE ZONES**

Geological formations through which fluids may move. Such zones often are the target of sub-surface sampling operations.

**RECOVERY GEAR**

(US = LUBRICATOR) Normally a flanged pipe bearing at its upper end a removable gland. Its purpose is to provide access for downhole instruments into pressurized wells. This is accomplished when the recovery gear is secured to the wellhead with the wireline threaded through the gland and shackled to an instrument contained within the recovery gear at which point the master valve may safely be opened and the instrument lowered. Upon retrieval of the instrument the master valve is closed and pressure within the recovery gear is exhausted through a valve to atmosphere. The instrument may then be recovered upon removal of the upper gland or by releasing the recovery gear from the wellhead. See Figure 8b.

<b>"ROTOFLO" FLASKS</b>	These derive their name from commercially available "Rotoflo" teflon sealed, valves.
<b>SAMPLE POINT PRESSURE</b>	The pressure at the sample point in the absence of any discharge.
<b>SAMPLE PRESSURE</b>	The pressure at which sampling takes place.
<b>STEAM FRACTION</b>	The water vapour component of a steam/water two-phase flow.
<b>SHIM</b>	A thin metal plate such as those used as puncture seals in the Klyen sub-surface sampler MkII, MkIIa and MkIIb.
<b>TWO-PHASE FLOW</b>	Any simultaneous liquid and gas flow along a confined path: geothermally, a steam plus gas/water flow normally within a pipe.
<b>TOMMY BAR</b>	A lever designed to fit a matching recess.
<b>THIMBLE:</b>	A peripherally grooved, tear-drop shaped ring for forming eyelets at the ends of wires and ropes.
<b>VAPOUR PRESSURE</b>	The pressure of a vapour exerted either by itself or in a mixture of gases.
<b>WATER FRACTION</b>	The liquid water component of a steam/water two-phase flow.
<b>WEBRE SEPARATOR</b>	A miniature, twin-cyclone, separator. See "cyclone separator".
<b>WEIRBOX</b>	A compartment located at the base of a geothermal well silencer. It contains a small dam over which flashed water from the silencer drains. Its known dimensions, together with other criteria, provide a ready means of enthalpy and mass flow measurement. Useful water samples are collected from the weirbox.
<b>WHP = WELLHEAD PRESSURE</b>	The pressure existing within the wellhead assembly.
<b>WIRELINE</b>	Normally a single strand, stainless-steel, wire from which some downhole logging and sampling instruments are suspended.

## **Appendix 3 - Climate Change (Unique Emissions Factors) Regulations 2009**



## **Climate Change (Unique Emissions Factors) Regulations 2009**

Rt Hon Sir Peter Blanchard, Administrator of the Government

### **Order in Council**

At Wellington this 28th day of September 2009

Present:

His Excellency the Administrator of the Government in Council

Pursuant to sections 163 and 164 of the Climate Change Response Act 2002, His Excellency the Administrator of the Government, acting on the advice and with the consent of the Executive Council and on the recommendation of the Minister for Climate Change Issues, makes the following regulations.

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## Regulations

### 1 Title

These regulations are the Climate Change (Unique Emissions Factors) Regulations 2009.

### 2 Commencement

These regulations come into force on 1 January 2010.

## Part 1 Preliminary matters

### 3 Interpretation

(1) In these regulations, unless the context otherwise requires,—

**Act** means the Climate Change Response Act 2002

**calorific value** means the energy content of a fuel on a gross or high heating value basis expressed in terajoules per tonne of fuel

**chief executive** means the chief executive of the department responsible for the administration of Part 4 of the Act

**coal importing participant** means a person who is a participant under section 54(1)(a) of the Act in respect of the activity listed in Part 3 of Schedule 3 of the Act of importing coal

**coal mining participant** means a person who is a participant under section 54(1)(a) of the Act in respect of the activity listed in Part 3 of Schedule 3 of the Act of mining coal, where the coal mined exceeds 2 000 tonnes in a year

**coal participant** means—

- (a) a coal importing participant; or
- (b) a coal mining participant; or
- (c) a coal purchasing participant

**coal purchasing participant** means a person who is a participant under section 54(1)(b) of the Act in respect of the activity listed in Part 4 of Schedule 4 of the Act of purchasing coal from 1 or more participants who mine coal, where the total coal purchased exceeds 250 000 tonnes per year

**default emissions factor** means an emissions factor that is specified in—

- (a) the Schedule of the Climate Change (Liquid Fossil Fuels) Regulations 2008; or
- (b) Schedule 2 of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009

**estimated uncertainty**, in relation to a unique emissions factor, means the uncertainty associated with the sampling and testing used to establish the unique emissions factor, estimated at a 90% confidence level

**fuel** means obligation fuel, obligation jet fuel, coal, natural gas, geothermal fluid, used oil, waste oil, used tyres, or waste

**geothermal participant** means a person who is a participant under section 54(1)(a) of the Act in respect of the activity listed in Part 3 of Schedule 3 of the Act of using geothermal fluid for the purpose of generating electricity or industrial heat

**mass fraction** means the ratio of the mass of a component in a mixture to the total mass of the mixture

**mix point** means the final point at which steam from 2 or more geothermal steam transmission lines is mixed before used in a geothermal plant

**natural gas purchasing participant** means a person who is a participant under section 54(1)(b) of the Act in respect of the activity listed in Part 4 of Schedule 4 of the Act of purchasing natural gas from 1 or more participants who mine natural gas, where the total natural gas purchased exceeds 2 petajoules per year

**obligation fuel** has the same meaning as in regulation 3 of the Climate Change (Liquid Fossil Fuels) Regulations 2008

**obligation fuel participant** means—

- (a) a person who is a participant under section 54(1)(a) of the Act in respect of an activity listed in Part 2 of Schedule 3 of the Act;
- (b) a person who is a participant under section 54(1)(b) of the Act in respect of an activity listed in Part 3 of Schedule 4 of the Act

**obligation jet fuel** has the same meaning as in regulation 3 of the Climate Change (Liquid Fossil Fuels) Regulations 2008



**periodic source testing option** means the option for calculating a unique emissions factor set out in regulations 21 to 23

**recognised verifier** means—

- (a) a person recognised under Part 3 to verify unique emissions factors for 1 or more activities specified in regulation 27; and
- (b) in relation to an activity specified in regulation 27, a person recognised under Part 3 to verify unique emissions factors for the activity

**representative**, in relation to samples of a fuel or to measurements or calculations, means taken or made at a sufficient frequency and duration to produce data that may be reliably extrapolated to provide estimates of, as relevant,—

- (a) the properties of a class of fuel;
- (b) emissions across the full range of operating conditions

**standard testing option** means the option for calculating a unique emissions factor set out in regulation 10 or 20

**waste combustion participant** means a person who is a participant under section 54(1)(a) of the Act in respect of the activity listed in Part 3 of Schedule 3 of the Act of combusting used oil, waste oil, used tyres, or waste for the purpose of generating electricity or industrial heat.

- (2) A reference to a test method containing an acronym listed in the left-hand column in the following table means a standard, or test method related to an organisation, that is listed in the right-hand column of the table:

Test method	Standard or organisation
AS	Australian Standard
ASTM	ASTM International
BS	British Standard
CEN/TS	Comité Européen de Normalisation (European Committee for Standardization) Technical Specification
EN	European Standard
IEC	International Electrotechnical Commission
IP	Energy Institute, which replaced the Institute of Petroleum, London
ISO	International Organization for Standardization
NZS	New Zealand Standard

Test method	Standard or organisation
USEPA	United States Environmental Protection Agency
VDI	The Association of German Engineers

- (3) Unless the context otherwise requires, if a test method prescribed in these regulations provides for alternative methods, each method has equal standing, and any of the methods may be used.

