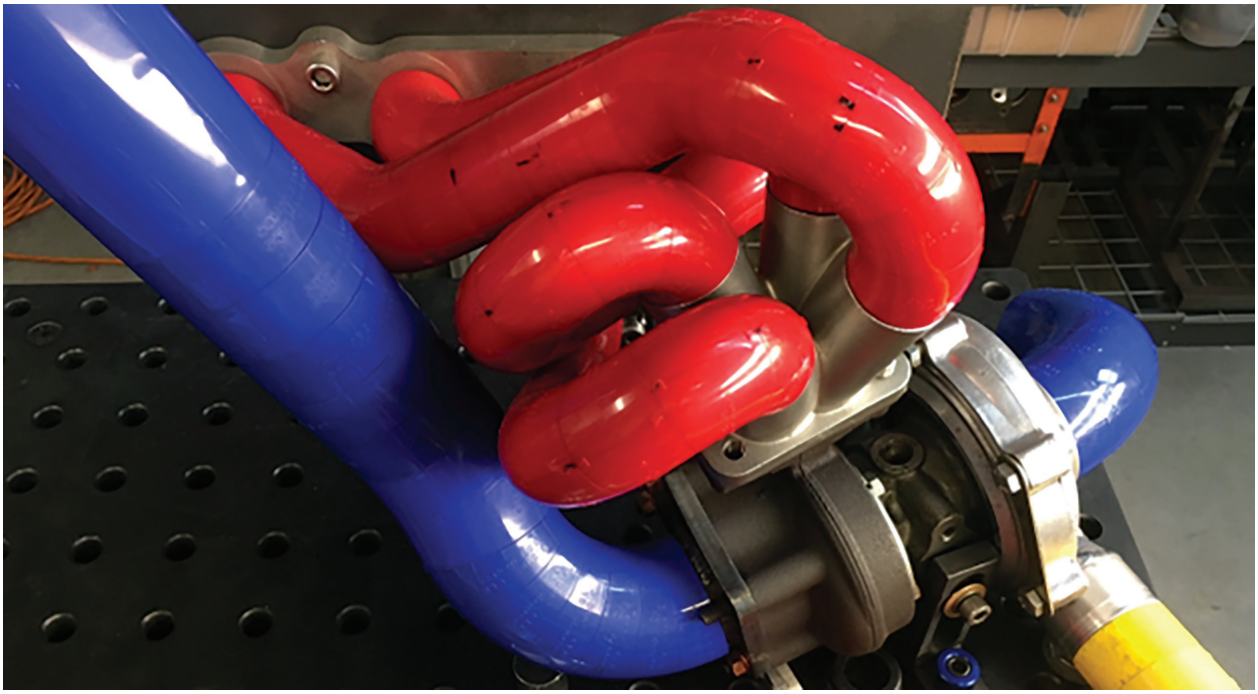
icengineworks®
precision exhaust design and fabrication

NPSeries Instructions Manual



Thank you for choosing the icengineworks® NPSeries for precisely designing and fabricating turbo manifolds when using weld elbows in Sch5, Sch10 or Sch40. This manual covers pipe sizes 1-1/4”NPS (1250NPSeries) and 1-1/2” NPS (1500NPSeries).

Despite their simple appearance and manual operation, the icengineworks® NPSeries modeling blocks pack an enormous amount of design power never seen before. When used as suggested, this system will quickly yield precise, full-scale, 3D turbo manifold models in real time, along with key design, budgeting and fabrication information for the user to easily plan and execute it in metal. With powerful design features such as curved blocks in industry-standard Short Radius (SR) and Long Radius (LR) in flexible and convenient 15-degree increments (for LR) or 30-degree increments (for SR), curved blocks with 1” arc length at the centerline for precise runner length control, and 1/2”- and 1”-long straight blocks for more detailed trimming, the icengineworks® NPSeries modeling blocks are a new, versatile, easy-to-use, high precision total design solution to a long standing problem. Each block is molded in tough ABS plastic and is labeled with information such as its OD, its centerline radius (CLR) and witness line marks for reference when building complex pipe assemblies. For any given design, adding, removing, replacing or rotating the NPSeries modeling blocks as many times as it takes until the design objectives are met becomes almost a playful task. This innovative ability to quickly and manually revise, change and modify any design with precise and immediate feedback directly from the model constitutes the strength of this tool. It can be done over and over again until the entire design is successfully completed with an effective use of the time invested. The dreaded waste of expensive pipe weld elbows, cutting or welding time is officially now a thing of the past.

With the plastic model completed, a metal version can then be safely fabricated and its recipe recorded and preserved for additional future reproduction. It is our mission that the use of this product will result in a very noticeable and immediate increase in productivity, the performance, quality and appearance of the resulting manifolds, and a drastic reduction in unnecessary waste of time and resources.

Before using, please read the following pages, which are meant as general guidelines and recommendations to get the most out of your investment. Experienced fabricators however, will be quick to adapt and incorporate their knowledge to this new design technology reaching even higher levels of productivity and creativity.

Made in USA. Icengineworks is a registered trademark.

