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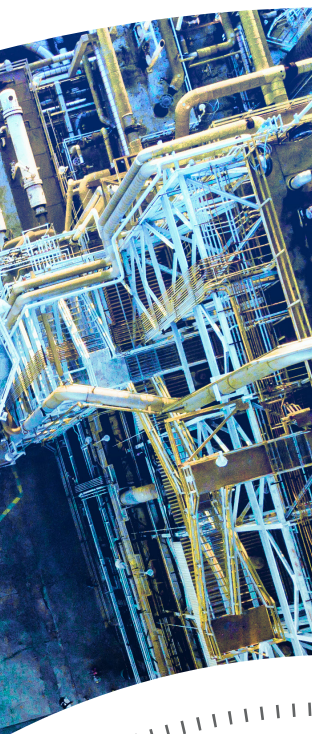
INSIGHTS

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CAD INTEGRATION

Automating the Creation of Pipe Specifications



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INSIGHTS FOR TOMORROW.

E²G | The
Equity
Engineering
Group, Inc.

CAD INTEGRATION

AUTOMATING THE CREATION OF PIPE SPECIFICATIONS

INTRODUCTION

Those that use plant design software such as AutoCAD Plant 3D or CADWorx are familiar with the challenges associated with creating and maintaining piping specifications (specs). These software packages typically require specs to be defined down to the component level by the user. This task is tedious and repetitive, but it is also extremely sensitive to error and demands the user's constant vigilance. Improperly defined specs can have severe ramifications that may not be discovered until the project has moved well past the piping design stage. On top of that, the discovery of a severe error in a single spec may necessitate a full review of all specs, which may number in the hundreds.

For clients that have adopted our Equity Engineering Practices® (EEPs), E²G developed our CAD Integration service to convert a full piping database into specs within either Plant 3D or CADWorx. It is an internal, purpose-built set of software tools for our Piping Database format that our engineers execute at regular update intervals or at the request of clients. It can be used to update an existing database or build a new one should a new client choose to utilize it. This eliminates the need for a months-long process of translating paper specs into CAD format, as well as the endless hassle of ensuring the CAD specs are aligned with the constantly evolving Piping Database. In addition, this approach to spec maintenance has the following benefits:

- 2.5X reduction in cost compared to manual effort
- Elimination of manual input errors; no need for exhaustive QA of all specs
- Ability to execute global changes to all specs in all aspects at a much faster rate than doing so manually

In the three years since E²G announced CAD Integration, dozens of sites have used this service across several clients. Throughout this early development period, E²G has enhanced our service based on input received from experienced piping design teams in regard to customization and routine maintenance practices within CAD specs.

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LINKING THE E²G PIPING DATABASE MATRIX TO CAD SPEC FORMAT

The E²G Piping Matrix tabulates all possible attributes that a component can have and assigns each attribute a unique character so that a 10 to 12 digit Compcode can be constructed. Similarly, the spec creation features within CADWorx and Plant 3D have a variety of values that exist as tables and references. These values define not only the basic callouts and standards, but also the dimensional data and their compatibility with other components.

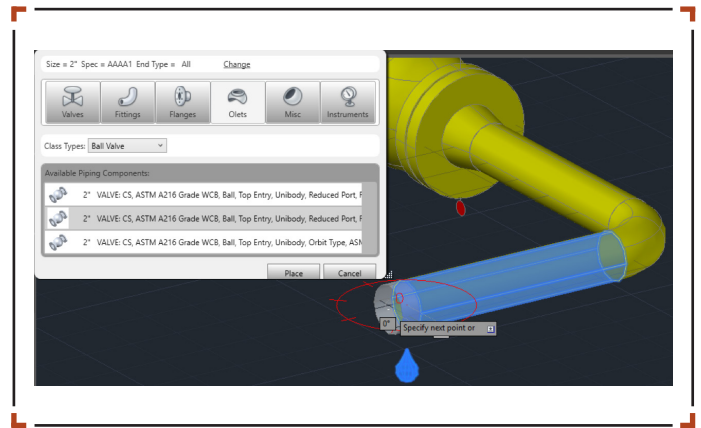
E²G now maintains a framework that thoroughly defines thousands of possible links between the Piping Matrix and the data structure of CADWorx and Plant 3D. Even new components that have just been added to our database can become fully defined by this framework with no manual intervention, unless the component is drastically different from an existing one. In such cases, the framework is simply updated to accommodate the new component type.

