RISER DESIGN INPUT GUIDE

There are many factors that impact the design of a Riser support system. Because many of these factors are not items that the Engineers at KNC can "guess" at and because they have significant cost/performance impact on the Riser support system being designed, it is critical that key input data be provided to Kinetics as early in the design process as possible.

As an aid to collecting the appropriate data, Kinetics Noise Control has developed a checklist (attached) to highlight the needed information. This instruction guide has been developed to go into a higher level of detail as to what information should be provided in the checklist, why it is needed and to indicate the ramifications of unknown or erroneous data.

General Data

The ***Project name and Address*** offer not only a link to tie the document to a particular project, but the address also allows Kinetics to locate the project on a map and estimate the seismic forces to which the system will be subjected. The 2 largest lateral loads that must be addressed in the design of a Riser are the seismic and lateral hydraulic thrust loads generated by unrestrained flex connectors. 90% of the time the Seismic load governs the size of the guides used to hold the pipe in alignment.

The ***Date*** provides us with a time line if we have multiple documents in the file so we can be assured of using the latest one.

The ***Primary Structure Material*** refers to the material from which the building is constructed. Often times people do not think about the impact of the structure itself shrinking or growing, but if the riser is installed at a time where the temperature of the structure is not close to the final occupied temperature, this growth or shrinkage can be significant and the riser support system will need to absorb it along with the changes in length of the riser itself. Sometimes with concrete construction, the risers are installed before the concrete is fully cured or there is an anticipation that compressive loads in the structure will result in some vertical shrinkage. In these cases, a ***Global Shrinkage Factor*** may be given and like the expansion or contraction of the building due to temperature changes, it will need to be absorbed by the Riser support system. It is possible to ignore the expansion/contraction of the building core due to thermal variations only if a global shrinkage factor is used or if the occupied building temperature is the same as the average temperature at which the riser was installed.

The ***Ambient Temperature at Installation*** addresses the average temperature of the structure when the Riser is being installed. For a non-enclosed structure, this would be midway between average daytime highs and nighttime lows. If the structure is enclosed and there is some form of heating, it will be somewhat higher than that. This is the temperature assumed for the structure and riser initially and forms the baseline for all isolator adjustment dimensions.

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The ***Maximum permitted floor loading at any one location*** is the peak point (or localized) load that the Structural engineer will allow to bear on the structure in the area where the riser is to be supported. Note that there are two support points per riser at any one level as the anchors or guides are installed in pairs. Confirm that the load provided is per component or per floor. The maximum capacity of the floor can determine whether a simple system involving a single support level for the whole Riser can be used or if additional spring supports are needed to share the weight load between various floors.

Additional Data to be Included

Provide any drawings that show relevant ***Structural Data and Riser Layout Information*** or which offer overall conceptual information on the project. Frequently the top sheet of the structural drawing package will include references to special requirements for the restraint of piping systems (including Risers). These drawings can also identify section changes, jogs, elevations between floors, branch line tie ins and conceptual locations for supports and guides.

If these drawings do not exist, or are incomplete, we still need the following geometrical items clearly identified for each individual riser run:

Overall Floor Elevations or Elevations between all adjacent floors. This is required so that KNC can determine possible locations for supports or guides and overall lengths of runs which in turn defines both the weight supported and the length over which and thermal variations act and drive the total growth or shrinkage in the supported system.

Define any Special Conditions at Starting and Ending Point of Risers to be analyzed. The type of end termination can significantly impact the design of the system. For instance, if the riser terminates at the top into a tee that is physically restrained by the interfacing horizontal piping, it may not be permissible to allow the top of the riser to move either upward or downward. Also indicate if there is any significant requirement to resist a lateral load or allow a lateral displacement that might be generated by the continuing horizontal run of piping. If so, these values must be provided to KNC. These types of loads/displacements could define the location for an anchor or force the addition of a flexible coupling. In some instances Risers may also be broken into segments with not all of the system included in the support system being designed by KNC. Breaks like this can occur at jogs, particularly if there is a significant pipe size reduction at the same time. Information on the treatment of branch lines should also be addressed. If KNC is responsible for the design of these interfaces, we need to know where they are, how big the lines are, etc.

Identify ***any and all jogs in the vertical Riser runs (including the amount of offset)***. These Jogs effectively break a single Riser into 2 separate adjoining Risers that need to be analyzed separately. For smaller offsets, the weight can be carried as part of the Riser support system, but KNC would need to know how long the offset is to determine the weight.

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Identify ***changes in the Riser section (pipe size) and the elevations of those changes***. Changes in section generate both changes in weight and introduce hydraulic forces that must be addressed.

In some cases, there may be ***preferential locations for supports and guides***. These may result from field access issues, capacities of the support structure, installation coordination or simply customer preference. None of these would be things that KNC could address if they are not provided to us up front for reference.

In some systems ***Victaulic or other grooved type couplings*** may be used to join pipe segments. When this is done, if the appropriate type of coupling is used, the clearance in the coupling can sometimes replace the need for a separate expansion joint. This also means however, that the pipe becomes a "noodle" and can flex more easily requiring additional guides. If the customer's intent is to use this type of coupling, KNC will need to know specifics about the coupling models selected.