1. Contents

This box includes the following according to the product part number, or as specified on the outside label.

	1250NPSeries (1-1/4" NPS, Sch5, 10 & 40) BASIC Block Set/PRO Block Set	1500NPSeries (1-1/2" NPS, Sch5, 10 & 40) BASIC Block Set/PRO Block Set
0.500" - long Straight Block	30/60	30/60
1.000" - long Straight Block	30/60	30/60
Short Radius (1D CLR) 30-deg Curved Block	30/60	30/60
Short Radius (1D CLR) 1"-long Curved Block	30/60(also 45-deg Block)	30/60
Long Radius (1.5D CLR) 15-deg Curved Block	30/60	30/60
Long Radius (1.5D CLR) 30-deg Curved Block	-	30/60
Long Radius (1.5D CLR) 1"-long Curved Block	30/60 (also 30-deg Block)	30/60
NPSeries Neoprene Block Adapters	4/8	4/8
NPSeries Manual & Control Sheet Pad	1	1
Plastic Storage Case	1	1

2. Getting Ready

The icengineworks® NPSeries modeling blocks snap firmly into each other providing adequate friction and holding power among them when connected. However, long, heavy sections should be supported as needed. Observe care when adding to or taking blocks away from an assembly to avoid upsetting other blocks. To take them apart, pull firmly away from each block as you gently spin them. Initial fitment will be tight when new. To preserve their useful life, avoid excessive rotation between them to avoid premature wear.

Plan key features ahead of time in your intended design such as the target pathway of the manifold runners, location of components (turbocharger, wastegates, water lines, etc). For faster results, test partial block sections by "floating them" around the intended location prior to connecting them. To start a design, it is suggested to have the turbocharger with its flanged collector in place and secure, and a manifold flange bolted to the cylinder head ready to receive the standard round pipe. Transition pipe sections, or starter stubs between the exhaust port shape and the round pipe profile in the manifold flange are recommended for a smooth, port-matched change. This will allow a quick connection of the icengineworks® modeling blocks to their pipe open ends using the rubber block adapters.

Each icengineworks® modeling block features two molded arrows at their highest radial point to symbolize a 'zero' mark that 'clicks' the blocks (of same CLR) into alignment representing a single metal section. These metal sections can be made to represent standard elbow angles (45s or 90s) for a speedy fabrication, or cut and trimmed to 15-deg/30-deg increments for more complex designs, and even cut and trimmed totally at will to create manifold runners of exact lengths (in inches) for radical and advanced equal length manifold designs. Every change in the blocks geometrical plane of bend (arrows not aligned) represents a weld. Keeping track of these and revising for the least amount results in an efficient and quick fabrication process.

3. Getting a design started

Any icengineworks® NPSeries modeling block can be anchored to an open pipe end of the manifold flange (starter pipe w/ round profile) or the turbocharger collector, to get the design started. Choose the design direction: following the gas flow direction (head to turbo), or going upstream (turbo to head) based on clearance, appearance, design complexity, welding sequence, etc.

The supplied icengineworks® NPSeries neoprene block adapters are plugs that fit inside the walls of pipe section on one end while grabbing the block from its female end. They are designed to be flexible so they work with straight, long and short radius, Schedule 5, 10 & 40 pipe. Rubber-friendly lube may help for SR Sch40 elbows which present the tightest situation. Make sure the resulting joint is gapless and concentric for guaranteed precision and accurate reproduction in metal.

The icengineworks® NPSeries modeling blocks have been conceived to be used in three different design modes: SIMPLE, ADVANCED and EQUAL LENGTH. Here is a description of each one, from the simplest and quickest to the most sophisticated and complex that will yield highly refined and visually striking precise and powerful turbo manifolds. All three follow the same basic and proven icengineworks® principles.

SIMPLE DESIGN MODE. Using standard “as-is” 45-deg and 90-deg weld elbows with cutting and trimming reserved **only** for the straight pipe sections connecting them. Design and modeling is done using icengineworks® NPSeries blocks that are marked with **angle** specifications.

ADVANCED DESIGN MODE. Using standard 45-deg and 90-deg weld elbows that can get cut and trimmed liberally to create additional angles in 15-deg increments for LR elbows or in 30-deg increments for SR elbows, which can contribute with more flexibility and freedom to the design. Straight pipe sections also get cut and trimmed accordingly. Design and modeling is done using icengineworks® NPSeries blocks that are marked with **angle** specifications.

EQUAL LENGTH MODE. Using standard 45-deg, 90-deg and even 180-deg weld elbows that get cut and trimmed liberally to create precise sections that are of a specific arc length (measured in inches at the imaginary centerline). Straight pipe sections also get cut and trimmed accordingly. Design and modeling is done using icengineworks® NPSeries blocks that are marked with **length** specifications. This approach very quickly produces equal length runners and it requires a higher skill level.