Below is a breakdown for a single component, and it shows how our Piping Matrix gets values pulled into the spec editor format.

This specific example relates to CADWorx. It is a forged 90° elbow with Compcode “30112M0000.” The combination “12M” for the 4th, 5th, and 6th characters gets linked to a single data table that defines the dimensions, and the 5th character, “2,” gets linked

to an end type table for compatibility with other components. The link for material characters “01” is maintained independent of the other characters, so this component can now be built with any material without additional intervention.

There are several variations in this logic across the different component types, and a separate (but similar) logic has been developed for Plant 3D’s format. However, the general method is always to isolate unique attributes and callouts so the components may be linked to the spec format. This is what allows us to programmatically build these specs.



^ Piping Matrix in spec editor.

CATEGORY 3 - FITTING (TYPICALLY FORGED MATERIAL)										
Material		Type	End	Rating	Sch 1	Sch 1		Sch 2		
01	CS, ASTM A105	1 90 Degree Elbow	1 Socket End	- Calculate	0-	Calculate	0-	Calculate	Calculate	
02	CS, ASTM A105, Galvanized	2 45 Degree Elbow	2 SocketWeld	1 Class 150	01	Std Wt	01	Std Wt		
03	CS, ASTM A350 Grade LF1	3 Tee	3 Threaded	2 Class 25	02	XS	02	XS		
04	CS, ASTM A350 Grade LF2 Cl 1	4 Cap	4 Socketweld/ Threaded	3 Class 300	03	XXS	03	XXS		
05	CS, ASTM A333 Grade 6	5 Reducer	5 ButtWeld	4 Class 400	04	Sch 10	04	Sch 10		
06	CS, ASME SA105	6 Union (Ground Joint Integral Seat)	6 Socketweld x Threaded x Threaded	5 Class 50	05	Sch 20	05	Sch 20		
08	CS, ASTM A105, Impact Tested	7 Coupling	7 Roll Grooved	6 Class 600	06	Sch 30	06	Sch 30		
09	CS, ASTM A350 Grade LF2 Cl 1 with S62 Supplementary Requirement of	8 45 Degree Lateral	8 Male	7 Class 75	07	Sch 40	07	Sch 40		
10	CS, ASTM A105 with S62 Supplementary Requirement of ASTM	9 Half Coupling	9 Female	8 Class 250	08	Sch 60	08	Sch 60		
12	C - 1/2 Mo, ASTM A182 Grade F1	A Elbolet	A Socket End x Male National Pipe Thread	9 Class 900	09	Sch 80	09	Sch 80		
13	CS, ASTM A694 Grade WPHY-42	B Thredolet	B Socket End x Female National Pipe Thread	A Class 1500	0A	Sch 100	0A	Sch 100		
14	CS, ASTM A694 Grade WPHY-52	C Sockolet	C ButtWeld x ButtWeld x Socketweld	B Class 2500	0B	Sch 120	0B	Sch 120		
15	CS, ASTM A694 Grade WPHY-60	D Union	D Butt Fusion	C Class 125	0C	Sch 140	0C	Sch 140		
16	CS, ASTM A105, PTFE Lined	E 45 Degree Latrolet	E Viegga ProPress Connection x Male Pipe	M Class 3000	0D	Sch 160	0D	Sch 160		

^ Sample output from Piping Matrix.