#### **4 Application for approval to use unique emissions factor**

- (1) A participant applying for approval to use a unique emissions factor must make the application using the form prescribed by the chief executive.
- (2) The application must—
- (a) state the activity to which the application relates; and
  - (b) describe—
    - (i) the class of fuel in respect of which the person applies for approval to use a unique emissions factor; or
    - (ii) if the unique emissions factor relates to fugitive coal seam gas, the category of coal in respect of which the person applies for approval to use a unique emissions factor; and
  - (c) specify the unique emissions factor for which approval is sought; and
  - (d) be accompanied by—
    - (i) a verification statement that complies with sub-clause (3);
    - (ii) a plan for ongoing sampling and testing of the fuel or gas to which the application relates;
    - (iii) any other information the chief executive may require.
- (3) The verification statement must—
- (a) certify that the verifier meets the requirements of regulation 24(1)(a) in relation to verifying unique emissions factors for the activity; and
  - (b) state the regulation or regulations under which the unique emissions factor was calculated; and

- (c) state that the verifier is satisfied as to all the matters in regulation 24(1)(b) to (d) in relation to the establishment and calculation of the unique emissions factor under these regulations; and
  - (d) be signed by the verifier.
- (4) An application for approval to use a unique emissions factor to calculate emissions in relation to a year must be submitted to the chief executive by 31 January in the following year.

**5 Chief executive may approve use of unique emissions factor**

- (1) The chief executive may approve the use by a participant of a unique emissions factor when calculating emissions from an activity if satisfied that—
  - (a) the person's application complies with regulation 4; and
  - (b) the class or category of fuel to which the application relates meets the criteria in regulation 6; and
  - (c) the verifier who has provided the verification statement required by regulation 4(2)(d) has been recognised by the chief executive as a person who can verify a unique emissions factor for the activity and that the recognition has not expired, or been surrendered, suspended, or revoked.
- (2) A unique emissions factor approved for use by a participant—
  - (a) may be used by the participant to calculate emissions only in relation to fuel within the class (or in the case of fugitive coal seam gas, coal within the category) that the unique emissions factor approval relates to; and
  - (b) is subject to any conditions notified by the chief executive at the time of approval.

**6 Criteria for class or category of fuel for which unique emissions factor may be used**

- (1) A class of fuel for which the chief executive may approve the use of a unique emissions factor must comply with the following criteria:
  - (a) if the activity for which the approval is sought—
    - (i) relates to owning or purchasing obligation fuel, the class must be a subset of a type of obligation

- fuel described in regulation 4(1) of the Climate Change (Liquid Fossil Fuels) Regulations 2008:
- (ii) relates to mining coal, the class must relate to coal from a particular coalfield, or a subset of coal from a particular coalfield:
  - (iii) relates to importing or purchasing coal, the class must relate to—
    - (A) coal from a particular coalfield or a subset of coal from a particular coalfield; or
    - (B) coal that is combusted in particular equipment:
  - (iv) relates to purchasing natural gas, the class must be a class or subset of a class of natural gas listed in regulation 4(d) of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 or a subset of natural gas mined at a field listed in Table 10 of Schedule 2 of those regulations, that is combusted in particular equipment:
  - (v) relates to using geothermal fluid, the class must relate to a particular plant or process that uses geothermal fluid (or geothermal steam from geothermal fluid):
  - (vi) relates to combusting used oil, waste oil, used tyres, or waste, the class must,—
    - (A) if the unique emissions factor is calculated in accordance with regulation 20, be a class or subset of a class in Table 7 of Schedule 2 of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009; or
    - (B) if the unique emissions factor is calculated in accordance with the periodic source testing option, be a class or subset of a class in Table 7 of Schedule 2 of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 that is combusted in particular equipment; and

- (b) the class must have well-defined parameters so that fuel within the class may be easily identified and accounted for separately from fuel that is not within the class.
- (2) A category of coal for which the chief executive may approve the use of a unique emissions factor for fugitive coal seam gas must—
  - (a) relate to underground mining at a particular coal mine or a subset of underground mining at a particular coal mine; and
  - (b) have well-defined parameters so that coal within the category may be easily identified and accounted for separately from coal that is not within the category.

## Part 2

### Activities for which unique emissions factor may be sought

#### *Owning and purchasing obligation fuel*

- 7 Obligation fuel participant may apply for approval to use unique emissions factor**
  - (1) An obligation fuel participant may apply to the chief executive for approval to use a unique emissions factor when calculating emissions in relation to a class of obligation fuel in accordance with the Climate Change (Liquid Fossil Fuels) Regulations 2008.
  - (2) However, an obligation fuel participant may apply for approval to use a unique emissions factor only if the difference between the unique emissions factor and the default emissions factor that would otherwise apply to the obligation fuel is more than 2%.
  
- 8 Requirements relating to application for unique emissions factor approval by obligation fuel participant**

An obligation fuel participant who wishes to apply for approval to use a unique emissions factor in relation to a class of obligation fuel must—

  - (a) obtain representative samples of the class of obligation fuel for which the unique emissions factor is sought at

intervals and in accordance with a procedure that complies with ISO/IEC 4259:2006; and

- (b) have the following tests carried out on each of the fuel samples by a person or laboratory that is accredited as complying with ISO/IEC 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand's mutual recognition arrangements to carry out the tests:
  - (i) ASTM D5291-02 (carbon content) or an equivalent standard or test method for testing carbon content related to an organisation that is listed in the table in regulation 3(2);
  - (ii) ASTM D1298-99 or ISO 3675:1998 (density at 15°C); and
- (c) calculate the emissions factor for carbon dioxide for the class of obligation fuel in accordance with the following formula:

$$EF_{CO_2} = m_c \times D \times EF_c$$

where—

- D is the mean density of the obligation fuel samples determined by reference to the results of the test chosen in paragraph (b)(ii) and expressed in kilograms per litre (kg/l)
- $EF_c$  is the emissions factor for pure carbon specified in Table 3 of the Schedule
- $EF_{CO_2}$  is the emissions factor for  $CO_2$  for the class of obligation fuel in tonnes of carbon dioxide per kilolitre (t $CO_2$ /kl)
- $m_c$  is the mean mass fraction of carbon in the obligation fuel samples determined by reference to the results of the tests in paragraph (b)(i); and
- (d) calculate the unique emissions factor for the class of obligation fuel in accordance with the following formula:

$$UEF = (EF_{CO_2} \times OF) + EF_{CH_4} + EF_{N_2O}$$

where—

$EF_{CH_4}$  is the emissions factor for  $CH_4$  from Table 1 of the Schedule that applies to the obligation fuel whose specifications are closest to the fuel for which a unique emissions factor is sought

$EF_{CO_2}$  is the emissions factor for  $CO_2$  determined under paragraph (c) expressed in tonnes of carbon dioxide per kilolitre ( $tCO_2/kl$ )

$EF_{N_2O}$  is the emissions factor for  $N_2O$  from Table 1 of the Schedule that applies to the obligation fuel whose specifications are closest to the fuel for which a unique emissions factor is sought; and

OF is an oxidation factor of 0.99

UEF is the unique emissions factor for the class of obligation fuel expressed in tonnes of carbon dioxide equivalent gases per kilolitre ( $tCO_2e/kl$ ); and

- (e) submit the following material to a recognised verifier:
  - (i) a record of the sampling regime that complies with the standard referred to in paragraph (a); and
  - (ii) confirmation that the person or laboratory that carried out the tests referred to in paragraph (b) holds the certification or accreditation required by that paragraph; and
  - (iii) the test results for the tests referred to in paragraph (b); and
  - (iv) the calculations done under paragraphs (c) and (d); and
  - (v) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.

*Importing, mining, and purchasing coal*

**9 Coal participant may apply for approval to use unique emissions factor**

- (1) A coal participant may apply to the chief executive for approval to use a unique emissions factor when calculating emissions in relation to—

- (a) a class of coal in accordance with the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009; and
  - (b) if the coal participant is a coal mining participant, fugitive coal seam gas from a category of coal mined from underground mining in accordance with the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009.
- (2) A coal mining participant must calculate a unique emissions factor for a class of coal in accordance with regulation 10.
- (3) A coal mining participant must calculate a unique emissions factor for fugitive coal seam gas from a category of coal in accordance with regulation 12.
- (4) A coal importing participant or a coal purchasing participant may—
  - (a) calculate a unique emissions factor for a class of coal in accordance with regulation 10; or
  - (b) if the class relates to coal that is combusted in particular equipment, calculate a unique emissions factor for the class of coal in accordance with regulation 11.
- (5) Despite subclauses (2) and (4)(a), a coal participant may apply for approval to use a unique emissions factor calculated in accordance with regulation 10 in relation to a class of coal only if the unique emissions factor is lower than the threshold emissions factor for the relevant type of coal specified in Table 2 of the Schedule.