3a. SIMPLE DESIGN MODE

Using the icengineworks® NPSeries modeling blocks in SIMPLE MODE entitles using only standard 45-deg and 90-deg weld elbows (Schedule 5, 10 & 40 – all share the same actual OD) “as-is” without cutting or modifying them, and only piecing them together using trimmed straight pipe sections between them. Straight lengths can be trimmed within 1/2” lengths using the 1.000” and 0.500”-long NPSeries blocks. This is the easiest way to build turbo manifolds as only cuts on straight pipe sections are required which are easily performed with a standard horizontal band saw or abrasive disc chop saw (a belt sander or grinding wheel still be required to cut bevels on pipe ends for proper weld penetration).

This technique utilizes same-radius curved blocks aligned (arrows on a line) forming 45 or 90 degrees sections only (for example 3x 30-deg blocks to recreate a 90-deg elbow, etc.). Multiples of these can be used to create complex layouts by changing the geometrical planes of bend.

For the 1250NPSeries this requires the following blocks: For Short Radius elbows (SR, marked as 1-1/4”-CLR), use blocks labeled 45-deg/1” long to form multiples of 45-degree sections (45-deg, 90-deg, etc.). This particular block also measures a 1.000” arc length at the centerline so it is also used in EQUAL LENGTH MODE.

For Long Radius elbows (LR, marked as 1-7/8”-CLR) connect (with arrows aligned) one block marked 15-degree and another marked 30-degree/1” long for every 45-deg elbow or to form multiples of 45 degrees. This last block also measures 1.000” arc length at the centerline so it is also used as part of the EQUAL LENGTH MODE.

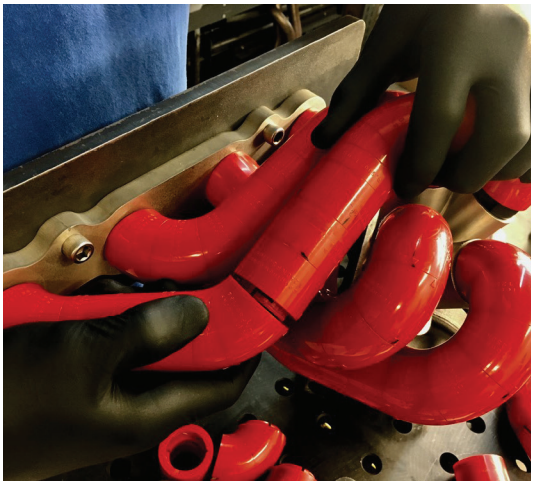
When changing geometrical planes of bend, make sure it is every 45- or 90-deg sections (or blocks) depending on what elbows you use.

For the 1500NPSeries this requires the following blocks:

For Short Radius elbows (SR, marked as 1-1/2”-CLR), use 3x blocks labeled 30-degree (arrows aligned) for every 90-deg elbow or to form multiples of 90-deg sections.

For Long Radius elbows (LR, marked as 2-1/4”-CLR) connect (with arrows aligned) one block marked 15-degree and another marked 30-degree for every 45-deg elbow or to form multiples of 45 degrees. Use 3x 30-deg blocks when using 90-deg pipe elbows and so on.

When changing geometrical planes of bend, make sure it is every 45- or 90-deg sections (or blocks) depending on what elbows you use.



After setting up the first block in each runner using the neoprene block adapters, begin laying out your design. Connect 45-deg/90-deg SR and LR block sections (single or multiples) with straight blocks to create manifold runners. Be sure to respect their intended compounded angle so the standard elbows can be used just as they come. Keep track of number of changes in geometrical planes of bend to control number of welds required as you build.

The icengineworks® NPSeries design method allows the study of different layouts very quickly. Design criteria ranges from the simplest layout to one that explores more radical/extreme designs. Examples could be but not limited to firing order dumping into the turbo collector, or the chosen firing order into the turbo collector but varying the clocking of cylinder 1 around the 4 possible locations (in a 4-cyl engine) for more efficiency or ease of fabrication. Also, the rotation of the cylinders firing into the collector can also be considered: clockwise or counter-clockwise, etc.

With little practice, it becomes evident how easy it is to design for the least amount of components, or work required. Complex designs can be revised to reach a simpler version to reproduce, always striving for the least amount of work and parts required. All this information is extremely valuable when estimating the final cost of the project (metal, cutting and welding labor) before committing to a given design.

Just like with any other design process, the icengineworks® design method requires constant revisions and corrections until the desired goal is achieved. What is so remarkable is the speed and simplicity at which this is achieved.

3a. SIMPLE DESIGN MODE – Transferring your Design to Metal

With a completed design, the information embedded in the blocks can be recorded. This is done by filling out an icengineworks® NPSeries Elbow Control Sheet included (to maximize space in the paper forms, drawings depicting pipe sections are shown as 180-deg bends with straight sections added to them). These forms track the sections that form each runner in the model. They also serve as the basis for budgeting and determining fabrication costs.

