RM Solar – Additional Instructions for Retro Fit (conversion) systems

1 Introduction

In order for the solar system to work effectively and it is essential that the panels are coupled to a hot water cylinder of suitable storage capacity and design.
Various factors need to be taken into account including size and likely occupancy of the dwelling , the type and output of the auxiliary heat source and any external factors such as criteria for compliance with the relevant legislation and grant requirements.
In many circumstances it is possible to convert an existing cylinder for solar use provided that it is of sufficient capacity , and in suitably good condition.

These instructions are supplementary to the main RMSolar panel fitting instructions and cover the conversion of both an existing Direct and an Indirect cylinder.

2 Guidance on capacity

For Solar water heating the total storage volume Vt is calculated by adding up the dedicated solar volume defined as the 'volume of water Vs that can only be heated by the solar input' and the additional volume Va which we heat using alternative means such as a boiler or immersion heater.

2a Dedicated Solar Volume (Vs) Calculation

The most relevant guidance on dedicated solar volume is in the "Domestic Heating Compliance Guide" to the Part L Building Regulations issued by the Government in April 2006. Whilst this is specifically targeted at England and Wales the technical guidance is also relevant albeit not necessarily a statutory requirement for Scotland and N Ireland.
Table 31 of the guide gives two alternative methods of demonstrating compliance in terms of dedicated storage volume (Vs)

Option 1

There should be at least 25 litres of dedicated solar volume (Vs) per square meter of net panel area.

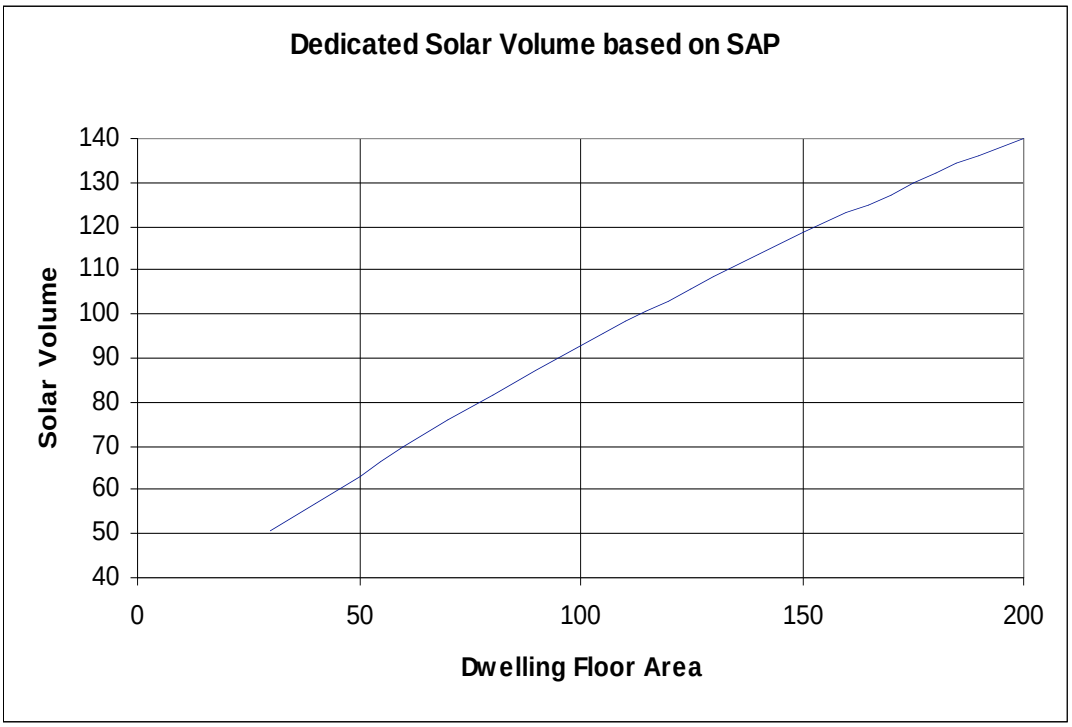
The RMSolar Panels have an aperture area of 1.74 m^2 so the following applies (note - capacities are rounded up to the nearest litre)

