



ARDI Site Builder Walkthrough

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ABSTRACT

This document contains a step-by-step walkthrough of setting up a simple ARDI system and dealing with common complications that may arise.

Overview

What Does This Document Cover?

This document is a walkthrough of how you can set up an ARDI database.

It is designed for users who may be unfamiliar with ARDI in general.

Assumed Knowledge

Basic web usage.

Basic ARDI usage and terminology.

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Why Have a Tutorial?

Although ARDI is not a particularly complicated system, it can take a little bit of time to fully understand what it's capable of and how it works.

The individual components and features are easy to explain, but it's hard to get an idea of how it all comes together into a complete ARDI system.

This is where the walkthrough comes in – it will guide you through the process of creating a simple ARDI database and connecting it to data.

This should let you get an idea of how to perform all of the important steps to both create and maintain your own ARDI database in the future.

A Word of Warning

It may take quite a few pages before you're actually **doing** something in this tutorial. This is because this document is just as much about *why* as *what*.

The tutorial endeavours to explain why we do something and how it works before we actually perform the steps required.

The biggest hurdle in understanding how to make an ARDI database isn't how to add assets – is how to think about your system and prepare before you actually add your first asset to the system.

It also follows best-practises – some of the steps it goes through are quite complicated for such a small application. We go through these steps so you'll be armed with the proper techniques to make much larger ARDI databases with a minimum of time.

Action Markers

If you're having trouble seeing the steps to follow, look for the Action Markers, as shown below...



- 1) Action markers will appear next to lists of steps to follow.
- 2) These steps are key parts of the tutorial – try not to skip them.
- 3) Sometimes these sequences are very small, or even a single point.

Setting Up Your Site

ARDI has features specifically designed to allow you to work with this tutorial.

Once your system is fully installed, visit your ARDI server using your web-browser and go to <http://<servername>/s/tutorial> in your preferred web-browser.

If nobody has done the tutorial in the past, it may take a few moments for the Tutorial Site will be prepared for you so that you can create an ARDI database.

Note that the assets you create in this site will **not** be counted towards your license total. However, there are severe limitations to what you can do in the Tutorial site.

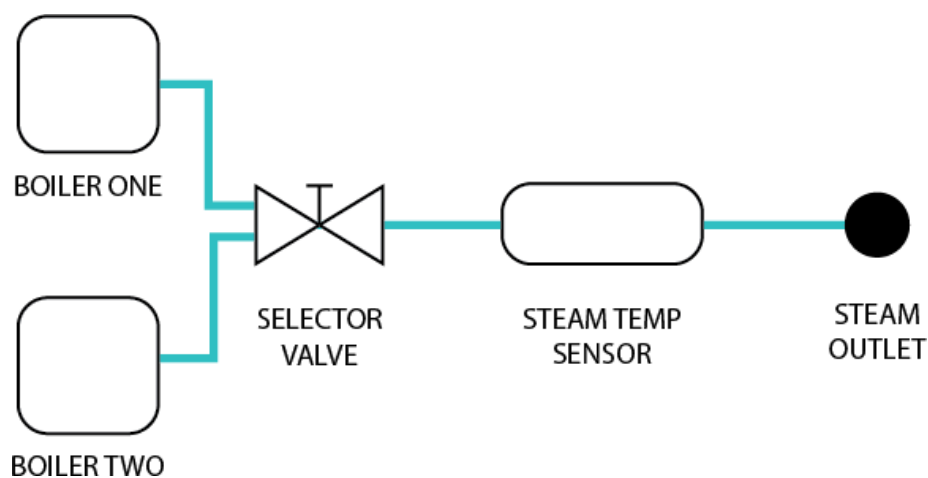
The Tutorial System

Blue Widget Boilers

For our tutorial, we are going to create a database to represent the high-pressure steam system for the Blue Widget Factory.

Note that this is an *extremely* stylised (not to mention unsafe) version of the process. We are using it simply as an example of a small but highly-connected system.

The steam system contains two boilers that burn natural gas to heat water to produce steam.



The two boilers are quite simply called **Boiler One** and **Boiler Two**.

The two boilers merge in a selector valve and pass the steam onto the 'Steam Outlet', which delivers steam to the rest of the plant (which we won't be concerned with in this tutorial).

Boiler Mechanical Details

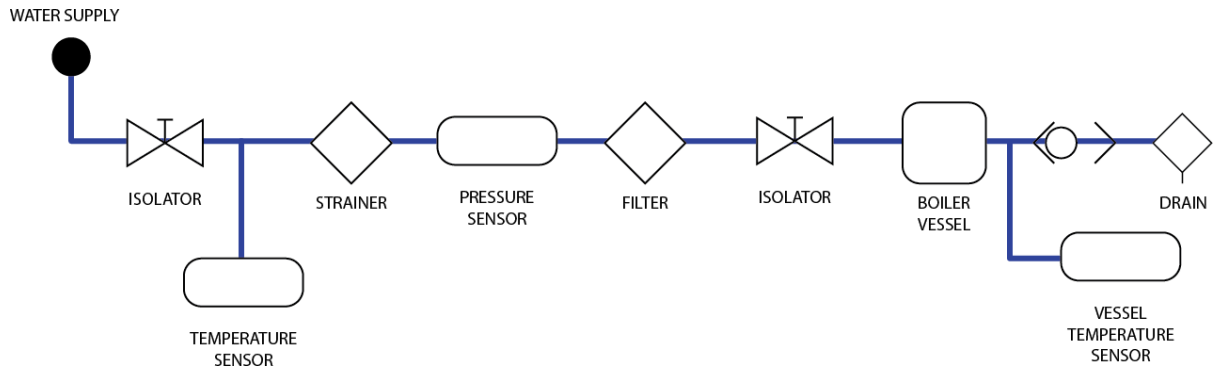
Mechanically, each boiler has two major components

- A large **vessel** in which the water is boiled to produce steam
- A **burner** that burns natural gas to heat the water in the tank

Boiler Water System

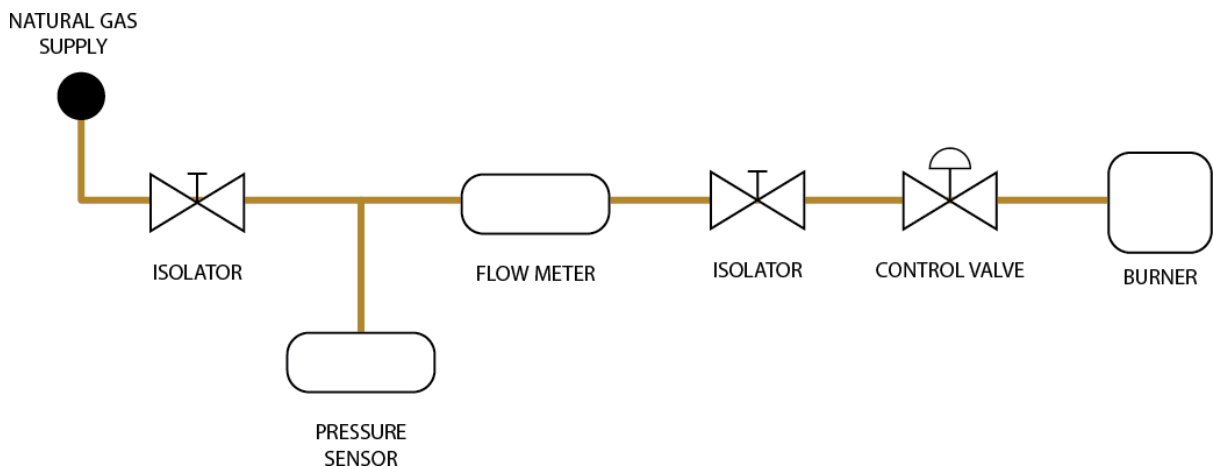
Each boiler has a water system that follows the instrumentation diagram below.

The water passes past a temperature sensor, strainer, pressure sensor and filter before it reaches the boiler.



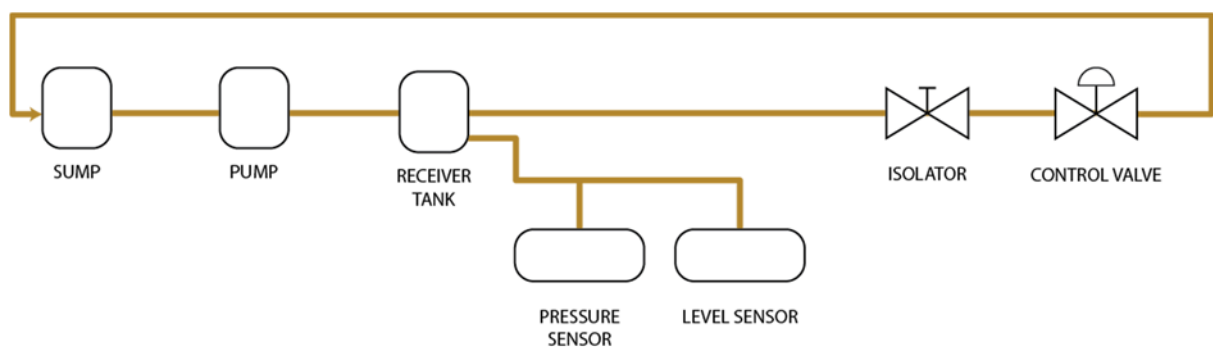
Boiler Burner System

Natural gas is used as the fuel to feed the burner. The control valve immediately before the burner controls the amount of gas being supplied so that the temperature of the vessel is maintained.



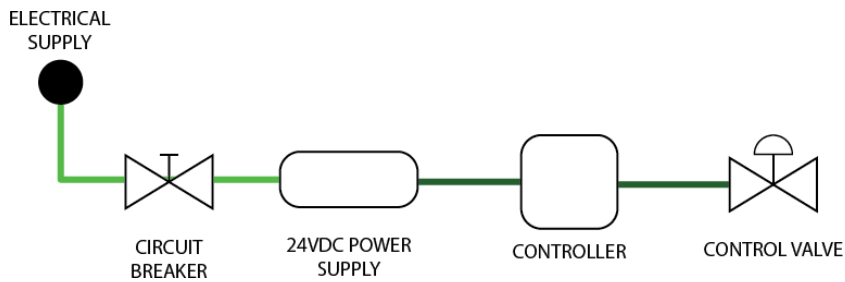
Boiler Hydraulic Supply

The control valve is operated using hydraulic pressure. The hydraulic circuit is shown below...



Boiler Electrical Supply

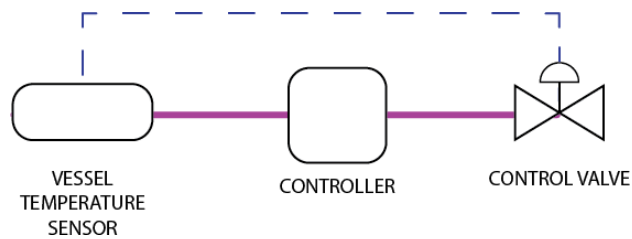
The system that controls the gas flow is powered electrically. The controller is powered by 24VDC, so we need a power-supply to take our 240V/110VAC down to 24VDC.



Boiler Control Loop

Our little boiler system has a very basic control loop to keep the temperature (and therefore our steam output) stable.

The signal from the temperature sensor attached to the vessel is fed to the controller, which in turn sends a control signal to our control valve to change how much gas is flowing.



Identifying Your Assets

The first part of the process is to identify all of your *assets*.

What Are Assets?

In ARDI, an asset is basically *anything*. Machines, components, valves, data acquisition gear – even people. When an asset represents an object, it's called a *physical* asset.

However, an asset doesn't have to be a physical thing at all – an asset can represent something more abstract, like an area of your plant or production, a department in your organisation or a group of similar items. These are known as *logical* assets.

Properties and Media

As well as their own name, assets have *properties* and *media*. Properties are simply details about the asset - if the asset represents a temperature sensor, the properties attached to the asset could include...

- The current temperature
- The manufacturer and model number of the device
- The last calibration date of the device

Media are files and web-links to further information that might be of use, such as...

- Calibration Sheets
- Isolation Instructions
- Maintenance Manuals
- Drawings

Physical Assets

Of the two, your physical assets are the easiest to identify. If you're making an extremely thorough ARDI database, then your physical assets are basically **every object shown in any diagram**.

So if you were to go back over our Blue Widget diagrams, you'll see that each shape represents a physical asset we would need to create in ARDI.

If you are making a less detailed ARDI database (for example, one that is designed with Augmented Reality in mind), then you can skip some of the passive equipment such as isolators and check valves, as these are unlikely to have their own tags or any measurements being made.

Logical Assets

Your logical assets are a little less obvious – normally you set these up when you design your hierarchies. This topic is covered in the next chapter.

Choosing a Level of Detail

The level of detail you put into your ARDI database depends on your needs.

Basic

Those who are thinking of using only Augmented Reality can build their database with only the most important assets (such as those that take live information from your other systems).

In the Blue Widget example, there are measurements being taken at each temperature, pressure and flow sensor – but the isolation valves, check valves and drains don't report anything of use and aren't unique enough to have their own Augmented Reality markers. In this case, we can simply ignore them.

Drawing-Accurate

If you're considering using some of the advanced features of ARDI, it might be worth making your database drawing-accurate, which means making sure that there is an asset in your system for every asset that appears in your drawings.

Although this does involve more work, it can produce more powerful results that are exceptionally well suited to the creation of Virtual Environments.

Relationships

What Are Relationships?

Relationships are connections between your assets.

Each relationship has a start point, an end point and a direction.

For example, a light switch feeds power to a light-bulb in the ceiling, so in this case the 'Power' relationship between the two moves from the switch to the bulb.

Like assets, there are two distinct types of relationship in ARDI.

Physical Relationships

Physical Relationships define actual, physical connections between assets, such as power cables, network connections or piping.

They can also be used to represent 'transparent' connections – although a WiFi network can't be physical seen, it can still be considered a physical relationship because volumes of data move through it the same way that water moves through a pipe.

Logical Relationships

Logical Relationships describe non-physical associations, such as describing concepts such as...

- This Asset Controls...
- This Asset Is Interlocked With...
- This Asset Starts Up Before...

These sorts of relationships are usually not obvious when you are out in the field, since there isn't the same visible connection as found in physical relationships.

Picking Your Relationships

Before we start creating our assets, it's a good idea to create our relationships.

Physical

Like physical assets, it's quite easy to pick out our physical relationships from any diagrams we have of our process.

For every distinct type of exchange between two assets, you should create a new relationship.

For example, our Blue Widget has both **cable** and **piping** connecting the various components. But the *method* of connection isn't quite the same as what is going through the connections.

For instance, in our plant cable carries three different types of media...

- AC Power (from the mains to our Power Supply – shown in light green)
- DC Power (from the Power Supply to the Controller – shown in dark green)
- Signals (from the Controller to the Control Valve – shown in purple)

So it is important to define your relationships in terms of what is going *through* the connection, not just what the connection is.