**10 Requirements relating to application for unique emissions factor approval for class of coal calculated using standard testing option**

A coal participant using the standard testing option to calculate a unique emissions factor for a class of coal must—

- (a) obtain at least 3 representative samples, taken at intervals of not less than a month, of the coal for which the unique emissions factor is sought in accordance with the procedures in ISO 18283:2006 (hard coal and coke); and



- (b) have the following tests carried out on each of the coal samples by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand's mutual recognition arrangements to carry out the tests:
- (i) AS 1038.6.4–2005 or ISO 12902:2001 (carbon content):
  - (ii) ISO 5068–1:2007, or ASTM D3302 (total moisture content):
  - (iii) ISO 1171:1997 or ASTM D3174–04 (ash content):
  - (iv) ISO 1928:1995 (gross calorific value); and
- (c) calculate the emissions factor for carbon dioxide for the class of coal in accordance with the following formula:

$$EF_{CO_2} = m_c \times \frac{EF_c}{CV}$$

where—

CV is the mean gross calorific value of the coal determined by reference to the results of the tests in paragraph (b)(iv)

$EF_c$  is the emissions factor for pure carbon specified in Table 3 of the Schedule

$EF_{CO_2}$  is the emissions factor for  $CO_2$  for the class of coal in tonnes of carbon dioxide per terajoule ( $tCO_2/TJ$ )

$m_c$  is the mean mass fraction of carbon in the coal samples determined by reference to the results of the tests in paragraph (b)(i) to (iii); and

- (d) calculate the unique emissions factor for the class of coal in accordance with the following formula:

$$UEF = (EF_{CO_2} \times OF) + EF_{M+N}$$

where—

$EF_{CO_2}$  is the emissions factor for  $CO_2$  determined under paragraph (c) expressed in tonnes of carbon dioxide per terajoule ( $tCO_2/TJ$ )

$EF_{M+N}$  is the aggregate emissions factor for  $N_2O$  and  $CH_4$  for coal specified in Table 4 of the Schedule

OF is an oxidation factor of 0.98

UEF is the unique emissions factor for the class of coal expressed in tonnes of carbon dioxide equivalent gases per terajoule ( $tCO_2e/TJ$ ); and

- (e) submit the following material to a recognised verifier:
  - (i) a record of the sampling regime that complies with the standard referred to in paragraph (a); and
  - (ii) confirmation that the person or laboratory that carried out the tests referred to in paragraph (b) holds the certification or accreditation required by that paragraph; and
  - (iii) the test results for the tests referred to in paragraph (b); and
  - (iv) the calculations done under paragraphs (c) and (d); and
  - (v) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.

# **11 Requirements relating to application for unique emissions factor approval for class of coal combusted in particular equipment**

- (1) A coal importing participant or a coal purchasing participant who wishes to calculate a unique emissions factor for a class of coal in accordance with this regulation must—
  - (a) first calculate a unique emissions factor for  $CH_4$  and  $N_2O$  for the class of coal in accordance with the periodic source testing option; and

- (b) then calculate the unique emissions factor for the class of coal in accordance with either subclause (2) or (3).
- (2) If the person wishes to include a unique emissions factor for carbon dioxide for the class of coal in the unique emissions factor, the person must—
- (a) comply with the sampling and testing requirements in regulation 10(a) and (b) in relation to the class of coal; and
- (b) calculate an emissions factor for carbon dioxide for the class of coal in accordance with regulation 10(c); and
- (c) calculate the unique emissions factor for the class of coal in accordance with the following formula:

$$UEF = (EF_{CO_2} \times OF) + UEF_{M+N}$$

where—

$EF_{CO_2}$  is the emissions factor for  $CO_2$  for the class of coal determined under regulation 10(c), expressed in tonnes of carbon dioxide per terajoule ( $tCO_2/TJ$ )

OF is an oxidation factor of 0.98

UEF is the unique emissions factor for the class of coal expressed in tonnes of carbon dioxide equivalent gases per terajoule ( $tCO_2e/TJ$ )

$UEF_{M+N}$  is the unique emissions factor for  $N_2O$  and  $CH_4$  for the class of coal calculated under the periodic source testing option.

- (3) If the person does not wish to include a unique emissions factor for carbon dioxide for the class of coal in the unique emissions factor, the person must calculate the unique emissions factor for the class of coal in accordance with the following formula:

$$UEF = DEF - EF_{M+N} + UEF_{M+N}$$

where—

DEF is the default emissions factor that would otherwise apply to the class of coal under the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009

$EF_{M+N}$  is the aggregate emissions factor for  $N_2O$  and  $CH_4$  for coal specified in Table 4 of the Schedule

UEF is the unique emissions factor for the class of coal expressed in tonnes of carbon dioxide equivalent gases per terajoule (tCO<sub>2</sub>e/TJ)

UEF<sub>M+N</sub> is the unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub> for the class of coal calculated under the periodic source testing option.

- (4) A participant calculating a unique emissions factor under this regulation must submit such of the following material as is relevant to a recognised verifier:
- (a) a record of the sampling regime that complies with the standard referred to in regulation 10(a); and
  - (b) a record of the measurement and testing regime that complies with regulation 22(3) and (4); and
  - (c) confirmation that the person or laboratory that carried out the tests in regulation 10(b) or 22(3) holds the certification or accreditation required by those regulations; and
  - (d) the test results for the tests referred to in regulation 10(b) or 22(3); and
  - (e) the calculations done under subclause (2) or (3) and regulations 10(c) and 23(1); and
  - (f) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.
- (5) To avoid doubt, a coal purchasing participant who has approval to use a unique emissions factor calculated under subclause (3) may apply to use a unique emissions factor calculated under subclause (2) relying on the same unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub>, but only if there has been no material change in the information on which the unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub> was based.

## **12 Requirements relating to application for unique emissions factor approval for fugitive coal seam gas**

- (1) A coal participant who wishes to apply for approval to use a unique emissions factor in relation to fugitive coal seam gas from a category of coal must—

- (a) collect information about the total tonnes of coal mined from underground mining at the relevant coal mine in a year; and
- (b) obtain at least 10 representative samples of the exhaust air from underground mining at the relevant coal mine during the year, taken from the ventilation shaft or shafts of the mine at intervals of not less than a month; and
- (c) regularly measure the volumetric flow rate of the exhaust air in the ventilation shaft or shafts in cubic metres per hour; and
- (d) at the time each sample is taken, measure and record—
  - (i) the pressure of the exhaust air in the ventilation shaft in kilopascals; and
  - (ii) the temperature of the exhaust air in the ventilation shaft in Kelvin; and
  - (iii) the concentration of CH<sub>4</sub> in the sampled exhaust air by volume; and
- (e) using the data collected under paragraphs (b) to (d), calculate the representative rate of emissions of CH<sub>4</sub> in the ventilation shaft or shafts in accordance with the following formula:

$$mr_{CH_4} = \frac{0.016 \times P \times F \times C}{R \times T}$$

where—

0.016 is the molecular mass of CH<sub>4</sub> in tonnes per kilomole

C is the mean concentration of CH<sub>4</sub> in the samples by volume

F is the mean volumetric flow rate of the exhaust air in cubic metres per hour at the time the samples were taken

mr<sub>CH<sub>4</sub></sub> is the representative rate of CH<sub>4</sub> emitted in tonnes of methane released per hour

P is the mean pressure of the exhaust air at the time the samples were taken in kilopascals

R is 8.314, the universal gas constant when expressed in J/K.mol

- T is the mean temperature of the exhaust air at the time of measurement, in Kelvin; and
- (f) calculate the unique emissions factor for the category of coal in accordance with the following formula:

$$\text{UEF} = \text{EF}_p + \frac{(21 \times \text{mr}_{\text{CH}_4} \times t)}{A}$$

where—

- A is the total tonnes of coal mined from the relevant coal mine, as recorded under paragraph (a)
- EF<sub>p</sub> is 0.0336, the emissions factor for post-mining in tonnes of carbon dioxide equivalent gases per tonne of coal mined (tCO<sub>2</sub>e/t)
- mr<sub>CH<sub>4</sub></sub> is the rate of CH<sub>4</sub> emitted in tonnes released per hour as calculated under paragraph (e)
- t is 8 760, the number of hours in a year
- UEF is the unique emissions factor for the category of coal expressed in tonnes of carbon dioxide equivalent gases per tonne of coal (tCO<sub>2</sub>e/t); and
- (g) submit the following material to a recognised verifier:
- (i) a record of the sampling and measurement regime that complies with paragraphs (b) to (d) and subclause (2); and
  - (ii) the calculations done under paragraphs (e) and (f); and
  - (iii) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor for the purposes of regulation 24.
- (2) For the purposes of subclause (1), sampling and measuring must be undertaken using devices that are regularly maintained and calibrated.

