

FIRE PROTECTION JUST GOT SMARTER

# ArmaGel<sup>®</sup> HTF

Technical Specification Guide

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ArmaGel<sup>®</sup>



**Fire  
Protection  
and Insulation  
Combined**

Our vision has always been to create innovative, technical insulation solutions and components to conserve energy and make a difference around the world. With ArmaGel® HTF we are going one step beyond into the future. ArmaGel HTF is an advanced insulation material which additionally provides fire protection - especially for hydrocarbon pool fires and jet fires to avoid escalation of the fire event, allow emergency responders to safely conduct their jobs, reduce the risk of shut-downs and protect assets.

**A sustainable one-step solution for fire protection and thermal insulation.**

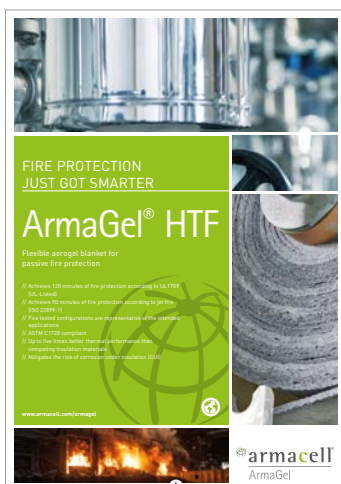




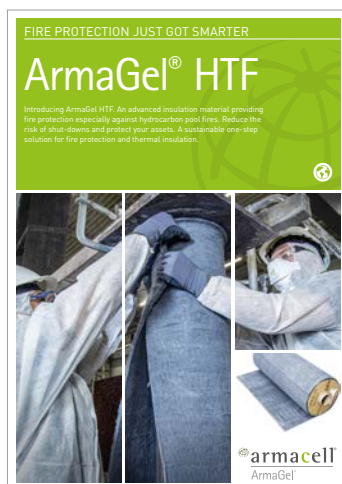


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This brochure is a compendium of technical and application documents.



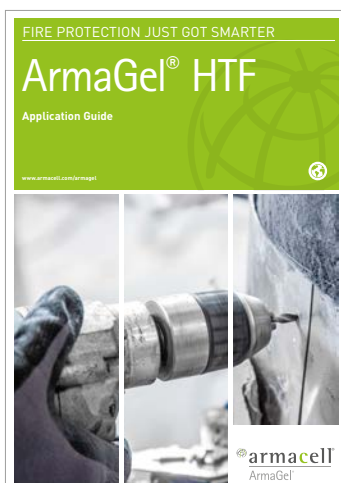
1. Technical Datasheet



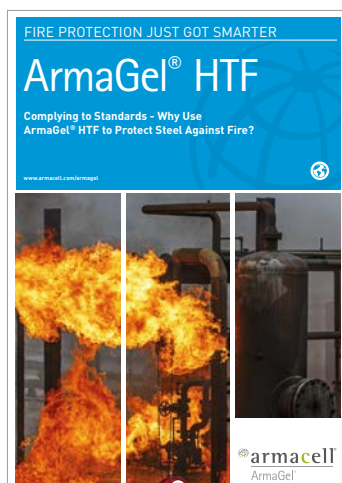
2. Marketing Brochure



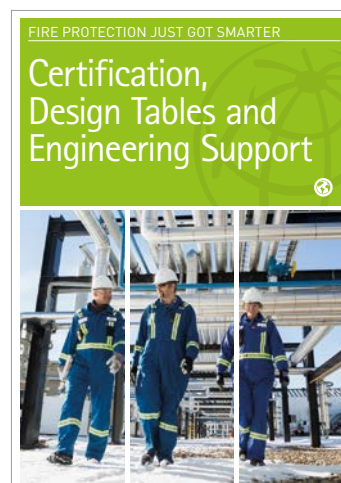
3. Instructions for use



4. Application Manual



5. White Paper



6. Certification, Design Tables and Engineering Support



FIRE PROTECTION  
JUST GOT SMARTER

# ArmaGel<sup>®</sup> HTF

Flexible aerogel blanket for  
passive fire protection

- // Achieves 120 minutes of fire protection according to UL1709 (UL-Listed)
- // Achieves 90 minutes of fire protection according to jet fire (ISO 22899-1)
- // Fire tested configurations are representative of the intended applications
- // ASTM C1728 compliant
- // Up to five times better thermal performance than competing insulation materials
- // Mitigates the risk of corrosion under insulation (CUI)

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## TECHNICAL DATA – ARMAGEL HTF

Brief description	ArmaGel HTF is a flexible aerogel blanket designed for passive fire protection meeting UL 1709 standard. Jet fire tested according ISO 22899-1. ArmaGel HTF is compliant with ASTM C1728, Type III, Grade 1A.
Material type	Aerogel blanket
Colour	Grey
Special features	ArmaGel HTF provides excellent passive fire protection and superior thermal performance with maximum operational use temperature up to 650 °C (1200 °F).
Product range	Sheets in rolls in 10 mm (0.4 in) thickness and width of 1.5 m (59 in). For further details, please refer to the product range tables at the end of this document.
Applications	Passive fire protection and thermal insulation of pipework and equipment in Energy and industrial process facilities.
Installation	For industrial applications, it is recommended to consult the relevant Armacell application manual(s). Please consult our Technical Services for further information and support.

Property	Value/Assessment										Standard/Test method	
<b>Temperature range<sup>*1/2/3</sup></b>												
Max. service temperature	+650 °C		+1200 °F								Tested according to ASTM C411 and ASTM C447	
<b>Thermal conductivity</b>												
Thermal conductivity <sup>4</sup> (metric units)	θm	+24	+38	+93	+149	+204	+260	+316	+371	[°C]	Tested according to ASTM C177 <sup>4</sup>	
	λd ≤	0.021	0.022	0.023	0.025	0.029	0.032	0.036	0.043	[W/(m·K)]		
Thermal conductivity <sup>4</sup> (imperial units)	θm	+75	+100	+200	+300	+400	+500	+600	+700	[°F]		
	λd ≤	0.14	0.15	0.16	0.18	0.20	0.22	0.25	0.30	[Btu-in/(h·ft <sup>2</sup> ·°F)]		
<b>Temperature resistance</b>												
Hot surface performance <sup>2</sup>	Pass										Tested according to ASTM C411	
Linear shrinkage under soaking heat	< 2% in width and length // Pass										Tested according to ASTM C356	
Water absorption	Pass										Tested according to ASTM C1763	
<b>Fire performance &amp; approvals</b>												
Surface burning characteristics	≤ 5 flame spread index ≤ 10 smoke development										Tested according to ASTM E84	
Fire resistance	Tested configurations for UL1709 compliance <sup>5</sup> :										Officially tested at UL according to UL1709 (UL-listed)  Certificate of Fire Approval by Llyods's Register	
		<b>Tested configuration</b>	<b>Fire rating</b>	<b>Outer diameter [min.]</b>	<b>Wall thickness [mm]</b>	<b>Hp/A Value [m<sup>-1</sup>]</b>	<b>ArmaGel® HTF [mm]</b>					
		Pipe 8"	120	219.1	3.68	276.4	10 x 10mm					
		Pipe 8"	120	219.1	6.3	163.4	7 x 10mm					
		Pipe 8"	120	219.1	14.2	74.8	4 x 10mm					
		Pipe 8"	90	219.1	6.3	163.4	5 x 10mm					
		Standard steel beam W10x49 (in x lb/ft)	120	-	-	177.3	3 x 10mm <sup>6</sup>					
	Tested configurations for jet fire compliance (ISO 22899-1) <sup>7</sup> :										Officially tested at Efectis/France according to ISO 22899-1	
	<b>Tested configuration</b>	<b>Fire rating</b>	<b>Outer diameter [min.]</b>	<b>Wall thickness [mm]</b>	<b>Hp/A Value [m<sup>-1</sup>]</b>	<b>ArmaGel® HTF [mm]</b>						
	Pipe 8"	90 (J-90) 180 (integrity)	219.1	6.3	163.4	5 x 10mm						



<b>Density</b>			
Nominal density	180 kg/m <sup>3</sup>	11 lb/ft <sup>3</sup>	Tested according to ASTM C303
<b>Mechanical properties</b>			
Compressive strength <sup>8</sup>	>3 psi/ 20.7 kPa	at 10% compression	Tested according to ASTM C165
Classifying the flexibility of mineral fibre blankets	Flexible		Tested according to ASTM C1101
<b>Corrosion mitigation</b>			
Stress corrosion cracking	Insulation for use over austenitic steel: no cracks, passed		Tested according to ASTM C692, ASTM C795
Corrosiveness of steel	Passed, Mass Loss Corrosion Rate (MLCR) not exceeding that of 5 ppm chloride solution on carbon steel coupon		Tested according to ASTM C1617, procedure A
<b>Other technical features</b>			
Weather resistance	In all industrial applications the outer layer of the material must be protected with an adequate covering like metal jacketing, or preformed UV-cured GRP (Glass-Reinforced Plastic) cladding. Please contact Technical Services for guidance on the temperature limitations and specific construction considerations which need to be made for each jacketing system.		
Passive fire protection	In passive fire protection applications the outer layer of the material must be protected with an adequate metal jacketing. Please contact Technical Services for guidance.		
Health aspects	Neutral, asbestos free.		
Hydrophobic	Yes		
Water vapour sorption	≤ 5% by weight		Tested according to ASTM C1104
Fungal resistance	No growth		Tested according to ASTM C1338
Storage	Material shall be stored indoors, in clean and dry conditions, away from direct sunlight.		
Shelf (storage) life <sup>9</sup>	Max. 3 years		

- For temperatures below or above those published please contact Technical Services to request the corresponding technical information.
- For operating temperatures above 400 °C (752 °F) a metallic foil barrier with 0.05 mm (0.002 inch) thickness must be additionally installed between the two outmost layers of ArmaGel HTF. For details please contact Technical Services.
- For live line installations please refer to the ArmaGel HTF application guide.
- Thermal conductivity tested under a load of 1.5 kPa (0.22 psi).
- All fire tests have been officially conducted at a UL laboratory under full witnessing by UL.
- For the installation procedure please contact Technical Services for guidance.
- The fire test has been officially conducted at a Efectis /France laboratory under full witnessing by Efectis and UL. Fire rating for test criteria (temperature increase on steel pipe below <math>538^{\circ}\text{K}</math>) was 90 minutes. No integrity failure was noticed during the full test period of 180 minutes.
- Test performed with a preload of 2 psi.
- Shelf life (maximum storage time) is limited in order to make sure that only currently manufactured products are applied on projects. This limitation is restricted solely to storage of the product and does not affect the lifetime of product after it has been installed.

## Sheets

		Metric sizes				Imperial sizes			
		Nominal thickness	Width	Length	Content per roll	Nominal thickness	Width	Length	Content per roll
		[mm]	[m]	[m]	[sqm]	[in]	[in]	[ft]	[sq ft]
<b>Standard Rolls</b>	<b>AGF-10-00/150S</b>	10	1.5	8	12	0.4	59	26.3	129.2
<b>Jumbo Rolls</b>	<b>AGF-10-00/150P</b>	10	1.5	40	60	0.4	59	131.2	645.8
<b>Tolerances</b>	<b>Thickness tolerances</b>	10 mm (0.4 in) nominal thickness				± 2.5 mm			
	<b>Width tolerances</b>					± 3%			
	<b>Length tolerances</b>					± 5%			

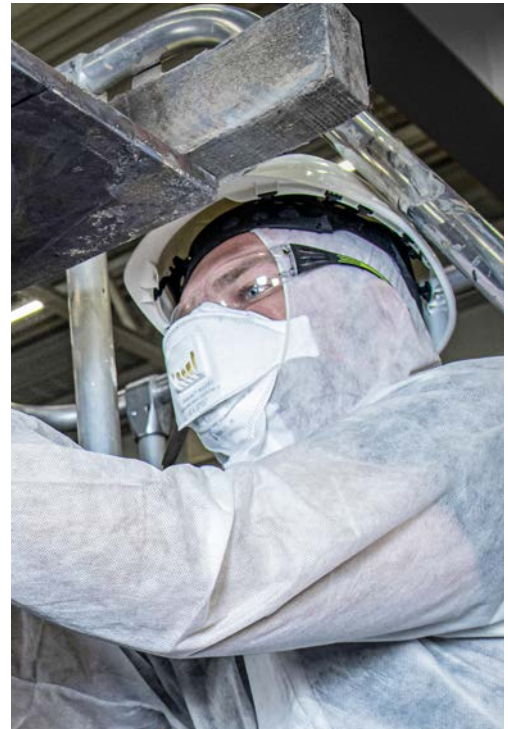


FIRE PROTECTION JUST GOT SMARTER



# ArmaGel<sup>®</sup> HTF

Introducing ArmaGel HTF. An advanced insulation material providing fire protection especially against hydrocarbon pool fires. Reduce the risk of shut-downs and protect your assets. A sustainable one-step solution for fire protection and thermal insulation.



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**A sustainable one-step solution for fire protection and thermal insulation.**

# ArmaGel<sup>®</sup> HTF

ArmaGel HTF is a new generation of aerogel fire protection blanket. A reliable solution for superior thermal insulation for high-temperature applications up to 650 °C (1200 °F). ArmaGel HTF provides additional fire protection to reduce the risk of shut-downs. Having an official UL1709 listing with design number XR207, ArmaGel HTF is easy to install, flexible and environmentally safe. The perfect solution for applications where both, thermal insulation and fire protection, is required.

Passive Fire Protection



Thermal



Hydrophobic



[Learn more.](#)

## AEROGEL

Used by NASA to bring home a piece of a comet because it's strong enough to stop a bullet in its track, aerogel offers an uncanny array of physical properties - thermal, acoustical - and so holds incredible potential for insulation uses. As the name suggests, aerogel is a solid derived from gel in which the liquid component of the gel has been replaced with air making it dry and porous. In fact, over 90 percent of the volume is empty space making aerogel the world's lightest solid material. It's also 1,000 times less dense than glass, making it the world's lowest density solid material.





# YOUR BENEFITS

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## // One-step solution

Advanced insulation material which additionally provides fire protection - reduce the risk of shut-downs in case of fire and protect assets.

## // Fire Protection

Passive Fire Protection with aerogel technology. UL1709 compliant and UL listed. Jet fire tested according ISO 22899-1. Fire Certification by Lloyd's Register. Durability and environmental testing successfully completed in accordance with UL2431

## // Superior thermal Insulation

For hot conditions up to 650°C (1200°F). Up to five times better thermal performance than competing insulation materials.

## // Cost efficient solution

Reduce labour cost. Reduce maintenance costs. The ideal choice for specifiers and contractors.

## // CUI defence

Mitigates the risk of corrosion under insulation (CUI).

## // Easy and reliable installation

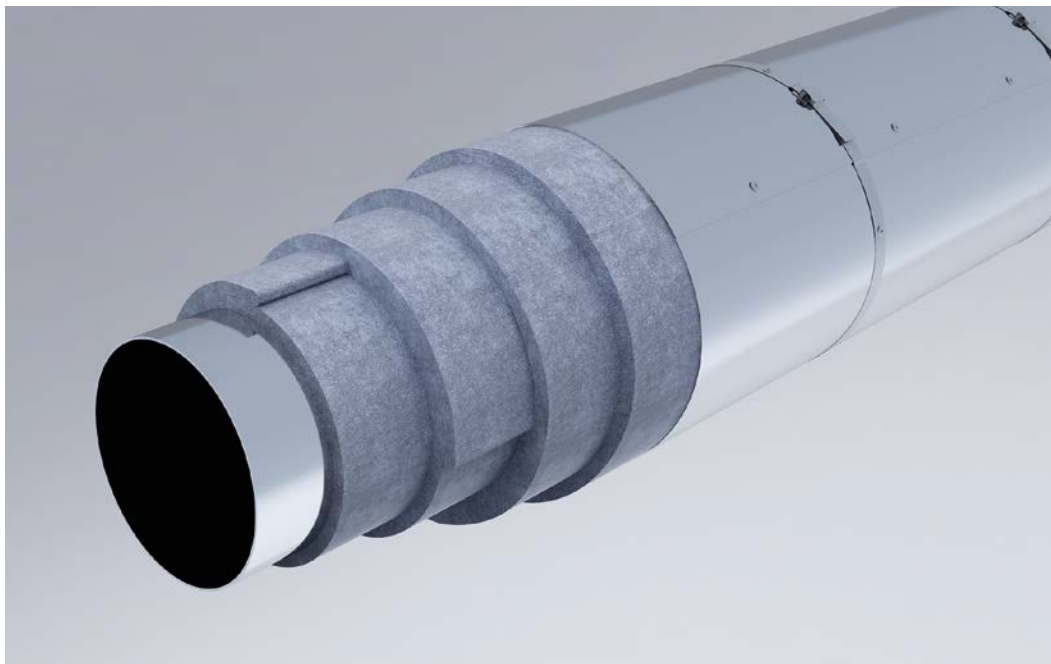
Highly flexible aerogel blanket material. No curing or drying time. No banding systems required to install ArmaGel HTF blankets. Butt joint designs included in the fire testing and certification, reflecting the actual application in the field.

## // Hydrophobic and breathable

Repels liquid water, but allows vapour to escape, helping to keep equipment drier for longer.

## // High temperature application

Fire protection for applications with operating temperature up to 650°C.



# ArmaGel<sup>®</sup> HTF

## Instructions for use

Fire protection aerogel insulation blanket  
Brandschutz-Aerogel-Dämmmatte

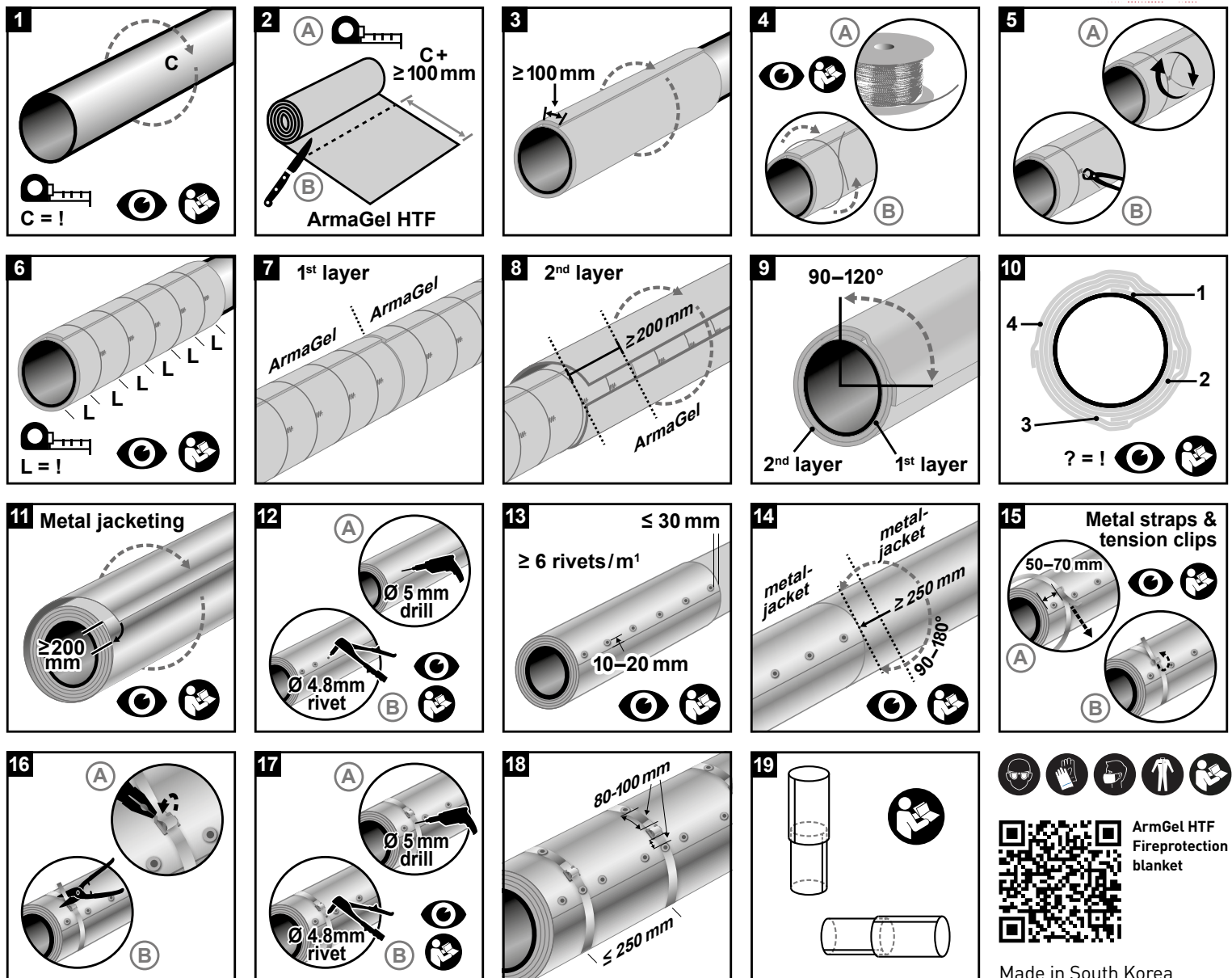
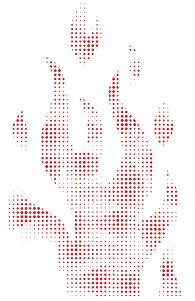
Matelas isolant en aérogel pour la protection incendie  
Manta aislante de aerogel para protección contra incendios

// **EN** For professional use only. Before handling and for specific application details, refer to third party publishing listed, and national approvals / assessments and Armacell product literature.

// **DE** Nur für gewerbliche Anwender. Vor Gebrauch und für spezifische Anwendungshinweise lesen Sie veröffentlichte Listungen von Fremdüberwachern, nationale Zulassungen / Bewertungen und Armacell Produktbeschreibungen.

// **FR** Seulement pour utilisateurs professionnels. Avant toute utilisation et pour tout détail concernant une application, se référer à la liste de publications des tierces parties, aux approbations / évaluation nationales et à la documentation Armacell.

// **ES** Solamente para los usuarios profesionales. Antes de usar y para detalles específicos de aplicación, véase el listado publicado por terceros, las aprobaciones / evaluación nacionales y la información que acompaña al product Armacell.



### Note:

- Wrap ArmaGel tightly to avoid gaps or voids.
- For applications with jet fire requirements, the penultimate layer of ArmaGel HTF needs to be fixed additionally with metal straps. For the outer jacking the distance between the metal straps should be max. 200 mm. For details please refer to relevant third party listings or contact Technical Services.
- For operating temperatures above 400 °C (752 °F) a metallic foil barrier with 0.05 mm (0.002 inch) thickness must be additionally installed between the two outmost layers of ArmaGel HTF. For detail please contact Technical Services,
- For live line installations please refer to the ArmaGel HTF application guide.



Made in South Korea



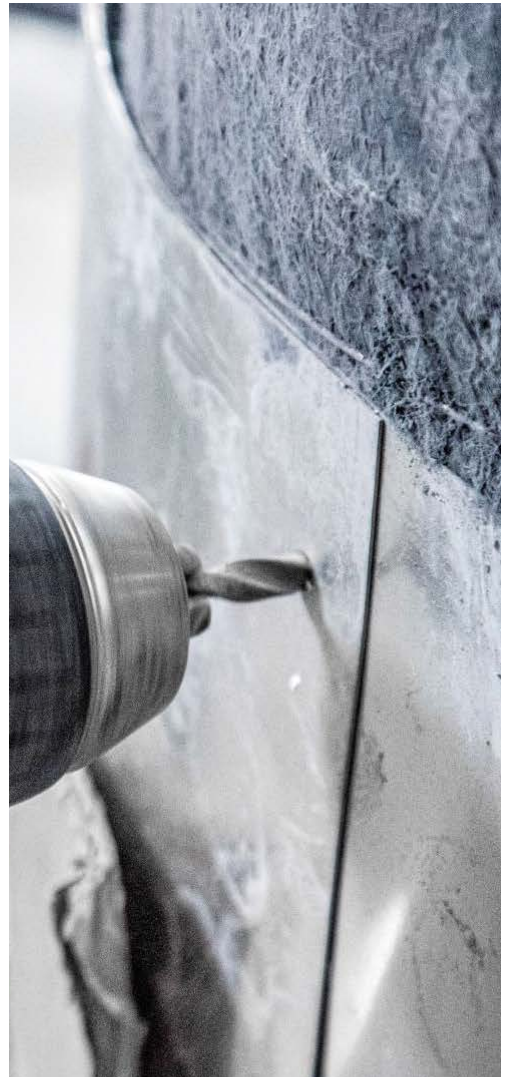
FIRE PROTECTION JUST GOT SMARTER



# ArmaGel<sup>®</sup> HTF

Application Guide

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# ArmaGel<sup>®</sup> HTF

## Consumption Guide



The sections of insulation shall include a minimum 100 mm overlap around the circumference, applicable to all insulation layers.