Following that rule, we can come up with the following physical relationships for our system...

- AC Power
- DC Power
- Signal
- Natural Gas Supply
- Water Supply
- Steam Supply
- Hydraulic Supply

Logical

Like logical assets, some of these are discovered as you start building your ARDI database and find assets where you'd like to provide more detail.

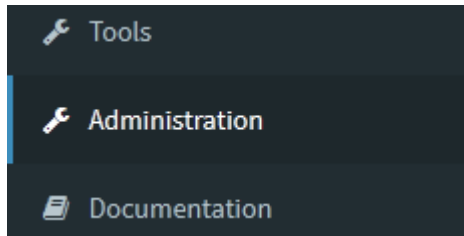
One logical relationship we will almost certainly need is **Controls** – a relationship we can use to let our users know that the position on our valve is controlled by the temperature in our vessel.

So now that we've decided which relationships we are going to need, it's time to actually create them.

The Relationship List

Lets get our hands dirty and start actually adding some relationships to ARDI.

To begin, we will need to make sure we are logged in as an administrator. If you're unsure how to do that, you should see *Appendix I – ARDI Basics*.



The Administration Page is where you access all of the major functions of ARDI outside managing your assets.

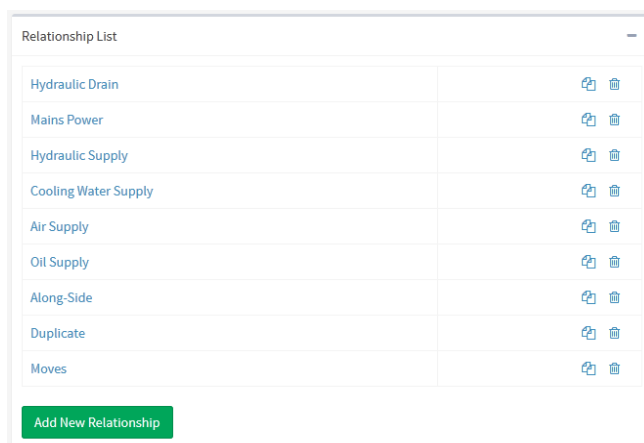
Properties, relationships and data acquisition are all set up here – it's where you'll spend time preparing your system.

- 1) Once you are logged in, click 'Administration' on the Sidebar to access the Admin Page.
- 2) Press the 'Relationships' button (shown below)



This will open the Relationship List, where you can add, edit and delete relationships.

Note that several relationships in ARDI are built-in and may not be removed or changed. These include **Location**, **ISA-95**, **Tagged** and **Monitors**. They do not appear in the list.



Basic Usage:

Click on the name of any relationship to edit it.

Click on the trashcan icon to delete it (you will be asked to confirm this action).

Click on the two pieces of paper to duplicate this relationship.

- 1) Press 'Add New Relationship' to create a new ARDI relationship.

Adding A Relationship

There are a few fields you'll need to fill in to create a new relationship...

Update Relationship

Name :	<input type="text" value="Hydraulic Drain"/>
Upstream :	<input type="text" value="Drained From"/>
Downstream :	<input type="text" value="Drains To"/>
Type :	<input type="text" value="A Physical Relationship"/>
Colour :	<input type="text" value=""/>

Parent *Drains To* Child & Child is *Drained From* Parent.

FIELD	MEANING
NAME	A unique name for this relationship that indicates what it represents. 'Signal', 'Hydraulic Supply', 'Air Supply', 'AC Power' etc. are all good names for a relationship.
UPSTREAM	The upstream directional name for this relationship (see below)
DOWNSTREAM	The downstream directional name for this relationship (see below)
TYPE	The type of relationship – <i>physical, logical or hierarchial</i>
COLOUR	The colour used to represent this relationship (rarely used outside ARDI Virtual Environments)

Directional Names

Every relationship has two directional names. These are the words inserted between the parent and the child or the child and the parent when describing the relationship in plain English.

If the relationship is parent-to-child, the words are inserted without modification. If the relationship is child-to-parent, it will be prefixed by 'is'.

In our AC Power relationship, we may want an upstream name of 'Powered By' and a downstream name of 'Powers'.

When describing the relationship in English, ARDI will then say that...

Asset A is **powered by** Asset B, or

Asset B **powers** Asset A

When giving your relationship upstream and downstream names, it's not a bad idea to consider adding the name of the media as well (ie. AC Powered By / Supplied Cooling Water By) as a way of differentiating it from other relationships.

Steps to Follow

Let's add the following new relationships....

Note that you can shortcut the creation of the last several relationships by using the 'Duplicate' button, as there is very little difference between them.

PROPERTY	VALUE
NAME	AC Power
UPSTREAM	AC Powered By
DOWNSTREAM	AC Powers
TYPE	Physical

PROPERTY	VALUE
NAME	DC Power
UPSTREAM	Powered By
DOWNSTREAM	Powers
TYPE	Physical

PROPERTY	VALUE
NAME	Signal
UPSTREAM	Sends signals to
DOWNSTREAM	Receives signals from
TYPE	Physical

PROPERTY	VALUE
NAME	Natural Gas Supply
UPSTREAM	Supplied Gas By
DOWNSTREAM	Supplied Gas From
TYPE	Physical

PROPERTY	VALUE
NAME	Water Supply
UPSTREAM	Supplied Water By
DOWNSTREAM	Supplied Water From
TYPE	Physical

PROPERTY	VALUE
NAME	Steam Supply
UPSTREAM	Supplied Steam By
DOWNSTREAM	Supplied Steam From
TYPE	Physical

PROPERTY	VALUE
NAME	Hydraulic Supply
UPSTREAM	Supplied Oil By
DOWNSTREAM	Supplied Oil From
TYPE	Physical

PROPERTY	VALUE
NAME	Controls
UPSTREAM	Controls
DOWNSTREAM	Controlled By
TYPE	Logical

Properties

What Are Properties?

Properties are single points of information about your asset.

If you were interested in storing the model number of your assets, you'd create a single property called 'Model Number' to store that information. When you wanted manufacturer, you'd create one called 'Manufacturer'.

Every property is available across every asset in your ARDI system – however, not all assets have to have a *value* for the property.

Property Types

Each property has a distinct *type*.

The type of a property effects where it appears, how you edit it and determines if it should appear on the Dashboard and in clients such as ARDI AR.

Common types include...

TYPE NAME	DESCRIPTION
TEXT	Plain text properties are used simply to store small text values, such as model numbers and manufacturer details. This information does <i>not</i> appear on the Dashboard or in Augmented Reality.
MEASUREMENT	A measurement is an analogue value (such as a temperature, pressure, distance, count etc.).
STATE	A state is a digital value (either on or off, such as a flow detector, door indicator or alarm).
STATUS	An extremely important text string, usually used to describe the status of an asset (running/offline etc.)
URL	A web link.
GEO	Geographic position – a latitude and longitude where the asset can be found.
ADDRESS	A postal/physical address for the asset (this is companied by a Google Map if an internet connection is available).

Picking Your Properties

Now that we have relationships, we can start to build properties.

From looking at the various sensors we have, we can determine that we are going to need the following...

- Pressure
- Temperature
- Flow
- Level

Splitting Properties By Media

It's not *quite* as simple as that. There's one more step before our property list is complete.

In our example, we have both pressure and temperature, but we are measuring that value on two completely different kinds of media.

We have *water* temperature, which should sit somewhere between -10 and 45 degrees, and *steam* temperature, which in our system should be somewhere between 100 and 200 degrees C.

If we wanted, we could cover both of these types of application with the one 'Temperature' measurement property, but it's better if we split the two up.

So in every case where you have media that should be within a different range – for example, the difference between steam and water temperatures, or between air and oil pressures, you should create a *different measurement property*.

To let ARDI understand that the measurements are related, following this format...

<measurement name> - <media name>

This gives us...

- Pressure – Water
- Pressure – Gas
- Pressure – Oil
- Temperature – Water
- Temperature – Steam
- Flow – Gas
- Level - Oil










































The Property List

We have our relationships, now it's time to add our properties.

- 1) Return to the Administration page.
- 2) Press the **Properties** button.

This will open the Properties List, where you can add, edit and delete your properties.

Note that several relationships in ARDI are built-in and may not be removed or changed. These include **Tag Number** and **Augmented Reality Marker ID**. They do not appear in the list.

Pressure - Air	  
Pressure - Hydraulic	  
Pressure - Water	  
Speed	  
SPOT	 
Starts	  
Temperature - Air	  
Temperature - Ambient	  
Temperature - Oil	  
Temperature - Surface	  
Temperature - Water	  
TUC	  
Vars	  
Watts	  

[Add New Property](#)

Basic Usage:

Click on the name of any property to edit it.

Click on the trashcan icon to delete it (you will be asked to confirm this action).

Click on the two pieces of paper to duplicate a property.

Press 'Add New Property' to create a new one.

Press the 'Camera' icon to adjust now a measurement is displayed in a Virtual Environment.

- 1) Press 'Add New Property' to create a new ARDI property.

Adding A Property

There are a few fields you'll need to fill in to create a new property...

Update Property

Name :	<input type="text" value="Temperature - Ambient"/>
Type :	<input style="border: none; border-bottom: 1px solid #ccc; width: 100%;" type="text" value="An Analogue Measurement"/>

FIELD	MEANING
NAME	A unique name for the property
TYPE	A property type

Additional Options for Measurements

Measurements have a few additional options that are important to fill in. We will cover these here....

Property Settings

Default Units :	<input type="text" value="Deg C"/>
Default Range :	<input type="text" value="0"/> - <input type="text" value="65"/>
Default Decimal Places :	<input type="text" value="1"/>
Display :	<input type="text" value="Zero is the Minimum Value"/>
Flow Through:	<input type="checkbox"/> Air Supply <input type="checkbox"/> Cooling Water Supply <input type="checkbox"/> Hydraulic Drain <input type="checkbox"/> Hydraulic Supply <input type="checkbox"/> Mains Power <input type="checkbox"/> Moves <input type="checkbox"/> Oil Supply
Options :	<input type="checkbox"/> This is a type of energy <input type="checkbox"/> This is a flow/consumption rate

Here you can set the default range, units of measurement and number of decimal places for your measurement.

The 'Display' option allows you to choose how the value should be charted.

Options allow you to mark the property as a source of potentially hazardous energy, or a rate of flow and/or consumption.

And finally, you're given a list of all of the **physical relationships** in your ARDI system that this property can 'flow through'.

For example, 'Temperature – Water' is a property that can flow through your 'Water Supply' relationship, since in most cases the asset immediately downstream from a temperature sensor is also getting water at the same temperature.

Consider the physical connections involved when checking any of these boxes. If your 'Water Supply' relationship reflects pipe, does the temperature and pressure measured at a given point normally pass on to the down-stream assets? If so, check the box.

Steps To Follow

Let's add the following new properties....

You can radically improve your creation time by using the 'Duplicate' button, as there is very little difference between many of these properties

PROPERTY	VALUE
NAME	Pressure - Water
TYPE	Measurement
UNITS	kPa*
RANGE	0-1100
POINTS	1
OPTIONS	Energy
FLows DOWN	Water Supply

PROPERTY	VALUE
NAME	Pressure - Gas
TYPE	Measurement
UNITS	kPa*
RANGE	0-50
POINTS	2
OPTIONS	None
FLows DOWN	Natural Gas Supply

PROPERTY	VALUE
NAME	Pressure - Oil
TYPE	Measurement
UNITS	MPa*
RANGE	0-40
POINTS	1
OPTIONS	None
FLows DOWN	Hydraulic Supply

PROPERTY	VALUE
NAME	Temperature - Water
TYPE	Measurement
UNITS	Deg C*
RANGE	0-50
POINTS	1
OPTIONS	None
FLows DOWN	Water Supply

PROPERTY	VALUE
NAME	Temperature - Steam
TYPE	Measurement
UNITS	Deg C*
RANGE	80-200
POINTS	1
OPTIONS	None
FLOWS DOWN	Steam Supply

PROPERTY	VALUE
NAME	Flow – Gas
TYPE	Measurement
UNITS	NL/min*
RANGE	0-25
POINTS	1
OPTIONS	Rate
FLOWS DOWN	Gas Supply

PROPERTY	VALUE
NAME	Level – Oil
TYPE	Measurement
UNITS	%
RANGE	0-100
POINTS	1
OPTIONS	
FLOWS DOWN	

* Note that this unit-of-measurement should have a **leading space**, to separate the units of measurement from the value.

Building Your Tags and Templates

The very first assets you should make in your ARDI database are **tags** and **templates**.

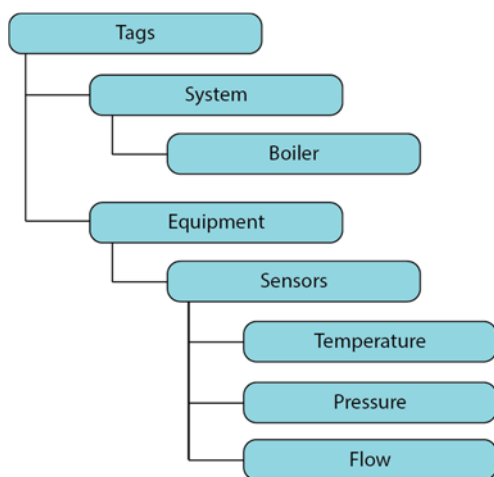
What is a Tag?

Most websites that deal with large collections of assets allow you to ‘tag’ them into categories, and ARDI is no different.

You can create a tag called ‘Gas’ to group all of your natural gas-related equipment together, ‘Sensors’ to group your various types of measuring sensor, ‘Employee’ to mark staff members etc.

Tags form their own unique hierarchy as well – you can have more specific tags (ie. ‘Temperature Sensor’) under the more generic tags (ie. ‘Sensor’).

For example, below you’ll see the start of our tagging hierarchy...



Our first level of tags only contain two different options – **system** and **equipment**.

Under ‘System’ are all of our major systems, allowing us to easily mark assets as part of a given system.

Below that is ‘Equipment’, where we create a tag for each of our common types of equipment.

System Tags

You don’t need to make system tags, but they can help when you have a large number of assets.

Some assets lie in a grey area – they could be seen as integral parts of a number of different systems (this is particularly common when you have a shared cooling system or energy supply).

The location hierarchy only allows a given asset to be attached to the tree at a single point.

However, tags don’t have that issue – a single asset can be connected to any number of tags, so can be marked as being related to a number of different systems.

Equipment Tags

While making equipment tags isn’t required, if you are building a large ARDI database, its well worth doing so.

They allow you to group your various types of sensor together, and become even more powerful when you begin to create *templates*.

What is a Template?

A template is a tag with properties attached.

Almost everything in ARDI is represented by an asset, and that includes tags.

However, when you add a property to a tag, it becomes a *template* and the property you added is copied to **every asset that uses the tag, or a tag below it**.