#### *Purchasing natural gas*

### **13 Natural gas purchasing participant may apply for approval to use unique emissions factor**

- (1) A natural gas purchasing participant may apply to the chief executive for approval to use a unique emissions factor for N<sub>2</sub>O

and CH<sub>4</sub> or for all emissions when calculating emissions in relation to a class of natural gas in accordance with the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009.

- (2) A natural gas purchasing participant who wishes to apply for approval to use—
  - (a) a unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub> in relation to a class of natural gas when calculating emissions in accordance with the standard formula in regulation 50(3) of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009, must calculate the unique emissions factor in accordance with the periodic source testing option;
  - (b) a unique emissions factor for all emissions in relation to a class of natural gas when calculating emissions in accordance with the field specific formula in regulation 50(4) of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009, must—
    - (i) first calculate a unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub> in accordance with the periodic source testing option; and
    - (ii) then calculate the unique emissions factor for the class of natural gas in accordance with subclause (3).
- (3) The formula for calculating a unique emissions factor under this subclause is—

$$UEF = DEF_{\text{fieldn}} - EF_{\text{M+N}} + UEF_{\text{M+N}}$$

where—

$DEF_{\text{fieldn}}$  is the default emissions factor that would otherwise apply to the class of natural gas specified in Table 10 of Schedule 2 of the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009

$EF_{\text{M+N}}$  is the aggregate emissions factor for N<sub>2</sub>O and CH<sub>4</sub> for natural gas from Table 4 of the Schedule

UEF is the unique emissions factor for the class of natural gas expressed in tonnes of carbon dioxide equivalent gases per terajoule (tCO<sub>2</sub>e/TJ)

$UEF_{M+N}$  is the unique emissions factor for  $N_2O$  and  $CH_4$  for the class of natural gas calculated under the periodic source testing option.

- (4) A natural gas purchasing participant must submit the following material to a recognised verifier:
- (a) a record of the measurement and testing regime that complies with regulation 22(3) and (4); and
  - (b) confirmation that the person or laboratory that carried out the tests referred to in regulation 22(3) holds the certification or accreditation required by that paragraph; and
  - (c) the calculations done under subclause (3), if relevant, and regulation 23; and
  - (d) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor for the purposes of regulation 24.

*Using geothermal fluid*

**14 Geothermal participant may apply for approval to use unique emissions factor**

- (1) A geothermal participant may apply to the chief executive for approval to use a unique emissions factor when calculating emissions in relation to a class of geothermal fluid in accordance with the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009.
- (2) However, a geothermal participant may apply for approval to use a unique emissions factor only if the difference between the unique emissions factor and the default emissions factor that would otherwise apply to the geothermal fluid is more than the estimated uncertainty.

**15 Requirements relating to application for unique emissions factor approval by geothermal participant**

A geothermal participant who wishes to apply for approval to use a unique emissions factor in relation to a class of geothermal fluid defined by reference to—

- (a) a plant that uses, or a particular use of, geothermal steam, must comply with regulation 16:



- (b) a plant that uses, or a particular use of, geothermal fluid that does not relate to steam production must comply with regulation 17.

**16 Requirements for applications for unique emissions factor approval for geothermal fluid use calculated by reference to steam production**

- (1) A geothermal participant who wishes to apply for approval to use a unique emissions factor in relation to a class of geothermal fluid defined by reference to a matter in regulation 15(a) must—
  - (a) obtain representative samples of the geothermal steam to which the application relates in accordance with either—
    - (i) the procedures and standards in—
      - (A) ASTM E947–83 (Reapproved 2007)—(equipment to be used for the collection of uncontaminated and representative samples from single-phase steam pipelines); and
      - (B) ASTM E1675–04 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single-phase steam only); or
    - (ii) the procedures and standards in a published geothermal fluid sampling methodology with accuracy and reliability equivalent to the standards in subparagraph (i); and
  - (b) have the following tests carried out on each of the samples of the steam by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand’s mutual recognition arrangements to carry out the tests:
    - (i) gas chromatography (to determine CH<sub>4</sub> content); and

- (ii) standard chemistry titration analysis methods (to determine CO<sub>2</sub> content); and
- (c) measure the tonnes of steam produced per hour at, or downstream of, each separation point, or if the system has multiple steam transmission lines, then at each mix point; and
- (d) calculate the emissions factor for each steam separation point or mix point in accordance with the following formula:

$$EF_s = m_{CO_2} + (m_{CH_4} \times 21)$$

where—

$EF_s$  is the emissions factor for the steam at the separation or mix point expressed as tonnes of carbon dioxide equivalent gases per tonne of steam (tCO<sub>2</sub>e/t steam)

$m_{CH_4}$  is the mean mass fraction of CH<sub>4</sub> in the steam samples at the separation or mix point as determined by reference to the results of the tests referred to in paragraph (b)(i) and expressed in tonnes of methane per tonne of steam (tCH<sub>4</sub>/t steam)

$m_{CO_2}$  is the mean mass fraction of CO<sub>2</sub> in the steam samples at the separation or mix point as determined by reference to the results of the tests referred to in paragraph (b)(ii) and expressed in tonnes of carbon dioxide per tonne of steam (tCO<sub>2</sub>/t steam); and

- (e) calculate the unique emissions factor for the class of geothermal fluid in accordance with the following formula:

$$UEF = \frac{\sum(EF_s \times A)}{\sum(A)} - EF_R$$

where—

$A$  is the tonnes of steam produced by each separation or mix point per hour as measured in accordance with paragraph (c)

$EF_R$  is,—

- (a) if an adjustment for reinjection of steam condensate is claimed, the emissions factor for steam condensate being reinjected as calculated under subclause (2); or
  - (b) if no adjustment for reinjection of steam condensate is claimed, zero
- EF<sub>s</sub> is the emissions factor for the relevant steam separation or mix point determined under paragraph (d)
- UEF is the unique emissions factor for the class of geothermal fluid expressed in tonnes of carbon dioxide equivalent gases per tonne of steam (tCO<sub>2</sub>e/t steam); and
- (f) submit the following material to a recognised verifier:
  - (i) a record of the sampling regime that complies with the procedures and standards referred to in paragraph (a) and, if relevant, a record of the sampling regime that complies with subclause (2)(a); and
  - (ii) confirmation that the person or laboratory that carried out the tests referred to in paragraph (b) and, if relevant, subclause (2)(b), holds the certification or accreditation required by that paragraph; and
  - (iii) the test results for the tests referred to in paragraph (b) and, if relevant, the test results for the tests in subclause (2)(b); and
  - (iv) the estimated uncertainty associated with the unique emissions factor; and
  - (v) the calculations done under paragraphs (d) and (e) and, if relevant, subclause (2)(c); and
  - (vi) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.
- (2) A geothermal participant who wishes to claim an adjustment to a unique emissions factor calculated under subclause (1) to account for the reinjection of condensate from the class of geothermal fluid into a geothermal field must—

- (a) obtain representative samples of the steam condensate being reinjected in accordance with the procedures and standards referred to in subclause (1)(a); and
- (b) have the tests referred to in subclause (1)(b) carried out on each of the samples of the steam condensate by a person or laboratory that is accredited as complying with that subclause; and
- (c) calculate an emissions factor for the reinjected condensate in accordance with the following formula:

$$EF_R = m_{CO_2} + (m_{CH_4} \times 21)$$

where—

$EF_R$  is the emissions factor for the condensate being reinjected expressed in tCO<sub>2</sub>e/t condensate

$m_{CH_4}$  is the mean mass fraction of CH<sub>4</sub> in the condensate being reinjected as determined by reference to the results of the tests referred to in paragraph (b) and expressed in tCH<sub>4</sub>/t condensate

$m_{CO_2}$  is the mean mass fraction of CO<sub>2</sub> in the condensate being reinjected as determined by reference to the results of the tests referred to in paragraph (b) and expressed in tCO<sub>2</sub>/t condensate.