Cut ArmaGel blanket into sections with the sizing dimensions that are equal to the length of the steel pipe specimens considering an 100 mm overlap plus an additional compensation factor (50 mm for 1st layer, 60 mm layer for 2nd layer, 70 mm for 3rd layer,...)



### Required circumference length of ArmaGel HTF =

- circumference based on outside diameter
- + compensation factor for overlapping (see table below)
- + overlap (100 mm)

### Example for steel pipe with outside diameter of 219.1 mm

Layer	Outside diameter w/o considering overlapping (mm)	Circumference based on outside diameter (mm)	Compensation factor for overlapping (mm)	Overlap (mm)	Required circumference length of ArmaGel HTF (mm)
1	219,1	688	50	100	838
2	239,1	751	60	100	911
3	259,1	814	70	100	984
4	279,1	877	80	100	1057
5	299,1	939	90	100	1129
6	319,1	1002	100	100	1202
7	339,1	1065	110	100	1275

**Note:** the above table is only an example. On jobsite deviations from the calculation model above could be possible. Therefore, for every layer the needed circumference length of ArmaGel HTF needs to be determined before cutting.





# ArmaGel<sup>®</sup> HTF

## Application Steps



### Installation Method of ArmaGel<sup>®</sup> HTF insulation blankets on steel pipes

Cut and fabricate sections of ArmaGel HTF blanket to the required number of layers requirement (see approval). The sections of insulation shall include a minimum 100 mm overlap around the circumference and an additional compensation factor, applicable to all insulation layers (see consumption guide).

Each section is cut so that there is an excess of approximately 25 mm of mat length for each section in the longitudinal direction on the pipe.







All insulation sections when installed shall have no visible gaps showing the bare steel specimen surface.

The ArmaGel insulation is tightly wrapped around the length and contour of the specimen in one full length of blanket (to avoid gaps and voides) - applicable for all insulation layers.

The ArmaGel insulation shall be secured tightly around the steel specimen circumference with industry standard stainless steel insulation binding wire of minimum 0.8 mm in diameter at maximum 200 mm on center for inner layers and 100 mm for the outmost layer.

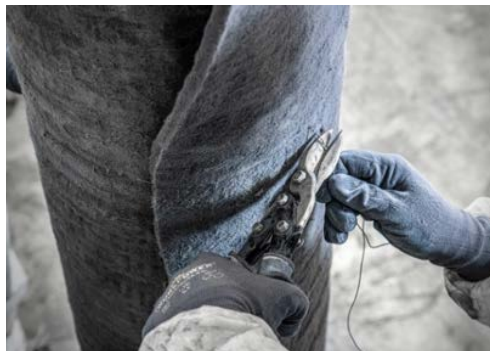
Install ArmaGel insulation on the same layer using a butt joint.

Stagger the butt joint between layers by a minimum of 200 mm.

All overlapping seams contained within the insulation layers shall be staggered by a minimum of 90° to 120° throughout for each consecutive layer.

Consult the approval and UL listing to determine the amount of insulation layers for the required fire rating relative to the steel member dimensions.

For applications with jet fire requirements, the penultimate layer of ArmaGel HTF need to be fixed additionally with metal straps (16 mm wide industry standard, with thickness of minimum 0.75 mm, tightened with stainless steel tension clips). For details please refer to relevant third party listings or contact Technical Services.



## Fixing and Securing of Stainless-Steel Metal Cladding

### Fabrication / design & installation of metal cladding

The insulated pipe has to be covered with metal cladding casing installed around the final insulation: use pre-rolled manufactured minimum 0.6 mm thick stainless-steel.

The cladding shall be installed in sections. Metal jacketing should be staggered. The longitudinal overlapping of jacketing should be  $\geq 250$  mm. Overlaps around the circumference of the cladding sections shall be a minimum of 200 mm.

For vertical applications, the 1st metal cladding section shall be installed at the bottom of the insulated specimen first, the following metal sections where applicable shall be overlapped facing in a downwards direction as per industry standard (roof tile effect).



### Use of blind stainless-steel rivets

All metal cladding shall be fixed and secured with 4.8 mm diameter – stainless steel countersunk type pop rivets in pre-drilled 5 mm diameter holes.

Install  $\geq 6$  rivets/m<sup>2</sup> along the edge of the jacketing. Distance of the first rivet to the edge of the jacketing is  $\leq 30$  mm. Distance of the rivets to the long edge of the jacketing is 10 to 20 mm.

In addition to the rivets installed on the leading edge, six additional rivets shall be installed around the circumference of the jacketing (two additional rivets at every 90°), at each horizontal overlap at approximately 30 mm and 200 mm from the horizontal edges of the cladding segments.





## Use of stainless-steel restraining bands and tension clips

All metal cladding shall also be additionally secured with 16 mm wide industry standard stainless-steel bands (with thickness of minimum 0.75 mm) and tension clips. Excess length of the band needs to be cut off.

Distance between the bands should be  $\leq 250$  mm, the distance of the first band to the edge of the jacketing is 50 to 70 mm.

4.8 mm diameter rivets are installed in pre-drilled 5 mm diameter holes, at a distance of 80 to 100 mm left and right from the clip.

For applications with jet fire requirements for the outer jacketing the distance between the metal straps (16 mm wide industry standard, with thickness of minimum 0.75 mm, tightened with stainless steel tension clips) should be max. 200 mm.

In the case of vertical pipe configurations, four 90° stainless-steel angle brackets, side length 2 times 60x18x1mm, installed around the circumference of the top segment of metal jacketing (at every 90°) to fix the top segment only to the upper supporting construction. Fixing with rivets to the jacketing and bolted to the upper supporting construction.



### Note:

All high-temperature insulation materials may release traces of organic residues during initial commissioning and exposure to high temperatures. This process may be accompanied by the emission of gaseous products and their oxidation, and consequently, a short-term exothermic reaction, which may be accompanied by a specific odour, smoke release, and in extreme cases glowing and/or flaming.

1. To ensure that any self-heating and/or exothermic reaction for operating temperatures above 400 °C is kept within an acceptable range, the following application instructions shall be followed:
  - a. All layers of ArmaGel HTF shall be installed and secured tightly to avoid any visible gaps between layers and along all longitudinal and circumferential joints.
  - b. The metallic foil (e.g. aluminium stainless steel foil) shall be installed between the two outmost layers of the ArmaGel HTF construction.
  - c. The cladding system shall be fully installed before operating the pipe equipment.
2. Do not apply ArmaGel HTF on live pipe equipment when operating above 350 °C and ensure that the insulation system is complete before turning the pipe/equipment on.
3. Do not apply ArmaGel HTF with a total thickness of more than 80mm without first contacting Armacell technical support.
4. The service temperature and application temperatures defined above do not reflect the performance under the fire conditions as per UL 1709 and ISO 22899-1.





## ArmaGel HTF Application video

Watch the application video for a step-by-step guide on installing ArmaGel HTF and the metal cladding.



# ArmaGel<sup>®</sup> HTF

## Approved Systems



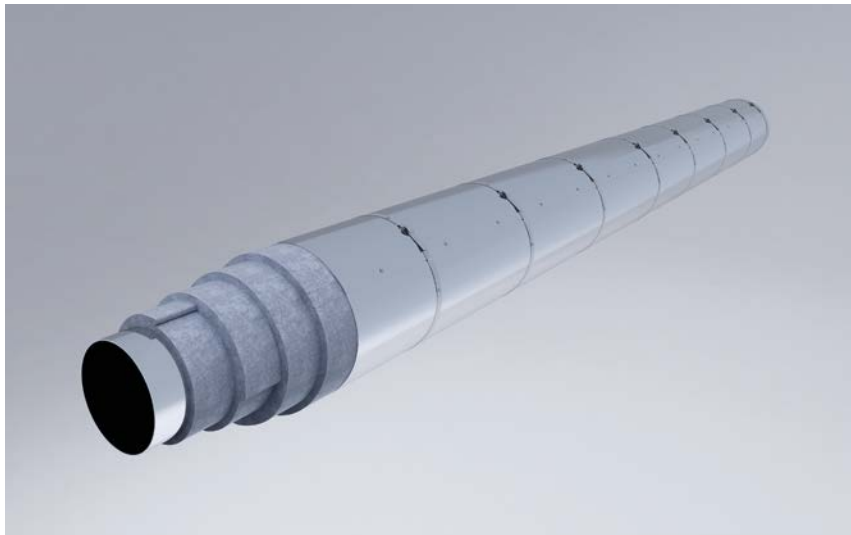
### ArmaGel<sup>®</sup> HTF system configuration

The ArmaGel<sup>®</sup> HTF system consists of multiple layers of the blanket, depending on the required fire rating and dimensions of the pipe. As per industry standards, a stainless steel outer jacketing system is being applied to cover the entire surface area of the ArmaGel HTF blankets.

#### Tested and certified configurations for UL1709 compliance<sup>1</sup>

Tested configuration	Fire rating [min.]	Outer diameter [mm]	Wall thickness [mm]	Hp/A Value [m <sup>-1</sup> ]	ArmaGel <sup>®</sup> HTF
Pipe 8"	120	219.1	3.68	276.4	10 x 10mm
Pipe 8"	120	219.1	6.3	163.4	7 x 10mm
Pipe 8"	120	219.1	14.2	74.8	4 x 10mm
Pipe 8"	90	219.1	6.3	163.4	5 x 10mm
Standard steel beam W10x49 (in x lb/ft)	120	-	-	177.3	3 x 10mm

<sup>1</sup> All fire tests have been officially conducted at a UL laboratory under full witnessing by UL.



**Fire performance & approvals**

Surface burning characteristics	≤ 5 flame spread index ≤ 10 smoke development						Tested according to ASTM E84
Fire resistance	Tested configurations for jet fire compliance (ISO 22899-1) <sup>6</sup> :						Officially tested at Efectis/France according to ISO 22899-1
	<b>Tested configuration</b>	<b>Fire rating</b>	<b>Outer diameter [min.]</b>	<b>Wall thickness [mm]</b>	<b>Hp/A Value [m<sup>-2</sup>]</b>	<b>ArmaGel® HTF [mm]</b>	
	Pipe 8"	90 (J-90) 180 (integrity)	219.1	6.3	163.4	5 x 10mm	

ArmaGel HTF Jet fire test at Efectis/France, officially witnessed by Efectis/France and UL Europe. The below pictures were taken during the test.





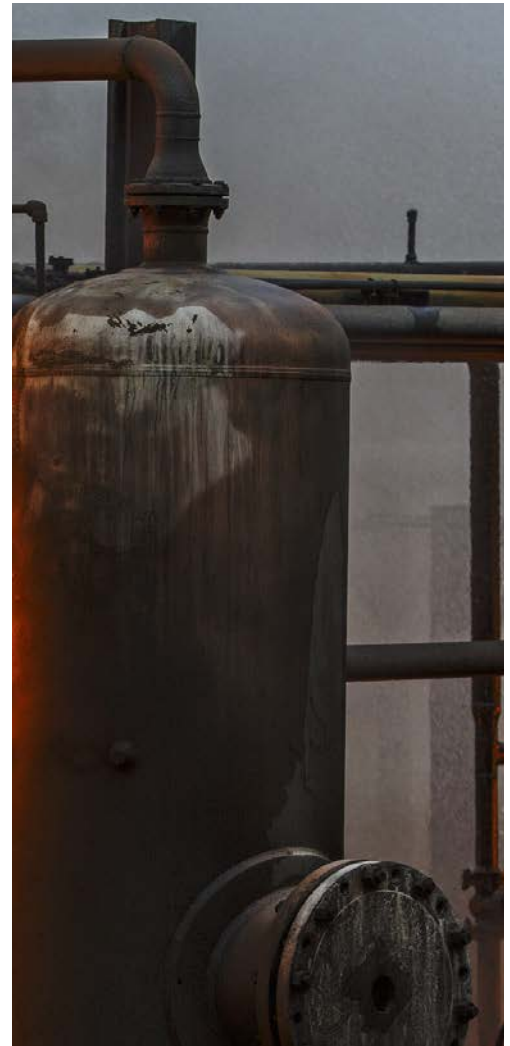
FIRE PROTECTION JUST GOT SMARTER



# ArmaGel<sup>®</sup> HTF

Complying to Standards - Why Use  
ArmaGel<sup>®</sup> HTF to Protect Steel Against Fire?

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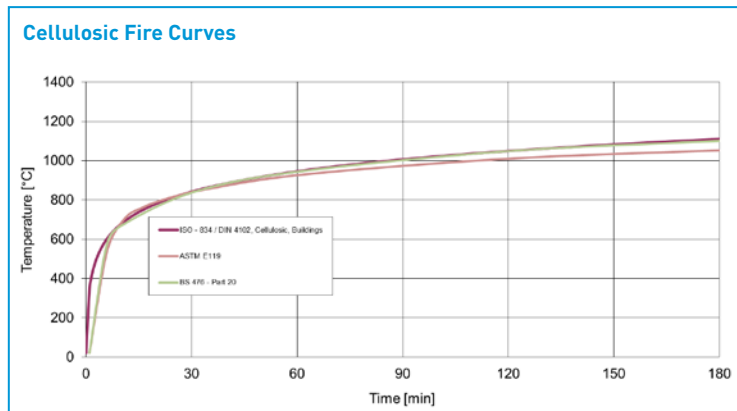
# ArmaGel<sup>®</sup> HTF

## Complying to Standards - Why Use ArmaGel<sup>®</sup> HTF to Protect Steel Against Fire?

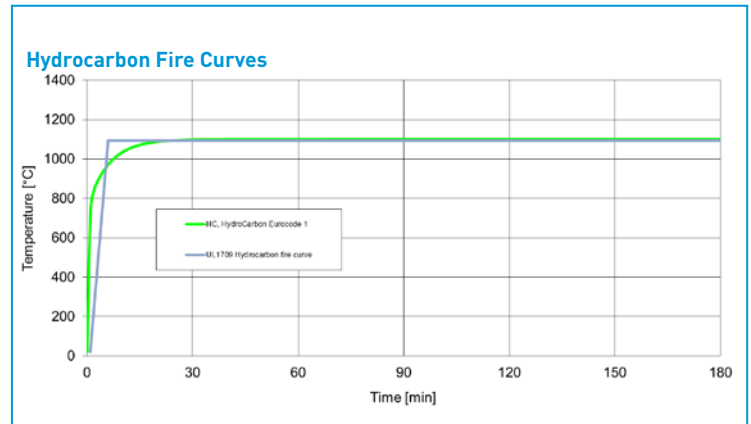
### 1. Fire growth rates and fire curves

The devastating effects that fires can have on assets and buildings are commonly known. Not only are fires, and predominantly smoke and toxic gases, lethal for the humankind, the temperatures associated with such fires can make process equipment and piping systems collapse and fail, and cause load bearing structures to collapse.

Fires in commercial or residential buildings have in common that the combustibles are mainly cellulosic based materials. Such fires have a moderate fire growth rate and maximum temperature. The time – temperature development (the fire curve) of such fires is regulated in several global and national standards, such as ISO-834, ASTM E119, BS 476-20 and AS 1503.4. These fire curves are based on the burning rate of general building materials and building contents, and are often referred to as Standard Fire Curve or Cellulosic Fire Curve.



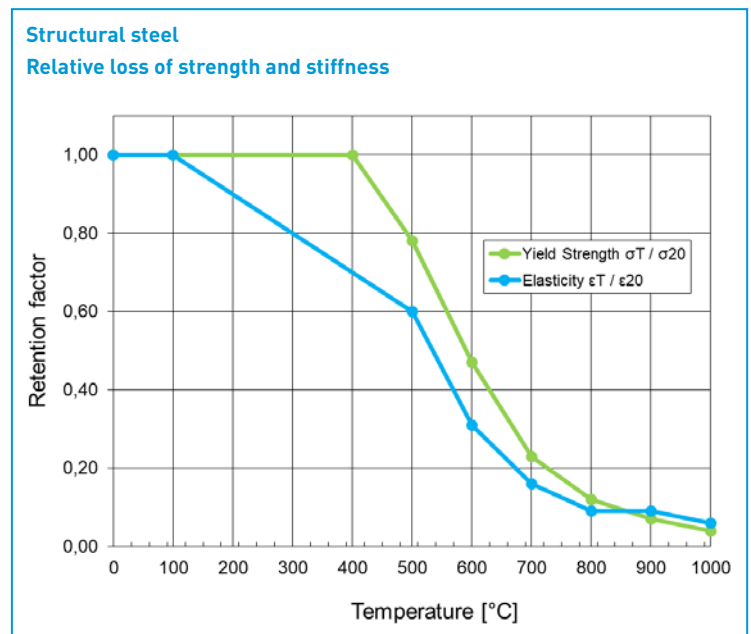
However, industrial fires are completely different, and much more severe, compared to the fires in commercial or residential buildings, as described above. Fires in oil and gas plants, refineries, petrochemical installations etc. are often based on liquid hydrocarbons, gasses or chemicals. The calorific value of such combustibles, expressed in kcal/m<sup>3</sup> or BTU/ft<sup>3</sup>, is much higher than those of cellulosic materials, and therefore the fire growth rate and maximum temperature generated by the fire are much higher. Also, these combustibles are almost unlimitedly available in an industrial plant, so the fire duration will be extended as well. The fire curve which represents such fire scenarios is regulated in UL1709, as well as by the Eurocode. Such fire scenarios represent a hydrocarbon pool fire in the open field, reflecting a fuel spill which forms a fuel reservoir and then ignites. These fire curves are often referred to as Hydrocarbon Fire Curve or Pool Fire Curve. The same regulated fire curves are used for on-shore and off-shore facilities. These fire scenarios are known for having a very steep temperature increase in the first minutes. For example, the UL1709 fire curve reaches 1093°C within 5 minutes and remains stable for the duration of the fire test at this temperature. This thermal shock poses a particular challenge to most building materials and it requires specifically designed products and engineered systems to survive such fires and protect the asset from failure or collapse.



Stakeholders in the oil and gas, petrochemical sector are commonly aware of such fire risks and are risk adverse for very good reasons. Industrial fires pose a direct risk to those working at the facility, and the risk of downtime, or even a total-loss of the entire facility, has to be mitigated as well for economic reasons.

### 2. Why protect steel against fire?

Even though steel is a non-combustible product, the loss of strength and stiffness when exposed to fire temperatures is significant. The Eurocode 3 provides retention values for both yield strength and elasticity, as a function of temperature, compared to the values at an ambient temperature of 20°C. The Eurocode 3 retention values are very similar to the ones listed in ATSM A36.







A key takeaway from the graph above is that, for example, at a fire temperature of 600°C the yield strength of steel has been reduced by more than 50% of the yield strength at ambient temperature, and the elasticity is only 30% of the ambient value. Another example: at 1000°C fire temperature, both the yield strength and elasticity have been reduced by over 90% of the ambient value.

As stated previously, fire temperatures increase very rapidly in the first few minutes of a fire, especially industrial fires which reach nearly 1100°C within 5 minutes. Leaving steel members fully exposed to such fire temperatures, would include a significant risk to deflection and structural collapse of the steel members, early on in the fire event.

For the reasons described above, industry practice is to protect critical steel members against fire risks by means of the application of passive fire protection systems. This is being regulated by industrial fire standards which are being addressed in the next paragraph.

### 3. Governing industrial fire standards

#### 3.1. UL1709

UL1709 [Rapid Rise Fire Tests of Protection Materials for Structural Steel] is the most commonly used fire standard, referred to in technical specifications by the oil majors, FEED engineers and EPC's. The current version of UL1709 is the 5th edition, issued in February 2017.

The basics of a compliance fire test to UL1709-05 is that, when exposed to the UL1709 fire curve, the average temperature of the thermocouples installed on the steel test specimen shall not exceed 538°C, and none of the thermocouples shall exceed a maximum recording of 649°C. For further details on the test procedure, reference is made to the UL1709-05 standard.

On their webpage <https://www.ul.com/resources/testing-and-certification-steelwork-fire-protection>, UL acknowledges the fact that the UL1709 standard gets adopted increasingly. At the same time, non-UL test laboratories which are not accredited for UL1709 fire testing, seem to have different interpretations of the intended test methodology. On the referenced webpage, UL addresses some of the misinterpretations and provides clarity on some key principles of the fire test method. UL states:

#### 3.1.1. Furnace calibration

The current method for calibrating the furnace requires a single calibration column to be placed centrally within the furnace chamber. This is intended to reflect what will happen in the subsequent type of testing, thereby exposing the sample under test to the same thermal dose as the calibration column and ensuring a high level of consistency in evaluating the protection system from test to test. It is not intended that more than one specimen is included in the furnace at the same time as this will result in one or more sides of the columns being shielded from some of the heat within the furnace chamber such that the intended Time-Temperature (t-T) and heat flux exposure to the specimen is not replicated. This practice is also likely to result in some columns being nearer to the walls of the furnace chamber, which can also result in a lower thermal dose on the protection system under evaluation.

#### 3.1.2. Furnace thermocouples

According to UL 1709, the furnace should be calibrated using eight thermocouples at a maximum distance of 102 millimetres from the exposed face of the specimen. That means eight thermocouples per column to ensure that the furnace temperature is controlled such that the test specimen is exposed to the intended t-T curve. These thermocouples must also be evenly distributed throughout the furnace to ensure an even evaluation of the thermal dose during the test. Uneven distribution of the thermocouples within the furnace chamber is likely to cause a heat gradient, causing uneven heating of the column(s).







### 3.1.3. Furnace control

As with most furnace testing, there are variables due to the very nature of the equipment being used. The Standard provides guidance on the level of acceptable variation, in particular with the temperature within the furnace chamber. The intention is that the tolerances are there as guidance to compensate for fluctuation and not to be used in continuous operation. In the ideal test, the tolerances would not be used and would operate within the mean values. To operate the furnace such that it runs toward the lower or upper tolerances will give a lack of consistency between tests as well as between protective systems being evaluated. This is of particular concern when the lower range of tolerance is targeted. This practice should not be followed, and test data generated via a test operated at the lower end of the tolerances throughout the test should be treated cautiously with the understanding it may not perform as other products evaluated to the prescribed fire curve.

### 3.1.4. Specimen thermocouples

UL 1709 is clear in the number of thermocouples to be used on each specimen. There are a number of reasons why this should be followed, not least to provide a consistent approach to the evaluation of the protective system. In some cases, we are aware that less than the number of required thermocouples are used on the test specimen(s). While this is not in accordance with the standard requirements, the greater concern is there may be a part of the protective system that gets overlooked because of the reduced number of specimen thermocouples. Given that this test is only evaluated to temperature limits rather than the structural limits, it is imperative that all instruments are installed as required such that a representative sampling across the full test specimen is captured. Chapter 5 of the Standard is clear that 20 specimen thermocouples should be used per column. As with the furnace control matter discussed above, data produced using less than 20 thermocouples per column should be treated with caution and considered not compliant with the requirements of the test standard.

### 3.1.5. Protective system

In all fire tests, the tested system should be representative of what will be used in the final installation on site. If changes are made to what was tested and certified, there will likely be an impact on performance. This means it is critical that the details of the tested system are recorded accurately and are then installed in practice as required in the certification documentation. If these details are not followed, there may be a loss of fire performance and a threat to life safety.