Looking at our earlier tag tree diagram, you'll see where we have a 'Equipment' tag, with 'Sensors' underneath it (and several items under that, such as 'Temperature' and 'Flow').

If we were to take 'Equipment' and make it a template by adding an 'Equipment Reference Number' property to it, that Equipment Reference Number property would then appear in every single asset tagged with 'Equipment'.

But it would *also* appear in any asset tagged as 'Sensor', 'Temperature', 'Pressure' or 'Flow'.

The same rule applies to media as well – by adding media to a template, it is distributed the same way that properties are.

Why use templates? There are two key advantages....

- **Single Point of Modification**

If you update an instruction manual or specification sheet for a piece of equipment that you have in a number of locations across your plant, it can be a massively time-consuming task to go through each one, remove an old document and add the new one.

However, if your equipment assets are based on a template, all you need to do is update the document on the *template*. All of the assets that use the template are updated at once.

- **Rapid Asset Creation**

By creating a template for a commonly-used item (such as a temperature sensor or an isolation valve), you can create new assets of that type very easily. Rather than having to add an asset, find the properties that apply and add them one by one, you simply tag the asset and all of the properties drop into place.

Templates for Instruments

For this reason, we suggest creating a template for **a sensor for every type of measurement**.

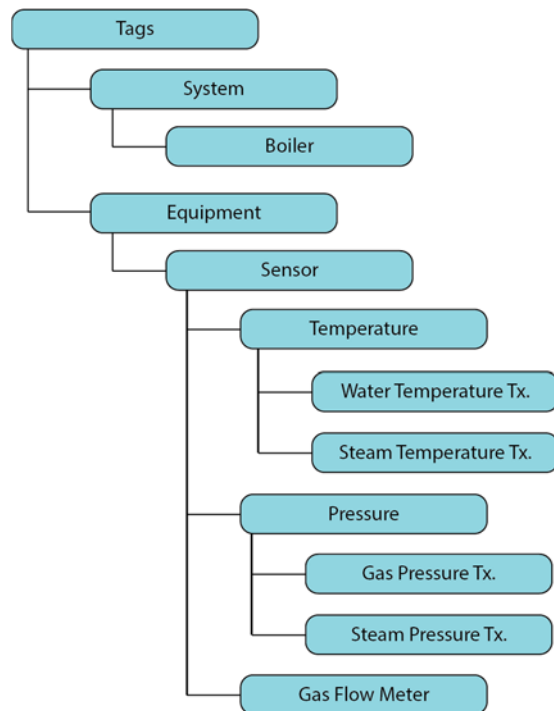
In our case, we have properties for 'Pressure – Water' and 'Pressure – Gas'. To make things more efficient for us, it would be best if we created a 'Water Pressure Transmitter' tag, and a 'Gas Pressure Transmitter' tag for those properties.

This makes our diagram look more like this...

Here we've extended our tag hierarchy so that we now have tags for our individual transmitter types.

If you wanted, you could go even further and make tags under 'Water Temperature Tx' for the different *brands* or *models* of transmitter on-site, but that is purely optional.

We go to all of this trouble to make our lives easier later on. While in this example we won't gain much by creating the templates, in a larger system it makes creating these devices much faster and simpler when we need to had a half-dozen of them.



Templates for Common Asset Types

Find other recurring assets that you might want to turn into templates.

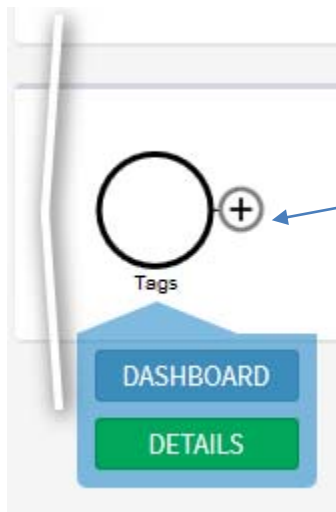
Looking at our diagrams, an obvious candidate would be isolators – there are at least six of them present.

Adding Tags

It's time to add your first asset to ARDI in the form of a tag.

- 1) Go to the Diagram page for tags. The easiest way is to hit 'Find Assets' in the sidebar (or simply visit the main page on your ARDI site) and hit 'By Tags' under 'Browse For Assets'.

You can also get there by choosing 'Browse' in the sidebar and 'Tags' in the popup list.
- 2) Press the '+' button to the right of your tag to bring up the Add Control (discussed on the next page)



When your ARDI data file is new, this is the most boring ARDI diagram possible – the base of your Tag hierarchy with nothing else in it.

To add a new tag, press on the 'plus' button

The Add Control



Above is an image of the Add Control. To begin adding an asset, simply start typing its name.

After you've typed a few characters the system will show you existing assets that match the name you are typing – if you want to add an *existing* asset to this point, you'd just click on its name in the list.

However, we want to create a **new** asset.

When you've entered a name that doesn't exist, the control will look like it does on the right – providing a link that will add the asset to ARDI.



Because we are adding new tags, all we need to do is provide the name – nothing further is required. Later when we add assets that aren't tags, there will be a little more work to do.

Each time you add a new tag, the diagram changes to focus on it.

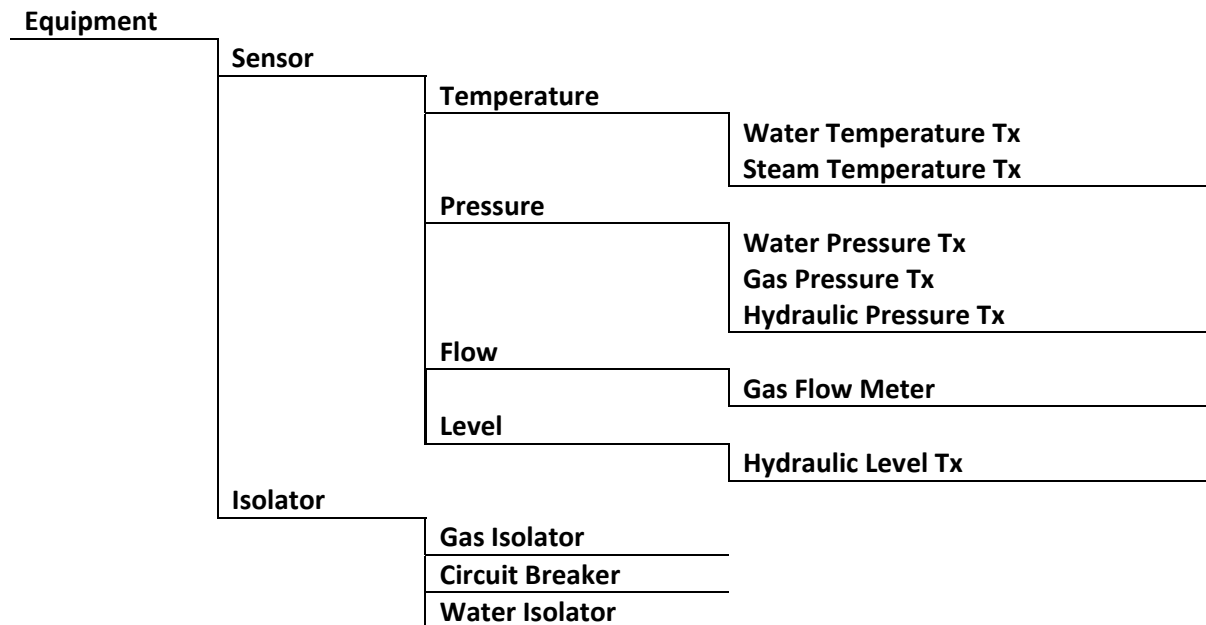
NOTE:

If you are adding an asset that shares a name with another, you may have difficulty reaching the 'Create' button.

To dismiss the 'auto-complete box' (the box showing possible matches to what you are typing), click on the black 'Asset To Add' square or hit the 'Escape' key. This will make the box disappear and let you get at the 'Create' button.

Steps to Follow

- 1) Press the 'Add' button
- 2) Type in 'Equipment'
- 3) Press 'Add Asset' in the list that appears, or 'Create' in the Add Control
- 4) Repeat steps 1-3 until you've created the structure below



Converting Tags to Templates

Equipment

Now it's time to turn these tags into templates.

We are going to want every piece of equipment on our site to have a Equipment Reference Number (often known as a 'Tag Number').

To do that, we will need to set a property in the **Equipment** tag.

Let's look at the process...

- 1) Find the tag, either by browsing the tag hierarchy or searching.
- 2) Go to the 'Details' page for the tag, in the 'Properties' tab (pictured below)

Details

Equipment

Click Here To Set A Description

Tags [Dropdown]

Properties

Name	Value
------	-------

Show All Properties Link Properties

Here you'll see that our Equipment asset has no properties – the list is empty.

To set a property that our asset doesn't have yet, press the 'Show All Properties' button located under the properties list.

This will expand the list to show all available ARDI properties.

Properties

Name	Value
Address	Not Set
Augmented Reality Tag	Not Set
Equipment Tag	Not Set
Flowing	Not Set
Isolation Point	Not Set
Layout	Not Set
Temperature - Water	Not Set

Show All Properties Link Properties

Once you've opened the list of all properties, you can click on any of the 'Not Set' links to set the property value.

For example, if we click on 'Equipment Tag', we can set the Equipment Resource Number.

You enter any values you want for the property, then hit 'Save' to record it.

Equipment Tag

[Text Input Field]

Save Cancel

- 3) Click on 'Not Set' next to **Equipment Tag**
- 4) Leave the field blank (we don't want to set the VALUE of this in each of the children) and hit 'Save'.

Transmitters

Then we will make sure that all of our transmitter tags have the appropriate properties – for example, the Water Pressure Transmitter should have a ‘Pressure – Water’ property.

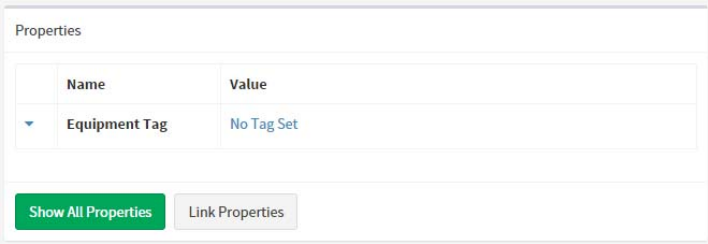
This is done exactly the same way that we set the property previously.

- 1) Find ‘Water Pressure Tx’ (it’s under **Equipment / Sensor / Pressure** in the tag hierarchy)
- 2) Go to it’s details
- 3) Hit ‘Show All Properties’
- 4) Find ‘Pressure – Water’ and click on ‘Not Set’ next to it.
- 5) Set the ‘measurement’ to ‘0’ and hit ‘Save’.

Substituting the appropriate property, repeat the steps above for...

- Steam Temperature Tx
- Water Temperature Tx
- Gas Pressure Tx
- Hydraulic Pressure Tx
- Gas Flow Meter
- Hydraulic Level Tx

When you edit these templates, you may notice that the initial property list isn’t blank anymore, the way it was with our Equipment tag.



Name	Value
Equipment Tag	No Tag Set

Show All Properties Link Properties

Because all of the tags we are modifying are *children* of Equipment, they’ve inherited it’s “Equipment Tag” property.

Hierarchies

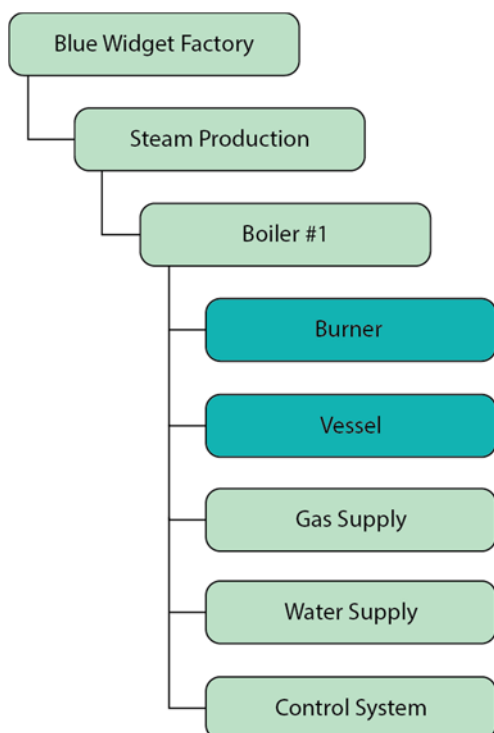
Design

Once you've identified your physical assets, it's time to figure out where to put them.

Hierarchies put your assets into groups to make them much easier to navigate and understand.

Hierarchies form what are known as 'classification tree structures' – a tree that begins from a single point then branches out into sections and sub-sections, until you reach the assets at the end of the branches.

One of the most common hierarchies – and the most critical in ARDI – is the 'Location' hierarchy, which is sketched out below.



On the left you can see one of the very many possible tree structures that we can produce to represent the Blue Widget factory.

We start at the most general point, the factory itself.

If our site had multiple buildings, we could place those under the site.

Then we move down to a major system of our site, such as **Steam Production**.

Now we add our first boiler, followed by some of its component sections – the major mechanical parts (the **Burner** and **Vessel**), and the sub-systems that feed them.

The location hierarchy gives a structure to all of the assets on your plant. Even if you don't use any of the alternative hierarchies (such as ISA-95), you should give *every* asset a place on the Location hierarchy.

Note that an asset may only appear *once* in any hierarchy, so you'll need to consider where you'd like to put your assets when it comes time to create them. For example, would you like to place the Control Valve on the natural gas line inside 'Burner' or inside 'Gas Supply'? Both answers are correct – it's simply a matter of preference.

The Full Name

The location of an asset is used to create its **full name** – this is a name made up of the all of the locations above it. This means that if you were to put the 'Control Valve' inside 'Burner' in the

diagram above, it's full name would be 'Blue Widget Factory Steam Production Boiler #1 Burner Control Valve'.

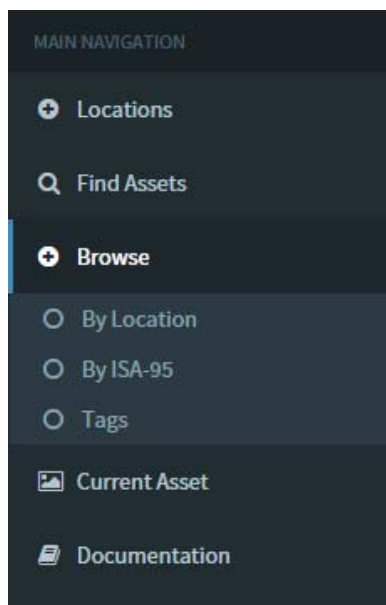
Try to let this inform where you put items – what locations work best to make the full name of the object sound like a proper description of where it is and what it does?

Special Rules for Full Names

There are also a few special rules used when creating the full name of an asset – any parent that is *plural* is ignored, and certain key words such as *system* are removed.