Riser Specific Data

Beyond the geometric data identified above, there are several items that need to be known about the individual Riser Pipe materials and operating conditions. These can be listed in the table at the bottom of the Checklist form and include:

The ***Riser Name***, an identifier so that our output can be associated with customer documents.

The ***Material Type/Schedule*** which is needed to compute the expansion rates of the piping, the weight, area and allowable stress.

The ***Connection type*** qualifies how much force can be carried, transferred, from one pipe section to the next

The ***Operating Temperature*** (there may be more than one, some systems may operate at one temperature in the summer and a completely different temperature in the winter). This governs the expansion and/or contraction of the pipe and the support system needs to be designed to accommodate all operating conditions.

Pressure at the top of the riser (for a steam system the pressure is constant, for a fluid filled system, the pressure will be a function of the elevation.) This pressure drives the forces that try to expand couplings and burst the pipe. For a system where one is simply dumping water out of the top and into a pan, the pressure would be low. If the flow can be blocked or throttled by a valve or if the system is a closed loop system and thermal energy is transferred in a heat exchanger, the "head" pressures can be significant.

Insulation Thickness and Density will generate additional weight that the riser support system must support. Some systems may have no insulation, some may have a lot. If no thickness or

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density is provided, but KNC is told that insulation is present, we will assume and insulation type and thicknesses based on ASHRAE “standard practices”.

The ***Type Code*** provides KNC with input as to the type of a Riser support system the contractor is looking for. There are many Riser support configurations that can work effectively, but they include trade-offs in cost, isolation performance, load impact on the structure, physical space requirements and many times simply customer preference or past experience. At KNC, we can not know the customer’s expectations unless they have been relayed to us. Common types of systems listed by increasing cost are as follows:

1) Anchored, Guided system with no Isolators
   (High floor loading, poor acoustic performance, good for large variations of length, moderate to high stresses in pipe and joints)

2) Anchored, Guided system with Isolators
   (Distributed floor loading, moderate to good acoustic performance, will not drop when fluid is added, large variations of length require more costly high deflection coils, minimized stresses in pipe and joints)

3) Full floating – non-restrained isolators and guides only
   (Will drop significantly when fluid is added resulting in possible interfacing issues, distributed floor loading, good acoustic performance, large variations of length require more costly high deflection coils, moderate stresses in pipe and joints)

4) Semi floating – combination of restrained and non-restrained isolators and guides.
   (Will not drop significantly when fluid is added, large variations of length require more costly high deflection coils, good acoustic performance, minimized stresses in pipe and joints)

Other

If KNC is to provide interfacing connections between horizontal runs of piping mating with the Riser which can accommodate the anticipated growth or shrinkage, it must be indicated to KNC that this is the case. Otherwise it will be expected that the installation contractor will address these issues through the use of long enough horizontal runs and/or expansion loops installed so that they can flex and tolerate the elevation changes.

System Changes

Because of the inter-relationship between the various factors in the design of Riser support systems, it is critical that if any changes made in the installed Riser versus that analyzed be reviewed and modeled before they are incorporated. KNC can take no responsibility for the negative impact of these modifications if we are not so informed and able to analyze and approve them ahead of time.

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RISER CHECKLIST

GENERAL DATA:

Project Name & Address:_____**Date:**_____
Primary Structure Material *(for exp factor)***(Conc, Steel, Ignore)**_____
Nominal Ambient Temperature at Installation _____
Maximum permitted floor loading at any one location _____
(Note: If Seismic treatment is required, complete Seismic Checklist as well)
Optional Global Shrinkage Factor:_____ (for Concrete Structures Only)

ADDITIONAL DATA TO BE INCLUDED:

Structure Data and/or Riser Layout Drawings showing:
Overall Floor Elevations or Elevations between adjacent Floors
Define any Special Conditions at Starting and Ending Point of Risers to be analyzed
Any and All Jogs in the Vertical Riser runs including the amount of Offset
Changes in Riser Sections and Approx Locations
OptionalPreferred locations of anchors/guides/expansion couplings
Other:
If Victaulic type coupling used, Data for Specific Model

RISER SPECIFIC DATA:

RISER NAME	MAT'L TYPE/ SCHEDULE	CONNECTION TYPE*	OPERATING TEMP	WORKING PRES AT TOP OF RISER	INSULATION THICKNESS & DENSITY	DESIGN TYPE CODE**

*TYPICAL CONNECTION TYPES – Welded, Brazed, Screwed, Glued, Groove Type Coupling
** DESIGN TYPE CODES: (1) Anchored, Guided system with no Isolators, (2) Anchored, Guided system with Isolators, (3) Full floating – non-restrained isolators and guides only, (4) Semi floating – combination of restrained and non-restrained isolators and guides. (If anchored and anchor elevation is inflexible, indicate desired location of anchor

I understand that KNC will be designing to the above parameters and that this and the included documents comprise the extent of their knowledge of this project. No Independent attempt will be made by KNC to verify the information and I take full responsibility for its accuracy.

Signed _____ **Date**_____

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