For instance, in cases where a stainless steel wrap is added to columns for the test, even though it does not have a high thermal insulation value, the addition of the casing will add thermal protection to the steel column. It will do this by creating an air gap that insulates the column and by stopping the convection of hot gases in the furnace, which otherwise might have penetrated the protective system. This is just one example where a small element of the protective system, one that may appear to add little or no thermal resistance, can be critical to the system's overall fire performance and proven by way of fire testing. Therefore the full configuration of the protective system, as tested, shall be installed on-site as well to help ensure the required fire safety levels are provided.

### 3.1.6. Durability

Often the protective products tested and certified to UL 1709 will be placed in harsh environments when placed in practice. It is for this reason that the Standard mandates durability testing that simulates these harsh environments be performed on all protection systems intending to be certified to UL 1709. The durability testing is conducted to UL 2431, the Standard for Safety for Durability of Fire Resistive Coatings and Materials, and the protection systems must comply with all requirements for Material Classification Category I-A: Outdoor, Heavy Industrial as prescribed in the Standard. The individual listing on UL's Product iQTM database will indicate the protection system's compliance with these durability testing requirements.

### 3.1.7. Official material sampling by UL for fire testing purposes

In addition to the clarifications above, provided by UL, UL also insists and ensures that the products which will be used for the actual UL1709 fire test(s), are being independently selected by a UL representative at the vendors factory. This aims to ensure that the tested product quality and specifications are representative for the actual products which are supplied and installed on-site.





## 4. Steel member dimensions and fire performance

Zooming into the failure mechanisms of steel members when exposed to fire, two parameters play a pivotal role: the steel mass of a steel member and the heated perimeter of the passive fire protection system.

### 4.1. Steel mass

The heating rate of a steel member is impacted by the steel mass of that particular steel member. A steel member can be a critical process equipment pipe, a load bearing steel column or beam. The more steel mass a steel member contains, the longer it takes for it to heat up. Vice versa, a steel member which holds a very small mass, will be heated up very quickly. This is why, in fire test standards the value of steel mass is included in the fire performance analyses of passive fire protection systems.

The European Standard refers to the value A, being the cross-sectional area of the steel section [m<sup>2</sup>]. UL1709 refers to the value W, being the weight per linear foot [lb]. Regardless of the unit, both standards acknowledge that the amount of steel is a relevant parameter to assess the fire performance of a steel member.

### 4.2. Heated perimeter

The surface area of the passive fire protection system, which gets heated by the fire, will transfer the temperature to the steel member, through a combination of radiation, convection and conduction. The surface area is referred to as the heated perimeter. The larger the heated perimeter, the faster a steel member will be heated up. In fire test standards, the value of the heated perimeter is included in the fire performance analyses of passive fire protection systems.

The European Standard refers to the value Hp, being the perimeter exposed to fire [m<sup>1</sup>]. UL1709 refers to the value D, being the heated perimeter [inch]. Regardless of the unit, both standards acknowledge that the heated perimeter is a relevant parameter to assess the fire performance of a steel member.

### 4.3. Steel mass and Heated perimeter

The European Standard applies the Hp/A [m<sup>-1</sup>] value as a reference to the massivity of a steel member. A higher Hp/A value means that a member is more vulnerable to be heated up faster. That member has a relatively high heated perimeter or a relatively low steel mass, or both. A lower Hp/A value means that a steel member can withstand the fire somewhat longer, before it reaches critical failure temperatures.

UL1709 expresses the massivity of a steel member as W/D [lbs/inch]. A steel member with a higher W/D value will take longer to be heated up. That steel member has a relatively high steel mass or a relatively low heated perimeter, or both. Regardless of the unit, both standards acknowledge that the ratio of steel mass and heated perimeter is a relevant ratio to assess the fire performance of a steel member.

For UL1709 fire testing of structural steel columns as per industry practice, the selected typical steel member dimension is W10x49, which is a wide flange beam (10 inch wide), weighing 49 lbs/feet. The corresponding massivity values are Hp/A = 159 m<sup>-1</sup> or W/D = 0,84 lbs/inch.

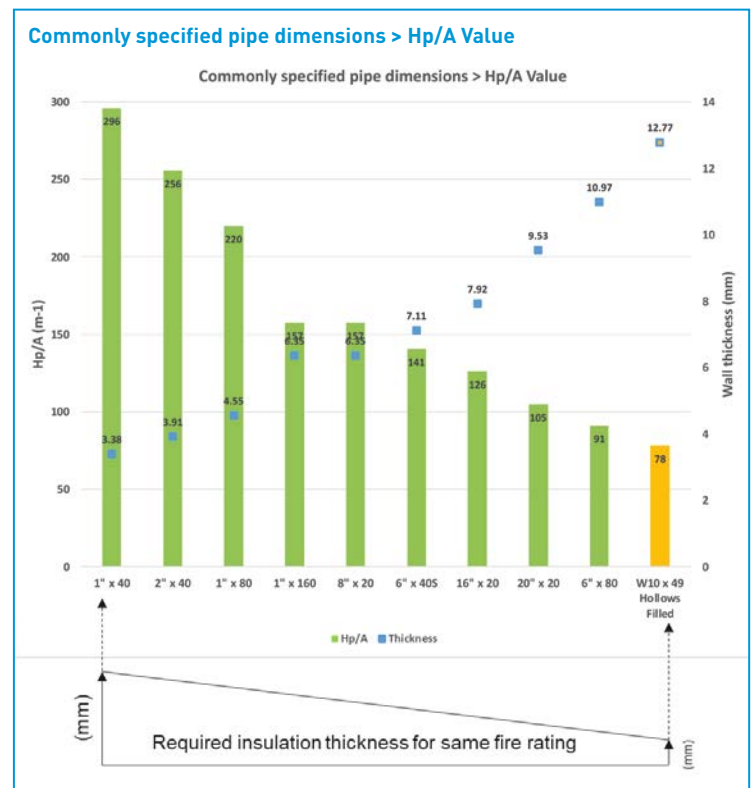
## 5. Critical process equipment piping systems

In industrial facilities, critical process equipment piping systems are pivotal to ensure smooth operations, maintain process temperatures at the required levels and avoid downtime. Piping systems are therefore equipped and protected against a number of potential exposures and deterioration, such as corrosion prevention, thermal insulation for operational use, protection against cryogenic spill, passive fire protection, acoustic insulation, impact protection and others. As space is very often limited in industrial facilities, stakeholders are requesting manufacturers of such protective products to develop multi-purpose systems which meet the requirements of multiple industry standards. By combining the compliance to multiple standards into one system, the space required for the full protection package on the pipe is being reduced, the system gets easier and cheaper to maintain and will be more economical from a material purchasing and labour cost point of view.

### 5.1. Massivity of pipe sections

Compared to structural steel wide flange beams, pipe sections intrinsically have a lower steel mass and a relatively large heated perimeter. This results in higher Hp/A values and therefore a higher vulnerability to being heated up in fire conditions, beyond the thermal failure criteria of UL1709 as outlined in paragraph 3.1 above.

To maintain fire safety designs of fire requirements on critical process equipment piping systems at the required level, fire rated pipe designs shall be treated differently as opposed to fire rated designs for structural steel wide flange beams. The graph below holds an overview of commonly specified pipe dimensions and their associated Hp/A values, compared with the Hp/A value of a W10x49 wide flange beam.



The impact of lower a wall thickness on the increasing Hp/A value is clearly demonstrated. Consequently, a higher Hp/A value leads to larger thickness of the insulation material, required to achieve the same fire rating. Comparing commonly specified pipe designs to the W10 x 49 wide flange beam, as per industry practice for structural steel members, it's clear that the Hp/A value of the beam is not at all

representative for Hp/A values found for pipe designs. Insulation thicknesses obtained from fire test data on beams are therefore not suitable for pipe applications. If applied incorrectly, the insulation thickness derived from fire test data on beams will be insufficient to achieve the intended fire protection levels on a specific pipe configuration, in which case the intended safety requirements are not met, exposing the facility and its users to premature failure and collapse of the equipment at hand.

## 6. Calculating Hp/A values in the Energy sector

### 6.1. Preamble

In the Energy sector, a variety of critical process equipment, having different shapes and dimensions, require passive fire protection means. It's mainly the shapes which can cause challenges in determining the Hp/A value. This chapter provides clarification and support in accurately calculating Hp/A values for pipes, vessel skirts, vessels and spheres. It also provides a simplified calculation method for each of these items, for quick Hp/A assessments.

### 6.2. Pipes / Vessel skirts / Vessels

Even though the dimensions of these 3 items can differ considerably, the Hp/A calculation principle is equal for all of them.

All systems consist of a single skin cylindrical steel shape which is protected by a means of passive fire protection. Regardless of the dimensions, the formulas used for the Hp/A calculation remain the same. Note that the longitudinal dimension of the pipe, vessel or vessel skirt is irrelevant for Hp/A calculations.

The Hp/A calculation of pipe-like configurations addresses the 2-dimensional cross section of the pipe-like design. The Hp value (heated perimeter), for a pipe-like Hp/A calculation, has the unit [m<sup>1</sup>] and the A value (steel mass) has the unit [m<sup>2</sup>], resulting in a unit [m<sup>-1</sup>] for Hp/A.

The attached formulas offer a detailed calculation method by taking the pipe Outer Diameter (OD) and Inner Diameter (ID) into account. It also offers a simplified calculation method by only taking the pipe wall thickness (or the thickness of the vessel skirt or vessel) into account. The latter method can be used for quick Hp/A calculations, but the detailed method provides 100% accuracy.

### 6.3. Spheres

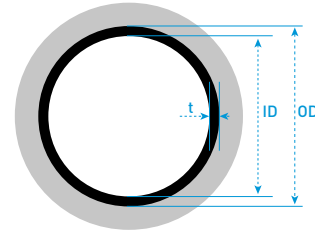
Mathematically, the Hp/A calculation of spheres is different from pipes, especially because a sphere has to be considered as a 3-dimensional object, whereas pipes can be addressed only 2-dimensionally.

The Hp value (heated perimeter), for a sphere Hp/A calculation, has the unit [m<sup>2</sup>] and the A value (steel mass) has the unit [m<sup>3</sup>], resulting in a unit [m<sup>-1</sup>] for Hp/A.

The attached formulas offer a detailed calculation method by taking the spheres Outer Diameter (OD) and Inner Diameter (ID) into account. It also offers a simplified calculation method by only taking the spheres wall thickness into account. The latter method can be used for quick Hp/A calculations, but the detailed method provides 100% accuracy.

## Pipes / Vessel skirts / Vessels

### Detailed calculation



$$Hp/A = \frac{4 \times OD}{(OD^2 - ID^2)}$$

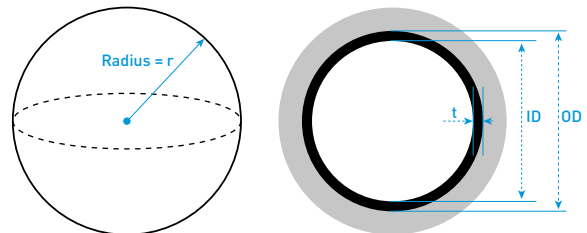
### Simplified calculation



$$Hp/A = \frac{1}{t}$$

## Spheres

### Detailed calculation



$$Hp/A = \frac{3 \times \left(\frac{OD}{2}\right)^2}{\left[\left(\frac{OD}{2}\right)^3 - \left(\frac{ID}{2}\right)^3\right]}$$

### Simplified calculation

$$Hp/A = \frac{1}{t}$$





## 7. Introducing ArmaGel HTF

With the statements made in paragraph 5 in mind, Armacell has developed a unique, state-of-the-art fire rated aerogel blanket, which is officially tested at the UL firetesting facilities to be fully compliant with UL1709, plus it has been tested in accordance with the aerogel product standard ASTM C1728-23 [Standard Specification for Flexible Aerogel Insulation], Type III, Grade 1, Category A.

Using a patented technology, ArmaGel HTF has proven to maintain its fire integrity for over 180 minutes, when exposed to the UL1709 fire curve. Applied as a pipe insulation configuration, the ArmaGel HTF system meets the UL1709 criteria for the duration of 120 minutes and the system complies to the requirements of UL2431.

The targeted application of ArmaGel HTF is to protect critical process equipment piping systems against fire, combined with thermal insulation properties required to keep the line temperature at the specified levels. Reference to paragraph 3.1.5. above, ArmaGel HTF has therefore been fire tested and certified as a pipe insulation configuration, ensuring that the tested system is representative of the actual application in the field.

Being tested at the official UL fire testing laboratories, the ArmaGel HTF system fully complies with the UL1709 and UL2431 requirements, including the key principles of the fire test method, as referred to in paragraph 3.1.

ArmaGel HTF:

- is the only UL-listed aerogel solution for passive fire protection in the market by completing both UL1709 and the environmental durability test in accordance with UL2431 and holds an official UL listing with design number XR207
- is the only UL1709 listed aerogel based blanket material for the intended application of fire rated pipe insulation, and
- complies with the requirements of the aerogel product standard ASTM C1728-23, Type III, Grade 1, Category A.

## 8. ArmaGel HTF system configuration

The ArmaGel HTF system consists of multiple layers of the blanket, depending on the required fire rating and dimensions of the pipe. As per industry standards, a stainless-steel outer jacketing system is being applied to cover the entire surface area of the ArmaGel HTF blankets. For further construction details of the system, reference is made to the ArmaGel HTF installation manual.

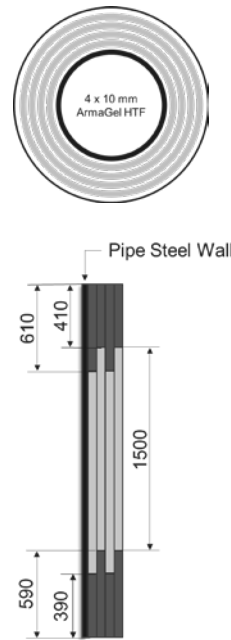
The key benefits related to the ease of installation and thorough test certification of the ArmaGel HTF system are listed below.

### Butt-joint designs

When installing ArmaGel HTF - or any insulation blanket for that matter - in the field, there will many occasions where the length of the pipe or the size of the vessel that needs to be protected, exceed the dimensions of the ArmaGel HTF material. In such situations, insulation contractors prefer to butt joint neighbouring blankets on the same layer for ease of installation and to limit waste of material. However, continuous blanket material is of course preferred to prevent any thermal leaks and such joints could have the potential to cause premature failure. In order to justify these best installation practices from a fire testing certification standpoint, ArmaGel HTF has been fire tested to UL1709, UL2431 and ISO22899-1 with butt-joint designs included during the fire test.

This butt-joint design is included in the UL listing XR207 and the Lloyds Register Type Approval LR2406554SF-01. The only condition is that butt-joints between neighbouring blanket segments on the same

layer shall be staggered by >200mm versus the previous layer butt-joints. Please refer to the Application Guide in this document for further application instructions.



### UL1709 blanket installation

Again for ease of installation and reduction of fixing materials, ArmaGel HTF blanket segments are installed using standard  $\varnothing 0,8$ mm stainless steel binding wire only. Should there be any mechanical or other reasons to install additional stainless steel bands on the ArmaGel HTF blankets for example, then this is allowed from a fire safety standpoint, considering that such stainless steel bands are non-combustible and will absorb some of the energy from the fire. However, from a certification standpoint bands are not required on the ArmaGel HTF blanket. Please refer to the Application Guide in this document for further application instructions



### ISO22899-1 blanket installation

In case of jet fire specifications to ISO22899-1, the installation principle for the ArmaGel HTF blanket system is similar to that for the UL1709 designs. The only difference is that for the jet fire design, only the penultimate (second to last) layer is being installed using alternating stainless steel wires and stainless steel bands. Please refer to the Application Guide in this document for further application instructions.



FIRE PROTECTION JUST GOT SMARTER



# Certification, Design Tables and Engineering Support





# Certificate of Compliance

## Certificate Number:

R40699

## Report Reference:

R40699-20240215

## Issue Date:

2024-02-15

Issued to:

**ARMACELL GMBH**  
**ROBERT-BOSCH-STRASSE 10**  
**MUENSTER Nordrhein-Westfalen, 48153 Germany**

This certificate confirms that representative samples of:

**MAT MATERIALS**

**See Addendum Page for Product Designation(s).**

Have been evaluated by UL in accordance with the Standard(s) indicated on this Certificate.

**ANSI/UL 1709, Rapid Rise Fire Tests of Protection Materials for Structural Steel**

Additional Information:

See UL Product iQ® at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.

David Piecuch  
UL Mark Certification Program Manager



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Form-ULID-013925-CoCa – ver 1.0





# CERTIFICATE OF COMPLIANCE

**Certificate number** R40699  
**Report reference** R40699-20240215  
**Date** 2024-02-15

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Model ArmaGel HTF

David Piecuch  
UL Mark Certification Program Manager

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# Official UL listing XR207

## Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BYBU - Fire-resistance Ratings - ANSI/UL 1709

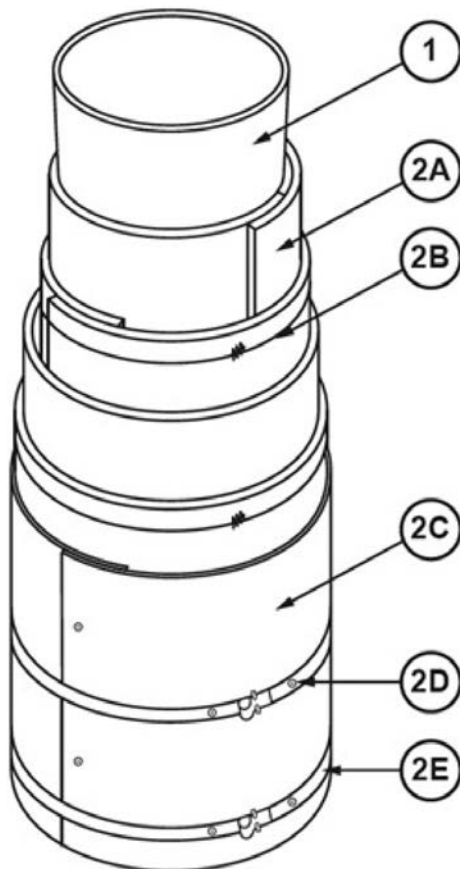
See *General Information for Fire-resistance Ratings - ANSI/UL 1709*

Design No. **XR207**

February 15, 2024

**Rating — 2Hr.**

\* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



1. **Steel Column** - Circular Hollow Section. Maximum Section Factor of column,  $H_p/A = 274.9 \text{ m}^1$ .

2. **Protective system** - The column protection assembly consists of mat, stainless steel binding wire, and stainless steel cladding. The details of the column assembly are summarized below:

A. **Mat Materials\* - Mat** - Flexible aerogel mat supplied in rolls of nominal 10 mm thickness. Each layer of mat is installed by cutting to size and tightly wrapping around the column and itself such that a minimum 100 mm (3.94 in) overlap is present along the vertical seam. The overlap position shall be staggered by 90° from one layer to the next one. Adjacent sections of material on the same layer abut one another forming the circumferential edge seam. Each section is cut so that there is an excess of approximately 25 mm of mat length for each section. Successive layers of mat installed in same manner with butted end seams offset a min 200 mm (7.87 in). from butted end seams of preceding layer. Sections are held in place with stainless steel binding wire  $\varnothing 0.8\text{mm}$  (0.03 in) applied as described under Item 2B.

The 2-hour (120 min) rating of the column assembly is dependent upon the total thickness of mat layers as shown in the following table:



A/P [in]	Hp/A [m <sup>2</sup> ]	Min Thickness
0.14	274.9	100
0.15	257.7	90
0.17	227.1	90
0.19	206.2	90
0.21	183.6	80
0.23	170.2	80
0.25	159.5	80
0.28	138.1	70
0.29	134.0	70
0.30	130.1	70
0.35	111.5	60
0.36	108.3	60
0.38	104.1	60
0.42	93.1	50
0.45	87.6	50
0.47	83.2	50
0.49	79.8	40
0.51	77.5	40
0.53	74.8	40

For A/P or Hp/A values which fall between the provided values in the table, the higher thickness of the corresponding lower and higher ArmaGel HTF thickness shall be used.

**ARMACELL GMBH** - ArmaGel HTF. Evaluated for and compliant to UL 2431 Classification Category I-A.

**B. Stainless steel binding wire** - Stainless steel binding wire Ø0.8 mm (0.03 in). Maximum separation of wire centers: 200 mm (7.87 in) for internal layers and 100 mm (3.94 in) for the last outer layer. The maximum distance between the edges of the mat sections on each butt joint and the first adjacent wires shall be 25 mm (0.98 in). Used to secure the mat sections (Item 2A) in place.

**C. Stainless steel cladding** - After installation of the mats, stainless steel (minimum 304 grade) cladding jackets with a nominal thickness of minimum 0.6 mm (0.024 in) form the protective covering for the mat material. The segments of stainless steel cladding are wrapped around the mat and itself such that a minimum 200 mm (7.87 in) overlap is present along the vertical seam. Overlap position staggered by 90° from one cladding segment to the next one. The segments are secured in position with stainless steel blind rivets (Item 2D). The first segment is installed at the bottom of the column. The second segment is then installed with a minimum 250 mm (9.84 mm) overlap over the lower section (roof tile effect). The following segments of metal cladding are installed with the same principle. The last segment is installed butted to the top of the column so that there is no exposed mat.

**D. Blind stainless steel rivets** - Stainless steel blind rivets, diameter: 4.8 mm (3/16 in), positioned at maximum 30 mm (1.18 in) from the segments ends and maximum 190 mm (7.48 in) centers along the vertical (longitudinal) seam. These rivets are installed at 10 - 20 mm (0.39 - 0.79 in) from the vertical edge of the cladding segment. Six additional rivets shall be installed around the circumference of the cladding (2 additional rivets at every 90°), at each horizontal overlap at approximately 30 mm and 200 mm (1.18 in and 7.87 in) from the horizontal edges of the cladding segments.

**E. Stainless steel restraining bands** - Stainless steel restraining bands are used for banding of the cladding segments (Item 2C). These stainless steel bands are minimum 16 mm (0.63 in) wide and minimum 0.75 mm (0.030 in) thick. The restraining bands are secured with tensioning clips (buckles) and rivets (Item 2D). One rivet each side of the clips, at maximum 100 mm (3.94 in) from the clip. The bands are fitted at maximum centers of 250 mm (9.84 in). One restraining band shall be installed at maximum 70 mm (2.76 in) from the horizontal edge of each cladding segment.

**F. Stainless steel angle brackets** - Four 90° stainless steel angle brackets, minimum 60 mm x 18 mm x 1mm + 60 mm x 18 mm x 1mm (2.36 in x 0.71 in x 0.039 in + 2.36 in x 0.71 in x 0.039 in), installed around the circumference of the top segment of metal cladding to fix the top section to the upper supporting construction. Fixing with rivets to the cladding and bolted/welded to the upper supporting construction.

*\* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.*

Last Updated on 2024-02-15

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Certificate No: LR2406554SF-02

Issue Date: 19/01/2024

Expiry Date: 18/01/2029

## Certificate Of Fire Approval

This is to certify that the product(s) detailed below will be accepted for compliance with the applicable Lloyd's Register Rules and Regulations for use on offshore units classed with Lloyd's Register, and for use on offshore units and onshore facilities when authorised by contracting governments to issue the relevant certificates, licences, permits etc.

<b>Manufacturer</b>	<b>Armacell GmbH</b>
<b>Address</b>	Robert-Bosch-Straße 10, 48153 Munster, Germany
<b>Type</b>	Structural Steel Rapid Temperature Rise Fire Protection System
<b>Description</b>	Steel Tubular Sections protected with "ArmaGel® HTF" Passive Fire Protection System, for UL 1709:2022 Rapid-Temperature rise fire exposures, for up to 180 minutes duration
<b>Trade Name</b>	ArmaGel® HTF
<b>Specified Standard</b>	Fire Tests utilising the UL 1709:2022, "UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel" Rapid Rise Hydrocarbon Time / Temperature Curve

This Certificate is not valid for equipment, the design or manufacture of which has been varied or modified from the specimen tested. The manufacturer should notify Lloyd's Register EMEA of any modification or changes to the equipment in order to obtain a valid Certificate.