So if you had an asset called 'Flame Monitor' in **Blue Widget Factory -> Steam Production -> Boilers -> Boiler #1-> Burner System**, ARDI would give it the full name "Blue Widget Factory Steam Production Boiler #1 Burner Flame Monitor"

Creation



Each of your hierarchies appears in the Browse section of the Sidebar and on your main page. These buttons all link to the Digram page for a hierarchy.

As we would like to create the 'Location' hierarchy, we should hit 'Browse' and then 'Location'.

Each of the points in a hierarchy is an asset. It may be a physical asset (ie. an object you can touch, such as a sensor or machine) or a logical one (a system or area).

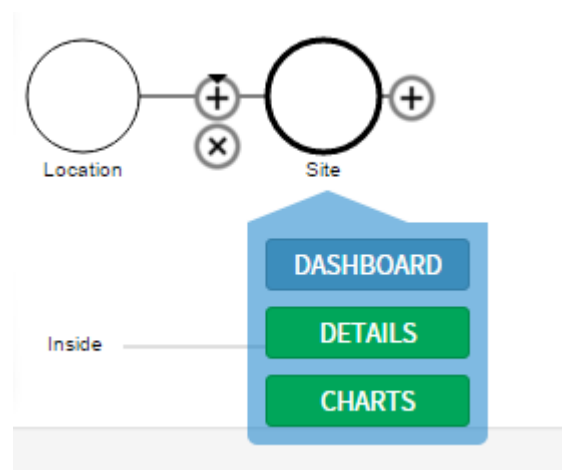
Each is created in exactly the same way that you added tags earlier – by pressing the 'plus' button next to the parent asset.

However, when we press 'Add New' or 'Create' now, we are presented with an additional page.

Steps to Follow

Start by selecting your site from the Location Hierarchy.

- 1) Press the 'Plus' button to open the Add Control (as documented on page 28)
- 2) Enter our first (and most general) Location, "Steam Production"
- 3) Press 'Add This Asset' or 'Create'



Asset Basics

Because we aren't creating a tag this time, ARDI is going to ask us a little more about the asset we are creating.

The screenshot shows a web form titled 'Details' for creating an asset. It contains three input fields: 'Name' (text input with 'Steam Production'), 'Description' (text area), and 'Tags' (dropdown menu with a plus sign button). A green 'Create Asset' button is located at the bottom left of the form.

FIELD	MEANING
NAME	A name for this asset. It does not have to be unique
DESCRIPTION	A small amount of text describing what the asset is and does.
TAGS	A list of tags attached to this asset.

Good Naming Practise

Note that while your asset names don't need to be unique, they should be informative – particularly when you get to making *physical* assets.

Calling something 'Temperature Sensor' is fine when you've only got one, but once you've got a few of them it's a better if the names of your physical assets contain enough information to figure out what it's function is.

If you have assets with the same name, the *full name* (see page 32) of the asset can help you figure out which one is which. This is why you get the full name of the asset with any search.

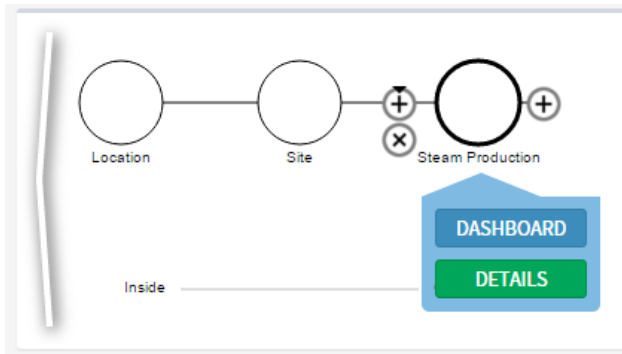
Steps to Follow

Create your asset by filling in the form.

- 1) Fill in a description – for example, you could type "Produces steam for the rest of the factory". Descriptions are **not** required, but are good practise.
- 2) Press 'Create Asset' without choosing a tag.

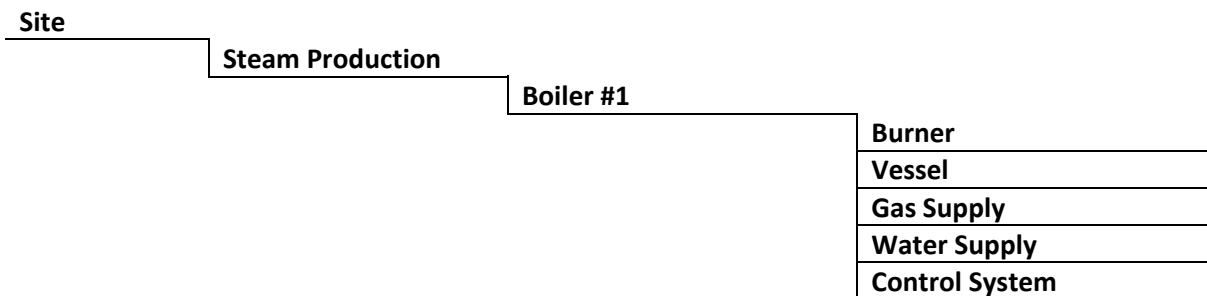
Note that when you don't choose a tag, you'll be taken to the Diagram page for the asset you've just created, allowing you to make more child objects.

This is because assets without tags are assumed to be *logical* assets and assets with tags are assumed to be *physical*. This is simply a convenience feature to make building your hierarchy faster.



Congratulations – you’ve created the first part of your asset hierarchy.

Now it’s a matter of adding the rest – repeat the steps to go through and build the rest of your hierarchy to match the diagram below...



Made a mistake? Do you need to rename or delete an asset? Check out Appendix 2 – Fixing Common Errors on page 71 to discover how you can fix it.

What, Why, When, How, Where?

For a quick summary, here is what the various aspects of an asset do.

- The **name**, **description** and **tags** help clarify *what* an asset actually is.
- The **hierarchy** relationships tell you *where* it is in terms of your system and/or plant. Using the Virtual Environment module takes that much further.
- The **physical relationships** describe *how* its connected.
- The **logical relationships** – ‘monitors’ among them - can be used to describe *why* its there.
- Your **data connections** – which we will set up later – takes care of *when* by providing both realtime and historical values.

Our First Set of Assets

We've spent a lot of time on infrastructure so far – preparing our ARDI database to do everything we need, without adding any of the really important elements to it.

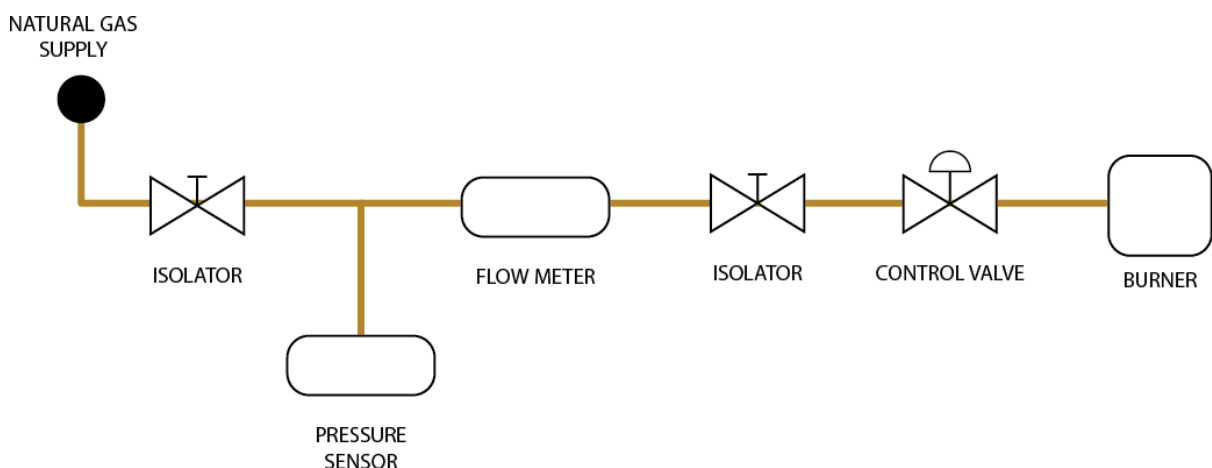
But now that we've taken the time to methodically set up our server, adding the bulk of our assets should be quite straight-forward.

The Best Order for Creation

Apart from your major mechanical components (which are usually featured as pieces of your Location hierarchy), it's best to build your assets in the order that they appear in your diagrams.

Choose one of your diagrams, start from the 'source' (assuming it has a source of energy or media) and follow the arrows until you've completed the full diagram.

To start with, we are going to pick the Natural Gas Supply, simply because it is relatively straight-forward. Your best starting points are diagrams that are long (ie. have many assets) but are relatively straight and don't have many branches.



Building our Gas Supply

Step 1 - The Source

We need to begin with the Natural Gas Supply.

And we run into a very common problem – we've forgotten to add anywhere in our location hierarchy for things that are sourced from outside our business.

The easiest way to fix this is to....

- 1) Go to the 'Location' hierarchy from "Browse" in the sidebar
- 2) Hit '+' on the **base** of the location hierarchy
- 3) Add a new asset called 'Utilities' (no description or tags are required)

Now that we've created somewhere for the Natural Gas Supply to live, let's create it too....

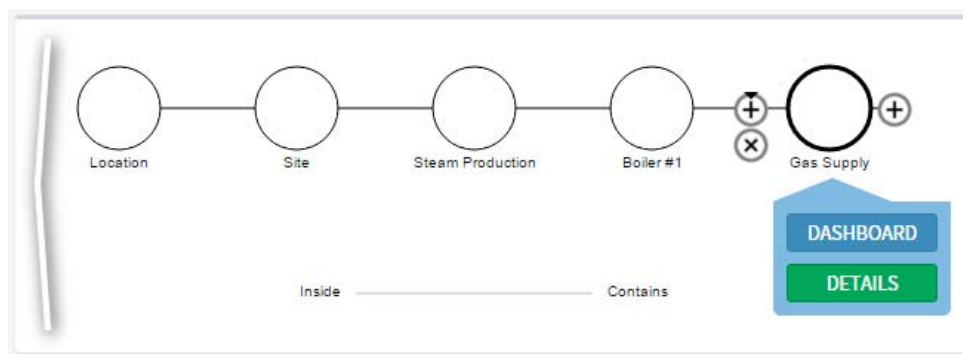
- 1) Hit the '+' button on our new Utilities asset.
- 2) Create an asset called "Natural Gas Provider" (no description or tags are required)

Step 2 - The Main Isolator

Now we've left the utilities and entered our site – we've come across our first isolator.

First, we need to find where we would like this asset to live.

In this case, browse the diagram until you get to **Site / Steam Production / Boiler #1 / Gas Supply** (or search for 'Gas Supply' and hit the Diagram button)



Just like adding tags (or locations), press the '+' button on the Gas Supply.

PROPERTY	VALUE
NAME	Boiler #1 Main Gas Isolator
DESCRIPTION	Isolates natural gas from the burner on Boiler #1
TAG(S)	Gas Isolator

This time, as well as a name and the description, we are going to use one of our tags - the one we created for a Gas Isolator.

In fact, since our asset name contains the name of an existing tag, ARDI has *automatically* added 'Gas Isolator' to our tag list.

If it hadn't dropped in automatically, we would have had to choose the tag name from the drop-list and pressed the small '+' button to the right.

To remove a tag we don't want, hit the '-' button to the right of its name.

Hit 'Create Asset' to bring our isolator to life.

Setting Up a Physical Asset

Properties

While most logical assets (the bulk of the assets we've created so far) don't contain any properties and only have single relationships, *physical* assets are more complex.

When you assign a tag to an asset you're creating, ARDI assumes you're working on a physical asset and takes you a quick-setup page where you can set up some of these relationships and properties.

At this point, ARDI has already created your asset. This is just a quick way of entering its details. The

Property	Value
Address	Not Set
Augmented Reality Tag	Not Set
Equipment Tag	Not Set
Flowing	Not Set
Temperature - Water	Not Set

[Diagram](#) [Dashboard](#)

The property list (shown above) is a list of every property defined in ARDI. However if any of the tags you used were *templates*, the properties defined in the template will be highlighted in bold and already set for you.

This is why we invest time in creating templates for our common asset types – it makes them easy to drop-in new ones in the future.

Clicking on any of the blue links in the property value will allow you to set it – a popup will appear with a 'Save' and 'Cancel' button. Simply update the value(s), hit "Save" and your property changes are saved.

Let's set the 'Equipment Tag' of this asset right now



- 1) Click on 'Not Set' next to 'Equipment Tag'.
- 2) Enter a made-up tag number.
- 3) Hit 'Save'

Equipment Tag

AQR7B

[Save](#) [Cancel](#)

Relationships

Physical Relationships	
Monitors - Monitored By	<input type="text"/>
Water Supply - Supplied By	<input type="text"/>
Gas Supply - Supplied Gas From	<input type="text"/>

Logical Relationships	
Data - Taken From	<input type="text"/>
Control - Controlled By	<input type="text"/>

The second part of the Quick Setup page is a list of relationships.

This allows you 'hook up' your new asset by connecting it to any existing ones.

In all of the relationships shown here, the new asset will be the *child*, not the parent.

So to hook this gas isolator up to gas system, we need to click on the 'Gas Supply – Gas Supplied From' column and begin typing the name of the asset that is directly up-stream.

In this case, it would be the asset we made previously – **Natural Gas Provider**.

- 1) Click on the field next to 'Gas Supply – Gas Supplied From'
- 2) Enter the text 'nat'
- 3) Wait for ARDI

You should notice that once you've got the first couple of characters written, ARDI will search for and find your 'Natural Gas Provider' asset and show it in a list.

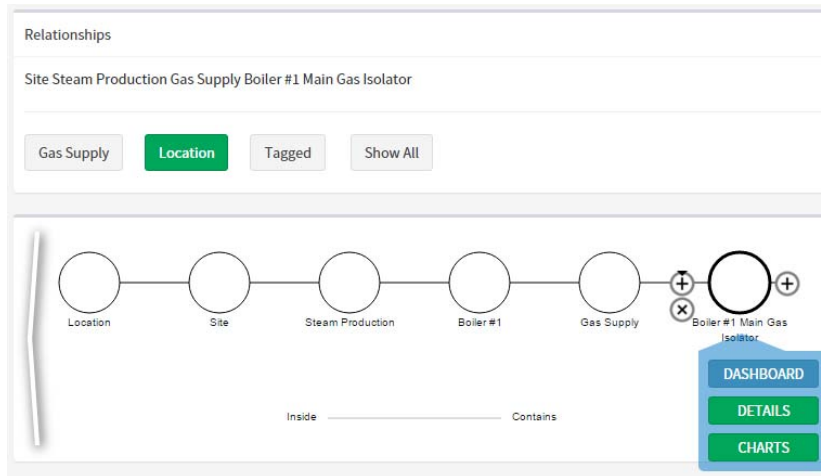
Gas Supply - Supplied Gas From	<input type="text" value="Natural Gas Provider"/>
	Natural Gas Provider Location

- 4) Click on 'Natural Gas Provider'

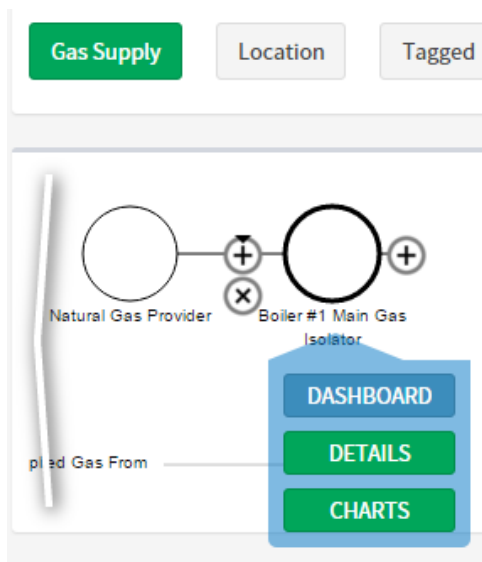
Once you're done, press the 'Diagram' button under the Properties list.