Characters “01” linked to CADWorx Material Table

Characters “12M” linked to CADWorx DataTable for [90 Degree SW 3000# Elbow](#) and CADWorx EndType Table for [SW 3000#](#)

Example Shown:
30112M0000 in AAAA1
“FITTING: CS, ASTM A105, 90 Degree Elbow, Socketweld, Class 3000”

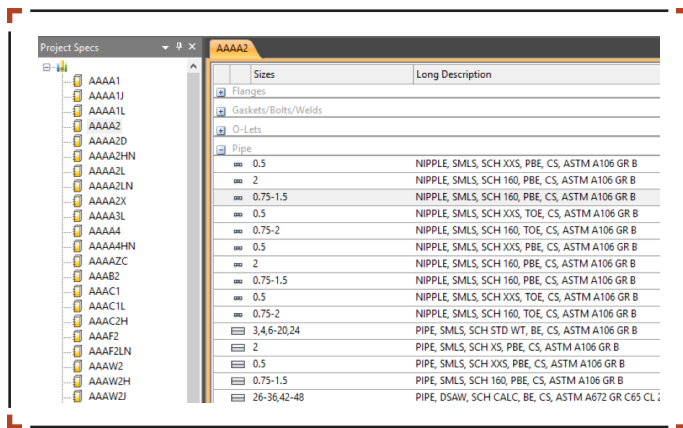
- Schedule is not applicable for this example, but would refer to the CADWorx Schedule table for other components.

- Other attributes such as Size Range, Compcode, and Description are pulled directly into CADWorx.

CUSTOMIZATION

E²G knows that every client has different preferences regarding appearance of specs. Through each new customization task, we have developed new techniques to reorder our standard Piping Database description format to the client's preference. We can even reproduce the description format of your legacy specs in both order and abbreviation, while maintaining an accurate 1-to-1 translation to the EEPs Piping Database content. This customization capability extends to all fields that can be conventionally modified by the user.

E²G also has a growing library of custom component offerings that extend beyond what is available in the EEPs Piping Database. If your designers require components such as control valves, bleed rings, or orifice plates, we can add them to every spec with the same level of description customization as our standard components. There are dozens of types of components that E²G has created for this purpose, and any client can request that a new type of component be added.



^ EEPs Piping Database.

QUALITY ASSURANCE

The process of automating spec creation offers a significant advantage in addressing any improper designations or dimensions for components within a spec. E²G's experience has shown that the two primary sources of error are dimensions being entered improperly and improper data table assignment. With thousands of data tables and tens of thousands of components, ensuring accurate designation can be a daunting task. However, E²G is proactive in reviewing our catalog and data table assignment with routine quality assurance.

The primary source of error and improper dimensions has the potential to be a costly mistake for a site. A project may progress such that components have been purchased yet cannot be installed due to a discrepancy, thus leading to significant delay. E²G is aware that we are the first line of defense against this potential problem for those that have adopted our catalog, so we review these dimensional values on a regular basis. Data tables are compared against their respective standard or manufacturer datasheet, and if errors are found, their resolutions are reviewed again by a separate engineer.

Improper data table assignment can introduce issues similar to improper dimensions, because it has the same end result within the model. E²G's data table assignments are reviewed not only internally, but also compared against data from similar efforts of outside contractors.

The automated nature of the specs we create allows us to address any of these resolutions on a much shorter timeframe than with manual creation. Additionally, this service is now shared across dozens of sites. On rare occasions when a discrepancy is identified by one of our clients, the issue is promptly addressed for all clients due to the centralized nature of our CAD Integration tools.

CONCLUSION

E²G believes that automation of specs is the most efficient method of spec maintenance when there is a significant number of specs that need to be built. Indeed, with several clients having their specs maintained by E²G, there are now thousands of specs that must be kept up to date. Manual creation is simply not an option. While the development of these tools has required significant time investment, creating a CADWorx or Plant 3D spec is now completely scalable when linked to the EEPs Database.

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