The Design Appraisal Document and its supplementary Type Approval Terms and Conditions form part of this Certificate.

This Certificate remains valid unless cancelled or revoked, provided the conditions in the attached Design Appraisal Document are complied with and the equipment remains satisfactory in service.

**Keith Taylor**

Technical Safety, Electrical & Control Team  
Lead to Lloyd's Register EMEA  
A member of the Lloyd's Register group

71 Fenchurch Street, London, EC3M 4BS, United Kingdom

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

This Design Appraisal Document forms part of the Certificate.

This Certificate supersedes and is an amendment of previous Lloyd’s Register Certificate No. LR2406554SF-01.

**APPROVAL DOCUMENTATION**

1. UL Solutions, Test Report No. R40699 - 4790115314, dated 15 February 2023.
2. UL Solutions, Sampling Report No’s: 4790115195, dated 19 October 2021; and 4790478193, dated 07 September 2022.

**CONDITIONS OF CERTIFICATION**

1. Applications in each case to be approved at the design stage by Lloyd's Register taking into account the various project specific parameters i.e. fire type, duration of protection required, maximum ambient temperature, maximum protected equipment’s operating temperature, protected equipment’s maximum allowable limiting temperature and the ‘Conditions of Certification’ outlined in this Certificate.
2. The “ArmaGel® HTF” Fire Protection System may be considered for applications on tubular steel sections, pipework with a maximum allowable Hp/A Section Factor of  $275m^{-1}$ . (Where ‘Hp’ is the outside circumference and ‘A’ is the cross-sectional area).
3. The “ArmaGel® HTF” Fire Protection System shall consist of the following construction compositions as outlined in Table 3.1 below. The performance of the particular system outlined in the ‘Fire Test Results’ Section of this Certificate shall be considered, evaluated and assessed for the particular project specific fire performance requirements when designing the protection system.

Test Specimen Ref.	Hp/A Section Factor	“ArmaGel® HTF” Insulation Thickness	Stainless-Steel 304 Outer Cladding Thickness	Outer Cladding Overlaps		Joint Securing Arrangements	Overall Securing Arrangements
				Longitudinal overlap on the circumferential seam	Circumferential overlap on the longitudinal seam		
01A	$163m^{-1}$	50mm (5 x 10mm Layers)	0.6mm thick	250mm	300mm	Stainless-Steel countersunk rivets (ø4.8mm) at 180mm centres	0.75mm thick x 16mm wide Stainless-Steel Straps at 250mm centres

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

Test Specimen Ref.	Hp/A Section Factor	“ArmaGel® HTF” Insulation Thickness	Stainless-Steel 304 Outer Cladding Thickness	Outer Cladding Overlaps		Joint Securing Arrangements	Overall Securing Arrangements
				Longitudinal overlap on the circumferential seam	Circumferential overlap on the longitudinal seam		
01B	163m <sup>-1</sup>	70mm (7 x 10mm Layers)	0.6mm thick	250mm	200mm	Stainless-Steel countersunk rivets (ø4.8mm) at 180mm centres	0.75mm thick x 16mm wide Stainless-Steel Straps at 250mm centres
02	75m <sup>-1</sup>	40mm (4 x 10mm Layers)	0.6mm thick	250mm	400mm	Stainless-Steel countersunk rivets (ø4.8mm) at 180mm centres	0.75mm thick x 16mm wide Stainless-Steel Straps at 270mm centres
05	275m <sup>-1</sup>	100mm (10 x 10mm Layers)	0.6mm thick	250mm	200mm	Stainless-Steel countersunk rivets (ø4.8mm) at 180mm centres	0.75mm thick x 16mm wide Stainless-Steel Straps at 275mm centres
06	75m <sup>-1</sup>	40mm (4 x 10mm Layers) *	0.6mm thick	250mm	200mm	Stainless-Steel countersunk rivets (ø4.8mm) at 190mm centres	0.75mm thick x 16mm wide Stainless-Steel Straps at 275mm centres

\* This test specimen incorporated butt-joints between neighbouring blanket segments on the same layer, and these were also staggered >200mm from the previous layers butt-joints.

**Table 3.1 – UL1709 Rapid Rapid-Temperature Rise Fire Tested Specimen Details**

- The various layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>) shall be installed with a 100mm circumferential overlap at longitudinal seams and each subsequent layer shall be staggered by 90°. The insulation shall be held in place with Stainless-Steel wire ø0.8mm at each layer for the total number of layers required. Additional Stainless-Steel wire shall be used to tightly secure joints / seams as required.
- Butt-joints between neighbouring blanket segments on the same layer shall be staggered by >200mm from the previous layers butt-joints.





**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

6. The 0.6mm thick Stainless-Steel 304 Outer Cladding shall incorporate circumferential and longitudinal overlaps (overlap widths as per Table 3-1 in this Certificate) and shall be secured 50mm from overlap edges by Stainless-Steel countersunk rivets ( $\varnothing$  4.8mm) at 180mm maximum centres to ensure the overlaps are tightly secured.
7. The overall "ArmaGel<sup>®</sup> HTF" Fire Protection System ("ArmaGel<sup>®</sup> HTF" Insulation & Stainless-Steel 304 Outer Cladding) shall be held in place by 0.75mm thick x 16mm wide Stainless-Steel Straps at 250mm maximum centres. All Stainless-Steel Straps shall be tightly secured.
8. Any structural members with a cross sectional area exceeding 3000mm<sup>2</sup> per m<sup>2</sup> in which are connected to the protected members shall be adequately protected by a suitable approved insulation system adopting a suitable industry accepted 'coatback' to mitigate against the effects of heat transfer.
9. Suitable approved insulation is to be applied to any other part of the protected fire exposed surfaces not covered by the "ArmaGel<sup>®</sup> HTF" Fire Protection System, in all cases. In particular, attention is to be paid to means of the adjoining of the two insulation systems and the prevention of heat bridging; an overlap of at least 250mm be provided between the two systems where the insulation arrangements on the adjacent areas are the same or equivalent to the as-tested arrangements.
10. Production items are to be manufactured in accordance with a quality control system which shall be maintained to ensure that items are of the same standard as the approved prototype.
11. The Certificate holder is solely responsible for the products supplied under this Certificate and to ensure that their products are fully compliant with the relevant statutory regulations and Lloyd's Register Class Rules as applicable and designed, manufactured and installed to the same quality and specifications as the prototype tested, including components that are designed and manufactured by third parties.

**NOTES**

1. This Certificate only approves the fire performance of the product in line with the testing standards. All other performance requirements, including durability, environmental exposure (UV, salt spray exposure, high humidity, condensation, corrosion, corrosion under PFP system) etc. are outside the scope of this Certificate. Separate Certification would have to be ascertained from a suitable Certification Body to demonstrate suitability for these aspects.
2. The "ArmaGel<sup>®</sup> HTF" Fire Protection Systems for tubular sections may be assigned **Rapid Temperature Rise Fire Classification** [Type of Fire / Type of Application / Critical Core Temperature Rise (<sup>o</sup>C) / Period of Resistance (Mins)], depending on type of application, particular construction make-up of the insulation system and maximum core temperatures specified. Applicable "Classifications" are outlined in the 'Fire Test Results' section of this Certificate depending upon the tested specimen configurations, however the maximum critical core / limiting temperature rise required for the tubular section being protected should be taken into account to confirm suitability. The project specific design requirements shall be consulted to confirm the appropriate maximum critical core / limiting temperature for the items being protected.



**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**FIRE TEST RESULTS**

**Test Results for the Circular Hollow Section Test Specimen (Test Specimen Ref. 01A – Hp/A of 163m<sup>-1</sup>) Protected with a 50mm thick “ArmaGel® HTF” Fire Protection System [Test Report No. R40699 - 4790115314, dated 15 February 2023]:**

**Test Description:** A fire test utilising the UL 1709:2022, “UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel” Rapid Rise Hydrocarbon Time / Temperature Curve for 121 minutes performed on a circular hollow column (tubular section) which measured 219.1mm O.D. x 6.3mm wall thickness and had an Hp/A of 163m<sup>-1</sup>.  
 The tubular section was protected with a 50mm thick “ArmaGel® HTF” Fire Protection System comprising 5 x 10mm thick layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>) and a 0.6mm thick Stainless-Steel 304 Outer Cladding secured by Stainless-Steel countersunk rivets (ø4.8mm) at 180mm maximum centres at overlaps and 0.75mm thick x 16mm wide Stainless-Steel Straps at 250mm maximum centres.

**Integrity:** **120 minutes** (protection remained intact for the duration of the test)

**Insulation:** The following **absolute temperatures** in line with UL 1709 (maximum average temperature band / maximum individual TC temperatures >649°C) were recorded on the test specimen at the following durations:

after 15 minutes of exposure:	24.5°C	after 90 minutes of exposure:	532.0°C
after 30 minutes of exposure:	99.1°C	after 120 minutes of exposure:	679.0°C
after 60 minutes of exposure:	339.5°C		

**Classification:** The 50mm thick “ArmaGel® HTF” Fire Protection System fire testes specimen (tubular section with an Hp/A of 163m<sup>-1</sup>) may be assigned a **Rapid Temperature Rise Fire Classification (based on absolute temperatures in line with UL 1709)** [Type of Fire/Type of Application/Critical Core Temperature (°C)/Period of Resistance (Mins)] in accordance with ‘Note 2’ of this Certificate as follows:

- |                              |                              |                               |
|------------------------------|------------------------------|-------------------------------|
| <b>UL1709/Tubular/30/15</b>  | <b>UL1709/Tubular/345/60</b> | <b>UL1709/Tubular/685/120</b> |
| <b>UL1709/Tubular/105/30</b> | <b>UL1709/Tubular/535/90</b> |                               |

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**Test Results for the Circular Hollow Section Test Specimen (Test Specimen Ref. 01B – Hp/A of 163m<sup>-1</sup>) Protected with a 70mm thick “ArmaGel® HTF” Fire Protection System [Test Report No. R40699 - 4790115314, dated 15 February 2023]:**

**Test Description:** A fire test utilising the UL 1709:2022, “UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel” Rapid Rise Hydrocarbon Time / Temperature Curve for 182 minutes performed on a circular hollow column (tubular section) which measured 219.1mm O.D. x 6.3mm wall thickness and had an Hp/A of 163m<sup>-1</sup>.  
 The tubular section was protected with a 70mm thick “ArmaGel® HTF” Fire Protection System comprising 7 x 10mm thick layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>) and a 0.6mm thick Stainless-Steel 304 Outer Cladding secured by Stainless-Steel countersunk rivets (ø4.8mm) at 180mm maximum centres at overlaps and 0.75mm thick x 16mm wide Stainless-Steel Straps at 250mm maximum centres.

**Integrity:** **180 minutes** (protection remained intact for the duration of the test)

**Insulation:** The following **absolute temperatures** in line with UL 1709 (maximum average temperature band / maximum individual TC temperatures >649°C) were recorded on the test specimen at the following durations:

after 15 minutes of exposure:	19.9°C	after 90 minutes of exposure:	369.9°C
after 30 minutes of exposure:	38.1°C	after 120 minutes of exposure:	517.0°C
after 60 minutes of exposure:	196.2°C	after 180 minutes of exposure:	701.4°C

**Classification:** The 70mm thick “ArmaGel® HTF” Fire Protection System fire testes specimen (tubular section with an Hp/A of 163m<sup>-1</sup>) may be assigned a **Rapid Temperature Rise Fire Classification (based on absolute temperatures in line with UL 1709)** [Type of Fire/Type of Application/Critical Core Temperature (°C)/Period of Resistance (Mins)] in accordance with ‘Note 2’ of this Certificate as follows:

<b>UL1709/Tubular/25/15</b>	<b>UL1709/Tubular/200/60</b>	<b>UL1709/Tubular/520/120</b>
<b>UL1709/Tubular/40/30</b>	<b>UL1709/Tubular/375/90</b>	<b>UL1709/Tubular/705/180</b>

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**Test Results for the Circular Hollow Section Test Specimen (Test Specimen Ref. 02 – Hp/A of 75m<sup>-1</sup>) Protected with a 40mm thick “ArmaGel® HTF” Fire Protection System [Test Report No. R40699 - 4790115314, dated 15 February 2023]:**

**Test Description:** A fire test utilising the UL 1709:2022, “UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel” Rapid Rise Hydrocarbon Time / Temperature Curve for 180 minutes performed on a circular hollow column (tubular section) which measured 219.1mm O.D. x 14.2mm wall thickness and had an Hp/A of 75m<sup>-1</sup>.  
 The tubular section was protected with a 40mm thick “ArmaGel® HTF” Fire Protection System comprising 4 x 10mm thick layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>) and a 0.6mm thick Stainless-Steel 304 Outer Cladding secured by Stainless-Steel countersunk rivets (ø4.8mm) at 180mm maximum centres at overlaps and 0.75mm thick x 16mm wide Stainless-Steel Straps at 270mm maximum centres.

**Integrity:** 180 minutes (protection remained intact for the duration of the test)

**Insulation:** The following **absolute temperatures** in line with UL 1709 (maximum average temperature band / maximum individual TC temperatures >649°C) were recorded on the test specimen at the following durations:

after 15 minutes of exposure:	29.4°C	after 90 minutes of exposure:	384.6°C
after 30 minutes of exposure:	98.4°C	after 120 minutes of exposure:	496.1°C
after 60 minutes of exposure:	252.2°C	after 180 minutes of exposure:	668.3°C

**Classification:** The 40mm thick “ArmaGel® HTF” Fire Protection System fire testes specimen (tubular section with an Hp/A of 75m<sup>-1</sup>) may be assigned a **Rapid Temperature Rise Fire Classification (based on absolute temperatures in line with UL 1709)** [Type of Fire/Type of Application/Critical Core Temperature (°C)/Period of Resistance (Mins)] in accordance with ‘Note 2’ of this Certificate as follows:

<b>UL1709/Tubular/35/15</b>	<b>UL1709/Tubular/255/60</b>	<b>UL1709/Tubular/500/120</b>
<b>UL1709/Tubular/100/30</b>	<b>UL1709/Tubular/390/90</b>	<b>UL1709/Tubular/670/180</b>

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**Test Results for the Circular Hollow Section Test Specimen (Test Specimen Ref. 05 – Hp/A of 275m<sup>-1</sup>) Protected with a 100mm thick “ArmaGel® HTF” Fire Protection System [Test Report No. R40699 - 4790115314, dated 15 February 2023]:**

**Test Description:** A fire test utilising the UL 1709:2022, “UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel” Rapid Rise Hydrocarbon Time / Temperature Curve for 180 minutes performed on a circular hollow column (tubular section) which measured 220mm O.D. x 3.7mm wall thickness and had an Hp/A of 275m<sup>-1</sup>.  
 The tubular section was protected with a 100mm thick “ArmaGel® HTF” Fire Protection System comprising 10 x 10mm thick layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>) and a 0.6mm thick Stainless-Steel 304 Outer Cladding secured by Stainless-Steel countersunk rivets (ø4.8mm) at 180mm maximum centres at overlaps and 0.75mm thick x 16mm wide Stainless-Steel Straps at 275mm maximum centres.

**Integrity:** 180 minutes (protection remained intact for the duration of the test)

**Insulation:** The following **absolute temperatures** in line with UL 1709 (maximum average temperature band / maximum individual TC temperatures >649°C) were recorded on the test specimen at the following durations:

after 15 minutes of exposure:	17.5°C	after 90 minutes of exposure:	242.0°C
after 30 minutes of exposure:	21.8°C	after 120 minutes of exposure:	459.2°C
after 60 minutes of exposure:	68.4°C	after 180 minutes of exposure:	710.0°C

**Classification:** The 100mm thick “ArmaGel® HTF” Fire Protection System fire testes specimen (tubular section with an Hp/A of 275m<sup>-1</sup>) may be assigned a **Rapid Temperature Rise Fire Classification (based on absolute temperatures in line with UL 1709)** [Type of Fire/Type of Application/Critical Core Temperature (°C)/Period of Resistance (Mins)] in accordance with ‘Note 2’ of this Certificate as follows:

<b>UL1709/Tubular/20/15</b>	<b>UL1709/Tubular/70/60</b>	<b>UL1709/Tubular/465/120</b>
<b>UL1709/Tubular/25/30</b>	<b>UL1709/Tubular/245/90</b>	<b>UL1709/Tubular/715/180</b>

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**Test Results for the Circular Hollow Section Test Specimen (Test Specimen Ref. 06 – Hp/A of 75m<sup>-1</sup>) Protected with a 40mm thick “ArmaGel® HTF” Fire Protection System [Test Report No. R40699 - 4790115314, dated 15 February 2023]:**

**Test Description:** A fire test utilising the UL 1709:2022, “UL Standard for Safety Rapid Rise Fire Tests of Protection Materials for Structural Steel” Rapid Rise Hydrocarbon Time / Temperature Curve for 181 minutes performed on a circular hollow column (tubular section) which measured 219mm O.D. x 14.3mm wall thickness and had an Hp/A of 75m<sup>-1</sup>.  
 The tubular section was protected with a 40mm thick “ArmaGel® HTF” Fire Protection System comprising 4 x 10mm thick layers of “ArmaGel® HTF” insulation (Density: 180 kg/m<sup>3</sup>), incorporating butt-joints\* and a 0.6mm thick Stainless-Steel 304 Outer Cladding secured by Stainless-Steel countersunk rivets (ø4.8mm) at 190mm maximum centres at overlaps and 0.75mm thick x 16mm wide Stainless-Steel Straps at 275mm maximum centres.  
 \* *Butt-joints were applied between neighbouring blanket segments on the same layer, and these were also staggered >200mm from the previous layers butt-joints.*

**Integrity:** 180 minutes (protection remained intact for the duration of the test)

**Insulation:** The following **absolute temperatures** in line with UL 1709 (maximum average temperature band / maximum individual TC temperatures >649°C) were recorded on the test specimen at the following durations:

after 15 minutes of exposure:	28.9°C	after 90 minutes of exposure:	377.9°C
after 30 minutes of exposure:	98.7°C	after 120 minutes of exposure:	483.0°C
after 60 minutes of exposure:	249.7°C	after 180 minutes of exposure:	647.6°C

**Classification:** The 40mm thick “ArmaGel® HTF” Fire Protection System fire testes specimen (tubular section with an Hp/A of 75m<sup>-1</sup>) may be assigned a **Rapid Temperature Rise Fire Classification (based on absolute temperatures in line with UL 1709)** [Type of Fire/Type of Application/Critical Core Temperature (°C)/Period of Resistance (Mins)] in accordance with ‘Note 2’ of this Certificate as follows:

- |                              |                              |                               |
|------------------------------|------------------------------|-------------------------------|
| <b>UL1709/Tubular/30/15</b>  | <b>UL1709/Tubular/255/60</b> | <b>UL1709/Tubular/485/120</b> |
| <b>UL1709/Tubular/100/30</b> | <b>UL1709/Tubular/380/90</b> | <b>UL1709/Tubular/650/180</b> |

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**ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. LR2406554SF-02**

**PLACE OF PRODUCTION**

**Armacell Jios Aerogels Corp (AJA)**  
106, 5sandan 1-ro, Seongnam-myeon  
Dongnam-gu, Cheonan-si  
Chungcheongnam-do  
South Korea, 31245

Keith Taylor  
Team Lead - Technical Safety, Electrical & Control  
Global Technical Support Office, Marine & Offshore  
Lloyd's Register

**Supplementary Type Approval Terms and Conditions**

*This Certificate and Design Appraisal Document relates to type approval, it certifies that the prototype(s) of the product(s) referred to herein has/have been found to meet the applicable design criteria for the use specified herein, it does not mean or imply approval for any other use, nor approval of any products designed or manufactured otherwise than in strict conformity with the said prototype(s)*

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## Numerical modelling – COMSOL Finite Element support

For relatively straightforward passive fire protection inquiries, the certifications provided in previous chapters of this Technical Specification Guide allow users to determine the required ArmaGel HTF thickness for given passive fire protection requirements. The UL-listing XR207, the Lloyds Register Type Approval LR2406554SF and the Lloyds Register COMSOL endorsement letter PRJ11100421219, provide ample support to quickly come to a certified solution.

However, the reality in practice often demonstrates that fire requirements are not so straightforward and that technical specifications can deviate from what is considered standard specifications. For example, a fire rating of 100 minutes, a critical steel temperature of 325°C, a complicated 3-dimensional steel structure, a medium in a vessel for which heat-sink credit needs to be taken in a fire situation, an operational temperature or maximum temperature of the medium that needs to be considered etc. complicate the determination of the required passive fire protection insulation thickness.

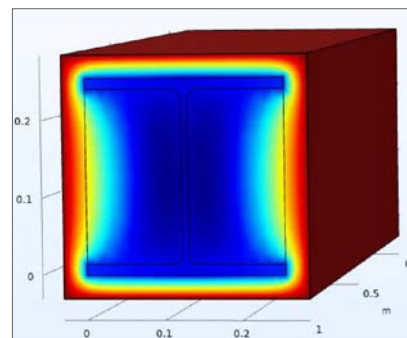
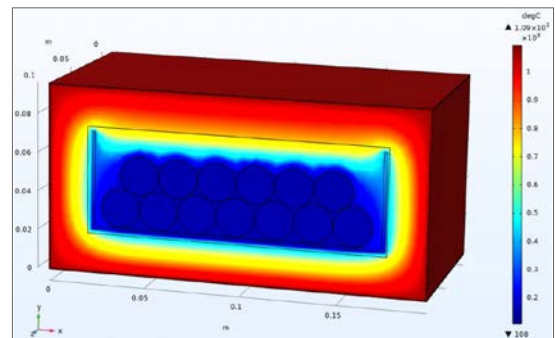
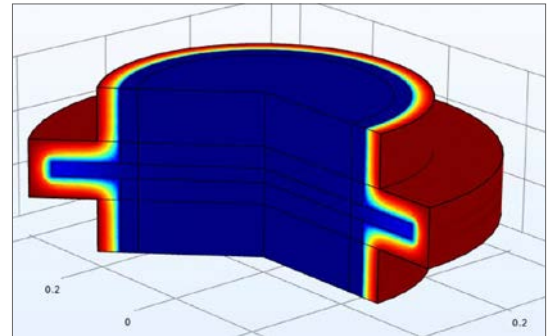
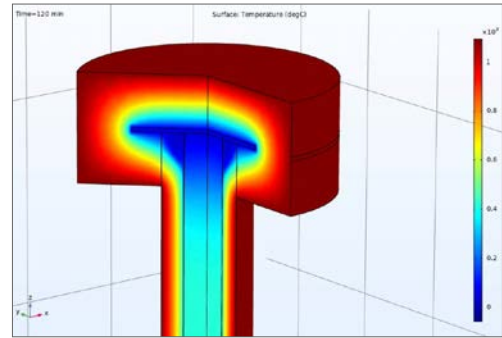
In those situations where complex geometries and/or complex combinations of design parameters apply, Armacell offers Finite Element calculation support utilising COMSOL Multiphysics. Armacell runs an official COMSOL license and several Armacell technical staff members have been trained by COMSOL engineers to ensure accurate and reliable calculation results.

Utilising the extensive dataset obtained by numerous UL1709 pool fire tests and ISO22899-1 jet fire testing, the thermal characteristics of ArmaGel HTF under those fire conditions have been derived. These characteristics have been used to populate the design tables which have been endorsed by Lloyds Register in their endorsement letter PRJ11100421219.

Armacell technical staff supports our customers to collect the information required to populate the finite element modelling. Our dedicated and trained engineers then build the finite element model and run the COMSOL calculations, applying a four eye-principle before the calculation results are shared with our customers.