One panel kit	44	Litres minimum Vs
Two panel kit	87	Litres minimum Vs
Three panel kit	130	Litres minimum Vs

Option 2

The dedicated solar volume (Vs) should be based on 80% of the hot water demand as calculated by table 1 of SAP 2005. This relates hot water usage to the dwellings floor area and for ease of reference the chart below chart can be used

Fig 1 (Based on 80% of the SAP 2005 volumes)



Worked Examples

Example 1 Two bedroom terrace house with 50 m^2 floor area

Assuming a single panel system then based on Option 1 then the minimum Vs would be 44 litres. Using Option 2 then for a floor area of 50m^2 the associated minimum Vs is circa 64 litres. On this basis compliance could be on the basis of 44 litres but obviously the larger volume associated with Option 2 would give better payback and further improve the effectiveness of the system.

Example 2 Three bedroom Semi with 75 m^2 of floor area

Assuming a two panel system then using Option 1 we get a Vs of 87 litres, using Option 2 we get a Vs of circa 80 litres so minimum compliance would be on the basis of the SAP method but again the larger volume is preferred.

Example 3 Four bedroom detached with 110 m^2 of floor area

Assuming a three panel system then using Option 1 we get a Vs of 130 litres and using Option 2 the Vs is circa 95 litres . Minimum compliance at 95 litres is therefore on the basis of the SAP method but if space and cost permit the larger volume is preferable for family home of this nature.

Further Improving Performance

The above guidance meets minimum requirements but where cost , space and other considerations permit then the performance can be generally enhanced by increasing the value of Vs. One source of guidance is the EST Solar Systems Guide where it is suggested that the Vs per square metre of panel area is increased from 25 litres to 35 litres (Option 1) or in the case of option 2 the volumes as shown on the graph are enhanced by a further 25%.

2b Assessing Additional Storage Volume (Va)

The additional storage volume (Va) depends on a number of factors but arguably the most important is the likely maximum hot water demand under adverse solar (winter) conditions and the rate at which heat can be added to the top of the cylinder.
With the exception if a combi system then it is generally accepted that the absolute minimum additional storage volume for a system heated from a boiler is around 60 litres but if a 3kW immersion heater is the only additional heat source and there is

likely to be a high hot water demand e.g two bathrooms then this volume should be increased significantly.

In the case of the RMSolar Combi system the additional storage volume can is reduced to around 30 litres as under extreme conditions the combi can still directly supply the hot water albeit at the normal lower combi flow rates.

2c Total Cylinder Volume (Vt = Vs + Va)

On the basis of the information so far it is now worth re-visiting the examples to look at the total cylinder volumes required. It should be noted that the table below is for guidance only and each installation should be considered on it individual merit including the likely life styles of the dwellings occupants.
The Combi options assume the use of the special RMSolar combi cylinder , if the cylinder is heated from the space heating output of the cylinder then the guidance for indirect heating should be used.

		Part L Compliance Minimum Volumes	Preferred Minimum
1 Panel	Indirect	Vs = 44 Va = 60 Vt = 144[1]	Vs = 61 Va = 90 Vt = 150
	Electric	Vs = 44 Va = 90 Vt = 144[2]	Vs = 61 Va = 90 Vt = 150
2 Panel	Indirect	Vs = 80 Va = 75 Vt = 155	Vs = 100 Va = 90 Vt = 190
	Electric	Vs = 80 Va = 90 Vt = 170	Vs = 100 Va = 90 Vt = 190
3 Panel	Indirect	Vs = 95 Va = 80 Vt = 175	Vs = 120 Va = 80 Vt = 200
	Electric	Vs = 95 Va = 100 Vt = 195	Vs = 120 Va = 80 Vt = 200