- (3) The following rules apply to measurement of steam for the purposes of this regulation:
  - (a) measurement of the steam quantity produced must be undertaken with a venturi flow meter (or other equipment with at least the same accuracy):
  - (b) the sample port where the samples are collected for the purposes of subclauses (1)(a) and (2)(a) must be located—
    - (i) immediately after the separation points; or
    - (ii) if the system has multiple steam transmission lines, at a point where a good mixed sample of the steam can be obtained:
  - (c) the calculation of steam quantities must be conducted on a continuous basis and in accordance with ISO 5167–1:2003.

**17 Requirements for applications for unique emissions factor approval for geothermal fluid use calculated by reference to non-condensable gas concentrations**

- (1) A geothermal participant who wishes to apply for approval to use a unique emissions factor in relation to a class of geothermal fluid defined by reference to a matter in regulation 15(b) must—

- (a) obtain representative samples of the 2-phase geothermal fluid for which the unique emissions factor is sought in accordance with the procedures and standards in—
  - (i) ASTM E1675–04 (for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis); or
  - (ii) a published geothermal fluid sampling methodology with equivalent accuracy and reliability to the standard referred to in subparagraph (i); and
- (b) have the following tests carried out on each of the samples of the 2-phase geothermal fluid by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand's mutual recognition arrangements to carry out the tests:
  - (i) gas chromatography (to determine CH<sub>4</sub> content); and
  - (ii) standard chemistry titration analysis methods (to determine CO<sub>2</sub> content); and
- (c) calculate the emissions factor for the 2-phase fluid in accordance with the following formula:

$$EF_{\text{fluid}} = m_{\text{CO}_2} + (m_{\text{CH}_4} \times 21)$$

where—

$EF_{\text{fluid}}$  is the emissions factor for the class of 2-phase fluid expressed in tonnes of carbon dioxide equivalent gases per tonne of 2-phase fluid (tCO<sub>2</sub>e/t fluid)

$m_{\text{CH}_4}$  is the mean mass fraction of  $\text{CH}_4$  in the samples of the 2-phase geothermal fluid as determined by reference to the results of the tests referred to in paragraph (b)(i) and expressed in tonnes of methane per tonne of 2-phase fluid ( $\text{tCH}_4/\text{t fluid}$ )

$m_{\text{CO}_2}$  is the mean mass fraction of  $\text{CO}_2$  in the samples of the 2-phase geothermal fluid as determined by reference to the results of the tests referred to in paragraph (b)(ii) and expressed in tonnes of carbon dioxide per tonne of 2-phase fluid ( $\text{tCO}_2/\text{t fluid}$ ); and

- (d) calculate the unique emissions factor for the class of geothermal fluid in accordance with the following formula:

$$\text{UEF} = \text{EF}_{\text{fluid}} - \text{EF}_T$$

where—

$\text{EF}_{\text{fluid}}$  is the emissions factor for the class of 2-phase fluid as calculated in accordance with paragraph (c) expressed in tonnes of carbon dioxide equivalent gases per tonne of geothermal fluid ( $\text{tCO}_2\text{e/t fluid}$ )

$\text{EF}_T$  is,—

- (a) if an adjustment for reinjection of single-phase fluid is claimed, the emissions factor for reinjected single-phase fluid relating to the class, calculated under subclause (2); or
- (b) zero, if no adjustment is claimed

UEF is the unique emissions factor for the class of geothermal fluid expressed in tonnes of carbon dioxide equivalent gases per tonne of 2-phase fluid ( $\text{tCO}_2\text{e/t fluid}$ ); and

- (e) submit the following material to a recognised verifier:
- (i) a record of the sampling regime that complies with the procedures and standards referred to in paragraph (a) and, if relevant, a record of the sampling regime that complies with subclause (2)(a); and

- (ii) confirmation that the person or laboratory that carried out the tests referred to in paragraph (b) and, if relevant, subclause (2)(b), holds the certification or accreditation required by those provisions; and
  - (iii) the test results for the tests referred to in paragraph (b) and, if relevant, the test results for the tests in subclause (2)(b); and
  - (iv) the estimated uncertainty associated with the unique emissions factor; and
  - (v) the calculations done under paragraph (c) and (d) and, if relevant, subclause (2)(c); and
  - (vi) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.
- (2) A geothermal participant who wishes to claim an adjustment to a unique emissions factor calculated under subclause (1) to account for the reinjection of single-phase geothermal fluid from the class of geothermal fluid into a geothermal field must—
- (a) obtain representative samples of the single-phase geothermal fluid reinjected which results from use of the 2-phase geothermal fluid in accordance with the procedures and standards referred to in subclause (1)(a); and
  - (b) have the tests referred to in subclause (1)(b) carried out on each of the samples of the single-phase geothermal fluid by a person or laboratory that is accredited as complying with that subclause; and
  - (c) calculate an emissions factor for the reinjected single-phase geothermal fluid in accordance with the following formula:

$$EF_T = m_{CO_2} + (m_{CH_4} \times 21)$$

where—

$EF_T$  is the emissions factor for the reinjected single-phase fluid expressed in tCO<sub>2</sub>e/t fluid

$m_{CH_4}$  is the mean mass fraction of CH<sub>4</sub> in the samples of the single-phase geothermal fluid as determined by reference to the results of the tests referred to in paragraph (b) and expressed in tCH<sub>4</sub>/t fluid

$m_{\text{CO}_2}$  is the mean mass fraction of  $\text{CO}_2$  in the samples of the single-phase geothermal fluid as determined by reference to the results of the tests referred to in paragraph (b) and expressed in  $\text{tCO}_2/\text{t}$  fluid.

*Combusting used oil, waste oil, used tyres, or  
waste*

**18 Waste combustion participant may apply for approval to use unique emissions factor**

- (1) A waste combustion participant may apply to the chief executive for approval to use a unique emissions factor when calculating emissions in relation to a class of used or waste oil, used tyres, or waste in accordance with the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009.
- (2) However, a waste combustion participant may apply for approval to use a unique emissions factor only if the difference between the unique emissions factor and the default emissions factor that would otherwise apply to the used or waste oil, used tyres, or waste is more than the estimated uncertainty.

**19 Requirements relating to application for unique emissions factor approval by waste combustion participant**

A waste combustion participant who wishes to apply for approval to use a unique emissions factor in relation to a class of used or waste oil, used tyres, or waste that—

- (a) consists of or contains non-biomass, may calculate a unique emissions factor for the class in accordance with regulation 20 or the periodic source testing option:
- (b) consists of or contains only biomass, must calculate a unique emissions factor for that class in accordance with the periodic source testing option.

**20 Requirements for applications for unique emissions factor approval for waste calculated using standard testing option**

- (1) A waste combustion participant using the standard testing option to calculate a unique emissions factor for a class of used or waste oil, used tyres, or waste must—



- (a) obtain representative samples of the used or waste oil, used tyres, or waste for which the unique emissions factor is sought in accordance with the procedures in,—
  - (i) for solid fuels, CEN/TS 14778–1:2005 or CEN/TS 15442:2006;
  - (ii) for used or waste oil, ASTM D4057–06, ASTM D4177–95 (2005), or ISO 3170:2004; and
- (b) have the following tests carried out on each of the samples of the fuel by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand’s mutual recognition arrangements to carry out the tests:
  - (i) for solid fuels—
    - (A) CEN/TS 15407:2006 (carbon content); and
    - (B) CEN/TS 15400:2006 (gross calorific value); and
    - (C) CEN/TS 15440:2006 or ASTM D6866–08 (determination of biomass content as a percentage) subject to subclause (2):
  - (ii) for used or waste oil—
    - (A) ASTM D5291–02 2007 (carbon content); and
    - (B) ASTM D240–02 2007 (gross calorific value); and
- (c) calculate the emissions factor for carbon dioxide for the fuel in accordance with the following formula:

$$EF_{CO_2} = \frac{m_C \times EF_C \times m_{NB}}{CV}$$

where—

CV is the mean gross calorific value of the fuel samples determined by reference to the results of the tests referred to in paragraph (b)(i)(B) or (b)(ii)(B)

$EF_C$  is the emissions factor for pure carbon specified in Table 3 of the Schedule

$EF_{CO_2}$  is the emissions factor for  $CO_2$  for the class of used or waste oil, used tyres, or waste in tonnes of  $CO_2$  per terajoule ( $tCO_2/TJ$ )