**armacell® | services**

*It is the Customer's responsibility to verify if the product is suitable for the intended application. Armacell accepts no liability for the accuracy of the material quantities quoted or ordered. It is the Customer's responsibility to review and validate the intended use, designs, drawings, specifications, assumptions, and the material quantities required. Final design, specification, and/or certification of any such insulation systems are out of scope. If required, the Customer shall be responsible for obtaining the approval of a certified designer or professional engineer.*



Attention: René van den Bosch

Armacell GmbH  
Robert-Bosch-Straße 10  
48153 Munster  
Germany

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Our ref PRJ11100421219

12 February 2024

### Independent Review of Armacell GmbH's "ArmaGel® HTF" Product Thickness Ranges via COMSOL Finite Element Analysis Software

Armacell GmbH have undertaken Finite Element Analysis utilising their COMSOL Finite Element Analysis Software to ensure that their Finite Element Analysis model is modelling performance which is conservative to the as tested "ArmaGel® HTF" Passive Fire Protection System configurations covered by the following Lloyd's Register (LR) 'Certificate of Fire Approval'.

Certificate No.	Manufacturer	Description	Expiry Date
LR2406554SF-02	Armacell GmbH	Steel Tubular Sections protected with "ArmaGel® HTF" Passive Fire Protection System, for UL 1709:2022 Rapid-Temperature rise fire exposures, for up to 180 minutes duration	18 January 2029

LR has undertaken sample validation checks of the data presented by Armacell GmbH to ensure a safe and effective correlation between the COMSOL Finite Element Analysis Software and the "ArmaGel® HTF" Passive Fire Protection Systems UL 1709:2022 Test results.

Following the validation checks conducted by LR, the "ArmaGel® HTF" Passive Fire Protection Systems Thickness Tables detailed in the Appendices of this letter are considered to be acceptable by LR based on the following **Conditions / Limitations**:

- The 'Conditions of Certification', 'Notes', and 'Place of Production' outlined on the LR 'Certificate of Fire Approval' referenced at the start of this letter shall be given due consideration.
- The "ArmaGel® HTF" Fire Protection System may be considered for applications on tubular steel sections and pipework.
- The minimum and maximum allowable "ArmaGel® HTF" insulation (Density: 180 kg/m<sup>3</sup>) thicknesses of 10mm and 130mm shall be adhered to.
- The minimum and maximum allowable Hp/A Section Factors (Where 'Hp' is the outside circumference and 'A' is the cross-sectional area) of 63m<sup>-1</sup> and 320m<sup>-1</sup> shall be adhered to.
- The various layers of "ArmaGel® HTF" insulation shall be installed with a >100mm circumferential overlap at longitudinal seams and each subsequent layer shall be staggered by 90°. The insulation shall be held in place with Stainless-Steel wire ø0.8mm at each layer for the total number of layers required. Additional Stainless-Steel wire shall be used to tightly secure joints / seams as required.

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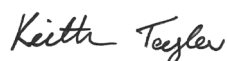
- Butt-joints between neighbouring blanket segments on the same layer shall be staggered by >200mm versus the previous layer butt-joints.
- The 0.6mm thick Stainless-Steel 304 Outer Cladding shall incorporate circumferential and longitudinal overlaps (>200mm circumferential overlap on the longitudinal seam & ≥250mm longitudinal overlap on the circumferential seam) and shall be secured 50mm from overlap edges by Stainless-Steel countersunk rivets (ø 4.8mm) at 180mm maximum centres to ensure the overlaps are tightly secured.
- The 0.6mm thick Stainless-Steel 304 Outer Cladding shall be held in place by 0.75mm thick x 16mm wide (minimum dimensions) Stainless-Steel Straps at 250mm maximum centres. All Stainless-Steel Straps shall be tightly secured.
- The final arrangements for the project must be separately approved in order to confirm suitability for the project specific fire scenarios.

The following Appendices to this letter replicate the calculated minimum thicknesses of “ArmaGel® HTF” insulation excluding the Stainless-Steel 304 Outer Cladding, required to restrict the average temperature in the steel core to the applicable critical core temperature within the specified time period (mins), for a maximum allowable Hp/A Section Factor (Where ‘Hp’ is the outside circumference and ‘A’ is the cross-sectional area):

- Appendix 1 -- 200°C Critical Core Temperature Thickness Table
- Appendix 2 -- 300°C Critical Core Temperature Thickness Table
- Appendix 3 -- 400°C Critical Core Temperature Thickness Table
- Appendix 4 -- 427°C Critical Core Temperature Thickness Table
- Appendix 5 -- 500°C Critical Core Temperature Thickness Table
- Appendix 6 -- 538°C Critical Core Temperature Thickness Table
- Appendix 7 -- 600°C Critical Core Temperature Thickness Table
- Appendix 8 -- 650°C Critical Core Temperature Thickness Table

If any clarification is required from LR relating to this letter, please feel free to contact the undersigned directly.

Yours sincerely,



**Keith Taylor**

Team Lead - Technical Safety, Electrical & Control  
Global Technical Support Office, Marine & Offshore  
Lloyd's Register EMEA

### Appendix 1 -- 200°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **200°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	64.7	-	-	-	-	-
20	151.8	-	-	-	-	-
30	320.0	92.3	-	-	-	-
40	-	152.3	-	-	-	-
50	-	273.9	73.2	-	-	-
60	-	320.0	102.0	-	-	-
70	-	-	146.8	69.4	-	-
80	-	-	244.2	92.7	-	-
90	-	-	320.0	128.3	71.2	-
100	-	-	-	192.8	92.8	-
110	-	-	-	320.0	125.7	-
120	-	-	-	-	184.2	65.5
130	-	-	-	-	298.8	82.5

### Appendix 2 -- 300°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **300°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	106.2	-	-	-	-	-
20	246.8	91.7	-	-	-	-
30	320.0	151.9	-	-	-	-
40	-	242.0	87.4	-	-	-
50	-	320.0	121.3	69.0	-	-
60	-	-	164.8	88.9	-	-
70	-	-	246.1	115.9	74.7	-
80	-	-	320.0	153.5	92.9	-
90	-	-	-	213.9	117.0	-
100	-	-	-	320.0	152.4	73.9
110	-	-	-	-	209.2	88.0
120	-	-	-	-	309.7	108.0
130	-	-	-	-	320.0	136.2



### Appendix 3 -- 400°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **400°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	152.7	-	-	-	-	-
20	320.0	130.0	-	-	-	-
30	-	217.9	88.2	-	-	-
40	-	320.0	124.9	75.8	-	-
50	-	-	173.6	99.2	69.8	-
60	-	-	243.8	128.3	86.6	-
70	-	-	320.0	166.8	107.9	63.1
80	-	-	-	219.5	134.5	74.9
90	-	-	-	312.6	169.7	87.8
100	-	-	-	320.0	223.2	106.5
110	-	-	-	-	304.4	127.1
120	-	-	-	-	320.0	159.0
130	-	-	-	-	-	200.8

#### Appendix 4 -- 427°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **427°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	166.1	68.6	-	-	-	-
20	320.0	141.8	-	-	-	-
30	-	237.0	96.3	-	-	-
40	-	320.0	136.0	82.7	-	-
50	-	-	189.4	108.2	75.7	-
60	-	-	266.7	137.9	94.7	-
70	-	-	320.0	180.9	118.4	68.9
80	-	-	-	242.7	147.5	81.8
90	-	-	-	320.0	184.1	97.5
100	-	-	-	-	246.7	116.2
110	-	-	-	-	320.0	139.9
120	-	-	-	-	-	174.3
130	-	-	-	-	-	222.2

### Appendix 5 -- 500°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **500°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	204.7	84.6	-	-	-	-
20	320.0	175.2	77.5	-	-	-
30	-	293.9	119.0	75.0	-	-
40	-	320.0	169.6	102.0	72.8	-
50	-	-	235.6	134.5	93.4	-
60	-	-	320.0	170.4	117.2	71.1
70	-	-	-	226.9	143.6	85.5
80	-	-	-	303.6	183.3	100.1
90	-	-	-	320.0	229.4	120.8
100	-	-	-	-	309.3	142.6
110	-	-	-	-	320.0	172.9
120	-	-	-	-	-	218.3
130	-	-	-	-	-	280.1



### Appendix 6 -- 538°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **538°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	222.4	94.7	-	-	-	-
20	320.0	193.8	86.6	-	-	-
30	-	316.4	131.8	82.4	-	-
40	-	320.0	189.1	113.5	80.8	-
50	-	-	258.4	149.0	103.8	64.8
60	-	-	320.0	194.4	130.1	78.9
70	-	-	-	246.8	159.5	94.6
80	-	-	-	320.0	205.6	112.8
90	-	-	-	-	259.7	134.4
100	-	-	-	-	320.0	161.7
110	-	-	-	-	-	197.9
120	-	-	-	-	-	245.5
130	-	-	-	-	-	317.1

### Appendix 7 -- 600°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **600°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	257.9	111.0	-	-	-	-
20	320.0	224.6	100.8	65.1	-	-
30	-	320.0	156.1	96.9	71.2	-
40	-	-	221.6	134.4	95.4	-
50	-	-	309.6	176.7	122.3	76.7
60	-	-	320.0	227.5	150.8	94.1
70	-	-	-	293.1	193.4	112.8
80	-	-	-	320.0	236.8	134.2
90	-	-	-	-	311.2	159.8
100	-	-	-	-	320.0	192.7
110	-	-	-	-	-	236.5
120	-	-	-	-	-	297.2
130	-	-	-	-	-	320.0

### Appendix 8 -- 650°C Critical Core Temperature Thickness Table

Minimum thickness of “ArmaGel® HTF” insulation for **Rapid-Temperature Rise Fire Exposures** when applied to Steel Tubular Sections, necessary to restrict the average temperature in the steel core to **650°C** within the specified time period (mins), for a maximum allowable Hp/A Section Factor.

Where: ‘Hp’ is the perimeter of the member exposed to the rapid-temperature rise fire (m).  
 ‘A’ is the cross-sectional area of the member exposed to the rapid-temperature rise fire (m<sup>2</sup>).

“ArmaGel® HTF” Thickness (mm)	Maximum Hp/A Section Factor (m <sup>-1</sup> ) at fire duration (mins)					
	15	30	60	90	120	180
10	291.9	126.9	-	-	-	-
20	320.0	253.8	115.4	73.4	-	-
30	-	320.0	178.1	111.4	80.3	-
40	-	-	253.1	151.0	108.4	68.8
50	-	-	320.0	198.4	141.8	87.3
60	-	-	-	256.8	177.1	105.6
70	-	-	-	320.0	214.7	128.9
80	-	-	-	-	278.1	153.9
90	-	-	-	-	320.0	178.4
100	-	-	-	-	-	215.6
110	-	-	-	-	-	269.9
120	-	-	-	-	-	320.0
130	-	-	-	-	-	-





## Design tables

### Preamble

In order to ease the process of selecting the correct ArmaGel HTF thickness for a given set of design parameters, this chapter offers a total of 48 design tables covering a large range of market requirements. The design parameters which are required to determine the correct ArmaGel HTF thickness are:

1. The required fire rating
2. The critical steel temperature of the pipe section
3. The outer diameter of the pipe section (NPS or OD value)
4. The wall thickness of the pipe section (pipe schedule)

### Scope of application

The design tables provided are applicable for the fire protection of pipes (tubular sections) against hydrocarbon pool fires, in accordance with the UL1709 fire test standard. The pipe temperature at the start of the fire is assumed to be ambient [20°C / 68°F] and air is assumed to be the medium in the pipe (no credit is taken for the heat sink into the medium). The values provided can also be used for the fire protection of other single skin, tubular steel sections, such as, but not limited to vessels, vessel skirts, spheres etc. as the heat flow would be identical to that of a pipe. Please consult Armacell technical department in case of any questions related to the applicability of the values provided, to your specific project details.

### Design table parameters

Each design table is applicable for a specific Fire Rating and a specific Critical Steel temperature as mentioned at the top of each design table.

Fire ratings of 15, 30, 60, 90, 120 and 180 minutes are covered in combination with critical steel temperatures of 200, 300, 400, 427, 500, 538, 600 and 650 °C, resulting in 48 design tables in total.

### Underlying certification

The design tables are populated using fire test data from multiple UL1709 fire tests and the corresponding UL-listing XR207. Additionally, a Lloyds Register Type Approval has been obtained, with certification number LR2406554SF, to verify the UL1709 test results for the as-tested Hp/A range and an assessment has been made by Lloyds Register, with reference number PRJ11100421219, to endorse the Armacell COMSOL Finite Element calculations, allowing the as-tested Hp/A range to be extended.

### Applicable standard for pipe dimensions

The design tables provided, are based on the ASME B36.10-2022 (Welded and Seamless Wrought Steel Pipe) standard for pipe diameters and schedules.

### Legend

The legend for the upper, middle and lower figures in the "Item" column is provided below:

UPPER FIGURES	Nominal wall thickness (NWT)	[mm]
MIDDLE FIGURES	Massivity (Hp/A)	[m <sup>-1</sup> ]
LOWER FIGURES	ArmaGel HTF thickness (HTF)	[mm]

### Hp/A value calculation

The Hp/A value for each pipe section is calculated using the below formula:

$$Hp/A = \frac{4 \cdot OD}{(OD^2 - ID^2)}$$

Hp/A	is the massivity factor of the pipe section	[m <sup>-1</sup> ]
Hp	is the Heater Perimeter of the pipe section	[m <sup>1</sup> ]
A	is the cross sectional area of the pipe section	[m <sup>2</sup> ]
OD	is the Outer Diameter of the pipe	[m <sup>1</sup> ]
ID	is the Inner Diameter of the pipe	[m <sup>1</sup> ]

### Applicable Hp/A range

The UL1709 as-tested massivity range is  $75 \leq Hp/A \leq 275 \text{ m}^{-1}$

The Lloyds Register endorsed massivity range is  $63 \leq Hp/A \leq 320 \text{ m}^{-1}$  using COMSOL Finite Element calculations.

ArmaGel HTF thicknesses for massivity values  $63 \geq Hp/A \geq 320 \text{ m}^{-1}$  are based on COMSOL Finite Element calculations. The ArmaGel HTF thicknesses in the design tables range from 10mm to 130mm, with 10mm increments, in line with the Lloyds Register COMSOL endorsement letter with reference PRJ11100421219. Please consult Armacell technical department in case a minus sign (-) is indicated for the required specification.



# FIRE RATING 15 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24			1.45	1.73	1.73		2.41	2.41				3.15	4.83
	10.29	Hp/A		914.1			802.8	695.8	695.8		541.4	541.4				457.6	390.3
		HTF		40			40	40	40		40	40				40	40
1/4	0.54	NWT		1.65			1.85	2.24	2.24		3.02	3.02				3.68	6.05
	13.72	Hp/A		688.6			624.8	534.5	534.5		424.4	424.4				371.4	295.7
		HTF		40			40	40	40		40	40				40	30
3/8	0.675	NWT	1.24	1.65			1.85	2.31	2.31		3.20	3.20				4.01	6.40
	17.15	Hp/A	866.4	670.2			605.9	500.1	500.1		384.2	384.2				325.5	249.3
		HTF	40	40			40	40	40		40	40				30	30
1/2	0.84	NWT	1.65	2.11			2.41	2.77	2.77		3.73	3.73				4.78	7.47
	21.34	Hp/A	656.5	526.3			467.8	415.1	415.1		324.6	324.6				269.8	206.0
		HTF	40	40			40	40	40		30	30				30	30
3/4	1.05	NWT	1.65	2.11			2.41	2.87	2.87		3.91	3.91				5.56	7.82
	26.67	Hp/A	645.7	515.1			456.2	390.4	390.4		299.6	299.6				227.1	180.9
		HTF	40	40			40	40	40		30	30				30	30
1	1.315	NWT	1.65	2.77			2.90	3.38	3.38		4.55	4.55				6.35	9.09
	33.40	Hp/A	637.2	393.8			377.6	329.3	329.3		254.6	254.6				194.4	151.1
		HTF	40	40			40	30	30		30	30				30	20
1-1/4	1.66	NWT	1.65	2.77			2.97	3.56	3.56		4.85	4.85				6.35	9.70
	42.16	Hp/A	630.4	386.6			362.2	307.1	307.1		232.9	232.9				185.4	133.9
		HTF	40	40			40	30	30		30	30				30	20
1-1/2	1.9	NWT	1.65	2.77			3.18	3.68	3.68		5.08	5.08				7.14	10.16
	48.26	Hp/A	627.1	383.2			336.6	294.0	294.0		220.0	220.0				164.4	124.7
		HTF	40	40			40	30	30		30	30				30	20
2	2.375	NWT	1.65	2.77			3.18	3.91	3.91		5.54	5.54				8.74	11.07
	60.33	Hp/A	622.7	378.6			332.0	273.4	273.4		198.8	198.8				133.8	110.6
		HTF	40	40			30	30	30		30	30				20	20
2-1/2	2.875	NWT	2.11	3.05			4.78	5.16	5.16		7.01	7.01				9.52	14.02
	73.03	Hp/A	488.4	342.4			223.9	208.7	208.7		157.8	157.8				120.8	88.3
		HTF	40	40			30	30	30		30	30				20	20
3	3.5	NWT	2.11	3.05			4.78	5.49	5.49		7.62	7.62				11.13	15.24
	88.90	Hp/A	485.9	339.7			221.1	194.3	194.3		143.5	143.5				102.7	79.2
		HTF	40	40			30	30	30		20	20				20	20
3-1/2	4	NWT	2.11	3.05			4.78	5.74	5.74		8.08	8.08					
	101.6	Hp/A	484.4	338.2			219.5	184.6	184.6		134.5	134.5					
		HTF	40	40			30	30	30		20	20					
4	4.5	NWT	2.11	3.05			4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12
	114.3	Hp/A	483.3	337.1			218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7
		HTF	40	40			30	30	30		20	20		20		20	20
5	5.563	NWT	2.77	3.40				6.55	6.55		9.52	9.52		12.70		15.88	19.05
	141.3	Hp/A	368.4	301.1				160.0	160.0		112.6	112.6		86.5		71.0	60.7
		HTF	40	30				30	30		20	20		20		20	10
6	6.625	NWT	2.77	3.40				7.11	7.11		10.97	10.97		14.27		18.26	21.95
	168.3	Hp/A	367.2	299.9				146.8	146.8		97.5	97.5		76.5		61.4	52.4
		HTF	40	30				20	20		20	20		20		10	10
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	40	30	30	20	20	20	20	20	20	20	10	10	10	10	10
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	30	30	30	20	20	20	20	20	20	10	10	10	10	10	10
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	30	30	20	20	20	20	20	10	10	10	10	10	10	10



# FIRE RATING 15 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 15 minutes  
Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	30	20	20	20	20	20	20	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	30	30	20	20	20	20	10	20	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	30	30	20	20	20	20	10	20	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	30	30	20	20	20	20	10	20	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	30	30	20	20			10	20	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	30	30	20	20	20	10	10	20	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	20		20			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	20	10	20			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	30	20	20	10	20			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	20	10	20	10		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	20	10	20	10		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	20	10	20	10		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			20							





# FIRE RATING 15 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		40		40	40	40		30	30				30	30	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		40		40	30	30		30	30				30	30	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	40	40		40	30	30		30	30				30	30	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	40	30		30	30	30		30	30				30	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	40	30		30	30	30		30	30				20	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	40	30		30	30	30		30	30				20	20	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	40	30		30	30	30		20	20				20	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	40	30		30	30	30		20	20				20	20	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	40	30		30	30	30		20	20				20	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	30	30		20	20	20		20	20				20	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	30	30		20	20	20		20	20				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	30	30		20	20	20		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	30	30		20	20	20		20	20		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	30	30			20	20		20	20		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	30	30			20	20		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	30	30	20	20	20	20	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	30	20	20	20	20	20	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	20	20	20	20	10	10	10	10	10	10	10	10	10	



**FIRE RATING 15 Minutes**  
**Critical Steel Temperature 300°C / 572°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 15 minutes**  
**Critical steel temperature 300°C / 572°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	20	20	20	20	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	20	20	20	20	20	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	20	20	20	10	20	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	20	20	20	10	20	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	20	20	20	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	20	20	20	10	20	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	10		20			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	10	10	20			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	20	20	10	10	20			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	10	10	20	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	10	10	20	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							



# FIRE RATING 15 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		40		40	30	30		30	30				30	30	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		30	30	30		30	30				30	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	40	30		30	30	30		30	30				20	20	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	30	30		30	30	30		20	20				20	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	30	30		30	30	30		20	20				20	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	30	30		30	20	20		20	20				20	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	30	30		30	20	20		20	20				20	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	30	30		20	20	20		20	20				20	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	30	30		20	20	20		20	20				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	30	30		20	20	20		20	20				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	30	20		20	20	20		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	30	20		20	20	20		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	30	20		20	20	20		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	30	20			20	20		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	30	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	20	20	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	20	20	20	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	14	14		355.6	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75
			Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1	
			HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	
16	16	406.4	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49	
			Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4	
			HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	
18	18	457.2	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24	
			Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5	
			HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	
20	20	508.0	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01	
			Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2	
			HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	
22	22.0	558.8	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98	
			Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5	
			HTF	20	20	10	10			10	10	10	10	10	10	10	
24	24	609.6	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54	
			Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6	
			HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	
26	26	660.4	NWT		7.92	12.70		9.52			12.70						
			Hp/A		127.7	80.3		106.6			80.3						
			HTF		10	10		10			10						
28	28	711.2	NWT		7.92	12.70	15.88	9.52			12.70						
			Hp/A		127.6	80.2	64.4	106.5			80.2						
			HTF		10	10	10	10			10						
30	30	762.0	NWT	6.35	7.92	12.70	15.88	9.52			12.70						
			Hp/A	158.8	127.5	80.1	64.3	106.4			80.1						
			HTF	20	10	10	10	10			10						
32	32	812.8	NWT		7.92	12.70	15.88	9.52	17.48		12.70						
			Hp/A		127.4	80.0	64.2	106.3	58.5		80.0						
			HTF		10	10	10	10	10		10						
34	34	863.6	NWT		7.92	12.70	15.88	9.52	17.48		12.70						
			Hp/A		127.4	79.9	64.2	106.2	58.4		79.9						
			HTF		20	20	10	20	10		20						
36	36	914.4	NWT		7.92	12.70	15.88	9.52	19.05		12.70						
			Hp/A		127.3	79.8	64.1	106.1	53.6		79.8						
			HTF		10	10	10	10	10		10						
38	38	965.2	NWT					9.52			12.70						
			Hp/A					106.1			79.8						
			HTF					10			10						
40	40	1016.0	NWT					9.52			12.70						
			Hp/A					106.0			79.7						
			HTF					10			10						
42	42	1066.8	NWT					9.52			12.70						
			Hp/A					106.0			79.7						
			HTF					10			10						
44	44	1117.6	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					10			10						
46	46	1168.4	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					10			10						
48	48	1219.2	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					10			10						





# FIRE RATING 15 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		40		30	30	30		30	30				30	30	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		30	30	30		30	30				20	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	40	30		30	30	30		30	30				20	20	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	30	30		30	30	30		20	20				20	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	30	30		30	30	30		20	20				20	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	30	30		30	20	20		20	20				20	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	30	30		20	20	20		20	20				20	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	30	30		20	20	20		20	20				10	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	30	30		20	20	20		20	20				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	30	20		20	20	20		10	10				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	30	20		20	20	20		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	30	20		20	20	20		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	30	20		20	20	20		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	20	20			10	10		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	20	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	20	10	10	10			10	10	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		10	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		10	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	10	10	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		10	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		10	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		10	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							



# FIRE RATING 15 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		30		30	30	30		30	30				20	20	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		30	30	30		20	20				20	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	30	30		30	30	30		20	20				20	230	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	30	30		20	20	20		20	20				20	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	30	30		20	20	20		20	20				20	10	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	30	20		20	20	20		20	20				10	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	30	20		20	20	20		20	20				10	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	30	20		20	20	20		20	20				10	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	30	20		20	20	20		10	10				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	30	20		20	20	20		10	10				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	30	20		20	10	10		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	30	20		20	10	10		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	30	20		20	10	10		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	20	20			10	10		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	20	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	20	10	10	10	10	10	10	20	10	10	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	20	10	10	10			10	10	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		10	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		10	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	10	10	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		10	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		10	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		10	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							