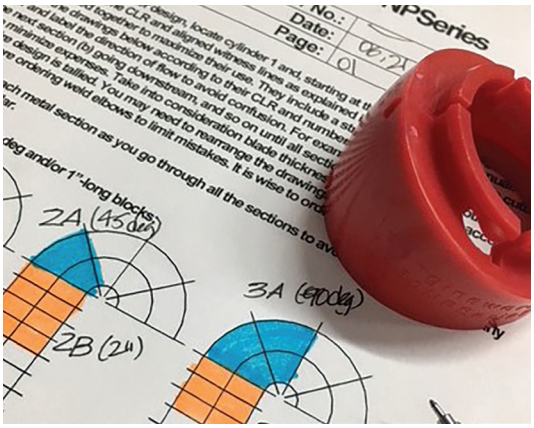
One at a time, the manifold runners will be analyzed into their components (elbows and straight pipe sections). This will unveil:

a) The material required: number of elbows and straight pipe length;

b) The cutting work needed to create the straight sections (typically one cut per straight section), and finally;

c) The number of welds in a given runner (number of sections + 1).

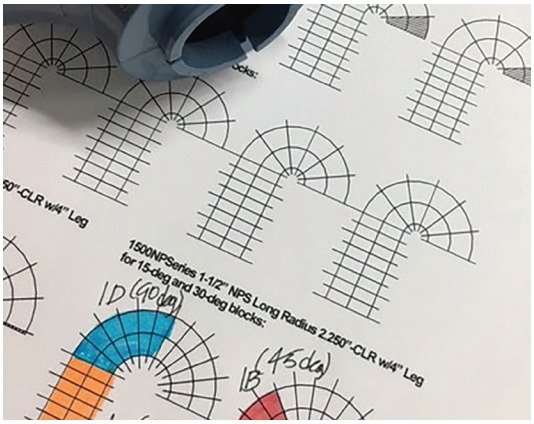
All these values put together will form the total cost of the designed turbo manifold. This will determine whether to move forward with the design, or not. Errors can be quickly revised and corrected or improved.



The process starts by designating pie sections in the drawings that correspond to each block section in the model. Each section in the drawing will require a label that identifies what cylinder it belongs to and its order within it (such as section 2C, meaning the third section in the runner for cylinder 2, etc.). Straight sections will have their own label.

For the 1250NPSeries in SIMPLE DESIGN MODE fill out the following drawings on the Control Sheet: For the SR sections use the 45-deg Short Radius drawings, one space per 45-deg block (or elbow), 2x spaces for each 90-deg elbow, etc. For the LR sections made of 90-deg elbows, use the 30-deg Long Radius drawings by filling out 3x spaces for each 90-deg section (or elbow). For the 45-deg elbows use 3x 15-deg LR drawings per section.

The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections in Section 4 of this manual.



For the 1500NPSeries in SIMPLE DESIGN MODE, the sections are 45-deg or 90-deg. For the SR sections use the 30-deg Short Radius drawings, 3x spaces per 90-deg block (or elbow). For the LR sections made of 90-deg elbows, use the15-deg/ 30-deg Long Radius drawings by filling out 3x 30-deg spaces per 90-deg section (or elbow). In the drawings, longer radial lines indicate 0-deg, 30-deg marks (in 30-deg intervals). For the 45-deg elbows use also the 15-deg/30-deg drawings and color 3x 15-deg spaces per section. In the drawings, shorter radial lines indicate 15-deg, 45-deg marks, etc. (in 30-deg intervals).

The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections in Section 4 of this manual.

3b. ADVANCED DESIGN MODE

With a completed design, the information embedded in the blocks can be recorded. This is done by filling out an icengineworks® NPSeries Elbow Control Sheet included (to maximize space in the paper forms, drawings depicting pipe sections are shown as 180-deg bends with straight sections added to them). These forms track the sections that form each runner in the model. They also serve as the basis for budgeting and determining fabrication costs.

One at a time, the manifold runners will be analyzed into their components (elbows and straight pipe sections). This will unveil:

a) The material required: number of elbows and straight pipe length;

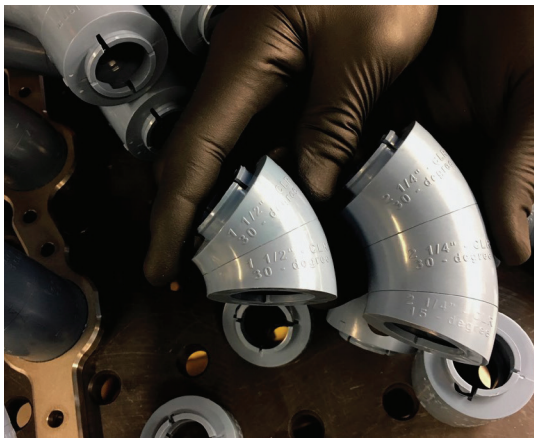
b) The cutting work needed to create the straight sections (typically one cut per straight section), and finally;

c) The number of welds in a given runner (number of sections + 1).

All these values put together will form the total cost of the designed turbo manifold. This will determine whether to move forward with the design, or not. Errors can be quickly revised and corrected or improved.

The process starts by designating pie sections in the drawings that correspond to each block section in the model. Each section in the drawing will require a label that identifies what cylinder it belongs to and its order within it (such as section 2C, meaning the third section in the runner for cylinder 2, etc.). Straight sections will have their own label.