Note 1 – Whilst in theory 104 litres is feasible we would recommend 144 litres as an absolute minimum
Note 2 - Whilst in theory 134 litres is feasible we would recommend 144 litres as an absolute minimum

All the above sizes are for guidance and can generally be rounded up or (slightly) down to the nearest ‘standard’ available size

3 Using an Existing Cylinder

Where the existing cylinder is in good condition and meets the guidance on Solar and total capacities then retro fit options are available.
Judgement on the condition of an existing cylinder is somewhat subjective and particular care should be taken in hard water areas where the existing cylinder might be significantly scaled up. The retro fitting option is usually applied to vented cylinders only, however some types of unvented may be suitable for conversion but this should be checked first with RMSolar. As a minimum requirement the vented cylinder should meet the relevant British Standard (BS 1566 or BS699) .

3a Retro Fitting an existing directly heated (immersion heater) cylinder

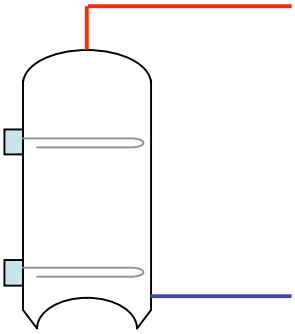
The principle involved is shown in Fig 2 where the Solar input is to one side of a plate type heat exchanger with the domestic hot water being circulated through the other side. This arrangement requires the cold water from the base of the cylinder being heated by the plate and returned to the cylinder point at a point equivalent to the dedicated solar volume and in a manner not likely to disturb any 'hot top' created by auxiliary heat input. The plate to plate heat exchanger and secondary circulation pup are already pre-plumbed into the conversion package.

The cold feed to the plate is normally achieved by teeing off at the normal cold feed position but there are three main options for returning the heated water to the cylinder.

Method 1
If there is an existing secondary return connection then it may be possible to utilise it. The connection may not be at the correct height but an internal pipe can often be inserted to ensure that water is returned to the correct height inside the cylinder.

This is shown in Fig 2a below

Before



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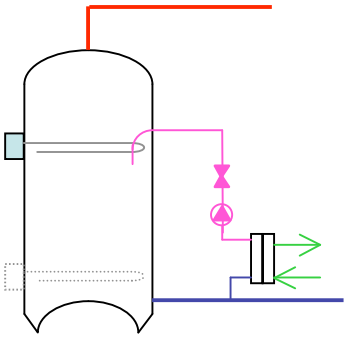
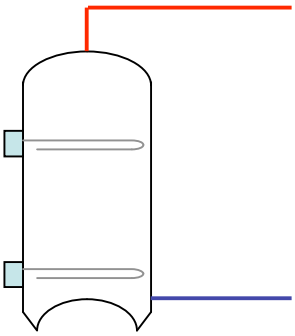


Method 2

An additional connection can be made by drilling a hole in the cylinder at the correct height and fitting an ‘Essex’ flange or equivalent connection.

This is shown in Fig 2b below

Before



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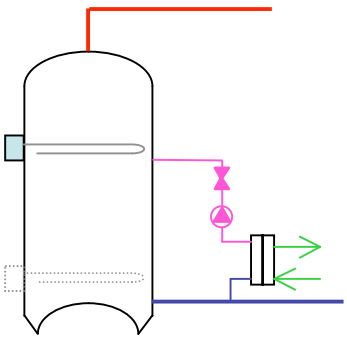


Method 3

A ‘pipe within a pipe’ connection can be made via the top connection by using a 10 or 15mm mm dip pipe down the centre of the cylinder to the correct return height as shown in Fig 2c.

It may be necessary to make a slight ‘dog leg’ in the pipe to avoid obstructions in the cylinder such as an immersion heater. In order to fully comply with the relevant codes of practice and avoid any restriction of the cylinders vent , this method is best suited where a 28mm draw off connection is available.

The connection can easily be fabricated on site using either solder or compression fittings as shown in Fig 2d.