# FIRE RATING 15 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		30		30	30	30		30	30				20	20	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		30	30	30		20	20				20	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	30	30		30	20	20		20	20				20	20	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	30	30		20	20	20		20	20				20	10	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	30	30		20	20	20		20	20				20	10	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	30	20		20	20	20		20	20				10	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	30	20		20	20	20		20	20				10	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	30	20		20	20	20		10	10				10	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	30	20		20	20	20		10	10				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	20	20		20	10	10		10	10				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	20	20		10	10	10		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	20	20		10	10	10		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	20	20		10	10	10		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	20	20			10	10		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	20	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	10	10	10	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		10	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		10	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	10	10	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		10	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		10	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		10	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							



# FIRE RATING 15 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		30		30	30	30		20	20				20	20	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		30	20	20		20	20				20	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	30	30		30	20	20		20	20				20	10	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	30	20		20	20	20		20	20				20	10	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	30	20		20	20	20		20	20				10	10	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	30	20		20	20	20		10	10				10	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	30	20		20	20	20		10	10				10	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	30	20		20	20	20		10	10				10	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	30	20		20	20	20		10	10				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	20	20		10	10	10		10	10				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	20	20		10	10	10		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	20	20		10	10	10		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	20	20		10	10	10		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	20	20			10	10		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	20	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	10	10	10	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		10	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		10	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	10	10	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		10	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		10	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		10	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							





# FIRE RATING 15 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 15 minutes

#### Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		30		30	30	30		20	20				20	20	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		30		20	20	20		20	20				20	20	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	30	20		20	20	20		20	20				20	10	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	20	20		20	20	20		20	20				10	10	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	20	20		20	20	20		20	20				10	10	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	20	20		20	20	20		10	10				10	10	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	20	20		20	20	20		10	10				10	10	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	20	20		20	20	20		10	10				10	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	20	20		20	10	10		10	10				10	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	20	20		10	10	10		10	10				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	20	20		10	10	10		10	10				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	20	20		10	10	10		10	10						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	20	20		10	10	10		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	20	20			10	10		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	20	20			10	10		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	20	10	10	10	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 15 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 15 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	10	10	10	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	10	10	10	10	10	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		10	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		10	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	10	10	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		10	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		10	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		10	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							



# FIRE RATING 30 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		70		70	70	70		60	60				60	60	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		70		60	60	60		60	60				60	60	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	70	70		60	60	60		60	60				60	50	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	70	60		60	60	60		60	60				50	50	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	60	60		60	60	60		60	60				50	50	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	60	60		60	60	60		50	50				50	50	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	60	60		60	60	60		50	50				50	50	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	60	60		60	60	60		50	50				50	50	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	60	60		60	50	50		50	50				40	40	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	60	60		50	50	50		50	50				40	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	60	60		50	50	50		40	40				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	60	60		50	50	50		40	40						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	60	60		50	50	50		40	40		40		30	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	60	60			50	50		40	40		30		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	60	60			40	40		40	40		30		30	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	60	50	50	40	40	40	40	30	30	30	30	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	60	50	50	40	40	40	30	30	30	30	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	60	50	50	40	40	40	30	30	30	20	20	20	20	20	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	50	50	40	40	40	40	30	30	20	20	20	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	50	50	40	40	40	30	30	30	20	20	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	50	50	40	30	40	30	20	30	20	20	20	20	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	50	50	40	30	40	30	20	30	20	20	20	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	50	50	40	30			20	30	20	20	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	50	50	40	30	40	30	20	30	20	20	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		40	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		40	30	30	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	50	40	30	30	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		40	30	30	40	30		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		40	30	30	40	30		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		40	30	30	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							





# FIRE RATING 30 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		60		60	60	60		60	60				60	50	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		60		60	60	60		50	50				50	50	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	60	60		60	60	60		50	50				50	50	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	60	60		60	50	50		50	50				50	40	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	60	60		60	50	50		50	50				40	40	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	60	50		50	50	50		50	50				40	30	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	60	50		50	50	50		40	40				40	30	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	60	50		50	50	50		40	40				40	30	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	60	50		50	50	50		40	40				30	30	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	60	50		40	40	40		40	40				30	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	60	50		40	40	40		30	30				30	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	60	50		40	40	40		30	30						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	60	50		40	40	40		30	30		30		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	50	50			40	40		30	30		20		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	50	50			30	30		30	30		20		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	50	50	40	30	30	30	30	20	20	20	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	50	50	40	30	30	30	20	20	20	20	20	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	50	40	40	30	30	30	20	20	20	20	10	10	10	10	



**FIRE RATING 30 Minutes**  
**Critical Steel Temperature 300°C / 572°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 30 minutes**  
**Critical steel temperature 300°C / 572°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	50	40	30	30	30	30	30	20	20	20	20	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	40	40	30	30	30	20	20	20	20	20	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	40	40	30	30	30	20	20	20	20	20	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	40	40	30	20	30	20	20	20	20	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	40	40	30	20			20	20	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	40	40	30	20	30	20	10	10	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		30	20		30			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		30	20	20	30			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	40	30	20	20	30			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		30	20	20	30	20		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		30	20	20	30	20		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		30	20	20	30	20		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					30			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					30			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					30			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					30			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					30			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					30			20							



# FIRE RATING 30 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		60		60	60	60		50	50				50	50	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		60		50	50	50		50	50				50	40	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	60	60		50	50	50		50	50				40	40	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	60	50		50	50	50		40	40				40	30	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	50	50		50	50	50		40	40				40	30	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	50	50		50	40	40		40	40				30	30	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	50	50		50	40	40		40	40				30	30	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	50	50		40	40	40		40	40				30	20	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	50	50		40	40	40		30	30				30	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	50	40		40	30	30		30	30				20	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	50	40		40	30	30		30	30				20	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	50	40		40	30	30		30	30						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	50	40		40	30	30		20	20		20		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	50	40			30	30		20	20		20		20	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	50	40			30	30		20	20		20		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	50	40	30	30	20	20	20	20	20	20	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	40	40	30	30	20	20	20	20	20	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	40	40	30	20	20	20	20	20	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	40	30	20	20	20	20	20	20	20	10	10	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	40	30	20	20	20	20	20	20	20	10	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	40	30	20	20	20	20	10	20	10	10	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	30	30	20	20	20	20	10	20	10	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	30	30	20	20			10	20	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	30	30	20	20	20	10	10	20	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	20		20			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	20	20	20			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	30	20	20	20	20			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	20	20	20	10		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	20	20	20	10		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	20	20	20	10		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			20							





# FIRE RATING 30 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 30 minutes  
Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		60		60	50	50		50	50				50	40	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		50		50	50	50		50	50				40	40	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	60	50		50	50	50		40	40				40	40	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	50	50		50	50	50		40	40				40	30	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	50	50		50	40	40		40	40				30	30	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	50	50		40	40	40		40	40				30	30	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	50	40		40	40	40		30	30				30	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	50	40		40	40	40		30	30				30	20	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	50	40		40	40	40		30	30				20	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	50	40		30	30	30		30	30				20	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	50	40		30	30	30		30	30				20	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	50	40		30	30	30		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	50	40		30	30	30		20	20		20		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	40	30			30	30		20	20		20		20	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	40	40			30	30		20	20		20		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	40	40	30	30	20	20	20	20	20	20	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	40	40	30	20	20	20	20	20	20	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	40	30	30	20	20	20	20	20	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	40	30	20	20	20	20	20	20	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	40	30	20	20	20	20	10	20	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	40	30	20	20	20	20	10	20	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	30	30	20	20	20	10	10	20	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	30	30	20	20			10	20	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	30	30	20	20	20	10	10	20	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	20		20			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	20	10	20			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	30	20	20	10	20			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	20	10	20	10		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	20	10	20	10		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	20	10	20	10		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			20							



# FIRE RATING 30 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		60		50	50	50		50	50				40	40	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		50		50	50	50		40	40				40	40	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	50	50		50	50	50		40	40				40	30	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	50	50		40	40	40		40	40				30	30	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	50	50		40	40	40		40	40				30	30	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	50	40		40	40	40		30	30				30	20	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	50	40		40	40	40		30	30				30	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	50	40		40	40	40		30	30				20	20	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	50	40		40	30	30		30	30				20	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	50	40		30	30	30		20	20				20	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	50	40		30	30	30		20	20				20	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	50	40		30	30	30		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	50	40		30	30	30		20	20		20		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	40	40			20	20		20	20		20		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	40	40			20	20		20	20		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	40	30	20	20	20	20	20	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	40	30	20	20	20	20	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	30	20	20	20	20	10	10	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 30 minutes  
Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	20	20	20	20	20	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	30	20	20	20	10	10	10	20	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	30	20	20	20	20	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	30	20	20	10	20	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	30	20	20	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	30	20	20	10	20	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	10		20			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	10	10	20			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	20	20	10	10	20			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	10	10	20	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	10	10	20	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	10	10	20	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			10							





# FIRE RATING 30 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 30 minutes  
Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		50		50	50	50		50	50				40	40	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		50		50	50	50		40	40				40	30	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	50	50		50	40	40		40	40				40	30	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	50	50		40	40	40		40	40				30	30	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	50	40		40	40	40		30	30				30	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	50	40		40	40	40		30	30				30	20	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	50	40		40	30	30		30	30				20	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	50	40		40	30	30		30	30				30	30	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	50	40		40	30	30		30	30				20	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	40	40		30	30	30		20	20				20	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	40	40		30	30	30		20	20				20	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	40	40		30	20	20		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	40	40		30	20	20		20	20		20		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	40	30			20	20		20	20		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	40	30			20	20		20	20		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	40	30	20	20	20	20	20	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	30	30	20	20	20	20	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	30	20	20	20	20	10	10	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 30 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	20	20	20	20	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	30	20	20	20	20	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	30	20	20	10	20	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	30	20	20	10	20	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	30	20	20	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	20	20	20	10	20	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	10		20			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	10	10	20			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	20	20	10	10	20			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	10	10	20	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	10	10	20	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	10	10	20	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			10							



# FIRE RATING 30 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		50		50	50	50		40	40				40	40	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		50		50	40	40		40	40				30	30	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	50	50		40	40	40		40	40				30	30	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	50	40		40	40	40		30	30				30	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	50	40		40	40	40		30	30				30	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	50	40		40	30	30		30	30				20	20	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	50	40		30	30	30		30	30				20	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	50	40		30	30	30		20	20				20	20	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	50	40		30	30	30		20	20				20	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	40	30		20	20	20		20	20				20	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	40	30		20	20	20		20	20				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	40	30		20	20	20		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	40	30		20	20	20		20	20		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	30	30			20	20		20	20		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	30	30			20	20		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	30	30	20	20	20	10	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	30	30	20	20	20	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	20	20	20	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 30 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	20	20	10	10			10	10	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	20	20	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							





# FIRE RATING 30 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 30 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		50		50	40	40		40	40				40	30	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		40		40	40	40		30	30				30	30	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	50	40		40	40	40		30	30				30	20	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	40	40		40	30	30		30	30				30	20	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	40	40		40	30	30		30	30				20	20	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	40	30		30	30	30		30	30				20	20	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	40	30		30	30	30		20	20				20	20	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	40	30		30	30	30		20	20				20	10	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	40	30		30	30	30		20	20				20	10	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	40	30		20	20	20		20	20				10	10	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	40	30		20	20	20		20	20				10	10	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	40	30		20	20	20		20	20						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	40	30		20	20	20		10	10		10		10	10	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	30	30			20	20		10	10		10		10	10	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	30	30			20	20		10	10		10		10	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	30	30	20	20	20	20	10	10	10	10	10	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	30	20	20	20	10	10	10	10	10	10	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10	10	



# FIRE RATING 30 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 30 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	30	20	20	10	10	10	10	10	10	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	20	20	20	10	10	10	10	10	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	20	20	20	10	10	10	10	10	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	20	20	10	10			10	10	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	20	20	10	10	10	10	10	10	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		20	10		10			10							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		20	10	10	10			10							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	20	20	10	10	10			10							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		20	10	10	10	10		10							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		20	10	10	10	10		10							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		20	10	10	10	10		10							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					10			10							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					10			10							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					10			10							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					10			10							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					10			10							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					10			10							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 60 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		100		100	100	100		100	100				90	90	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		100		100	100	100		90	90				90	90	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	100	100		100	100	100		90	90				90	90	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	100	100		90	90	90		90	90				90	80	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	100	100		90	90	90		90	90				80	80	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	100	90		90	90	90		90	90				80	80	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	100	90		90	90	90		80	80				80	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	100	90		90	90	90		80	80				80	70	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	100	90		90	90	90		80	80				70	70	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	100	90		80	80	80		80	80				70	60	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	100	90		80	80	80		70	70				70	60	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	100	90		80	80	80		70	70						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	100	90		80	80	80		70	70		60		60	50	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	90	90			80	80		70	70		60		50	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	90	90			80	80		60	60		60		50	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	90	90	80	80	70	70	60	60	60	50	50	50	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	90	80	80	70	70	70	60	60	50	50	40	40	40	40	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	90	80	80	70	70	60	60	60	50	40	40	40	30	40	



# FIRE RATING 60 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 60 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	90	80	70	70	70	60	50	60	50	40	40	30	30		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	80	80	70	70	70	60	50	60	40	40	30	30	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	80	80	70	60	70	50	50	60	40	30	30	30	30		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	80	80	70	60	70	50	40	60	40	30	30	30	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	80	80	70	60			40	60	30	30	30	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	80	80	70	50	70	30	40	60	30	30	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		70	60		70			60							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		70	60	50	70			60							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	80	70	60	50	70			60							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		70	60	50	70	50		60							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		70	60	50	70	50		60							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		70	60	50	70	50		60							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			60							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			60							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			60							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			60							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			60							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			60							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 60 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		100		90	90	90		90	90				90	80	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		90		90	90	90		90	90				80	80	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	100	90		90	90	90		80	80				80	80	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	90	90		90	90	90		80	80				80	70	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	90	90		90	80	80		80	80				70	70	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	90	80		80	80	80		80	80				70	60	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	90	80		80	80	80		70	70				70	60	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	90	80		80	80	80		70	70				60	60	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	90	80		80	80	80		70	70				60	50	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	90	80		70	70	70		60	60				50	50	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	90	80		70	70	70		60	60				50	40	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	90	80		70	70	70		60	60						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	90	80		70	70	70		60	60		50		40	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	80	80			60	60		50	50		40		40	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	80	80			60	60		50	50		40		30	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	80	80	60	60	60	60	50	40	40	40	30	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	80	70	60	60	50	50	40	40	40	30	30	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	80	70	60	60	50	50	40	40	30	30	30	20	20	20	





# FIRE RATING 60 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 60 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	80	60	60	50	50	50	40	40	30	30	20	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	70	60	60	50	50	40	40	40	30	30	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	70	60	60	50	50	40	30	40	30	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	70	60	50	40	50	40	30	40	20	20	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	70	60	50	40			30	40	20	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	70	60	50	40	50	30	30	40	20	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		60	40		50			40							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		60	40	40	50			40							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	60	60	40	40	50			40							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		60	40	40	50	30		40							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		60	40	40	50	30		40							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		60	40	40	50	30		40							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					50			40							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					50			40							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					50			40							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					50			40							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					50			40							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					50			40							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 60 minutes  
Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	1/8	0.405		NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		90		90	90	90		80	80				80	80	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		90		90	80	80		80	80				80	70	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	60	90		90	80	80		80	80				70	70	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	90	80		80	80	80		70	70				70	60	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	90	80		80	80	80		70	70				60	60	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	90	80		80	70	70		70	70				60	50	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	90	80		80	70	70		60	60				60	50	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	90	80		70	70	70		60	60				50	40	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	90	80		70	70	70		60	60				50	40	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	80	70		60	60	60		50	50				40	40	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	80	70		60	60	60		50	50				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	80	70		60	60	60		50	50						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	80	70		60	60	60		50	50		40		30	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	80	70			50	50		40	40		30		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	80	70			50	50		40	40		30		30	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	80	70	50	50	50	50	40	30	30	30	30	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	70	60	50	50	40	40	30	30	30	30	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	70	60	50	40	40	40	30	30	30	20	20	20	20	20	



**FIRE RATING 60 Minutes**  
**Critical Steel Temperature 400°C / 752°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 60 minutes**  
**Critical steel temperature 400°C / 752°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	70	50	50	40	40	40	40	30	30	20	20	20	20	20	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	60	50	50	40	40	30	30	30	20	20	20	20	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	60	50	50	40	40	30	20	30	20	20	20	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	60	50	40	30	40	30	20	30	20	20	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	60	50	40	30			20	30	20	20	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	60	50	40	30	40	30	20	30	20	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		50	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		50	30	30	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	50	50	30	30	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		50	30	30	40	30		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		50	30	30	40	30		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		50	30	30	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 60 minutes

#### Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		90		90	90	90		80	80				80	70	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		90		80	80	80		80	80				70	70	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	90	90		80	80	80		70	70				70	60	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	90	80		80	80	80		70	70				70	60	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	80	80		80	70	70		70	70				60	50	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	80	70		70	70	70		60	60				60	50	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	80	70		70	70	70		60	60				50	40	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	80	470		70	70	70		60	60				50	40	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	80	70		70	70	70		60	60				40	40	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	80	70		60	60	60		50	50				40	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	80	70		60	60	60		50	50				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	80	70		60	50	50		40	40						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	80	70		60	50	50		40	40		40		30	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	70	70			50	50		40	40		30		30	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	70	70			50	50		40	40		30		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	70	70	50	50	40	40	40	30	30	30	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	70	60	50	40	40	40	30	30	30	20	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	70	60	50	40	40	40	30	30	20	20	20	20	20	20	



# FIRE RATING 60 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 60 minutes  
Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	60	50	40	40	40	30	30	30	20	20	20	20	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	60	50	40	40	40	30	20	30	20	20	20	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	60	50	40	30	40	30	20	30	20	20	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	60	50	40	30	40	30	20	30	20	20	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	60	50	40	30			20	30	20	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	50	50	40	30	40	20	20	30	20	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		40	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		40	30	30	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	50	40	30	30	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		40	30	30	40	20		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		40	30	30	40	20		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		40	30	30	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							





# FIRE RATING 60 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 60 minutes  
Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	1/8	0.405		NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		90		80	80	80		80	80				70	70	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		80		80	80	80		70	70				70	60	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	90	80		80	80	80		70	70				60	60	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	80	80		70	70	70		60	60				60	50	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	80	80		70	70	70		60	60				50	50	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	80	70		70	60	60		60	60				50	40	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	80	70		70	60	60		50	50				50	40	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	80	70		70	60	60		50	50				40	40	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	80	70		60	60	60		50	50				40	30	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	80	70		50	50	50		40	40				40	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	70	70		50	50	50		40	40				30	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	70	70		50	50	50		40	40						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	70	70		50	50	50		40	40		30		30	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	70	60			40	40		30	30		30		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	70	60			40	40		30	30		20		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	70	60	40	40	40	30	30	30	30	20	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	60	60	40	40	30	30	30	30	20	20	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	60	50	40	40	30	30	20	20	20	20	20	10	10	20	



# FIRE RATING 60 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	60	40	40	30	30	30	30	20	30	20	20	20	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	60	40	40	30	30	30	20	30	20	20	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	60	40	40	30	30	20	20	30	20	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	50	40	30	30	30	20	20	30	20	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	50	40	30	30			20	30	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	50	40	30	20	30	20	20	30	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		40	30		30			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		40	30	20	30			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	40	40	30	20	30			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		40	30	20	30	20		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		40	30	20	30	20		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		40	30	20	30	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					30			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					30			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					30			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					30			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					30			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					30			30							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		80		80	80	80		70	70				70	70	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		80		80	70	70		70	70				70	60	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	80	80		80	70	70		70	70				60	50	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	80	70		70	70	70		60	60				60	50	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	80	70		70	70	70		60	60				50	40	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	80	70		70	60	60		50	50				50	40	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	80	70		70	60	60		50	50				40	40	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	80	70		60	60	60		50	50				40	30	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	80	70		60	60	60		50	50				40	30	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	70	60		50	50	50		40	40				30	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	70	60		50	50	50		40	40				30	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	70	60		50	40	40		40	40						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	70	60		50	40	40		30	30		30		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	70	60			40	40		30	30		20		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	70	60			40	40		30	30		20		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	70	60	40	40	30	30	30	20	20	20	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	60	50	40	40	30	30	20	20	20	20	20	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	60	50	40	30	30	30	20	20	20	20	10	10	10	10	



# FIRE RATING 60 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	50	40	30	30	30	30	30	20	20	20	20	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	50	40	30	30	30	20	20	20	20	20	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	50	40	30	30	30	20	20	20	20	20	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	50	40	30	20	30	20	20	20	20	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	50	40	30	20			20	20	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	40	40	30	20	30	20	10	20	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		30	20		30			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		30	20	20	30			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	40	30	20	20	30			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		30	20	20	30	20		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		30	20	20	30	20		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		30	20	20	30	20		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					30			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					30			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					30			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					30			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					30			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					30			20							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		80		80	80	80		70	70				70	60	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		80		70	70	70		60	60				60	50	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	80	80		70	70	70		60	60				60	50	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	70	70		70	60	60		60	60				50	40	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	70	70		70	60	60		50	50				50	40	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	70	60		60	60	60		50	50				40	30	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	70	60		60	50	50		50	50				40	30	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	70	60		60	50	50		40	40				40	30	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	70	60		60	50	50		40	40				30	30	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	70	60		50	40	40		40	40				30	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	70	60		40	40	40		30	30				30	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	70	60		40	40	40		30	30						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	70	60		40	40	40		30	30		20		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	60	50			40	40		30	30		20		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	60	50			30	30		20	20		20		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	60	50	40	30	30	30	30	20	20	20	20	20	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	50	50	40	30	30	30	20	20	20	20	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	50	50	40	30	30	20	20	20	20	10	10	10	10	10	





# FIRE RATING 60 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	50	40	30	30	30	20	20	20	20	10	10	10	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	50	40	30	30	30	20	20	20	10	10	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	50	40	30	20	30	20	20	20	10	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	40	40	30	20	30	20	10	20	10	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	40	40	30	20			10	20	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	40	40	30	20	30	20	10	20	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		30	20		30			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		30	20	20	30			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	40	30	20	20	30			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		30	20	20	30	20		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		30	20	20	30	20		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		30	20	20	30	20		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					30			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					30			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					30			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					30			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					30			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					30			20							



# FIRE RATING 60 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		80		80	70	70		70	70				60	60	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		70		70	70	70		60	60				60	50	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	80	70		70	70	70		60	60				50	40	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	70	70		60	60	60		50	50				50	40	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	70	70		60	60	60		50	50				40	40	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	70	60		60	50	50		50	50				40	30	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	70	60		60	50	50		40	40				40	30	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	70	60		50	50	50		40	40				30	30	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	70	60		50	50	50		40	40				30	20	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	60	50		40	40	40		30	30				30	20	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	60	50		40	40	40		30	30				20	20	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	60	50		40	40	40		30	30						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	60	50		40	30	30		30	30		20		20	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	60	50			30	30		20	20		20		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	60	50			30	30		20	20		20		20	10	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	60	50	30	30	30	30	20	20	20	20	20	10	10	10	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	50	40	30	30	20	20	20	20	20	20	10	10	10	10	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	50	40	30	30	20	20	20	20	20	10	10	10	10	10	



# FIRE RATING 60 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 60 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	50	30	30	20	20	20	20	20	20	10	10	10	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	40	30	30	20	20	20	20	20	20	10	10	10	10	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	40	30	30	20	20	20	10	20	10	10	10	10	10	10	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	40	30	20	20	20	20	10	20	10	10	10	10	10	10	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	40	30	20	20			10	20	10	10	10	10	10	10	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	40	30	20	20	20	20	10	20	10	10	10	10	10	10	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		30	20		20			20							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		30	20	20	20			20							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	30	30	20	20	20			20							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		30	20	20	20	20		20							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		30	20	20	20	10		20							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		30	20	20	20	10		20							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					20			20							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					20			20							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					20			20							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					20			20							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					20			20							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					20			20							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 90 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		130		130	130	130		120	120				120	120	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		130		120	120	120		120	120				120	110	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	130	130		120	120	120		120	120				120	110	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	120	120		120	120	120		110	110				110	110	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	120	120		120	120	120		110	110				110	100	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	120	120		120	120	120		110	110				110	100	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	120	120		120	110	110		110	110				100	100	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	120	120		120	110	110		110	110				100	90	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	120	120		120	110	110		110	110				100	90	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	120	120		110	110	110		100	100				90	80	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	120	120		110	110	110		100	100				90	80	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	120	120		110	100	100		100	100						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	120	120		110	100	100		90	90		90		80	70	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	120	110			100	100		90	90		80		80	70	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	120	110			100	100		90	90		80		70	60	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	120	110	100	100	90	90	90	80	80	80	70	60	60	60	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	110	110	100	100	90	90	80	80	80	70	60	60	50	60	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	110	110	100	90	90	90	80	80	70	60	60	50	50	60	