For the 1250NPSeries in SIMPLE DESIGN MODE fill out the following drawings on the Control Sheet: For the SR sections use the 45-deg Short Radius drawings, one space per 45-deg block (or elbow), 2x spaces for each 90-deg elbow, etc. For the LR sections made of 90-deg elbows, use the 30-deg Long Radius drawings by filling out 3x spaces for each 90-deg section (or elbow). For the 45-deg elbows use 3x 15-deg LR drawings per section. The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections in Section 4 of this manual.



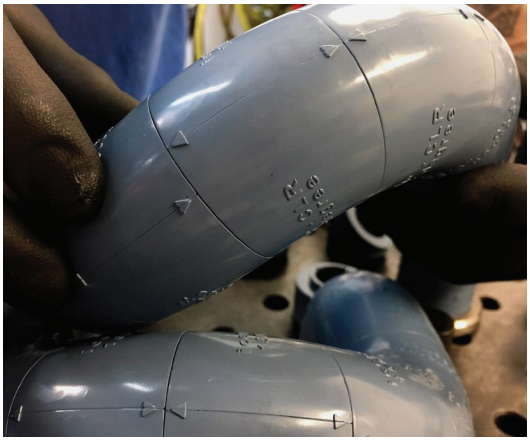
For the 1500NPSeries in SIMPLE DESIGN MODE, the sections are 45-deg or 90-deg. For the SR sections use the 30-deg Short Radius drawings, 3x spaces per 90-deg block (or elbow). For the LR sections made of 90-deg elbows, use the15-deg/ 30-deg Long Radius drawings by filling out 3x 30-deg spaces per 90-deg section (or elbow). In the drawings, longer radial lines indicate 0-deg, 30-deg marks (in 30-deg intervals).

For the 45-deg elbows use also the 15-deg/30-deg drawings and color 3x 15-deg spaces per section. In the drawings, shorter radial lines indicate 15-deg, 45-deg marks, etc. (in 30-deg intervals).

The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections in Section 4 of this manual.

After setting up the first block in each runner in your design using the neoprene block adapters, begin laying out blocks to start the design. In ADVANCED DESIGN MODE you can use standard elbow angles and also create new combinations as explained previously to generate more sophisticated layouts.

The icengineworks® NPSeries design method allows the user to study several possible layouts very quickly. Design criteria ranges from the simplest layout to one that can explore more radical or extreme designs. For example, the firing order dumping into the turbo collector, or evaluating the same chosen order of firing cylinders around the receiving turbo collector but varying the clocking of cylinder one around the 4 possible locations (in a 4-cyl engine) for more efficiency or ease of fabrication. Also, the direction of the cylinders firing into the collector can also be considered: clockwise or counter-clockwise, etc.



With little practice, it becomes evident how easy it is to design for the least amount of components or work required. Complex designs can always be revised to reach a simpler version to reproduce, for example in cases of hard-to-reach weld joints. All this information is extremely valuable when estimating the final cost of the project (metal, cutting and welding labor) before starting to cut metal.

As with any other design process that requires constant revisions and corrections until the desired goal is achieved, the icengineworksTM design method is no exception to this rule. What is unique is the speed and simplicity at which this is achieved.

3b. ADVANCED DESIGN MODE – Transferring your Design to Metal

Once the design is complete and meets the objectives preset, all the information embedded in the blocks to recreate the model in metal can be recorded. This will be done by filling out an icengineworks® NPSeries Elbow Control Sheet from the pad included.

These forms track the sections that form each runner in the model. They also serve as the basis for budgeting and determining fabrication costs.

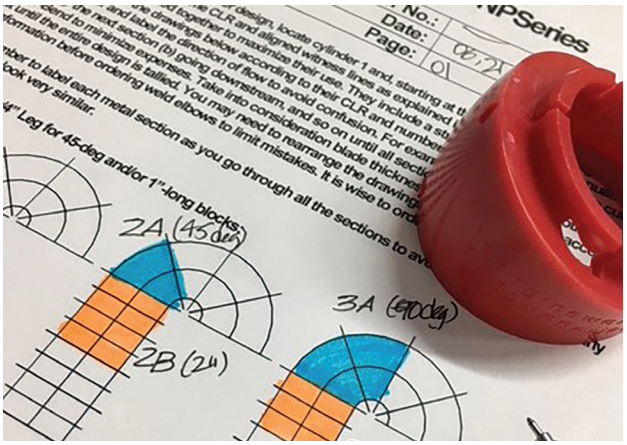
One runner at a time, the assembly is broken into its components (elbows and straight pipe sections) unveiling:

a) The material required: number of elbows and straight pipe length

b) The amount of cutting needed to create the custom elbows; featuring different than standard angles, and the straight sections (typically one cut per straight section), and finally;

c) The number of welds in a given runner.

All these values put together will form the total cost of the designed turbo manifold. This will become the deciding factor before pulling the trigger on the design, or not. If something doesn't look right, the model can be quickly revised and a new analysis can be conducted.