$m_C$  is the mean mass fraction of carbon in the fuel samples determined by reference to the results of the tests referred to in paragraph (b)(i)(A) or (b)(ii)(A)

$m_{NB}$  is the mean non-biomass fraction of the fuel determined by reference to the results of the tests referred to in paragraph (b)(i)(C); and

- (d) calculate the unique emissions factor for the class of waste or used oil, used tyres, or waste, in accordance with the following formula:

$$UEF = EF_{CO_2} + EF_{M+N}$$

where—

$EF_{CO_2}$  is the emissions factor for  $CO_2$  determined under paragraph (c)

$EF_{M+N}$  is the aggregate emissions factor for  $N_2O$  and  $CH_4$  for waste specified in Table 4 of the Schedule

$UEF$  is the unique emissions factor for the class of used or waste oil, used tyres, or waste expressed in tonnes of carbon dioxide equivalent gases per terajoule ( $tCO_2e/TJ$ ); and

- (e) submit the following material to a recognised verifier:
- (i) a record of the sampling regime that complies with a standard referred to in paragraph (a); and
  - (ii) confirmation that the person or laboratory that carried out the tests referred to in paragraph (b) holds the certification or accreditation required by that paragraph; and
  - (iii) the test results for the tests referred to in paragraph (b); and
  - (iv) the estimated uncertainty associated with the unique emissions factor; and
  - (v) the calculations done under paragraphs (c) and (d); and

- (vi) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor under regulation 24.
- (2) In subclause (1)(b)(i)(C), selective dissolution under CEN/TS 15440:2006 is not to be used if—
  - (a) the sampled fuel contains more than 10% of rubber residues (whether natural, synthetic, or a combination of both); or
  - (b) the sampled fuel contains a combination of more than 5% by weight of nylon, polyurethane or other polymers containing molecular amino groups, or biodegradable plastics of fossil fuel origin; or
  - (c) the sampled fuel contains a combination of more than 5% by weight of wool or viscose, or non-biodegradable plastic of biogenic origin, or oil or fat present as a constituent of biomass.

*Periodic source testing option*

**21 Requirements for applications for unique emissions factor approval for coal, natural gas, used or waste oil, used tyres, or waste calculated using periodic source testing option**

- (1) A participant who wishes to calculate a unique emissions factor in accordance with the periodic source testing option must comply with regulations 22 and 23, and,—
  - (a) if a coal purchasing participant or coal importing participant, comply with regulation 11; or
  - (b) if a natural gas purchasing participant, comply with regulation 13; or
  - (c) if a waste combustion participant, submit such of the following material as is relevant to a recognised verifier:
    - (i) a record of the sampling regime that complies with regulation 22; and
    - (ii) a record of the measurement and testing regime that complies with regulation 22(3) and (4); and
    - (iii) confirmation that the person or laboratory that carried out the tests referred to in regulation 22(2) and (3) holds the certification or accreditation required by those subclauses; and

- (iv) the estimated uncertainty associated with the unique emissions factor; and
  - (v) the calculations done under regulation 23; and
  - (vi) any other information required by the recognised verifier as necessary to provide verification of the unique emissions factor for the purposes of regulation 24.
- (2) The participant must conduct sampling and testing, and calculate the rate of emissions under regulations 22 and 23 for a measurement period that is sufficient to ensure that the sampling, testing and calculated emissions accurately represent emissions for the class of fuel combusted in the particular equipment over the full range of operating conditions.

## **22 Sampling and testing requirements for the periodic source testing option**

- (1) A coal purchasing participant, coal importing participant, or a natural gas purchasing participant using the periodic source testing option to calculate a unique emissions factor for N<sub>2</sub>O and CH<sub>4</sub> in relation to a class of coal or natural gas must collect information about,—
  - (a) the total tonnes of the class of fuel combusted in the particular equipment during the measurement period; and
  - (b) the mean gross calorific value of the class of fuel combusted in the particular equipment during the measurement period.
- (2) A waste combustion participant using the periodic source testing option to calculate a unique emissions factor in relation to a class of used or waste oil, used tyres, or waste must,—
  - (a) if the person wishes to use the method specified in regulation 23(2)(a) to calculate total energy input to the particular equipment from the class of fuel during the measurement period,—
    - (i) collect information about the total tonnes of the class of fuel combusted in the particular equipment during the measurement period; and
    - (ii) collect representative samples of the class of fuel for which the unique emissions factor is sought

- during the measurement period in accordance with the procedures in,—
- (A) for solid fuels, CEN/TS 14778–1:2005 or CEN/TS 15442:2006;
  - (B) for used or waste oil, ASTM D4057–06, ASTM D4177–95 (2005), or ISO 3170:2004; and
- (iii) have the following tests carried out on each of the samples of the fuel by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand’s mutual recognition arrangements to carry out the tests:
- (A) for solid fuels, CEN/TS 15400:2006 (gross calorific value); or
  - (B) for used or waste oil, ASTM D240–02 (2007) (gross calorific value):
- (b) if the person wishes to use the method specified in regulation 23(2)(b) to calculate total energy input to the particular equipment from the class of fuel during the measurement period,—
- (i) record the total quantity of energy generated from the particular equipment through its combustion of the class of fuel during the measurement period in terajoules; and
  - (ii) estimate the efficiency, on a gross energy basis, of the particular equipment during the measurement period; and
  - (iii) if the class of fuel is a class of used or waste oil, calculate—
    - (A) the total number of tonnes of obligation fuel component of the used or waste oil combusted by the particular equipment during the measurement period; and

- (B) the calorific value of the used or waste oil by obtaining samples and carrying out tests in accordance with paragraph (a)(ii) and (iii).
- (3) A participant using the periodic source testing option must, at sufficient intervals during the measurement period to ensure that the data is representative,—
  - (a) measure in accordance with the procedures in ISO 10780:1994 or ISO 14164:1999 the volumetric flow rate for the stacks from which gases resulting from combustion of the class of fuel are emitted ; and
  - (b) have tests to measure CH<sub>4</sub> and N<sub>2</sub>O concentrations (and if relevant for waste combustion participants, CO<sub>2</sub> concentrations) by volume in the gas stream from the stacks carried out in accordance with one of the following standards by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand's mutual recognition arrangements to carry out the tests:
    - (i) ISO 12039:2001:
    - (ii) USEPA—Method 3A—2006:
    - (iii) USEPA—Method 3C—1996:
    - (iv) VDI 2469–1 (measurement of nitrous oxide):
    - (v) ASTM D6348–03 (determination of gaseous compounds); and
  - (c) at the time of each of the measurements referred to in paragraph (b),—
    - (i) measure and record the pressure of the gas stream in the stacks in kilopascals; and
    - (ii) measure and record the temperature of the gas stream in the stacks in Kelvin; and
    - (iii) if the participant is a waste combustion participant and the class of fuel contains non-biomass, have tests to measure the non-biomass fraction of the CO<sub>2</sub> concentrations in the gas stream in

the stacks carried out in accordance with ASTM D6866–08 by a person or laboratory that is accredited as complying with ISO 17025:2005 by International Accreditation New Zealand, an overseas accreditation agency with whom International Accreditation New Zealand has a mutual recognition agreement, or an overseas accreditation agency recognised under New Zealand’s mutual recognition arrangements to carry out the tests.

- (4) For the purposes of the tests referred to in subclause (3), sampling and measuring must be undertaken using devices that are regularly maintained and calibrated.