Fig 2c Schematic arrangement

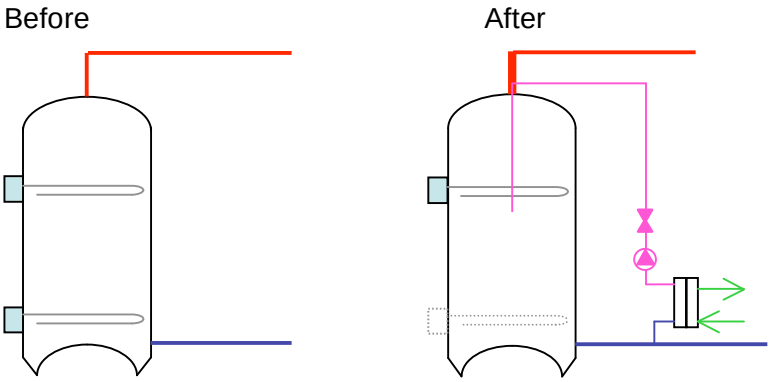
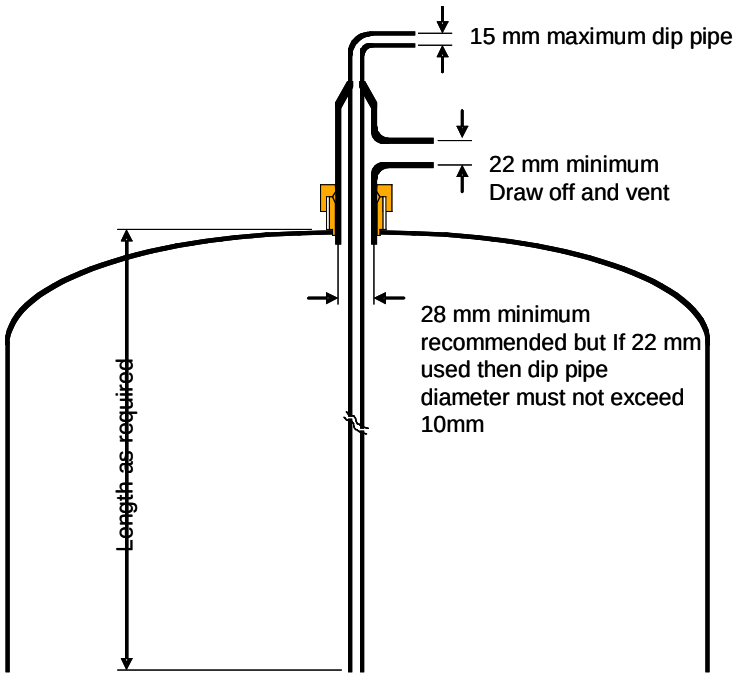


Fig 2d Details of Pipe in Pipe connection



Controls

If converting an existing cylinder then the provision of a dedicated solar thermostat pocket may not be possible . This should be overcome by removing a small section of insulation and using it to clamp the sensor head against the side wall of the cylinder at a height of approximately 50 mm above the combined cold feed /plate feed connection. The radial position sensor should not be too close to the draw off connection otherwise false readings may occur.