# FIRE RATING 90 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 90 minutes  
Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	14	14		355.6	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75
			Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1	
			HTF	110	100	100	90	90	90	70	80	70	60	50	50	40	
16	16	406.4	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49	
			Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4	
			HTF	110	100	100	90	90	80	70	80	60	50	50	40	40	
18	18	457.2	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24	
			Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5	
			HTF	110	100	100	80	90	80	70	80	60	50	40	40	40	
20	20	508.0	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01	
			Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2	
			HTF	110	100	90	80	90	70	60	80	50	50	40	40	30	
22	22.0	558.8	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98	
			Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5	
			HTF	110	100	90	80			60	80	50	40	40	30	30	
24	24	609.6	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54	
			Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6	
			HTF	100	100	90	80	90	70	60	80	50	40	30	30	30	
26	26	660.4	NWT		7.92	12.70		9.52			12.70						
			Hp/A		127.7	80.3		106.6			80.3						
			HTF		90	80		90			80						
28	28	711.2	NWT		7.92	12.70	15.88	9.52			12.70						
			Hp/A		127.6	80.2	64.4	106.5			80.2						
			HTF		90	80	70	90			80						
30	30	762.0	NWT	6.35	7.92	12.70	15.88	9.52			12.70						
			Hp/A	158.8	127.5	80.1	64.3	106.4			80.1						
			HTF	100	90	80	70	90			80						
32	32	812.8	NWT		7.92	12.70	15.88	9.52	17.48		12.70						
			Hp/A		127.4	80.0	64.2	106.3	58.5		80.0						
			HTF		90	80	70	90	70		80						
34	34	863.6	NWT		7.92	12.70	15.88	9.52	17.48		12.70						
			Hp/A		127.4	79.9	64.2	106.2	58.4		79.9						
			HTF		90	80	70	90	70		80						
36	36	914.4	NWT		7.92	12.70	15.88	9.52	19.05		12.70						
			Hp/A		127.3	79.8	64.1	106.1	53.6		79.8						
			HTF		90	80	70	90	60		80						
38	38	965.2	NWT					9.52			12.70						
			Hp/A					106.1			79.8						
			HTF					90			80						
40	40	1016.0	NWT					9.52			12.70						
			Hp/A					106.0			79.7						
			HTF					90			80						
42	42	1066.8	NWT					9.52			12.70						
			Hp/A					106.0			79.7						
			HTF					90			80						
44	44	1117.6	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					90			80						
46	46	1168.4	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					90			80						
48	48	1219.2	NWT					9.52			12.70						
			Hp/A					105.9			79.6						
			HTF					90			80						





# FIRE RATING 90 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 90 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]			5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		120		120	120	120		110	110				110	110	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		120		120	110	110		110	110				110	100	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	120	120		120	110	110		110	110				110	100	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	120	110		110	110	110		110	110				100	90	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	120	110		110	110	110		100	100				100	90	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	120	110		110	110	110		100	100				90	80	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	120	110		110	100	100		100	100				90	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	120	110		110	100	100		100	100				90	80	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	120	110		110	100	100		90	90				80	70	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	110	110		100	90	90		90	90				80	60	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	110	110		100	90	90		80	80				70	60	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	110	110		100	90	90		80	80						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	110	110		100	90	90		80	80		70		60	50	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	110	100			90	90		70	70		60		60	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	110	100			80	80		70	70		60		50	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	110	100	90	80	80	80	70	60	60	60	50	50	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	100	100	90	80	70	70	60	60	60	50	40	40	30	40	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	100	100	90	80	70	70	60	60	50	40	40	30	30	40	



**FIRE RATING 90 Minutes**  
**Critical Steel Temperature 300°C / 572°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 90 minutes**  
**Critical steel temperature 300°C / 572°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	100	90	80	70	70	70	70	60	60	50	40	30	30	30	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	100	90	80	70	70	60	50	60	40	40	30	30	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	100	90	80	70	70	60	50	60	40	30	30	30	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	90	90	70	60	70	50	40	60	40	30	30	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	90	90	70	60			40	60	30	30	30	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	90	90	70	60	70	50	40	60	30	30	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		80	60		70			60							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		80	60	50	70			60							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	90	80	60	50	70			60							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		80	60	50	70	50		60							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		80	60	50	70	50		60							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		80	60	50	70	50		60							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			60							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			60							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			60							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			60							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			60							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			60							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 90 minutes  
Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		120		110	110	110		110	110				100	100	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		110		110	110	110		100	100				100	90	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	110	110		110	110	110		100	100				100	90	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	110	110		100	100	100		100	100				90	80	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	110	110		100	100	100		90	90				90	80	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	110	100		100	100	100		90	90				80	70	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	110	100		100	90	90		90	90				80	70	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	110	100		100	90	90		90	90				70	60	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	110	100		100	90	90		80	80				70	60	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	110	100		90	80	80		70	70				60	50	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	110	100		90	80	80		70	70				60	50	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	110	100		90	80	80		70	70						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	110	100		80	80	80		60	60		60		50	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	100	90			70	70		60	60		50		40	40	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	100	90			70	70		50	50		50		40	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	100	90	70	70	60	60	60	50	50	40	40	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	90	90	70	70	60	60	50	50	40	40	30	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	90	90	70	60	60	60	40	50	40	30	30	30	20	30	



# FIRE RATING 90 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 90 minutes Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	90	70	70	60	60	50	40	50	30	30	30	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	90	70	70	60	60	50	40	50	30	30	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	90	70	70	50	60	40	30	50	30	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	80	70	60	50	60	40	30	50	30	20	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	80	70	60	50			30	50	20	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	80	70	60	40	60	40	30	50	20	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		60	50		60			50							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		60	50	40	60			50							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	70	60	50	40	60			50							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		60	50	40	60	40		50							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		60	50	40	60	40		50							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		60	50	40	60	30		50							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					60			50							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					60			50							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					60			50							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					60			50							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					60			50							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					60			50							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 90 minutes  
Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	1/8	0.405		NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		110		110	110	110		110	110				100	100	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		110		110	110	110		100	100				100	90	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	110	110		110	100	100		100	100				90	90	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	110	100		100	100	100		90	90				90	80	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	110	100		100	100	100		90	90				80	70	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	110	100		100	90	90		90	90				80	70	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	110	100		100	90	90		80	80				80	60	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	110	100		90	90	90		80	80				70	60	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	110	100		90	90	90		80	80				60	60	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	100	100		80	80	80		70	70				60	50	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	100	90		80	80	80		70	70				50	40	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	100	90		80	80	80		60	60						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	100	90		80	70	70		60	60		50		50	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	100	90			70	70		60	60		50		40	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	100	90			70	70		50	50		40		40	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	100	90	70	70	60	60	50	50	50	40	30	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	90	80	70	60	60	60	40	40	40	30	30	30	20	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	90	80	70	60	60	50	40	40	30	30	30	20	20	30	





**FIRE RATING 90 Minutes**  
**Critical Steel Temperature 427°C / 800°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 90 minutes**  
**Critical steel temperature 427°C / 800°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	90	70	60	50	50	50	50	40	40	30	30	20	20	20	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	80	70	60	50	50	40	40	40	30	30	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	80	70	60	50	50	40	30	40	30	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	80	70	50	40	50	40	30	40	20	20	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	80	70	50	40			30	40	20	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	80	70	50	40	50	30	30	40	20	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		60	40		50			40							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		60	40	40	50			40							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	70	60	40	40	50			40							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		60	40	40	50	30		40							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		60	40	40	50	30		40							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		60	40	40	50	30		40							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					50			40							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					50			40							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					50			40							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					50			40							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					50			40							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					50			40							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 90 minutes

#### Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		110		110	110	110		100	100				100	90	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		110		100	100	100		90	90				90	80	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	110	100		100	100	100		90	90				90	80	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	100	100		100	90	90		90	90				80	70	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	100	100		100	90	90		80	80				80	70	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	100	90		90	90	90		80	80				70	60	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	100	90		90	90	90		80	80				70	50	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	100	90		90	80	80		70	70				60	50	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	100	90		90	80	80		70	70				50	50	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	100	90		70	70	70		60	60				50	40	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	100	90		70	70	70		60	60				50	40	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	100	90		70	70	70		50	50						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	100	90		70	70	70		50	50		40		40	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	90	80			60	60		50	50		40		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	90	80			60	60		40	40		40		30	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	90	80	60	60	50	50	40	40	40	30	30	30	20	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	80	80	60	50	50	50	40	40	30	30	30	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	80	70	60	50	50	40	30	40	30	30	20	20	20	20	



**FIRE RATING 90 Minutes**  
**Critical Steel Temperature 500°C / 932°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 90 minutes**  
**Critical steel temperature 500°C / 932°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	80	60	50	50	50	40	30	40	30	20	20	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	80	60	50	50	50	40	30	40	20	20	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	80	60	50	40	50	30	30	40	20	20	20	20	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	70	60	50	40	50	30	30	40	20	20	20	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	70	60	50	40			20	40	20	20	20	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	70	60	50	30	50	30	20	40	20	20	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		50	40		50			40							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		50	40	30	50			40							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	60	50	40	30	50			40							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		50	40	30	50	30		40							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		50	40	30	50	30		40							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		50	40	30	50	30		40							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					50			40							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					50			40							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					50			40							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					50			40							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					50			40							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					50			40							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 90 minutes

#### Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		110		110	100	100		100	100				90	90	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		100		100	100	100		90	90				90	80	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	110	100		100	100	100		90	90				80	80	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	100	100		90	90	90		80	80				80	70	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	100	100		90	90	90		80	80				70	60	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	100	90		90	80	80		80	80				70	60	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	100	90		90	80	80		70	70				60	50	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	100	90		80	80	80		70	70				60	50	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	100	90		80	80	80		70	70				50	40	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	90	90		70	70	70		60	60				50	40	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	90	80		70	60	60		50	50				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	90	80		70	60	60		50	50						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	90	80		70	60	60		50	50		40		40	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	90	80			60	60		40	40		40		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	90	80			50	50		40	40		30		30	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	90	80	60	50	50	50	40	40	40	30	30	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	80	70	60	50	40	40	40	40	30	30	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	80	70	60	50	40	40	30	30	30	20	20	20	20	20	



# FIRE RATING 90 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 90 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	80	60	50	40	40	40	40	30	30	30	20	20	20	20	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	70	60	50	40	40	30	30	30	30	20	20	20	20	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	70	60	50	40	40	30	20	30	20	20	20	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	70	60	40	30	40	30	20	30	20	20	20	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	70	60	40	30			20	30	20	20	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	60	60	40	30	40	30	20	30	20	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		50	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		50	30	30	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	60	50	30	30	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		50	30	30	40	30		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		50	30	30	40	30		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		50	30	30	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							





# FIRE RATING 90 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 90 minutes Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		100		100	100	100		90	90				90	80	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		100		100	90	90		90	90				80	80	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	100	100		100	90	90		80	80				80	70	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	100	90		90	90	90		80	80				70	60	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	100	90		90	80	80		80	80				60	60	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	100	80		80	80	80		70	70				60	50	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	100	80		80	80	80		70	70				60	40	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	100	80		80	80	80		60	60				50	40	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	100	80		80	70	70		60	60				40	40	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	90	80		60	60	60		50	50				40	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	90	80		60	60	60		50	50				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	90	80		60	60	60		50	50						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	90	80		60	50	50		40	40		40		30	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	80	80			50	50		40	40		30		30	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	80	80			50	50		40	40		30		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	80	70	50	50	40	40	40	30	30	30	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	80	70	50	40	40	40	30	30	30	20	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	70	60	50	40	40	40	30	30	20	20	20	20	20	20	



# FIRE RATING 90 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 90 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	70	50	40	40	40	30	30	30	20	20	20	20	10		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	70	50	40	40	40	30	20	30	20	20	20	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	70	50	40	30	40	30	20	30	20	20	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	60	50	40	30	40	30	20	30	20	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	60	50	40	30			20	30	20	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	60	50	40	30	40	20	20	30	20	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		40	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		40	30	20	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	50	40	30	20	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		40	30	20	40	20		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		40	30	20	40	20		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		40	30	20	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							



# FIRE RATING 90 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 90 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		100		100	90	90		90	90				80	80	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		90		90	90	90		80	80				80	70	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	100	90		90	90	90		80	80				70	60	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	90	90		80	80	80		70	70				70	60	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	90	90		80	80	80		70	70				60	50	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	90	80		80	70	70		60	60				50	50	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	90	80		80	70	70		60	60				50	40	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	90	80		80	70	70		60	60				50	40	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	90	80		70	70	70		60	60				40	30	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	90	80		60	60	60		50	50				40	30	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	90	80		60	50	50		40	40				30	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	90	80		60	50	50		40	40						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	90	80		60	50	50		40	40		30		30	20	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	80	70			50	50		40	40		30		20	20	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	80	70			40	40		30	30		30		20	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	80	70	50	40	40	40	30	30	30	20	20	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	70	60	50	40	40	40	30	30	20	20	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	70	60	50	40	30	30	20	30	20	20	20	20	10	20	



# FIRE RATING 90 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 90 minutes Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	60	50	40	30	30	30	30	20	30	20	20	20	10	10	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	60	50	40	30	30	30	20	30	20	20	10	10	10		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	60	50	40	30	30	20	20	30	20	10	10	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	60	50	30	30	30	20	20	30	20	10	10	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	60	50	30	30			20	30	10	10	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	50	50	30	20	30	20	20	30	10	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		40	30		30			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		40	30	20	30			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	50	40	30	20	30			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		40	30	20	30	20		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		40	30	20	30	20		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		40	30	20	30	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					30			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					30			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					30			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					30			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					30			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					30			30							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	130	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	130	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				130	130	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				130	120	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		130	130				130	120	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		130	130				130	120	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	130	130		130	130				120	110	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	130	130		130	130				120	110	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		130	130	130		120	120				110	100	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		130	130	130		120	120				110	100	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		130	130	130		120	120						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		130	120	120		120	120		110		100	90	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			120	120		110	110		100		90	90	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			120	120		110	110		100		90	80	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	130	120	120	120	120	110	100	100	100	90	80	80	80	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	130	130	120	120	110	110	100	100	90	90	80	70	70	70	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	130	130	120	110	110	110	100	100	90	80	70	70	60	70	





# FIRE RATING 120 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	130	120	120	110	110	100	90	100	80	70	70	60	60		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	130	120	120	110	110	100	90	100	80	70	60	60	50		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	130	120	120	100	110	100	80	100	70	60	60	50	50		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	130	120	110	100	110	90	80	100	70	60	50	50	50		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	130	120	110	100			80	100	70	60	50	50	50		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	120	120	110	100	110	90	70	100	60	50	50	50	50		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		120	100		110			100							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		120	100	90	110			100							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	120	120	100	90	110			100							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		120	100	90	110	90		100							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		120	100	90	110	90		100							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		120	100	90	110	80		100							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					110			100							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					110			100							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					110			100							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					110			100							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					110			100							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					110			100							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				130	130	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		130	130				130	120	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	130	130		130	130				130	120	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		130	130	130		130	130				120	110	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		130	130	130		120	120				120	110	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	130		130	130	130		120	120				110	100	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	130		130	120	120		120	120				110	100	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	130		130	120	120		120	120				110	100	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	130		130	120	120		110	110				100	90	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	130	130		120	110	110		110	110				100	80	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	130	130		120	110	110		100	100				90	80	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	130	130		120	110	110		100	100						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	130	130		120	110	110		100	100		90		80	70	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	130	120			110	110		90	90		80		70	70	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	130	120			100	100		90	90		80		70	60	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	130	120	110	100	100	100	90	80	80	70	60	60	60	60	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	120	120	110	100	90	90	80	80	70	60	60	50	50	50	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	120	120	110	100	90	90	70	80	60	60	50	50	40	50	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 120 minutes  
Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	[mm]		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	14	14		NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71
355.6		Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	120	110	100	90	90	80	70	80	60	50	50	40	40		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	120	110	100	90	90	80	70	80	60	50	40	40	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	120	110	100	80	90	70	60	80	50	40	40	30	30		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	120	110	90	80	90	70	60	80	50	40	30	30	30		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	120	110	90	80			50	80	40	40	30	30	30		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	110	110	90	70	90	60	50	80	40	30	30	30	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		100	80		90			80							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		100	80	70	90			80							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	110	100	80	70	90			80							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		100	80	70	90	60		80							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		100	80	70	90	60		80							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		100	80	70	90	60		80							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					90			80							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					90			80							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					90			80							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					90			80							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					90			80							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					90			80							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 120 minutes  
Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	130	130		130	130				120	120	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		130		130	130	130		120	120				120	110	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	130		130	130	130		120	120				120	110	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	130	130		130	120	120		120	120				110	100	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	130	130		120	120	120		110	110				110	100	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	130	120		120	120	120		110	110				100	90	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	130	120		120	120	120		110	110				100	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	130	120		120	110	110		100	100				90	80	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	130	120		120	110	110		100	100				80	80	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	130	120		110	100	100		90	90				80	70	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	130	120		100	100	100		90	90				70	60	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	130	120		100	100	100		80	80						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	130	120		100	100	100		80	80		70		60	50	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	120	110			90	90		80	80		60		60	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	120	110			90	90		70	70		60		50	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	120	110	90	90	80	80	70	60	60	60	50	40	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	110	110	90	80	80	80	60	60	60	50	40	40	30	40	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	110	100	90	80	80	70	60	60	50	40	40	30	30	40	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 120 minutes Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	110	90	80	80	80	70	50	60	50	40	30	30	30		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	110	90	80	70	70	60	50	60	40	40	30	30	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	110	90	80	70	70	60	50	60	40	30	30	30	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	100	90	70	60	70	50	40	60	30	30	30	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	100	90	70	60			40	60	30	30	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	100	90	70	60	70	50	40	60	30	30	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		80	60		70			60							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		80	60	50	70			60							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	90	80	60	50	70			60							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		80	60	50	70	50		60							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		80	60	50	70	50		60							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		80	60	50	70	40		60							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			60							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			60							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			60							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			60							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			60							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			60							





# FIRE RATING 120 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		130	130	130		130	130				120	120	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		130		130	130	130		120	120				120	110	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	130	130		130	120	120		120	120				110	110	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	130	130		120	120	120		110	110				110	100	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	130	130		120	120	120		110	110				100	90	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	130	120		120	110	110		110	110				100	90	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	130	120		120	110	110		100	100				100	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	130	120		110	110	110		100	100				90	80	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	130	120		110	110	110		100	100				80	70	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	120	120		100	100	100		90	90				80	60	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	120	110		100	100	100		80	80				70	60	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	120	110		100	100	100		80	80						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	120	110		100	90	90		80	80		70		60	50	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	120	110			90	90		70	70		60		50	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	120	110			80	80		70	70		60		50	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	120	110	90	80	80	80	70	60	60	50	50	40	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	110	100	90	80	70	70	60	60	50	40	40	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	110	100	90	80	70	70	50	60	50	40	30	30	30	30	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 120 minutes Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	110	90	80	70	70	60	50	60	40	40	30	30	30		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	100	90	80	70	70	60	50	60	40	30	30	30	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	100	90	80	60	70	50	40	60	30	30	30	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	100	90	70	60	70	50	40	60	30	30	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	100	90	70	60			40	60	30	30	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	90	90	70	50	70	40	30	60	30	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		80	60		70			60							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		80	60	50	70			60							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	90	80	60	50	70			60							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		80	60	50	70	40		60							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		80	60	50	70	40		60							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		80	60	50	70	40		60							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			60							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			60							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			60							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			60							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			60							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			60							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 120 minutes  
Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		130		130	130	130		120	120				120	110	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		130		120	120	120		110	110				110	100	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	130	130		120	120	120		110	110				110	100	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	120	120		120	110	110		110	110				100	90	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	120	120		120	110	110		100	100				90	80	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	120	110		110	110	110		100	100				90	80	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	120	110		110	100	100		100	100				90	70	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	120	110		110	100	100		90	90				80	70	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	120	110		110	100	100		90	90				70	60	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	120	110		90	90	90		80	80				70	50	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	120	110		90	90	90		70	70				60	50	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	120	110		90	90	90		70	70						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	120	110		90	80	80		70	70		60		50	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	110	100			80	80		60	60		50		40	40	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	110	100			80	80		60	60		50		40	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	110	100	80	80	70	70	60	50	50	40	40	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	100	100	80	70	60	60	50	50	40	40	30	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	100	90	80	70	60	60	50	50	40	30	30	30	20	30	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 120 minutes Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	100	80	70	60	60	50	40	50	40	30	30	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	100	80	70	60	60	50	40	50	30	30	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	100	80	70	50	60	40	40	50	30	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	90	80	60	50	60	40	30	50	30	20	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	90	80	60	50			30	50	30	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	80	80	60	40	60	40	30	50	20	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		70	50		60			50							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		70	50	40	60			50							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	80	70	50	40	60			50							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		70	50	40	60	40		50							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		70	50	40	60	40		50							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		70	50	40	60	30		50							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					60			50							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					60			50							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					60			50							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					60			50							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					60			50							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					60			50							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		130		130	120	120		120	120				110	110	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		120		120	120	120		110	110				110	100	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	130	120		120	120	120		110	110				100	90	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	120	120		110	110	110		100	100				100	90	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	120	120		110	110	110		100	100				90	80	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	120	110		110	100	100		90	90				80	70	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	120	110		110	100	100		90	90				80	70	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	120	110		100	100	100		90	90				80	60	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	120	110		100	100	100		80	80				70	60	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	110	100		90	90	90		70	70				60	50	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	110	100		90	80	80		70	70				50	40	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	110	100		90	80	80		70	70						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	110	100		90	80	80		60	60		50		50	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	110	100			80	80		60	60		50		40	40	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	110	100			70	70		50	50		40		40	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	110	100	80	70	60	60	50	50	50	40	30	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	100	90	80	70	60	60	50	50	40	30	30	30	20	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	100	90	80	60	60	50	40	50	40	30	30	20	20	30	





# FIRE RATING 120 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 120 minutes Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	90	80	60	60	60	50	40	50	30	30	20	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	90	80	60	60	60	50	40	50	30	30	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	90	80	60	50	60	40	30	50	30	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	90	70	60	40	60	40	30	40	20	20	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	90	70	60	40			30	40	20	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	80	70	60	40	60	30	30	40	20	20	20	20	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		60	40		60			40							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		60	40	40	60			40							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	70	60	40	40	60			40							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		60	40	40	60	30		40							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		60	40	40	60	30		40							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		60	40	40	60	30		40							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					60			40							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					60			40							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					60			40							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					60			40							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					60			40							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					60			40							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		120		120	120	120		110	110				110	100	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		120		120	110	110		110	110				100	90	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	120	120		120	110	110		100	100				100	90	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	120	110		110	100	100		100	100				90	80	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	120	110		110	100	100		90	90				80	70	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	120	100		100	100	100		90	90				80	70	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	120	100		100	90	90		80	80				70	60	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	120	100		100	90	90		80	80				70	60	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	120	100		100	90	90		80	80				60	50	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	110	100		80	80	80		70	70				50	40	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	110	100		80	80	80		60	60				50	40	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	110	100		80	70	70		60	60						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	110	100		80	70	70		60	60		50		40	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	100	90			70	70		50	50		40		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	100	90			60	60		50	50		40		30	30	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	100	90	70	60	60	60	50	40	40	40	30	30	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	90	90	70	60	50	50	40	40	30	30	30	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	90	80	70	60	50	50	40	40	30	30	20	20	20	20	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	90	70	60	50	50	40	30	40	30	20	20	20	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	90	70	60	50	50	40	30	40	30	20	20	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	90	70	60	40	50	40	30	40	20	20	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	80	70	50	40	50	30	30	40	20	20	20	20	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	80	70	50	40			20	40	20	20	20	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	70	70	50	40	50	30	20	40	20	20	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		60	40		50			40							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		60	40	30	50			40							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	70	60	40	30	50			40							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		60	40	30	50	30		40							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		60	40	30	50	30		40							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		60	40	30	50	30		40							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					50			40							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					50			40							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					50			40							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					50			40							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					50			40							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					50			40							