## **23 Calculation of unique emissions factor in accordance with periodic source testing option**

- (1) A participant using the periodic source testing option to calculate a unique emissions factor must,—
- (a) using each set of data collected under regulation 22(3), calculate the rate of emissions of CH<sub>4</sub> and N<sub>2</sub>O (and if relevant for a waste combustion participant, of CO<sub>2</sub>) from the stacks in accordance with the following formula:

$$mr_{\text{gas type}} = \frac{mw_{\text{gas type}} \times P \times F \times C}{R \times T}$$

where—

C is the concentration of CH<sub>4</sub>, N<sub>2</sub>O, or CO<sub>2</sub>, as the case may be, by volume in the gas stream at the time of measurement of the gas concentrations

F is the flow rate of the gas stream in cubic metres per second at the time of measurement of the gas concentrations

mr<sub>gas type</sub> is the rate of each of CH<sub>4</sub> and N<sub>2</sub>O (and if relevant CO<sub>2</sub>) emitted in tonnes of gas type released per second

mw<sub>gas type</sub> is the molecular mass of CH<sub>4</sub>, N<sub>2</sub>O, or CO<sub>2</sub>, as the case may be, in tonnes per kilomole, where—

- (a) CO<sub>2</sub> and N<sub>2</sub>O values are 0.044; and
  - (b) CH<sub>4</sub> value is 0.016
- P is the pressure of the gas stream in kilopascals at the time of measurement of the gas concentrations
- R is 8.314, the universal gas constant when expressed in J/K.mol; and
- T is the temperature, in Kelvin, of the gas stream at the time of measurement of the gas concentrations; and
- (b) using the results of the calculations referred to in paragraph (a), estimate representative values of mr<sub>N<sub>2</sub>O</sub> and mr<sub>CH<sub>4</sub></sub> (and if relevant, mr<sub>CO<sub>2</sub></sub>) for the measurement period; and
  - (c) calculate the unique emissions factor for the class of fuel, in accordance with the following formula:

$$\text{UEF} = \frac{(\text{mr}_{\text{CO}_2} \times m_{\text{NB}} \times t) + (\text{mr}_{\text{CH}_4} \times 21 \times t) + (\text{mr}_{\text{N}_2\text{O}} \times 310 \times t)}{H}$$

where—

- H is the total energy input to the particular equipment over the measurement period expressed in terajoules and calculated in accordance with subclause (2)
- m<sub>NB</sub> is, if relevant, the mean non-biomass fraction of mr<sub>CO<sub>2</sub></sub> as calculated by reference to the results of the tests under regulation 22(3)(c)(iii)
- mr<sub>CH<sub>4</sub></sub> is the representative rate of CH<sub>4</sub> emitted for the measurement period in tonnes released per second, as estimated under paragraph (b)
- mr<sub>CO<sub>2</sub></sub> is—
- (a) the representative rate of CO<sub>2</sub> emitted for the measurement period in tonnes released per second, as estimated under paragraph (b); or
  - (b) zero,—



- (i) for a coal purchasing participant, coal importing participant, or natural gas participant; or
- (ii) if the fuel consists of or contains only biomass

$mr_{N_2O}$  is the representative rate of  $N_2O$  emitted for the measurement period in tonnes released per second, as estimated under paragraph (b)

$t$  is the time interval of the measurement period in seconds

UEF is,—

- (a) for a coal purchasing participant, coal importing participant, or natural gas purchasing participant, the unique emissions factor for  $N_2O$  and  $CH_4$  for the class of fuel expressed in tonnes of carbon dioxide equivalent gases per terajoule ( $tCO_2e/TJ$ ); and
- (b) for a waste combustion participant, the unique emissions factor for the class of fuel expressed in tonnes of carbon dioxide equivalent gases per terajoule ( $tCO_2e/TJ$ ).

- (2) For the purposes of subclause (1)(c),  $H$  must be calculated in accordance with either of the following formulae, as relevant:

(a) 
$$H = A \times CV$$

where—

$A$  is the total tonnes of the class of fuel combusted by the particular equipment during the measurement period as recorded under regulation 22(1)(a) or 22(2)(a)(i)

$CV$  is the mean gross calorific value of the fuel samples as recorded under regulation 22(1)(b) or as determined by reference to the results of the tests referred to in regulation 22(2)(a)(iii)(A) or (B); or

$$(b) \quad H = \frac{D}{U} - B \times CV$$

where—

B is,—

- (a) if the class relates to used or waste oil, the total number of tonnes of obligation fuel component of the used or waste oil combusted in the particular equipment during the measurement period, as recorded under regulation 22(2)(b)(iii)(A); and

- (b) in any other case, zero

CV is,—

- (a) if the class relates to used or waste oil, the weighted average calorific value of the used or waste oil as calculated by reference to the information recorded under regulation 22(2)(b)(iii)(B); and

- (b) in any other case, zero

D is the energy output in terajoules produced by the particular equipment through its combustion of the class of fuel during the measurement period as recorded in regulation 22(2)(b)(i)

U is the gross efficiency of the particular equipment during the measurement period as estimated under regulation 22(2)(b)(ii).

### *Verification*

#### **24 Verification**

(1) A recognised verifier may verify a unique emissions factor for an activity if the verifier—

- (a) has been recognised under these regulations as able to verify unique emissions factors for the activity and the recognition has not expired, or been surrendered, suspended, or revoked; and
- (b) is satisfied that any samples collected by the participant and tested for the purposes of the relevant regulation—
  - (i) meet any standard for sampling required by the regulation; and

- (ii) have been tested by a person with any prescribed certification or accreditation to carry out the prescribed tests; and
  - (c) is satisfied that any measurements or other tests required to be carried out by the participant for the purposes of a regulation have been carried out in accordance with the requirements of the regulation; and
  - (d) is satisfied that the unique emissions factor—
    - (i) has been calculated correctly in accordance with the prescribed methodology, having conducted his or her own calculations using the test or measurement results provided by the participant; and
    - (ii) meets any prescribed threshold for applications for approval for use of a unique emissions factor for the activity.
- (2) Despite anything in these regulations, a recognised verifier may not verify a unique emissions factor for the purposes of an application for approval of a unique emissions factor by a participant if the verifier—
- (a) was involved in any way with the taking or testing of any samples, or the taking of any measurements, that support the application; or
  - (b) is an employee of the applicant or any person involved in the taking or testing of any samples, or the taking of any measurements, that support the application; or
  - (c) has any other conflict of interest or relationship with the applicant or any associated person of the applicant that could reasonably be regarded as likely to affect his or her impartiality in carrying out his or her verification function.

### **Part 3**

#### **Recognition of verifiers**

##### **25 Applications for recognition**

- (1) An application for recognition as a verifier in relation to any activity must—
- (a) be made to the chief executive on the form prescribed for the purpose by the chief executive; and

- (b) be accompanied by any supporting information that the chief executive may require.
- (2) For the purpose of assessing the application, the chief executive may require an applicant to supply information additional to that contained in the application.
- (3) If the applicant fails to supply the information within 3 months after the request, or within such further time as the chief executive may allow, the application lapses.

**26 Chief executive may recognise individuals as verifiers**

- (1) The chief executive may, on the application of an individual who meets the requirements in subclause (2), recognise the individual as a person who can verify unique emissions factors for 1 or more of the activities referred to in regulation 27.
- (2) An applicant must—
  - (a) be—
    - (i) a chartered accountant (within the meaning of section 19 of the Institute of Chartered Accountants of New Zealand Act 1996); or
    - (ii) a chartered professional engineer (within the meaning of section 6 of the Chartered Professional Engineers of New Zealand Act 2002); and
  - (b) have—
    - (i) at least 100 working days' verification experience, obtained within the 3 years immediately before the date of application; or
    - (ii) at least 5 years' full-time work experience as an accountant or engineer, obtained since becoming a chartered accountant or chartered professional engineer.
- (3) In carrying out the verification functions for which he or she is recognised, a recognised verifier must—
  - (a) perform verification functions only in relation to the activities in respect of which he or she is recognised;
  - (b) comply with the relevant requirements of these regulations;
  - (c) maintain an appropriate degree of impartiality and independence in carrying out his or her verification functions.

**27 Activities in respect of which recognition can be given**

The activities for which the chief executive may recognise an individual to verify unique emissions factors are 1 or more of the following:

- (a) the activities relating to owning obligation fuel (Part 2 of Schedule 3 of the Act) and purchasing obligation jet fuel (Part 3 of Schedule 4 of the Act):
- (b) the activities relating to importing coal (Part 3 of Schedule 3 of the Act), mining coal (Part 3 of Schedule 3 of the Act), and purchasing coal (Part 4 of Schedule 4 of the Act):
- (c) the activity relating to purchasing natural gas (Part 4 of Schedule 4 of the Act):
- (d) the activity relating to using geothermal fluid (Part 3 of Schedule 3 of the Act):
- (e) the activity relating to combusting used oil, waste oil, used tyres, or waste (Part 3 of Schedule 3 of the Act).