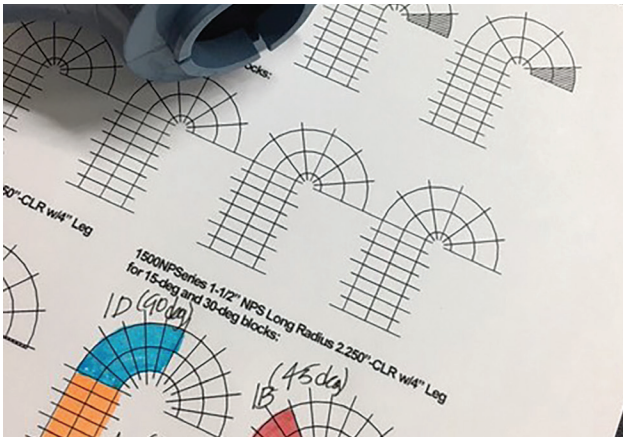
The process starts by coloring the pie sections in the drawings corresponding to each block section in the model. Properly label each section in the drawing identifying what cylinder it belongs to and its order in it to avoid confusion. For example: section 2C, meaning the third section in the flow direction in runner for cylinder 2. Straight sections will have their own label.

For the 1250NPSeries in ADVANCE DESIGN MODE, the sections are multiples and combinations of 15- and 30-deg for both SR and LR. The Control Sheets feature drawings of partially divided 90-deg elbows forming 180-deg sections with straight sections for convenience.

For the SR sections use both the 30-deg and 45-deg SR drawings to accommodate the angle combinations created.

For the LR sections use the 15-deg and 30-deg LR drawings by filling out pie areas based on the angle combination in each section.

Please note that sections beyond 90-deg will require 2x 90-deg elbows tacked together before cutting to the desired larger than 90-deg angle.



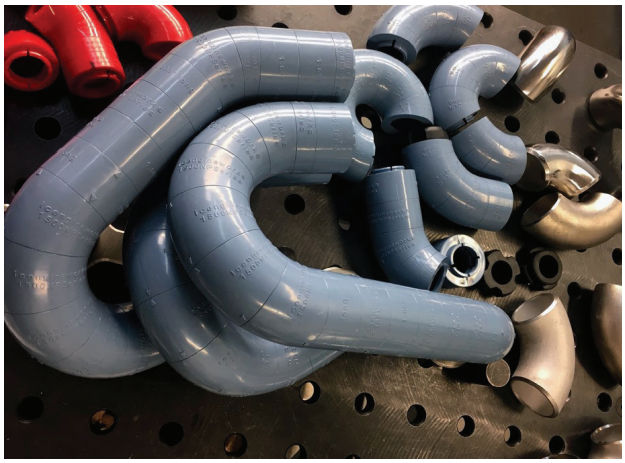
The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. The next step is moving into the cutting of metal sections.

For the 1500NPSeries in ADVANCED DESIGN MODE, the sections are multiples of 15- and 30-deg for both SR and LR. The Control Sheets feature drawings of partially divided 90-deg elbows forming 180-deg sections with straight sections for convenience. For the SR sections use the 30-deg SR drawings to represent the angle combinations created.

For the LR sections use the 15-deg and 30-deg LR drawings by filling out accordingly based on your design. Please note that sections beyond 90-deg will require 2x 90-deg elbows tacked together before cutting to the desired larger than 90-deg angle.

The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections.

3c. EQUAL LENGTH MODE



The icengineworks® NPSeries modeling blocks used in EQUAL LENGTH MODE require standard 45-deg and 90-deg weld elbows (Schedule 5, 10 or 40 – all share the same actual OD) to be partially cut to have access to exact arc lengths (at the imaginary centerline of the elbow) measured in whole inches. This method is actually very simple and only requires a mental adjustment on how to approach it. When properly calculated and executed, this technique expands the performance potential of any given design. It is highly critical to have access to a vertical band saw and a standard horizontal band saw (or abrasive disc chop saw) for the cuts. A belt sander or grinding wheel is also required to cut bevels on pipe ends for proper weld penetration.

The EQUAL LENGTH MODE is based on and recommends the use of the icengineworks® NPSeries cutting tools to achieve precise square cuts on curved elbows, more information on this below.

For the 1250NPSeries this requires the following blocks: For Short Radius elbows (SR, marked as 1-1/4”-CLR), use blocks labeled 45-deg/1” long **only** to form 1”-long or longer sections in 1” increments. For Long Radius elbows (LR, marked as 1-7/8”-CLR), use the 30-degree/1” long blocks **only** to form 1”-long or longer sections in 1” increments.

These length-based elbow sections will be joined with straight pipe sections just like in the previous two MODES. The only difference is that these straight sections will measure a specific length in inches that can be rounded to ½” of length to achieve the overall desired runner length. For modeling straight sections use the 1”-long and ½”-long stratight blocks.

For the 1500NPSeries this requires the following blocks: For Short Radius elbows (SR, marked as 1-1/2”-CLR), use blocks labeled 1.000”-long **only** to form 1”-long or longer sections in 1” increments. For Long Radius elbows (LR, marked as 2-1/4”-CLR), use blocks labeled 1.000”-long **only** to form 1”-long or longer sections in 1” increments.