Checking Your Work So Far

The diagram for the new gas isolator should look something like this...



Note that in the 'Relationships' section, we have Location (the default), Tagged (letting us know our asset has one or more tags) and Gas Supply (as it is connected to the gas provider).



If we press the 'Gas Supply' button, we can now see that the items are connected correctly and we've started replicating our diagram in ARDI.

Our little diagram on the left shows our main gas isolator directly after the natural gas provider, exactly as per our diagram.

Add The Rest

After this, the next steps are basically 'rinse and repeat' for all of the other objects in the diagram.

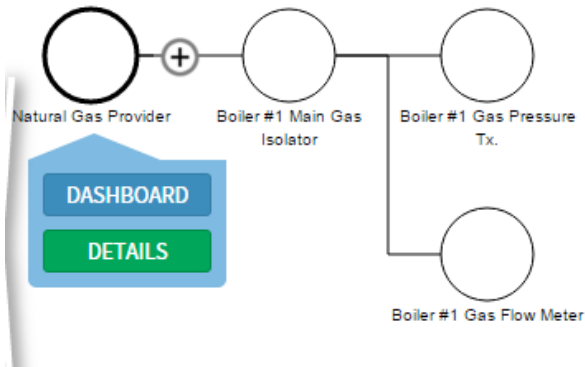
Return to the 'Gas Supply' location diagram, then follow Step 2 again for each of the objects in the table below...

PROPERTY	VALUE
NAME	Boiler #1 Gas Pressure Tx.
DESCRIPTION	Measures incoming gas pressure for Boiler #1
TAG(S)	Gas Pressure Tx
GAS SUPPLY	Main Gas Isolator

PROPERTY	VALUE
NAME	Boiler #1 Gas Flow Meter

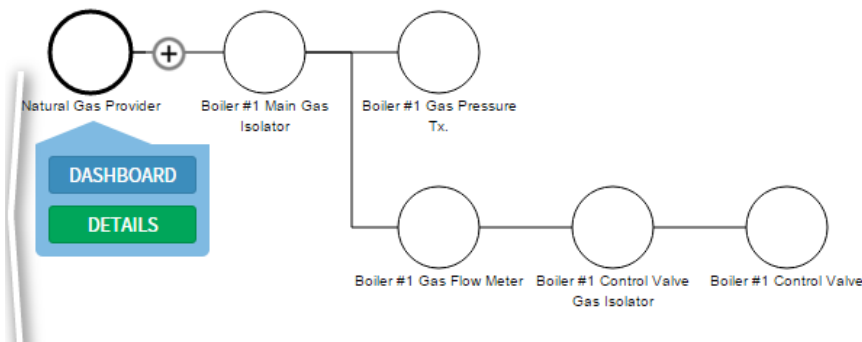
DESCRIPTION	Measures incoming gas flow for Boiler #1
TAG(S)	Gas Flow Meter
GAS SUPPLY	Main Gas Isolator

After these two are added, you'll find that you now have a fork in your diagram for the gas supply relationship, again as per the diagram.



PROPERTY	VALUE
NAME	Boiler #1 Control Valve Gas Isolator
DESCRIPTION	Isolates the control valve on Boiler #1
TAG(S)	Gas Isolator
GAS SUPPLY	Gas Flow Meter

PROPERTY	VALUE
NAME	Boiler #1 Control Valve
DESCRIPTION	Measures incoming gas pressure for Boiler #1
TAG(S)	Gas Pressure Tx
GAS SUPPLY	Valve Gas Isolator

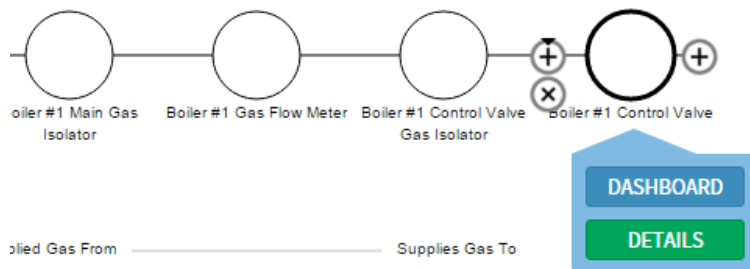


The above diagram shows our final gas relationship (from the perspective of the Natural Gas Provider).

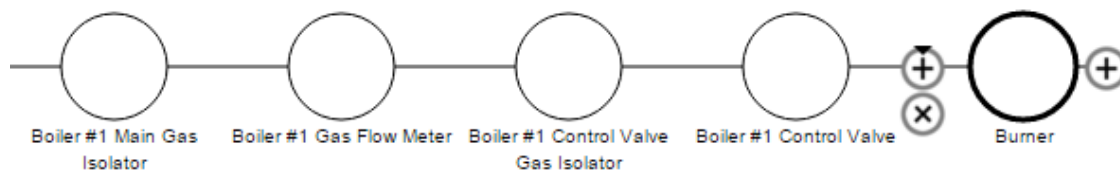
Adding Existing Items

We've now reached the point where we need to connect an EXISTING asset (the Burner) to our relationship.

- 1) Select the asset that will be supplying the gas to the burner – in this case, the **Boiler #1 Control Valve**
- 2) Go to the Gas Supply diagram for the asset



- 3) Hit '+' to the right of the **Boiler #1 Control Valve**
- 4) Type the start of the name 'Burner'
- 5) ARDI will suggest a list of matching names – at this point, there should be only the one.
- 6) Click on the 'Burner' in the list to connect the existing asset.

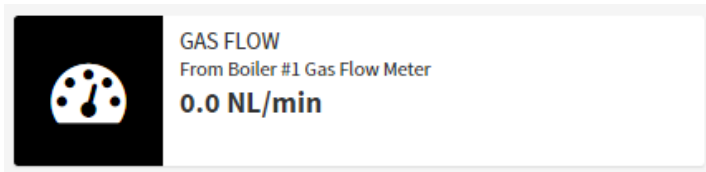


And the relationship for our gas flow is now complete.

Reviewing Property Flow

After you finish entering the details for a complete relationship chain, it's a good idea to take a few moments to see if your properties are flowing as expected.

Click on Burner and open the Dashboard for it.



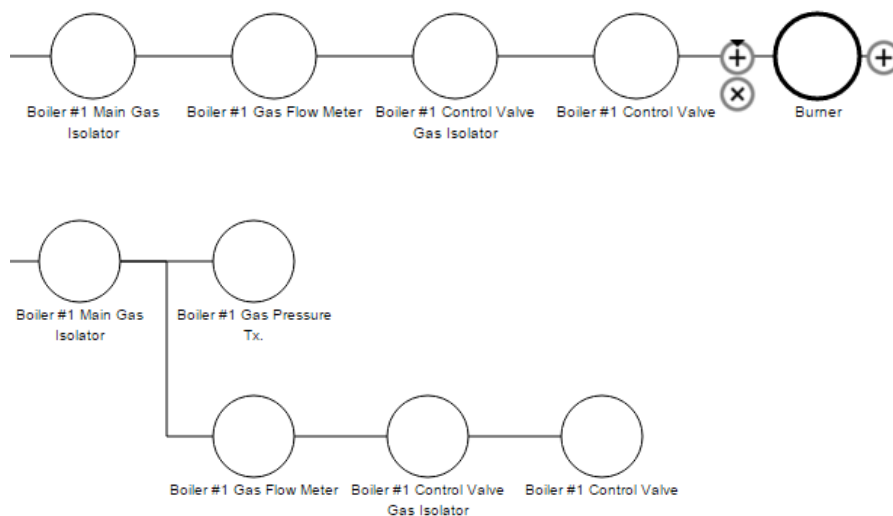
Because we marked 'Flow – Gas' as a property that can flow down the Natural Gas Supply relationship, our burner is picking up the gas flow rate from the upstream flow meter.

But where is our *pressure*?

Monitoring

We know we have **Boiler #1 Gas Pressure Tx.** In our natural gas supply line – but its measurement isn't flowing down to the burner like we'd expect.

Take a look at the relationship diagram below for Burners Natural Gas Supply, and compare it to the diagram for the Main Gas Isolator and you'll see the issue.



The gas pressure sensor isn't visible, because it's in a fork after the Main Gas Isolator. ARDI can't be sure that the measurement taken in the fork applies to the rest of the system, so it doesn't automatically allow it to flow to your burner.

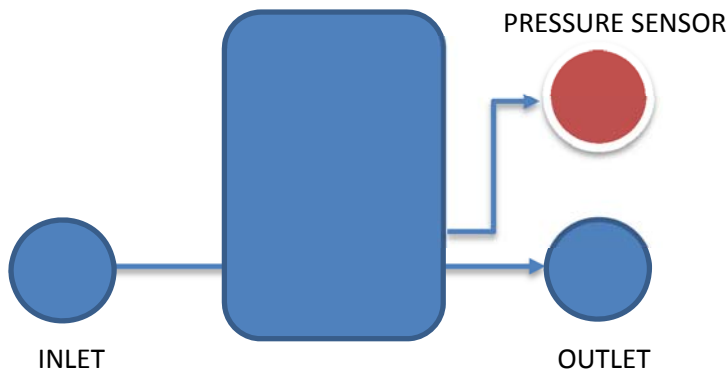
But there's a trick – we can use the Monitors relationship.

What Is The Monitors Relationship?

The Monitors relationship takes a little bit of explaining.

If asset A has a 'Monitors' relationship that points to asset B, it means that the measurement(s) being taken in asset A *actually belong to asset B*.

Let's look at a simple tank monitoring system for example.



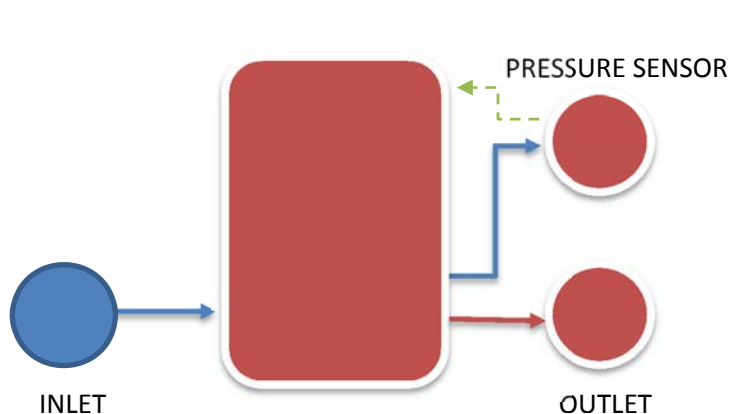
Here we have a tank with an inlet and an outlet, plus a pressure sensor.

The main job of the pressure sensor is to monitor the pressure in the tank.

But since properties only flow *downstream* from assets, that information doesn't make it to the tank. The tank dashboard would have no mention of pressure. The reading only appears in the assets marked in red (the sensor itself).

The solution is simply to **tell ARDI that the pressure sensor monitors the tank**.

By going to the pressure sensor and adding a 'Monitors' relationship with the tank (where the sensor is the parent and the tank is the child), the pressure being measured in the pressure sensor is copied into the tank exactly as if the measurement was taking place there.



Now as well as appearing in the tank itself, the pressure will flow down the Outlet and any other downstream equipment.

Monitors Usage

The relationship is used basically anywhere where you're making a measurement of another asset. As such, it's quite common.

The most common situations where 'monitors' is used include..

- When an asset is down a short 'fork' – eg, when a pressure sensor or temperature sensor have their own piping, or
- When your sensor is significantly downstream from the point at which the temperature measurement would actually be valid, such as when a temperature sensor measuring the outlet of a heater is located downstream, past a filter, flow meter and pressure sensor.

Properties that are Monitored

The Monitors relationship doesn't copy *every* property indiscriminately – there are rules governing what it does.

For properties to be copied into the monitored asset, one of two conditions need to be met...

- The asset must already have the property, or
- The property must flow through a relationship that the asset is connected by.

This is to cater for those situations where an asset takes multiple measurements, but only *some* of those measurements apply to the device being monitored. For example, many pressure sensors also record their internal temperature – however this value should never be copied onto the device the pressure sensor is monitoring.

In the Blue Widget Factory, the flow and pressure sensors are monitoring the flow and pressure *from the natural gas provider*.

The Natural Gas Provider asset doesn't have a **Pressure – Gas** or **Flow – Gas** property. If the provider wasn't connected to anything, we would need to go in and set those properties in order for the Monitors relationship to work.

But we don't need to create them, because the Natural Gas Provider asset is connected to other assets via the *Natural Gas Supply* relationship, and that relationship allows the flow of those two properties.

Adding the Monitors Relationship

There are two ways of adding a new relationship to an asset – one is from the Relationships tab in the Detail page of either asset, the other is to use the Diagram.

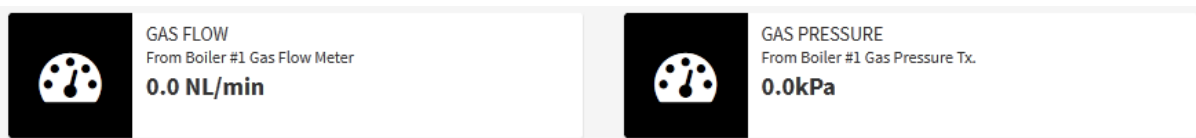
We will cover the Diagram method, since it should be the most familiar to you from our work so far.

- 1) Go to the diagram for **Boiler #1 Gas Pressure Tx.**
- 2) In the list of relationships at the top of the page, choose 'Show All'
- 3) In the drop-list that appears, choose 'Monitors'
- 4) Press the '+' button on the right of the gas pressure transmitter.
- 5) Start typing 'Natural Gas Provider' – when the full name appears in the list, click on it to connect the two.



Discover the Results

Let's look at the dashboard for the burner now...