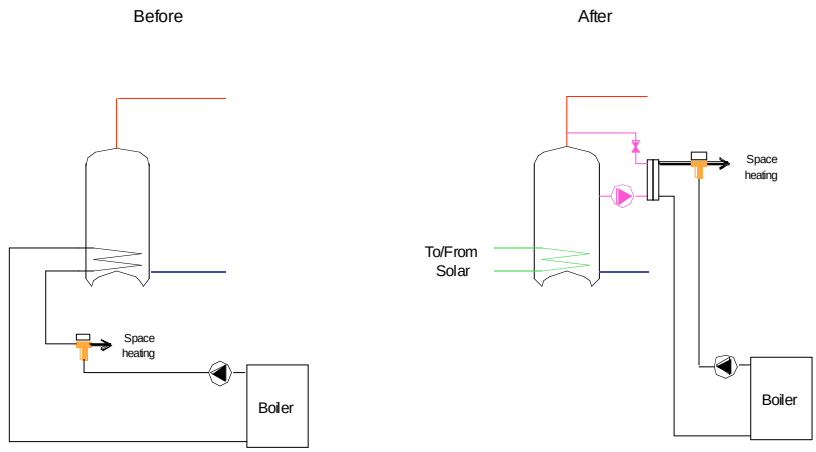
Immersion Heaters

Whilst the above diagrams show two side entry immersion heaters the system works equally well with top dual element immersion heater.
In the case of twin side entry immersion heaters the electrical input to the lower element should be switched off although provision might be allowed for it being occasionally switched on at a reduced thermostat setting under 'emergency' winter conditions. In the case of a dual element top entry heater the longer element should be treated in a similar manner.

3b Retro Fitting an existing indirectly heated cylinder

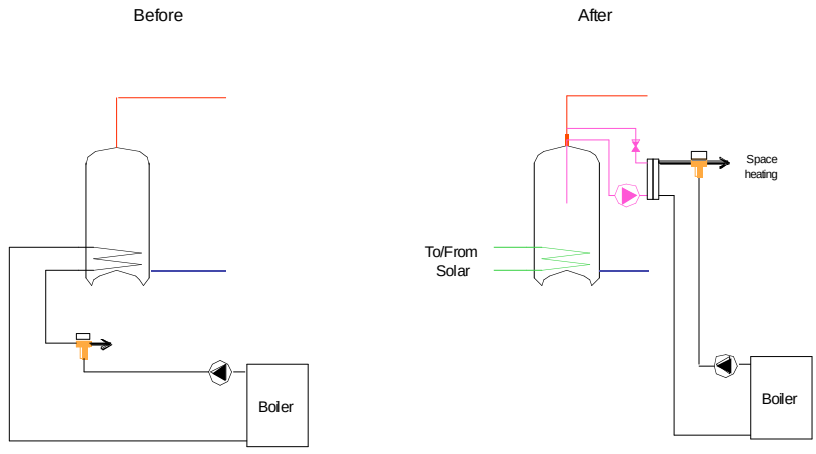
The principles involved are shown in Fig 3a and 3b and is differs from the 'direct' solution in that the boiler primaries are disconnected from the existing indirect coil and diverted to heat one side of the plate to plate heat exchanger. The other side of the plate heat exchanger is connected such that it heats the top part of the cylinder (Va). The options for connection are essentially the same as for the direct conversion i.e existing secondary return , Essex flange or pipe in pipe.
This arrangement frees up the existing indirect coil in the bottom of the cylinder for connection to the solar system.
Connection using secondary return or Essex Flange

Fig 3a



Connection using ‘pipe in pipe’

Fig 3b



Controls

As is the case for the direct conversion it is normally necessary to make provision for control of the Solar by means of clamping the sensor to the cylinder , the same criteria for positioning apply.

The indirect heat input should be controlled via a normal cylinder thermostat situated mid way between the top of the cylinder and the height at which the feed to the plate is taken off. The additional pump is wired so as to run only when there is a DHW demand and the boiler is called to fire. The auxiliary heat input should be time controlled.

Due to the high heat exchange rate from the plate type heat exchanger then given a suitable boiler output reheat can be very rapid (less than 15 minutes) thus under summer conditions the ‘on’ time can often be delayed to give an opportunity for solar input early in the day.

4 General Installation Considerations

In both the direct and indirect conversions care should be taken to minimise hydraulic losses by using adequately sized pipe-work.

The retrofit package should be fitted as low in the system as possible to maximise the pressure head of the domestic hot water circulation pump. Under no circumstances should the pump (in the conversion pack) be sited with less than 1 meter between the water level in the cold supply cistern and the inlet level of the pump.

Wherever possible the outlet from the plate heat exchanger should have a continuous rise to the cylinder co(or dip pipe) connection . If a ‘high point’ is unavoidable and additional automatic air valve should be fitted.