These length-based elbow sections will be joined with straight pipe sections just like in the previous two MODES. The only difference is that these straight sections will measure a specific length in inches that can be rounded to ½” of length to achieve the overall desired runner length. For modeling straight sections use the 1”-long and ½”-long straight blocks.

After setting up the first block in each runner using the neoprene block adapters, begin laying out blocks to start the design. In EQUAL LENGTH MODE sections will be created of known length (in inches) that will contribute to develop turbo manifold runners of precise lengths (measured at the imaginary centerline).

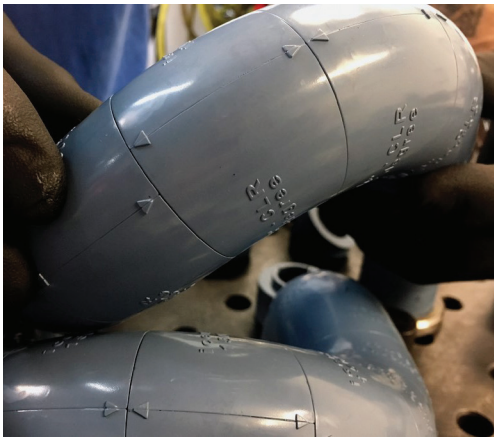
The icengineworks® NPSeries design method allows the user to study several possible layouts very quickly. Design criteria ranges from the simplest layout to one that can explore more radical or extreme designs. For example, the firing order dumping into the turbo collector, or evaluating the same chosen order of firing cylinders around the receiving turbo collector but varying the clocking of cylinder one around the 4 possible locations (in a 4-cyl engine) for more efficiency or ease of fabrication. Also, the direction of the cylinders firing into the collector can also be considered: clockwise or counter-clockwise, etc. There is always full control of total manifold runner lengths regardless of the design's simplicity or complexity.

With little practice, it becomes evident how easy it is to design for the least amount of components or work required. Complex designs can always be revised to reach a simpler version to reproduce, for example in cases of hard-to-reach weld joints.

All this information is extremely valuable when estimating the final cost of the project (metal, cutting and welding labor) before starting to cut metal.

As with any other design process that requires constant revisions and corrections until the desired goal is achieved, the icengineworks® design method is no exception to this rule. What is unique is the speed and simplicity at which this is achieved.

3c. EQUAL LENGTH MODE – Transferring your Design to Metal



Once the design is complete and meets the objectives preset, all the information embedded in the blocks to recreate the model in metal can be recorded. This will be done by filling out an icengineworks® NPSeries Elbow Control Sheet from the pad included.These forms track the sections that form each runner in the model. They also serve as the basis for budgeting and determining fabrication costs.

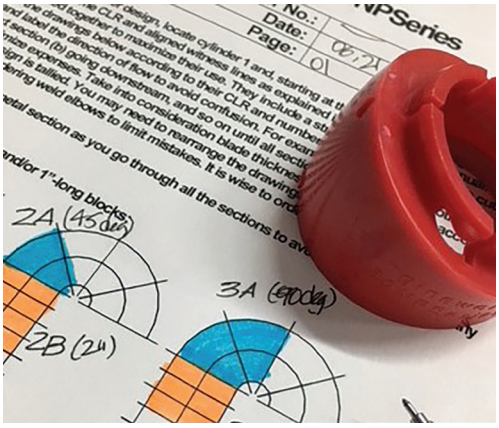
One runner at a time, the assembly is broken into its components (elbows and straight pipe sections) unveiling:

a) The material required in total number of elbows and straight tubing length;

b) The amount of cutting needed to create the custom elbow sections based on their length and the straight sections, and finally;

c) The number of welds in a given runner including joining standard elbows to create long curved sections on the same plane of bend.

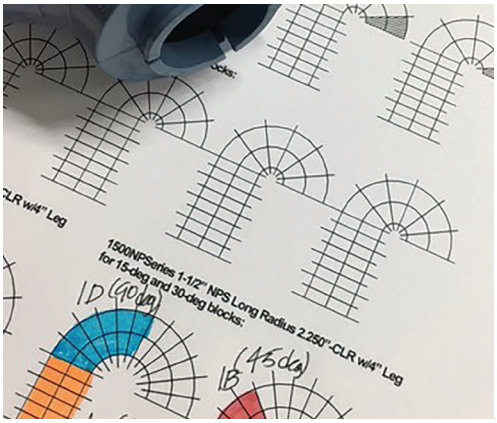
All these values put together will form the total cost of the designed turbo manifold. If something doesn't look right, the model can be quickly revised and a new analysis can be conducted.



The process starts by designating pie sections in the drawings that correspond to each block section in the model. Properly label each section in the drawing identifying what cylinder it belongs to and its order in it to avoid confusion. For example: section 2C, meaning the third section in the flow direction in runner for cylinder 2. Straight sections will have their own label.