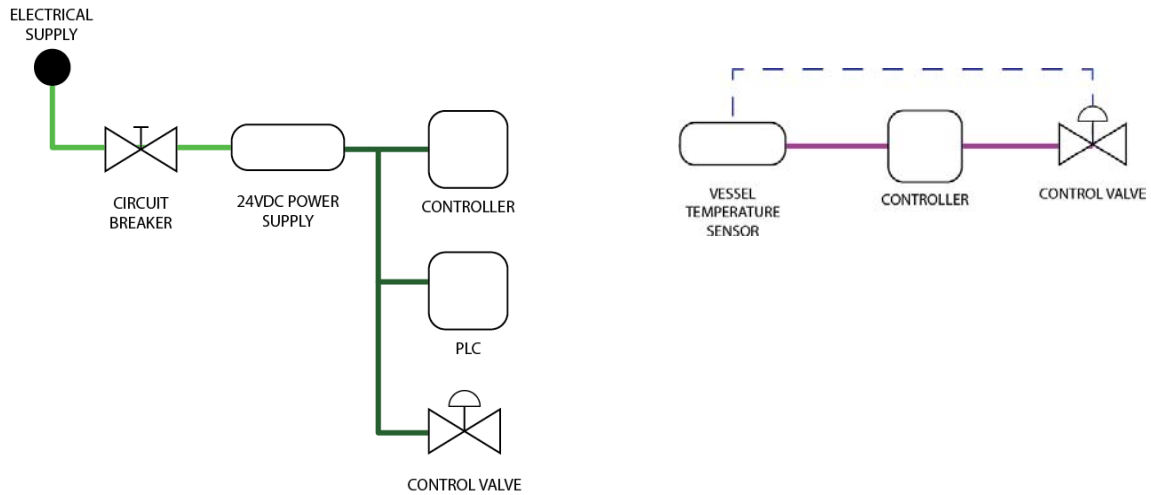


Perfect – when we look at our burner, we can see both the natural gas pressure and flow rate.

Also, rather than looking down through our relationships to find the gas pressure, going to the dashboard of "Natural Gas Provider" immediately gives us the pressure they are supplying.

The Control System

The control system is relatively small, so we will tackle both the electrical and the signal diagrams at the same time.



Steps to Follow

To begin, we create an asset to represent the electrical supply as we did with the gas supply.

- 1) Browse your Loction hierarchy and go to **Utilities**
- 2) Add a new asset called 'AC Power Provider', with no tags.

Now we are ready to add some of the control system components.

- 1) Browse to **Site / Steam Production / Boiler #1 / Control System**
- 2) Create the follwing assets...

PROPERTY	VALUE
NAME	Boiler #1 Main Circuit Breaker
DESCRIPTION	Isolates AC power to Boiler #1
TAG(S)	Circuit Breaker
AC SUPPLY	AC Power Provider

For the next asset, we are using the very generic 'Equipment' tag, as we don't have any other tags that are suitable for a power supply. Since this won't appear automatically, you **must remember to press the plus button** after choosing the new tag from the list.

PROPERTY	VALUE
NAME	Boiler #1 24VDC Power Supply
DESCRIPTION	Provides 24VDC Power to the Control System
TAG(S)	Equipment
AC SUPPLY	Main Circuit Breaker

Also note that in the next assets, we switch to the **DC Supply** rather than the **AC Supply** relationship.

PROPERTY	VALUE
NAME	Boiler #1 PLC
DESCRIPTION	Controls and monitors the entire boiler
TAG(S)	Equipment
DC SUPPLY	24VDC

PROPERTY	VALUE
NAME	Boiler #1 Burner Controller
DESCRIPTION	Controls the position of the burner gas control valve
TAG(S)	Equipment
DC SUPPLY	24VDC

Again, we will need to finish this control sequence by connecting our controller to an asset that already exists – in this case, the **Boiler #1 Control Valve** we created earlier.

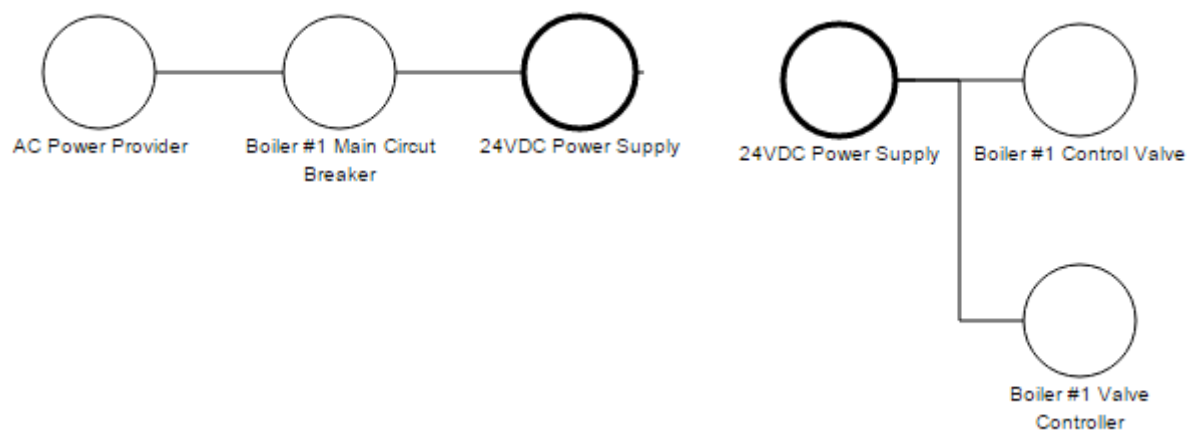
- 1) Go to the 'DC Supply' relationship for **Boiler #1 24VDC Power Supply**
- 2) Press the 'Add' button to the right of the asset.
- 3) Type the name 'Control Valve' and select the name of the valve from the list that appears.

Checking the Results

You should now be able to trace the power all the way from the AC power provider to your controller.

Follow these steps to trace the connections...

- 1) Search for **AC Power Provider** and open the diagram.
- 2) Change the relationship to *AC Power* rather than *Location* in your diagram
- 3) Go to the 24VDC power supply.
- 4) Change the relationship to *DC Power* rather than *AC Power* in your diagram.
- 5) Go to the Controller.



Adding the Temperature Transmitter

Before we can create the signal links for the control system, we are going to have to create our **Vessel Temperature Sensor**.

This measures the temperature of the liquid/gas inside the tank, which is fed to the controller and which in turn controls the gas valve.

- 1) Browse to (or search for) the **Site / Steam Production / Boiler #1 / Vessel** asset.
- 2) While still in the Location diagram, add the asset below...

PROPERTY	VALUE
NAME	Boiler #1 Vessel Water Temperature Tx
DESCRIPTION	Measures the temperature inside the boiling vessel.
TAG(S)	Water Temperature Tx
WATER SUPPLY	Vessel

Let's take a moment to describe what this temperature sensor does. It...

- Monitors the temperature of the cooling water in the vessel
- Sends its signal directly to the Controller, and
- Indirectly controls the Control Valve

So let's let ARDI know this...

- 1) From the diagram of the temperature sensor, select the 'Show All' button in the list of relationships and select *Monitors*
- 2) Add the **Vessel**.
- 3) From the diagram of the temperature sensor, select the 'Show All' button in the list of relationships and select *Signal*
- 4) Add the **Controller**
- 5) From the diagram of the temperature sensor, select the 'Show All' button in the list of relationships and select *Controls*
- 6) Add the **Burner Control Valve**

This describes the function of the device to ARDI. It can pass those details onto others and can also use it (particularly in terms of the *monitors* relationship) to make decisions about your data.

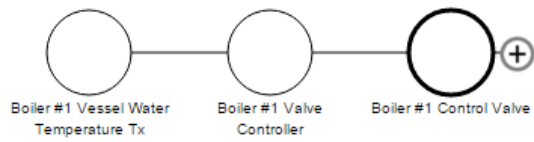
Finishing the Control Loop

Finally, we can finish off the control loop by linking the **Controller** to the **Burner Control Valve**.

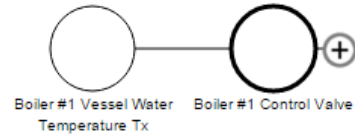
- 1) Follow the 'Signal' relationship from the temperature transmitter to the controller.
- 2) Hit 'Show All' in the relationship list and choose *Signal*
- 3) Add the **Burner Control Valve**

The Final Results

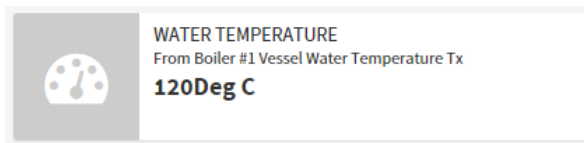
Signal Relationship for Boiler #1 Control Valve



Control Relationship for Boiler #1 Control Valve



Dashboard panel for the Vessel on Boiler #1



Connecting Relationships

There's a relationship we haven't catered for as yet – if we were to look at our vessel or our burner, there's nothing to describe that the two are connected in any way.

This sounds like an ideal place for a new relationship.

Following the same pattern we saw earlier on page 15, you can add an additional relationship with the following options...

PROPERTY	VALUE
NAME	Heating
UPSTREAM	Heated By
DOWNSTREAM	Heats
TYPE	Physical

And by following the pattern on page 42, you can connect **Burner** to **Vessel** via this new *Heating* relationship.

This is not only informative and important, by making bridges between relationship chains (such as the gas supply system and the water supply system), you make it easier to navigate your entire system by following the relationships.

With 'Heating' in place, we can now use our relationships to walk our way from the natural gas provider, trace through the gas piping to the burner, across the burner to the vessel and from there to the water system, right the way back to the source.

Linking to Data

Now that we have the structure of our system coming together and you are getting the hang of setting up assets, it's time to connect them to 'live' data.

Although this section covers a few pages, the first two steps (adding a driver and a data source) are only done once. The process is a little less daunting than it looks.

Starting a Driver

The first thing you need to do before you can get *any* data into your system is to start up a driver.

Drivers are broken into two distinct types.

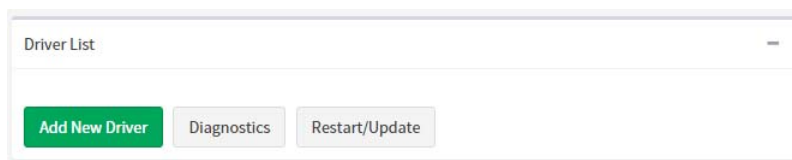
Live drivers are designed to get *current* values. They are always closely monitoring your system and providing ARDI with the latest updates. These drivers can be connected to databases, or directly to data-acquisition systems in the field.

Historical drivers are used to request *old* values. They spend most of their time waiting for requests. These are often linked to databases and historians.

Because this is purely a demonstration, we are going to start the 'Random' driver – this generates a constant stream of random numbers between 0-100 for all of our measurements.

The Driver List

The driver list is found by clicking the 'Drivers' button on the Administration page, and works very much like the properties and relationships lists covered earlier.



- 1) Press 'Add New Driver' to proceed.

Adding Your Driver

Add New Driver

Driver :	<input type="text" value="SQLite Database"/>
Name :	<input type="text"/>
Address : <small>Leave blank to run on the local server</small>	<input type="text"/>
Port Number : <small>Leave blank to automatically allocate</small>	<input type="text"/>

Add New Driver

For most applications, all you will need to do on this page is select a driver from the list at the top – all of the other fields will be automatically filled in or can be ignore.

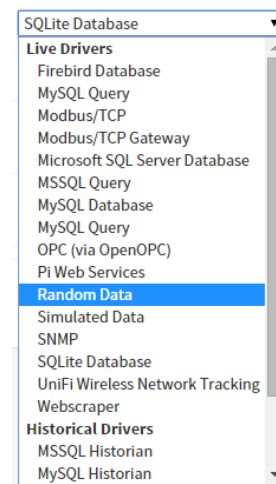
FIELD	VALUE
DRIVER	A list of both the live and historical drivers installed on this system.
NAME	An informal name for this driver
ADDRESS	The IP address or domain name of the machine this driver is running on (left blank if it is running on the local ARDI server)
PORT NUMBER	The unique port number for this driver (left blank for automatic allocation)

It is important to leave the 'Address' and 'Port Number' fields blank unless you are sure you need them. These are used when your actual data-acquisition is on a different machine to your ARDI web server – arrangements that are sometimes required to get around firewalls or improve general performance.

- 1) Pick 'Random Data' from the 'Live Drivers' section. The 'name' field will be automatically filled in as well.
- 2) Press 'Add New Driver'.

If your ARDI server runs on Linux, your driver will be run up immediately.

If your server is running on Windows or another OS, you'll be given instructions on how to start the driver.



Creating your Data Source

Picking A Source Asset

A data source is the place that measurement values are taken from.

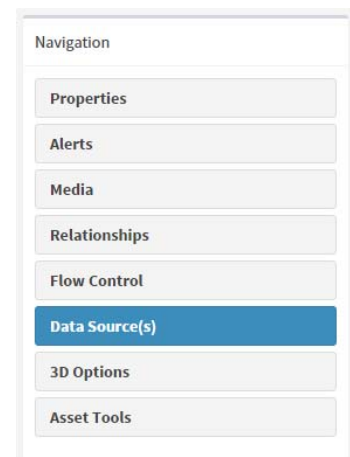
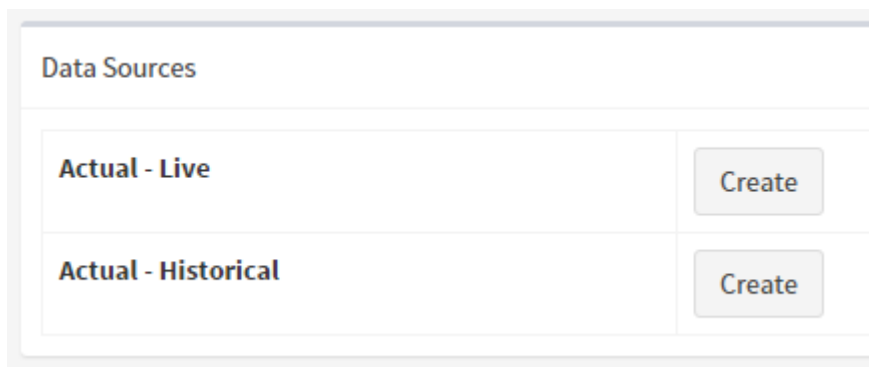
While your *driver* defines what kind of data source you'll be working with (such as a MySQL database, a MODBUS/TCP PLC etc.), the data source is a **specific** database or piece of equipment.

In our case, the electrical diagram shows a PLC (short for Programmable Logic Controller). We will be using this device as a data source.

In the real world, we would use an industrial control protocol to talk to it – but for the purposes of this example, we will just use the Random driver.

So lets set up our data source.