**28 Grant of recognition**

- (1) Where the chief executive grants an application by an individual for recognition to verify unique emissions factors, the chief executive must supply to the applicant a notice of recognition that specifies—
  - (a) the activities for which the applicant may verify unique emissions factors; and
  - (b) any conditions applying to the recognition; and
  - (c) whether the duration of the recognition is indefinite or for a stated period.
- (2) A grant of recognition—
  - (a) comes into force on the date specified in the notice of recognition; and
  - (b) continues in force until—
    - (i) it is surrendered under regulation 32; or
    - (ii) it is suspended under regulation 30 or revoked under regulation 31; or
    - (iii) in the case of recognition granted for a stated period, the expiry of the period.

- (3) If the chief executive proposes to refuse to grant recognition for the activities applied for, the chief executive must first give the applicant—
  - (a) a notice containing the particulars that will clearly inform the applicant of the substance of the grounds on which the chief executive proposes to refuse to recognise the applicant; and
  - (b) a copy (or adequate summary) of any information on which the chief executive relies in proposing to refuse to grant recognition; and
  - (c) a reasonable opportunity to make written submissions or be heard in respect of the matter.
- (4) If the chief executive subsequently decides to refuse to grant recognition, the chief executive must, as soon as practicable, give the applicant written notice of his or her decision and the reasons for the decision.

## **29 Conditions of recognition**

- (1) A grant of recognition under regulation 26 may be subject to any conditions that the chief executive thinks fit to specify in the notice of recognition.
- (2) A recognised verifier must notify the chief executive if for any reason the verifier breaches the conditions of recognition.
- (3) The chief executive may at any time, by written notice to a recognised verifier, revoke, amend, or add to any conditions imposed under subclause (1).
- (4) The chief executive may not vary any condition of recognition imposed under this regulation without (to the extent practicable) first giving the recognised verifier concerned a reasonable opportunity to make written submissions to, or be heard by, the chief executive in relation to the matter.
- (5) However, subclause (4) does not apply where any variation to the conditions of recognition is made on the application of the recognised verifier concerned and in accordance with the terms of the application.

**30 Suspension of recognition**

- (1) The chief executive may, by notice in writing to a recognised verifier, suspend the verifier's recognition for a period not exceeding 3 months if the chief executive has reasonable grounds to believe that the performance of the verifier is unsatisfactory having regard to the requirements of these regulations.
- (2) The chief executive may impose conditions or requirements that must be satisfied if the suspension is to be lifted.
- (3) If the chief executive considers that conditions or requirements have not been satisfied within the suspension period, the chief executive may, by notice in writing, extend the suspension for a further period not exceeding 3 months.
- (4) If the chief executive suspends recognition or extends a period of suspension, the notice of suspension or extension must specify—
  - (a) the reason for the suspension or extension; and
  - (b) the period of the suspension or extension; and
  - (c) the date and time when the suspension or extension commences; and
  - (d) the functions and activities that the suspension or extension relates to; and
  - (e) any conditions or requirements to be met before or during the suspension.

**31 Revocation of recognition**

- (1) The chief executive may at any time, by notice in writing to a recognised verifier, revoke the verifier's recognition if satisfied that—
  - (a) the verifier is not, or is no longer, competent or able to undertake the functions or activities for which the recognition was granted; or
  - (b) the verifier has failed to comply with any conditions of the recognition; or
  - (c) the verifier has contravened, or failed to comply with, any requirement of these regulations in any particular that in the opinion of the chief executive casts doubt on the verifier's competency to undertake the functions or activities for which the recognition was granted.

- (2) The chief executive may not revoke recognition unless he or she has first given the verifier a reasonable opportunity to make written submissions to, or to be heard by, the chief executive in relation to the matter.
- (3) If recognition is revoked by the chief executive, the verifier whose recognition is revoked must, as soon as practicable,—
  - (a) surrender to the chief executive his or her notice of recognition; and
  - (b) take all reasonable steps to notify the fact of the revocation of recognition to each person who was a client of the verifier (in the verifier's capacity as a recognised verifier) immediately before the revocation.

### **32 Surrender of recognition**

- (1) A recognised verifier may at any time surrender his or her recognition by notice in writing to the chief executive.
- (2) A surrender takes effect on—
  - (a) the expiry of 3 months after the date of receipt of the notice by the chief executive; or
  - (b) any earlier date that the chief executive may approve.
- (3) On or before the surrender takes effect, the recognised verifier must return his or her notice of recognition to the chief executive.

### **33 Substituted notice of recognition**

The chief executive may, if he or she thinks fit, cancel a notice of recognition, and issue a new notice in substitution for it,—

- (a) if the terms or conditions of the recognition are to be or have been varied under regulation 29; or
- (b) if the existing notice has become disfigured or dilapidated or contains a mistake; or
- (c) if the chief executive is satisfied that the notice has been lost or destroyed.

### **34 List of recognised individuals**

- (1) The chief executive must keep a list of individuals who have been recognised as verifiers.
- (2) The list must—



- (a) contain—
  - (i) the names of recognised verifiers; and
  - (ii) the activities for which each recognised verifier is authorised to undertake verification functions under these regulations; and
- (b) be available on—
  - (i) the Internet site of the chief executive; and
  - (ii) on request from the office of the chief executive at no cost.
- (3) The chief executive must note next to a verifier's name if his or her recognition has been suspended, and must remove the name immediately if the recognition expires or is revoked.

**Schedule** rr 8(c), (d), 9(5), 10(c), (d),  
11(3), 13(3), 20(1)(c), (d)

**Emissions factors and thresholds**

Table 1  
Emissions factors for CH<sub>4</sub> and N<sub>2</sub>O for  
obligation fuel participants

Types of obligation fuel	Emissions factor for CH <sub>4</sub> in tCO <sub>2</sub> e/kl	Emissions factor for N <sub>2</sub> O in tCO <sub>2</sub> e/kl
Regular petrol, as defined in regulation 4(1)(a) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.014	0.015
Premium petrol, as defined in regulation 4(1)(b) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.014	0.016
Automotive diesel and marine diesel, as defined in regulation 4(1)(c) and (d) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.003	0.044
Aviation spirit, as defined in regulation 4(1)(e) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.001	0.020

Table 1—*continued*

Types of obligation fuel	Emissions factor for CH <sub>4</sub> in tCO <sub>2</sub> e/kl	Emissions factor for N <sub>2</sub> O in tCO <sub>2</sub> e/kl
Jet fuel, as defined in regulation 4(1)(f) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.001	0.022
Light fuel oil, as defined in regulation 4(1)(g) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.006	0.024
Heavy fuel oil, as defined in regulation 4(1)(h) of the Climate Change (Liquid Fossil Fuels) Regulations 2008	0.006	0.024

Table 2

## Unique emissions factor thresholds for coal

Class	Emissions factor tCO <sub>2</sub> e/TJ
Lignite—all other coalfields, or peat	93.85
Lignite—Waimumu or Roxburgh coalfields	91.04
Sub-bituminous	90.26
Bituminous, including anthracite	87.01

Table 3

## Emissions factor for carbon

Emissions source category	Unit	Emissions factor
EF <sub>C</sub> —carbon	tCO <sub>2</sub> /tC	3.6641

Table 4

## Emissions factors for methane and nitrous oxide

Fuel type	Methane (CO <sub>2</sub> e)	Nitrous oxide (CO <sub>2</sub> e)	Aggregate (M+N)	Unit
Coal	0.01397	0.4172	0.485	tCO <sub>2</sub> e/TJ

Table 4—*continued*

<b>Fuel type</b>	<b>Methane (CO<sub>2</sub>e)</b>	<b>Nitrous oxide (CO<sub>2</sub>e)</b>	<b>Aggregate (M+N)</b>	<b>Unit</b>
Natural gas	0.0265	0.0279	0.054	tCO <sub>2</sub> e/TJ
Waste	0.663	1.305	1.969	tCO <sub>2</sub> e/TJ

Michael Webster,  
for Clerk of the Executive Council.

### Explanatory note

*This note is not part of the regulations, but is intended to indicate their general effect.*

These regulations, which come into force on 1 January 2010,—

- provide for the activities for which applications for a unique emissions factor may be made:
- provide the process by which a participant may apply for approval to use a unique emissions factor:
- prescribe the information that must be collected to support an application for use of a unique emissions factor:
- prescribe the methodologies for calculating unique emissions factors:
- provide for certain persons to be recognised verifiers for the purpose of verifying unique emissions factors.

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These regulations are administered by the Ministry for the Environment.