The Control Sheets feature drawings of partially divided 90-deg elbows forming 180-deg sections with straight sections for convenience. For the 1250NPSeries SR sections in EQUAL LENGTH MODE use the 45-deg/1”-long SR drawings, one space per 1”-long block (or elbow), 2x spaces for 2”-long sections, etc.

For the LR sections in EQUAL LENGTH MODE for the 1250NPSeries use the 30-deg/1”-long LR drawings by filling out one space for every 1”-long in any given section. The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections.



The process starts by designating pie sections in the drawings that correspond to each block section in the model. Properly label each section in the drawing identifying what cylinder it belongs to and its order in it to avoid confusion. For example: section 2C, meaning the third section in the flow direction in runner for cylinder 2. Straight sections will have their own label. The Control Sheets feature drawings of partially divided 90-deg elbows forming 180-deg sections with straight sections for convenience.

For the 1250NPSeries SR sections in EQUAL LENGTH MODE use the 45-deg/1”-long SR drawings, one space per 1”-long block (or elbow), 2x spaces for 2”-long sections, etc.

For the LR sections in EQUAL LENGTH MODE for the 1250NPSeries use the 30-deg/1”-long LR drawings by filling out one space for every 1”-long in any given section.

The straight sections in the drawings are divided in 1/2” increments. Fill out accordingly. Once completed, the next step is moving into the cutting of metal sections.

4. Fabricating the Metal Sections with the icengineworks® CUT system

The icengineworks® NPSeries cutting spacers and pivoting table (p/n PIV1001) are especially engineered to simplify the fabrication of your ADVANCE or EQUAL LENGTH design (SIMPLE mode does not require cuts around pipe elbows as it utilizes them “as is”) by delivering consistent and fast cuts that are square (perpendicular to the tangent) in curved pipe elbows. These cutting tools require the access to a vertical band saw equipped with a rip fence (or straight edge) and a minimum 10” throat as shown. This is critical towards achieving precise butt-to-butt (circle to circle) joints that provide better internal gas flow, are easier to weld and have a smooth appearance.

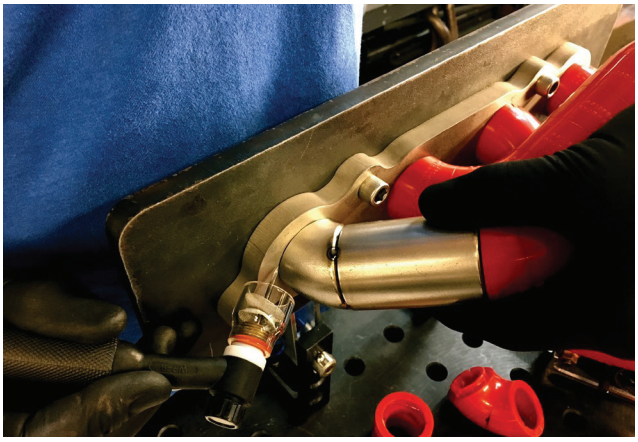
Follow the manufacturer instructions for properly setting up the band saw before cutting metal belonging to your project. Settings include choosing the right blade type, adjusting blade speeds, blade tension, alignment of blade, etc. It is highly recommended trying some test pieces first.

Following the Control Sheet, use spare icengineworks® NPSeries blocks to recreate the partial sections in your design. Add a leg (4”-5” straight block section) for support and alignment. Place the plastic block section around the matching icengineworks® NPSeries cutting spacer making sure there are **no gaps** between the cutting spacer and the blocks section. Find the “angle of cut” position by slowly sliding the PIV plate forward towards the blade and rotating the cutting space/block section until the open end of the blocks touches the side of the blade. Tighten the wing nut to secure angle of cut.

It is recommended to use 180-deg elbows especially in EQUAL LENGTH mode. 45-deg or 90-deg elbows can work as well (for ADVANCED or EQUAL LENGTH modes). It’s also necessary to tack a straight pipe section to one end to create a “J-bend” for support against the cutting spacer while cutting. Additionally, for curved sections longer than 45- or 90-deg, tacking another similar elbow to the other end (concentrically on the same plane) will be required.

Place the actual pipe metal around the cutting spacer. We strongly recommend using a carpenter’s clamp to secure the formed pipe “J-bend” section tightly around the cutting spacer to avoid vibration or the pipe rolling over blade. Make the cut by pushing the PIV plate forward slowly keeping an eye on vibration, heat build-up, etc. If not part of the partial section, break the tacks joining the support straight pipe section. Label the curved section accordingly. Move on to the next curved section in the Control Sheet and repeat until all the metal sections are cut and labeled as required. Use a horizontal band saw or chop saw to trim all straight pipe sections per Control Sheet. The success of the icengineworks® system depends on the ability to faithfully recreate metal versions of the plastic model.

5. Welding the Metal Sections



With all the curved and straight pipe sections cut per your Control Sheet, begin replacing them in your model. **Plan ahead the welding sequence to avoid dead ends.** Place at least 3 tacks around each joint that form the manifold runners for safety. Adjust accordingly until assembly is ready to be fully welded. Follow industry standard manifold welding procedures and techniques to complete your design.