- 1) Search for 'PLC' and hit the pencil icon to immediately go to the detail page.
- 2) From the list of tabs, chose 'Data Source(s)'.
- 3) Under 'Actual – Live', press the button marked 'Create'



Enter Source Details

Data Source Details

Driver : Random Data

Driver Settings

No Configuration Required

Save Data Source Settings

Here you can enter the details of your data source.

First, pick the driver you'd like to use from the driver list. In this case, only the **Random** driver will be available, as that is the only one we installed.

When you select the driver, you'll be asked to enter configuration details for it.

The Random driver doesn't actually need any, but if you were to pick others, you would be asked for additional information such as addresses,

usernames and passwords, tables or unit numbers – the questions asked depend on the type of device or service you are connecting to.

Each driver includes its own documentation. We would suggest referring to it when creating a new data source for anything other than the Random driver.

- 1) Choose 'Random Driver' from the driver list
- 2) Hit 'Save Data Source Settings'.

Linking Measurements to Live Data

Now that we've set up the back-end, it's time to connect one of our measurements to live data. In ARDI, this is known as 'binding' a property to a data source.

Lets start with the vessel temperature transmitter.

- 1) Search for the **Boiler #1 Vessel Water Temperature Tx**
- 2) Go into its Details, in the Properties tab.
- 3) Find the Temperature – Water property.
- 4) Click on the small triangle next to the name of the property.
- 5) In the popup menu, choose 'Link To...'
- 6) Find the 'Measurement' property in the 'Data Bindings' list.
- 7) Open the drop-down menu and choose 'PLC'
- 8) Hit 'Save Link'

Name	Value
Equipment Tag	No Tag Set
Temperature -	120Deg C [0 - 100, to 0 decimal place(s)]

Link To...
Remove...
Cancel

Link Properties

Measurement PLC

The actual measured value. No Config Required

Save Link

Normally, you'd be asked some additional questions after choosing the Data Source for the measurement – things like field names, tag numbers or data addresses, depending on the type of data source used.

However since the Random Data source doesn't need any of that, you can hit 'Save Link' immediately after choosing the source.

And that is it – you’ve created **driver**, a **data source** and a **data link**.

You can test if your new data is working by going to the Dashboard for the Boiler #1 Vessel. By clicking on the temperature, you’ll be taken to a chart that should be randomly jumping up and down every 30 seconds.

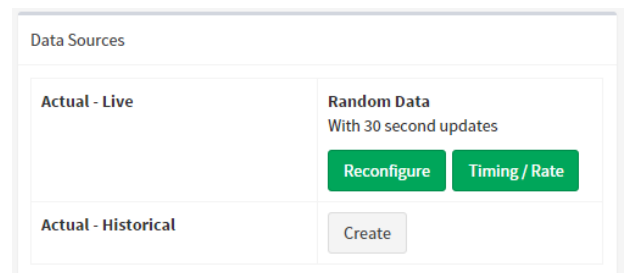
Changing Source Timing

The 30-second timing may not be good enough for your application – most people need their ARDI information to update faster.

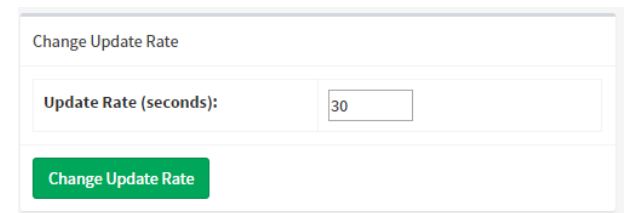
Altering the speed of your data retrieval is quite straight forward – go back to your data source and adjust the update rate in the Data Source settings.

- 1) Search for your **PLC**
- 2) Go to the Data Source(s) tab on the Details page.
- 3) Check the current timing shown – in the example here, it appears as 30 seconds between data updates.
- 4) Hit ‘Timing / Rate’
- 5) Enter the new rate, in seconds. Try ‘1’ or ‘2’.
- 6) Hit ‘Change Update Rate’

Your new update rate won’t be applied immediately – you will need to wait for the *last* update cycle to complete before the new rate takes effect.



Data Sources	
Actual - Live	Random Data With 30 second updates Reconfigure Timing / Rate
Actual - Historical	Create



Change Update Rate

Update Rate (seconds):

[Change Update Rate](#)

So if you had 30 second updates and changed the update rate to 2 seconds, you may have to wait 32 seconds for the update rate to speed up.

You can verify the new update rate on the Dashboard or by viewing a chart.

NOTE: Some drivers (such as the *PI Web Services* driver) tend to disregard the update rate, because rather than polling your data source with frequent requests, they are *sent* the changes. If changing the timing has no result, this may be the reason.

Adding Digitals

Each of our burners has an internal flame-detector to ensure that the natural gas is actually being burned. We would like to show that information in ARDI as well.

Ask yourself the following questions.

Is the flame monitor a separate part with its own tag number?

If yes, we will need to create a new *asset* for it.

Does this property fit neatly into any of our existing properties?

If no, we are going to have to create a new *property* for it.

In this case, we will assume that the flame detector is embedded in the burner (which never happens in the real world), so it won't require an asset of its own.

However, since 'Flame Status' doesn't really fit into any of the measurements we've already created, we will need to create a new property.

Status Properties

- 1) Follow the steps on page 21 to create a property with the values found below.

PROPERTY	VALUE
NAME	Flame Status
TYPE	Status
WHEN ZERO	Not Burning
WHEN ONE	Burning

In this case, rather than an **Analogue Measurement** property - which are used to store analogue measurements and numbers - we want a **Digital Status** property. A status is a digital property that moves between two values, 0 and 1.

Now we can add the 'Flame Status' to our 'Burner' asset the same way we set our other properties.

Adding Complex Properties

Our boiler unit as a whole can be in one of several different states.

STATE	DESCRIPTION
RUNNING	Actively producing steam
HEATING	Getting up to temperature, but not quite ready to produce
STANDBY	Not producing steam, but ready to start
UNAVAILABLE	Not producing steam and not ready to start (ie. due to maintenance)

There are two complications showing this in ARDI.

Important Text

First, this information is extremely important, so we want it to appear on the dashboard of *Boiler #1*. The normal 'Text' property type doesn't appear on the dashboard so we need to use something different.

This is solved by using the **Important Text** property type. This property is highlighted on the Dashboard and will appear in most clients such as ARDI-AR.



- 1) Follow the steps on page 21 to create our new property with the values in the table below.
- 2) Add the property to **Boiler #1**. Set its current value to 'Unavailable'.

PROPERTY	VALUE
NAME	Boiler State
TYPE	Important Text

Unlike most of the properties we've dealt with previously, this one doesn't have any special options (Important Text properties don't flow down relationships like measurements do).

Transforming Data

The second complication is our PLC stores the state as a number.

- 0 = Running
- 1 = Heating
- 2 = Standby
- 3 = Unavailable

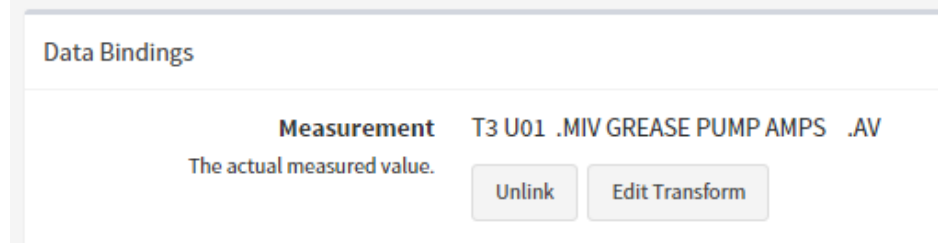
While some of your engineers will understand what the number means, it would help a lot to convert the number into text so that *everyone* can understand it.

This is where Data Transforms come in.

Data transforms alter the incoming data from your data source to make it more suitable for display.

Transforms can also be used to correct for minor errors in incoming data – although we always suggest fixing these things in the field rather than in ARDI, as it is always best to have accurate values from the field.

Linking and Transforming

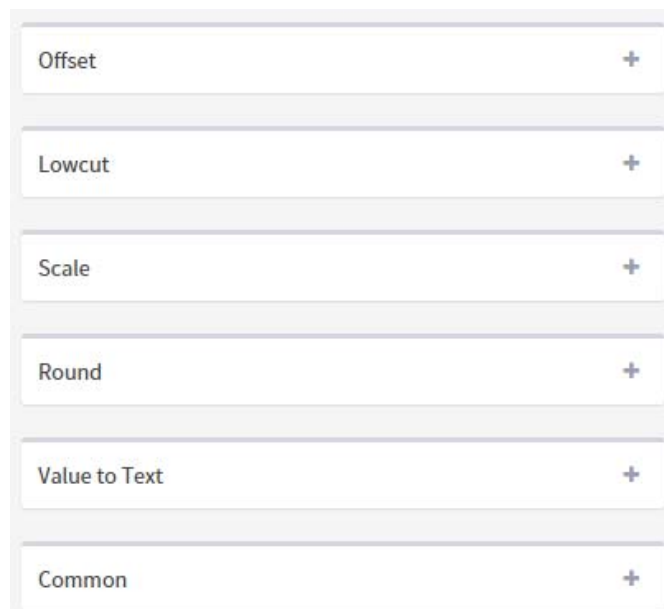


To get to the Transform Options page, you'll need to...

- 1) Go to the Details of **Boiler #1**
- 2) Follow the instructions in *Linking Measurements to Live Data* on page 55 to link this property to some random data.
- 3) When you return to the connection page (the page that appeared after pressing the *Link* button), hit the 'Edit Transform' button.

Transformation Types

There are several different options when transforming your data. Each is enabled by clicking on the '+' button next to their name to expand their options.



Note that these transformations occur in the order they appear in the list.

So if you were to perform a Low Cut, a Scale and Rounding, they would occur in exactly that order – because that is the order they appear in.


If you want to *remove* a step in your transform, simply collapse it by pressing the '+' button again. There is no need to erase any information – just closing it and pressing 'Save' is enough.

Offset

The offset transformation is used to apply a flat correction to any incoming numbers. For example, you can use it to add 50 or remove 120 from a value.

Offset transformations are often used if your measurement is taken from a different reference point than you'd like to display it as, or if your sensor has a small zero error that you are not able to correct in the field.

Source Value:	10
Offset Amount:	25
Result:	35



Offset

Amount:

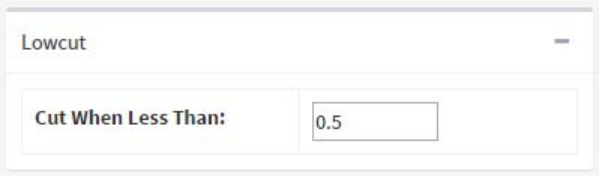
Low Cut

Low Cut sets the value to zero if it is below a certain threshold.

Low Cut is often used on flowmeters, which tend to drift slightly on very low measurements.

Source Value:	0.25
Low Cut Amount:	0.5
Result:	0

Source Value:	1.27
Low Cut Amount:	0.5
Result:	1.27



Lowcut

Cut When Less Than:

Scale

Scale re-scales the number from one range to another.

Scale is one of the most commonly used transforms, as it allows you to use data acquired directly from systems that don't acquire data in the correct units of measurement (such as Modbus TCP remote I/O devices).

It can also be used to multiply, divide and invert your values if required.

Source Value: **50**
Input Minimum: **0**
Input Maximum: **100**
Output Minimum: **0**
Output Maximum: **1000**

Result: **500**

The screenshot shows the 'Scale' configuration window with the following fields:

Field	Value
Input Minimum	
Input Max	
Output Minimum	
Output Max	

Round

This transform removes any digits after a certain number of decimal points (rounding as appropriate)

Source Value: **10.25**
Round Places: **1**

Result: **10.3**

The screenshot shows the 'Round' configuration window with the following field:

Field	Value
Decimal Places	0

Value To Text

Converts numeric values to text

This is most often used with *enumerations* – where a specific number relates to a specific state, condition or alarm.

To use, enter the *from* value (the value you are getting from the data source) and the *to* value (the one you would like to see in ARDI) and press the '+' button.

Source Value: **2**
Options: **0=Off**
1=Standby
2=On

Result: **On**

The screenshot shows the 'Value to Text' configuration window with the following table:

When Value Is	Output
2	On +
0	Off -
1	Standby -

Options & Special Transforms

The last set of selections are options that don't need any specific configuration – inverting the sign of your number (ie. changing a positive number to a negative one) and some other application-specific transformations appear here.

Setting Up Our Transform

If this was a production system, we would need only one transform – **value to text**.

- 1) Click on the '+' next to **Value to Text**
- 2) Under When Value Is, type *0*
- 3) Under Output, type *Running*
- 4) Hit the blue '+' button
- 5) Under Output, type *Heating*
- 6) Note that the number automatically incremented – we can just press the blue '+'
- 7) Under Output, type *Standby*
- 8) Hit the blue '+' button
- 9) Under Output, type *Unavailable*
- 10) Hit the blue '+' button

However, for this test system we aren't quite done.

Because our random data is coming in as 0-100, we are first going to need to **scale** our information down to the range of 0-3 that we are expecting.

- 11) Click on the '+' button next to **Scale**
- 12) Set the Input Minimum to 0
- 13) Set the Input Maximum to *100*
- 14) Set the Output Minimum to 0
- 15) Set the Output Maximum to 4

This gives us a number between 0 and 4, but right now it will have a large number of decimal places. Next, we are going to need to **round** the data, since the **value to text** transformation needs an exact match between our value and the values in its list.

- 16) Click on the '+' button next to **Round**
- 17) Don't make any changes – the default number of decimal places is already zero.

Finally...

- 18) Click 'Save Changes and Return'

And we are done – we've used transformations to take our incoming 0-100 value and turn it into clear and meaningful text.

Checking It All Worked


Your link should now include some text to describe your transformation.

Data Bindings

Text	Not Required
The plain text information that is displayed to the user.	Scaled 0-100 to 0-4 then rounded to 0 decimal places then change so 0 = "Running", 1 = "Heating", 2 = "Standby" and 3 = "Unavailable"

[Unlink](#) [Edit Transform](#)

Now is a good time to check the Dashboard for **Boiler #1**. It should now include a new property that is occasionally jumping between the various states.

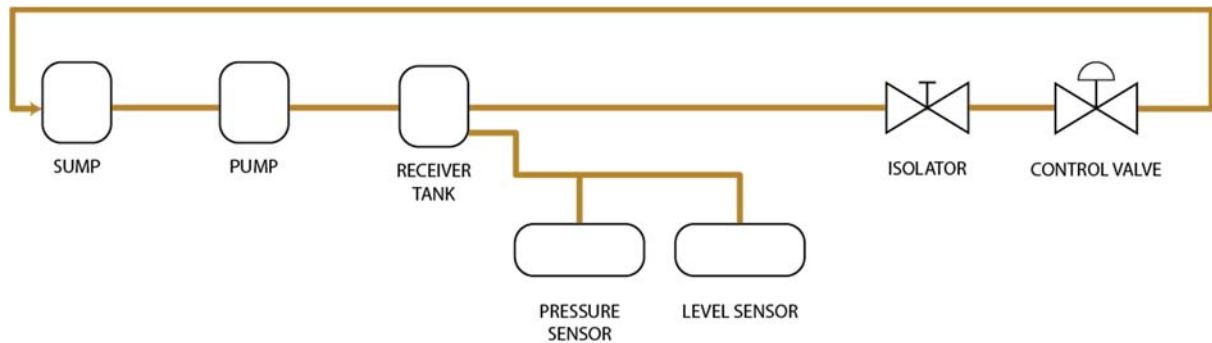


BOILER STATUS
Running

The Hydraulic System

As yet, we haven't played with the hydraulic relationship that gives our valve the power to turn.

If you compare the diagram for the hydraulic relationship to our other diagrams, you'll notice one distinct difference – the system forms a *closed loop*.



In a hydraulic system, your oil is constantly recirculated – the pressure is generated by the pump, held in the receiver, then it flows through to the control valve. Once it's done its work, the oil is then pumped back into the sump, where it waits for the pump to begin the process again.

Avoiding Cyclic Relationships

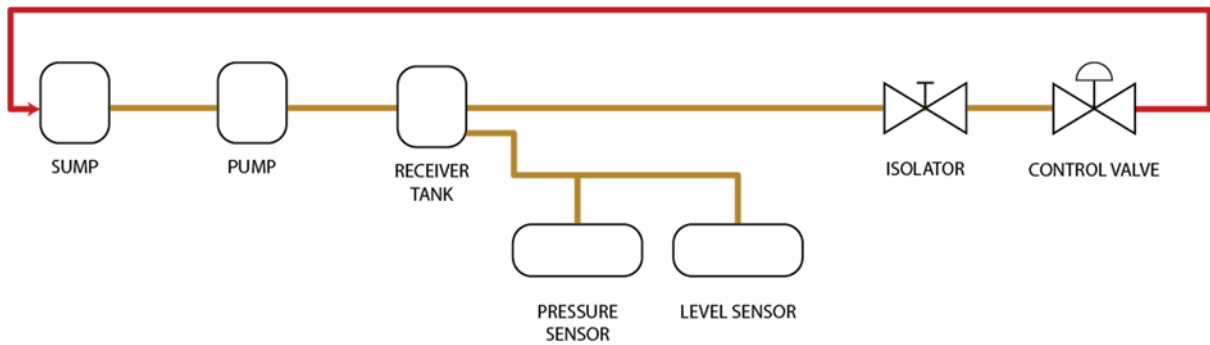
Cyclic relationships such as this are difficult for ARDI – without a defined 'start' point, it's hard to tell where any energy is generated from or where to stop drawing your diagrams.

The best way to deal with this is to split your one relationship (in this case, Hydraulic Supply) into **two** relationships.

A good rule of thumb is that one of your relationships should start at the source of energy and finish where the energy is used. You can then use your alternative relationship to cover the rest of the process.

So in this case, the pressure is generated by the **pump** and used by the **control valve**. Our first relationship, 'Hydraulic Supply', is used for this part of the system.

This means that the remaining part of the diagram should be covered by our new relationship, which we could call 'Hydraulic Drain'.



The diagram above shows the two distinct relationships. The yellow line shows our original 'Hydraulic Supply' relationship and the new red line represents our 'Hydraulic Drain'.

Adding Main Assets

Using what we've covered in the tutorial so far, you should have the ability to follow these steps to add the assets in the diagram to ARDI.



- Create a new 'Hydraulic Drain' relationship
- Create the Hydraulic Sump, Hydraulic Pump, Hydraulic Receiver Tank and Hydraulic Isolator, all connected to one-another by 'Hydraulic Supply'. Use (or create) appropriate tags.
- Connect the Hydraulic Isolator to the Control Valve via 'Hydraulic Supply'.
- Connect the Control Valve to the Sump via the 'Hydraulic Drain' relationship

Adding Tank Monitoring

Adding the Monitors Relationship

The Hydraulic Receiver Tank has two attached sensors – a pressure and a level sensor.

These are both good places to use our **monitors** relationship (discussed in *Monitoring* on page 43)

The level sensor monitors the level in the tank.

The pressure sensor monitors the pressure in the tank, but it also is effectively measuring the pressure generated by the pump. For this reason, we will actually link it to the *pump* rather than to the tank.



- Create the Hydraulic Pressure Sensor and Hydraulic Level Sensor assets. Both should be connected to the Hydraulic Receiver Tank by the 'Hydraulic Supply' relationship.
- Connect the level sensor to the tank via the 'Monitors' relationship.
- Connect the pressure sensor to the pump via the 'Monitors' relationship.

Checking the Results

However, if you go to the dashboard of the tank, you'll notice that while you see the **pressure** coming from the pump, you do not see the **level**.

This is because we haven't quite obeyed the rules of the monitors relationship for our level.

ARDI needs to know which properties should be copied from our level sensor to our tank, and unlike the *Pressure - Hydraulic* property, *Level - Hydraulic* doesn't flow through the Hydraulic Supply.

This means that we need to give the tank a value for *Level - Hydraulic* to tell ARDI that it's OK to copy the level from the Hydraulic Level Sensor to the Hydraulic Receiver Tank.

Adding the Property



- Open the details of the Hydraulic Receiver Tank
- Hit the 'Show All Properties'
- Enter a value for *Level - Hydraulic* and hit 'Save'.
- Go back to the dashboard. The details from the level sensor will now be shown.

Applying Bulk Changes

One rule of setting up any system is that you are *never* given all of the correct information on the first try, no matter how much effort is put into double-checking it.

In some cases the change needed is trivial – but often someone will make a revision that will need you to update properties on dozens or even hundreds of assets.

In this example case, we've just been told that the oil pressure in our system is measured in **BAR**, not in **MPa** like we were originally informed. This means that we will need to change the pressure across all of the components of the hydraulic system.

Doing this asset-by-asset would be quite irritating, but luckily we have an alternative.

- Go to 'Administration' in the Sidebar
- Choose 'Utilities' from the 'Tools' panel.
- In the following menu, choose 'Apply Bulk Changes'.

The page you've opened gives us the ability to change a given property across your entire ARDI database.

On the right you can see the options available.

- Leave 'Action' as **Update a Property Value**
- Change Property to **Pressure – Oil**
- Change Sub-Property to **Units**
- In 'Value', type "**BAR**" (with the leading space but without the quotes).
- Hit the 'Apply Changes' button.

This will go through every ARDI asset (including the asset templates) and update the unit of measurement for all of those assets that have an oil pressure.

Note that this may take some time on larger databases.

Since BAR is 10x smaller than MPa, you should also take this opportunity to change the *Max* (maximum value) of the oil pressure property to **400** rather than the existing **40**.

Note that you can also access Bulk Changes from the Tools tab of the Detail page for an asset. In this case, the changes will be restricted to only those assets that are a child of the asset. This allows you to change only the assets attached to a single machine or on a single line.

The screenshot shows the 'Tools' panel with the following configuration:

- Tools** (Header)
- Buttons: Backup Database, Restore Database, Utilities (selected)
- Select Utility** (Section)
- Buttons: Sync Live & Historical Bindings, Apply Bulk Changes (selected)
- For** (Section)
- Text: This change applies to all assets... In This ARDI Database (dropdown)
- Change** (Section)
- Form fields:
 - Action: Update a Property Value (dropdown)
 - Property: Pitch - Arm (dropdown)
 - Sub-Property: Units (dropdown)
 - Value: BAR (text input)

Duplicating Assets

If you remember back to the start of our document, our system has *two* identical boilers working side-by-side.

But you'll be glad to know we don't need to do all of this work again.

To create the second boiler, all we need to do is go to our first one and **duplicate** it.

How To Perform a Duplication

You duplicate an asset from Asset Tools.

- Search for 'Boiler #1'
- Open the details page for the boiler.
- Open the 'Asset Tools' tab (usually located to the right of the page).
- From the list of tools, choose 'Duplicate This Asset'
- Type in the number of copies you'd like to create (in this case, 1).
- Hit 'Duplicate Asset'

The screenshot shows a user interface for duplicating an asset. It is divided into two main sections: 'Navigation' and 'Options'.
The 'Navigation' section contains four buttons: 'Create Asset Bundle', 'Duplicate This Asset' (which is highlighted), 'Change Assets Under/After This One', and 'Delete This Asset'.
The 'Options' section contains a table with two rows. The first row has a label 'Quantity to Create:' and an input field containing the number '1'. The second row has a label 'Options:' and a checkbox labeled 'Simulated' which is checked. Below the table is a green button labeled 'Duplicate Asset'.

What Gets Duplicated

When you duplicate an asset, you're doing more than just making a new copy of the asset you've got selected.

All of the assets located inside it (via the Location relationship) are also copied.

So this duplicates your entire boiler – all major components including all of the gas, electrical and hydraulic assets we have set up so far.

It also duplicates all of your relationships.

In the case of an *internal* relationship – one that begins and ends with assets that are part of the asset being duplicated – the relationship is copied exactly. This means that in your new duplicate, your new hydraulic pump will be connected to your new hydraulic tank and won't have anything to do with the old one.

With an *external* relationship – where one end is inside the asset and the other is outside – you will end up with all of your duplicated assets connected to the external one. So when we duplicate our boiler, the Natural Gas Provider will be connected to each boiler separately.

What Gets Changed

A few changes may occur to your asset during duplication.

Most importantly, if you have any assets with a '#' in their name followed by a number, the number will be incremented.

This is why we called our first boiler 'Boiler #1'. During duplication, ARDI looks for the number and increases it on any duplicates. This means our *new* boiler will be created with the name 'Boiler #2' – we won't even have to go in and rename it.

Remapping Data

ARDI will also attempt to re-map the connections between your asset and your live data sources. However, this remapping is only rarely successful – you'll most likely have to remap your data yourself using a Bulk Change.

Using the same page that we used in *Applying Bulk Changes* on page 67, you'll be able to change where your data links point.

Assuming that all of the measurements on Boiler #1 were linked to addresses that started with **BLR1**, we could do the following...

- Open the details page for the boiler.
- Open the 'Asset Tools' tab (usually located to the right of the page).
- From the list of tools, choose 'Change Assets Under/After This One'
- Make sure that the 'This change applies to all assets...' is set to **Inside Boiler #2 (Location)**
- Set Action to **Search and Replace in Bindings**
- In 'Search For', type **BLR1**
- In 'Replace With', type **BLR2**
- Hit 'Apply Changes'

For	
This change applies to all assets... Inside Boiler #2 (Location) ▼	
Change	
Action	Search and Replace in Bindings ▼
Search For	<input type="text" value="BLR1"/>
Replace With	<input type="text" value="BLR2"/>

This will go through all of the connections between Boiler #2 and your data sources, swapping any occurrence of 'BLR1' with 'BLR2'. When done, ARDI will immediately start data acquisition on these revised points.

Because we specified that the assets we are changing must be children of Boiler #2, the data points in Boiler #1 will be unaffected.

Since we are using the Random Data driver for this tutorial, this process won't actually have an effect, but it is important to go through the process.

Appendix 1 – ARDI Basics

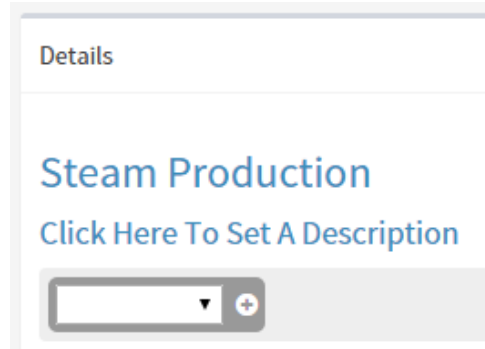
Logging In

Appendix 2 – Fixing Common Errors

Renaming An Asset

Nobody's perfect – we don't get the asset names right first time, every time.

To change the name of an existing asset, you first find it (either via Search or the Location hierarchy) and go to the Details page for the asset.

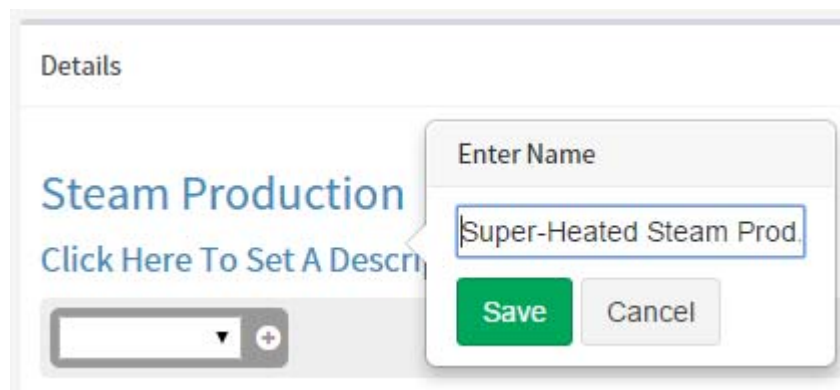


At the top of the page you'll see the name and description of the item, shown in blue.

All you need to do to rename the item (or to change the description, or to change *any* property shown on the page) is to click on it.

A popup will appear, allowing you to change the value to something new.

Hit 'Save' to finalise your changes.

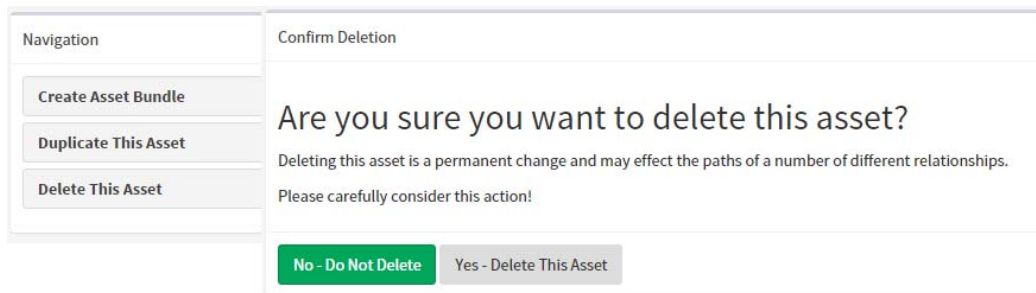


Deleting An Asset

The delete button is kept deep inside the asset Details, since inadvertently deleting an asset can cause serious issues in a live system.

In order to erase an existing asset, you'll need to go to the **Asset Tools** tab of the **Details** page.

Here you've got the option of deleting an asset permanently. Note that you will be asked to confirm the action.



You should ideally make sure that your asset has been removed from all relationships (including hierarchies such as Location). However, if still connected when an asset is deleted ARDI will attempt to *fill the gap*.

For each relationship, all assets that were upstream from the asset will be connected to all assets downstream from it.

So if you began with the relationship...

A -> B -> C

...and then chose to delete 'B', you'll be left with

A -> C