# FIRE RATING 120 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		120		120	110	110		110	110				100	100	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		110		110	110	110		100	100				100	90	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	120	110		110	110	110		100	100				90	80	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	110	110		100	100	100		90	90				80	70	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	110	110		100	100	100		90	90				80	70	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	110	100		100	90	90		80	80				70	60	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	110	100		100	90	90		80	80				70	50	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	110	100		90	90	90		80	80				60	50	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	110	100		90	80	80		70	70				50	50	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	100	90		80	70	70		60	60				50	40	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	100	90		80	70	70		60	60				40	30	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	100	90		80	70	70		50	50						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	100	90		80	60	60		50	50		40		40	30	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	100	90			60	60		50	50		40		30	30	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	100	90			60	60		40	40		30		30	20	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	100	80	60	60	50	50	40	40	40	30	30	20	20	20	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	90	80	60	50	50	50	40	40	30	30	20	20	20	20	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	80	80	60	50	40	40	30	40	30	20	20	20	20	20	



# FIRE RATING 120 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 120 minutes

#### Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	80	60	50	40	40	40	40	30	40	30	20	20	20	20	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	80	60	50	40	40	40	40	30	40	20	20	20	20	10	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	80	60	50	40	40	30	30	40	20	20	20	10	10		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	70	60	40	40	40	30	20	40	20	20	20	10	10		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	70	60	40	40			20	40	20	20	10	10	10		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	70	60	40	30	40	30	20	40	20	10	10	10	10		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		50	30		40			30							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		50	30	30	40			30							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	60	50	30	30	40			30							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		50	30	30	40	30		30							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		50	30	30	40	30		30							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		50	30	30	40	20		30							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					40			30							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					40			30							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					40			30							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					40			30							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					40			30							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					40			30							





# FIRE RATING 180 Minutes

## Critical Steel Temperature 200°C / 392°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 180 minutes  
Critical steel temperature 200°C / 392°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	-	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	-	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				-	-	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				-	-	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		-	-				-	-	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		-	-				-	-	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	-	-		-	-				-	-	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	-	-		-	-				-	-	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		-	-	-		-	-				-	-	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		-	-	-		-	-				-	130	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		-	-	-		-	-						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		-	-	-		-	-		-		-	130	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			-	-		-	-		-		130	120	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			-	-		-	-		130		120	110	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	-	-	-	-	-	-	-	-	130	120	120	110	110	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	-	-	-	-	-	-	-	-	-	130	120	110	100	100	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	-	-	-	-	-	-	-	130	130	120	110	100	90	100	



**FIRE RATING 180 Minutes**  
**Critical Steel Temperature 200°C / 392°F**

**ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs**  
**Fire Rating 180 minutes**  
**Critical steel temperature 200°C / 392°F**

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	-	-	-	-	-	-	130	130	120	110	100	90	80		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	-	-	-	-	-	130	120	130	110	100	90	80	80		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	-	-	-	-	-	130	120	130	100	90	80	80	70		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	-	-	-	130	-	130	110	130	100	90	80	70	60		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	-	-	-	130			110	130	90	80	70	70	60		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	-	-	-	130	-	120	100	130	90	80	70	60	60		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		-	130		-			130							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		-	130	120	-			130							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	-	-	130	120	-			130							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		-	130	120	-	120		130							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		-	130	120	-	120		130							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		-	130	120	-	120		130							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					-			130							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					-			130							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					-			130							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					-			130							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					-			130							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					-			130							



# FIRE RATING 180 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 180 minutes  
Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	-	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	-	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				-	-	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				-	-	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		-	-				-	-	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		-	-				-	130	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	-	-		-	-				-	130	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	-	-		-	-				130	130	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		-	-	-		-	-				130	120	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		-	-	-		-	-				120	110	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		-	-	-		130	130						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		-	-	-		130	130		120		110	100	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			-	-		130	130		110		100	90	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			-	-		120	120		110		90	90	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	-	-	-	130	130	120	110	110	100	90	90	80	80	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	-	-	-	130	130	130	110	110	100	90	80	70	70	70	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	-	-	-	130	130	120	100	110	90	80	70	70	60	70	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 300°C / 572°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 180 minutes Critical steel temperature 300°C / 572°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	-	-	130	120	120	120	100	110	90	80	70	60	60		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	-	-	130	120	120	110	100	110	80	70	60	50	50		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	-	-	130	120	120	100	90	110	80	60	60	50	50		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	-	-	120	110	120	100	80	110	70	60	50	50	40		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	-	-	120	110			80	110	70	60	50	40	40		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	-	-	120	100	120	90	70	110	60	50	40	40	40		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		130	110		120			110							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		130	110	100	120			110							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	-	130	110	100	120			110							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		130	110	100	120	90		110							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		130	110	100	120	90		110							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		130	110	100	120	90		110							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					120			110							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					120			110							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					120			110							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					120			110							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					120			110							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					120			110							



# FIRE RATING 180 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 180 minutes  
Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	-	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	-	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				-	-	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				-	130	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		-	-				130	120	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		-	-				130	120	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	-	-		-	-				130	110	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	-	-		130	130				120	110	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		-	-	-		120	120				110	100	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		-	130	130		120	120				100	90	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		-	130	130		120	120						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		-	130	130		110	110		100		90	80	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			130	130		110	110		90		80	70	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			120	120		100	100		90		70	60	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	-	130	120	110	110	100	90	90	80	70	70	60	60	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	-	-	130	120	110	110	90	90	80	70	60	50	50	50	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	-	-	130	110	110	100	80	90	70	60	50	50	40	50	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 400°C / 752°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 400°C / 752°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	-	130	120	110	110	100	80	90	70	60	50	40	40		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	-	130	120	110	110	90	70	90	60	50	50	40	40		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	-	130	120	100	110	80	70	90	60	50	40	40	30		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	-	130	110	90	110	80	60	90	50	40	40	30	30		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	-	130	110	90			60	90	50	40	30	30	30		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	130	130	110	80	110	70	50	90	40	40	30	30	30		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		120	90		110			90							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		120	90	80	100			90							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	120	120	90	80	100			90							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		120	90	80	100	70		90							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		120	90	80	100	70		90							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		120	90	80	100	70		90							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					100			90							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					100			90							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					100			90							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					100			90							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					100			90							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					100			90							





# FIRE RATING 180 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

Fire Rating 180 minutes  
Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	-	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	-	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				-	130	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				-	130	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		-	-				130	120	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		-	-				130	110	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	-	-		130	130				120	110	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	-	-		130	130				110	100	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		-	130	130		120	120				110	90	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		130	130	130		120	120				100	80	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		130	130	130		110	110						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		130	130	130		110	110		100		90	70	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			120	120		100	100		90		80	70	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			120	120		100	100		80		70	60	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	-	120	120	110	110	100	90	90	80	70	60	60	60	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	-	-	120	110	100	100	90	90	80	70	60	50	50	50	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	-	130	120	110	100	100	80	90	70	60	50	50	40	50	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 427°C / 800°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 427°C / 800°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	-	120	110	100	100	90	80	80	60	50	50	40	40		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	-	120	110	100	100	80	70	80	60	50	40	40	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	-	120	110	90	100	80	60	80	50	40	40	30	30		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	130	120	100	80	100	70	60	80	50	40	30	30	30		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	130	120	100	80			50	80	40	40	30	30	30		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	130	120	100	80	100	70	50	80	40	30	30	30	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		110	80		100			80							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		110	80	70	100			80							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	120	110	80	70	100			80							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		110	80	70	100	70		80							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		110	80	70	100	70		80							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		110	80	70	100	60		80							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					100			80							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					100			80							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					100			80							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					100			80							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					100			80							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					100			80							



# FIRE RATING 180 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 180 minutes Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	-	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	130	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				130	120	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		-	-				130	120	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		130	130				120	110	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	-	-		130	130				120	100	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	-	-		130	130				110	100	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	130	130		120	120				100	90	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		130	120	120		110	110				90	80	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		130	120	120		110	110				90	70	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		130	120	120		100	100						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		130	120	120		100	100		80		70	60	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	-			110	110		90	90		80		60	60	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	-			110	110		80	80		70		60	50	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	130	110	110	100	100	90	70	70	70	60	50	50	50	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	-	130	110	100	90	90	70	70	60	60	50	40	40	40	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	130	130	110	100	90	90	70	70	60	50	40	40	30	40	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 500°C / 932°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 180 minutes Critical steel temperature 500°C / 932°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	130	110	100	90	90	80	60	70	50	40	40	30	30		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	130	110	100	90	90	70	60	70	50	40	30	30	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	130	110	100	80	90	70	50	70	40	40	30	30	30		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	120	110	90	70	90	60	50	70	40	30	30	30	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	120	110	90	70			50	70	40	30	30	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	120	110	90	70	90	60	40	70	30	30	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		100	70		90			70							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		100	70	60	90			70							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	110	100	70	60	90			70							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		100	70	60	90	60		70							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		100	70	60	90	60		70							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		100	70	60	90	50		70							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					90			70							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					90			70							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					90			70							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					90			70							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					90			70							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					90			70							



# FIRE RATING 180 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				-	130	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		-	-				-	130	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		-	-				130	120	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		130	130				120	110	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		-	-	-		130	130				110	100	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	-		-	130	130		120	120				110	90	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	-		-	130	130		120	120				110	90	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	-		-	130	130		120	120				90	80	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	-		120	120	120		100	100				90	70	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	-		120	110	110		100	100				80	70	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	-		120	110	110		100	100						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	-		120	110	110		90	90		80		70	60	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	-	130			100	100		80	80		70		60	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	-	130			100	100		80	80		60		50	50	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	-	130	110	100	90	90	80	70	70	60	50	50	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	130	120	100	90	80	80	70	70	60	50	40	40	30	40	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	130	120	100	90	80	80	60	70	50	40	40	30	30	40	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 538°C / 1000°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 538°C / 1000°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	130	100	90	80	80	70	60	70	50	40	30	30	30		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	120	100	90	80	80	70	50	70	40	40	30	30	30		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	120	100	90	70	80	60	50	70	40	30	30	30	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	120	100	80	70	80	60	40	70	40	30	30	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	120	100	80	70			40	70	30	30	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	110	100	80	60	80	50	40	70	30	30	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		90	70		80			70							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		90	70	50	80			70							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	100	90	70	50	80			70							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		90	70	50	80	50		70							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		90	70	50	80	50		70							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		90	70	50	80	50		70							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					80			70							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					80			70							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					80			70							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					80			70							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					80			70							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					80			70							





# FIRE RATING 180 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	-	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		-	-				130	120	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		130	130				130	120	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	-	-		130	130				120	110	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		-	-	-		130	130				110	100	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	-		130	130	130		120	120				110	90	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	130		130	130	130		110	110				100	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	130		130	120	120		110	110				100	80	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	130		130	120	120		110	110				80	70	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	130		110	110	110		90	90				80	60	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	130		110	110	110		90	90				70	60	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	130		110	100	100		90	90						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	130		110	100	100		80	80		70		60	50	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	130	130			100	100		70	70		60		50	50	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	130	130			90	90		70	70		50		50	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	130	120	100	90	80	80	70	60	60	50	40	40	40	40	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	130	120	100	80	70	70	60	60	50	40	40	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	120	110	100	80	70	70	50	60	40	40	30	30	30	30	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 600°C / 1112°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs Fire Rating 180 minutes Critical steel temperature 600°C / 1112°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	120	100	80	70	70	60	50	60	40	30	30	30	20		
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	120	100	80	70	70	60	50	60	40	30	30	20	20		
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	120	90	80	60	70	50	40	60	30	30	20	20	20		
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	110	90	70	60	70	50	40	60	30	30	20	20	20		
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	110	90	70	60			40	60	30	20	20	20	20		
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	100	90	70	50	70	40	30	60	30	20	20	20	20		
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		80	60		70			60							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		80	60	50	70			60							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	90	80	60	50	70			60							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		80	60	50	70	40		60							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		80	60	50	70	40		60							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		80	60	50	70	40		60							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			60							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			60							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			60							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			60							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			60							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			60							



# FIRE RATING 180 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
1/8	0.405	NWT		1.24		1.45	1.73	1.73		2.41	2.41				3.15	4.83	
	10.29	Hp/A		914.1		802.8	695.8	695.8		541.4	541.4				457.6	390.3	
		HTF		-		-	-	-		-	-				-	130	
1/4	0.54	NWT		1.65		1.85	2.24	2.24		3.02	3.02				3.68	6.05	
	13.72	Hp/A		688.6		624.8	534.5	534.5		424.4	424.4				371.4	295.7	
		HTF		-		-	-	-		130	130				130	120	
3/8	0.675	NWT	1.24	1.65		1.85	2.31	2.31		3.20	3.20				4.01	6.40	
	17.15	Hp/A	866.4	670.2		605.9	500.1	500.1		384.2	384.2				325.5	249.3	
		HTF	-	-		-	-	-		130	130				120	110	
1/2	0.84	NWT	1.65	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47	
	21.34	Hp/A	656.5	526.3		467.8	415.1	415.1		324.6	324.6				269.8	206.0	
		HTF	-	-		-	130	130		120	120				110	100	
3/4	1.05	NWT	1.65	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82	
	26.67	Hp/A	645.7	515.1		456.2	390.4	390.4		299.6	299.6				227.1	180.9	
		HTF	-	-		130	130	130		120	120				110	100	
1	1.315	NWT	1.65	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09	
	33.40	Hp/A	637.2	393.8		377.6	329.3	329.3		254.6	254.6				194.4	151.1	
		HTF	-	130		130	120	120		110	110				100	80	
1-1/4	1.66	NWT	1.65	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70	
	42.16	Hp/A	630.4	386.6		362.2	307.1	307.1		232.9	232.9				185.4	133.9	
		HTF	-	130		130	120	120		110	110				100	80	
1-1/2	1.9	NWT	1.65	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.16	
	48.26	Hp/A	627.1	383.2		336.6	294.0	294.0		220.0	220.0				164.4	124.7	
		HTF	-	130		120	120	120		110	110				90	70	
2	2.375	NWT	1.65	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07	
	60.33	Hp/A	622.7	378.6		332.0	273.4	273.4		198.8	198.8				133.8	110.6	
		HTF	-	130		120	120	120		100	100				80	70	
2-1/2	2.875	NWT	2.11	3.05		4.78	5.16	5.16		7.01	7.01				9.52	14.02	
	73.03	Hp/A	488.4	342.4		223.9	208.7	208.7		157.8	157.8				120.8	88.3	
		HTF	-	120		110	100	100		90	90				70	60	
3	3.5	NWT	2.11	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24	
	88.90	Hp/A	485.9	339.7		221.1	194.3	194.3		143.5	143.5				102.7	79.2	
		HTF	-	120		110	100	100		80	80				60	50	
3-1/2	4	NWT	2.11	3.05		4.78	5.74	5.74		8.08	8.08						
	101.6	Hp/A	484.4	338.2		219.5	184.6	184.6		134.5	134.5						
		HTF	-	120		110	100	100		80	80						
4	4.5	NWT	2.11	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12	
	114.3	Hp/A	483.3	337.1		218.3	175.4	175.4		126.3	126.3		99.6		84.1	68.7	
		HTF	-	120		110	90	90		70	70		60		50	40	
5	5.563	NWT	2.77	3.40			6.55	6.55		9.52	9.52		12.70		15.88	19.05	
	141.3	Hp/A	368.4	301.1			160.0	160.0		112.6	112.6		86.5		71.0	60.7	
		HTF	130	120			90	90		70	70		50		50	40	
6	6.625	NWT	2.77	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95	
	168.3	Hp/A	367.2	299.9			146.8	146.8		97.5	97.5		76.5		61.4	52.4	
		HTF	130	120			80	80		60	60		50		40	40	
8	8.625	NWT	2.77	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.22	
	219.1	Hp/A	365.8	270.7	162.2	146.8	127.0	127.0	101.8	83.6	83.6	71.2	59.7	53.5	48.6	50.1	
		HTF	130	120	90	80	70	70	60	50	50	50	40	40	30	30	
10	10.75	NWT	3.40	4.19	6.35	7.80	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40	
	273.1	Hp/A	297.5	242.3	161.2	132.0	111.7	111.7	82.6	82.6	70.2	58.7	50.6	43.4	39.1	43.4	
		HTF	120	110	90	80	70	70	50	50	50	40	30	30	30	30	
12	12.75	NWT	3.69	4.57	6.35	8.38	9.52	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	
	323.9	Hp/A	274.1	221.9	160.6	122.5	108.2	100.2	73.3	82.0	60.5	50.0	42.7	38.4	33.4	42.7	
		HTF	120	110	90	70	70	60	50	50	40	30	30	30	20	30	



# FIRE RATING 180 Minutes

## Critical Steel Temperature 650°C / 1202°F

### ArmaGel HTF - Passive Fire Protection Design Table to UL1709 - Pipe Designs

#### Fire Rating 180 minutes

#### Critical steel temperature 650°C / 1202°F

NPS	O.D.		Item	Schedule													
	[inch]	Item		5	10	20	30	STD	40	60	XS	80	100	120	140	160	XXS
	[mm]																
14	14	NWT	3.96	6.35	7.92	9.52	9.52	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71		
	355.6	Hp/A	255.2	160.3	129.1	107.9	107.9	92.8	69.2	81.7	55.5	45.0	39.0	34.6	31.1		
		HTF	110	90	80	70	70	60	50	50	50	40	30	30	20	20	
16	16	NWT	4.19	6.35	7.92	9.52	9.52	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49		
	406.4	Hp/A	241.1	160.0	128.7	107.6	107.6	81.3	62.6	81.3	49.2	40.8	35.0	30.1	27.4		
		HTF	110	90	70	70	70	50	40	50	50	30	30	20	20	20	
18	18	NWT	4.19	6.35	7.92	11.13	9.52	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24		
	457.2	Hp/A	240.8	159.7	128.4	92.1	107.3	72.3	54.8	81.0	44.3	36.4	31.0	27.6	24.5		
		HTF	110	90	70	60	70	50	40	50	50	30	30	20	20	20	
20	20	NWT	4.78	6.35	9.52	12.70	9.52	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01		
	508.0	Hp/A	211.4	159.5	107.0	80.8	107.0	68.3	50.5	80.8	40.3	32.8	28.4	24.7	22.2		
		HTF	100	90	70	50	70	40	30	50	50	30	20	20	20	20	
22	22.0	NWT	4.78	6.35	9.52	12.70			22.22	12.70	28.58	34.92	41.28	47.62	53.98		
	558.8	Hp/A	211.0	159.3	106.9	80.6			46.9	80.6	36.9	30.5	26.2	23.0	20.5		
		HTF	100	90	70	50			30	50	30	20	20	20	20	20	
24	24	NWT	5.54	6.35	9.52	14.27	9.52	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54		
	609.6	Hp/A	182.3	159.1	106.7	71.7	106.7	58.9	42.3	80.4	34.0	27.5	23.5	20.9	18.6		
		HTF	100	90	70	50	70	40	30	50	20	20	20	20	20	20	
26	26	NWT		7.92	12.70		9.52			12.70							
	660.4	Hp/A		127.7	80.3		106.6			80.3							
		HTF		70	50		70			50							
28	28	NWT		7.92	12.70	15.88	9.52			12.70							
	711.2	Hp/A		127.6	80.2	64.4	106.5			80.2							
		HTF		70	50	40	70			50							
30	30	NWT	6.35	7.92	12.70	15.88	9.52			12.70							
	762.0	Hp/A	158.8	127.5	80.1	64.3	106.4			80.1							
		HTF	90	70	50	40	70			50							
32	32	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	812.8	Hp/A		127.4	80.0	64.2	106.3	58.5		80.0							
		HTF		70	50	40	70	40		50							
34	34	NWT		7.92	12.70	15.88	9.52	17.48		12.70							
	863.6	Hp/A		127.4	79.9	64.2	106.2	58.4		79.9							
		HTF		70	50	40	70	40		50							
36	36	NWT		7.92	12.70	15.88	9.52	19.05		12.70							
	914.4	Hp/A		127.3	79.8	64.1	106.1	53.6		79.8							
		HTF		70	50	40	70	40		50							
38	38	NWT					9.52			12.70							
	965.2	Hp/A					106.1			79.8							
		HTF					70			50							
40	40	NWT					9.52			12.70							
	1016.0	Hp/A					106.0			79.7							
		HTF					70			50							
42	42	NWT					9.52			12.70							
	1066.8	Hp/A					106.0			79.7							
		HTF					70			50							
44	44	NWT					9.52			12.70							
	1117.6	Hp/A					105.9			79.6							
		HTF					70			50							
46	46	NWT					9.52			12.70							
	1168.4	Hp/A					105.9			79.6							
		HTF					70			50							
48	48	NWT					9.52			12.70							
	1219.2	Hp/A					105.9			79.6							
		HTF					70			50							



API 521 F-factor Assessment of ArmaGel HTF

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## ArmaGel HTF F-factors

ArmaGel HTF is an aerogel insulation and passive fire protection system that provides ISO 22899-1 and UL1709 fire resistance. In the event of fire, it will protect the underlying hydrocarbon facility storage tank or pressure vessel, thereby reducing the amount of hydrocarbon vapours that are produced and need to be controlled, and potentially preventing escalation via an explosive BLEVE event (boiling liquid expanding vapour explosion).

The API 521 standard provides design and sizing guidance for relief devices that also allows thermal insulation/passive fire protection material to be taken into consideration. Equation 17 of API 521 gives a method of calculating an Environmental Factor, F, from the insulation thickness, mean thermal conductivity, and vessel relief temperature. These F factor values are given below.

For insulation and passive fire protection to comply with the requirements of API 521 it must function adequately at temperatures in excess of 900°C for a duration of 2 hours, maintaining its shape and integrity, and resist being dislodged by hose-streams. The ArmaGel HTF system has demonstrated this capability, and gone further by exposure to high-impact and high-velocity jet fires, with temperatures in excess of 1250°C.

API 521 requires use of *“the thermal conductivity of the insulation at the mean temperature between 904°C and the process temperature expected at the relieving conditions”*. F-factors values based on this description are shown below.

Thickness (mm)	Relief vessel temperature		
	200°F (93°C)	300°F (149°C)	400°F (204°C)
<b>10</b>	0.0769	0.0783	0.0792
<b>20</b>	0.0385	0.0391	0.0396
<b>30</b>	0.0256	0.0261	0.0264
<b>40</b>	0.0192	0.0196	0.0198
<b>50</b>	0.0154	0.0157	0.0158
<b>60</b>	0.0128	0.0130	0.0132
<b>70</b>	0.0110	0.0112	0.0113
<b>80</b>	0.0096	0.0098	0.0099
<b>90</b>	0.0085	0.0087	0.0088
<b>100</b>	0.0077	0.0078	0.0079
<b>110</b>	0.0070	0.0071	0.0072
<b>120</b>	0.0064	0.0065	0.0066
<b>130</b>	0.0059	0.0060	0.0061



However, it is also possible to interpret the above requirement as the mean thermal conductivity value across the stipulated temperature range. This approach is arguably more accurate and would give the following F-factor values.

Thickness (mm)	Relief vessel temperature		
	200°F (93°C)	300°F (149°C)	400°F (204°C)
<b>10</b>	0.1003	0.0981	0.0958
<b>20</b>	0.0502	0.0491	0.0479
<b>30</b>	0.0334	0.0327	0.0319
<b>40</b>	0.0251	0.0245	0.0239
<b>50</b>	0.0201	0.0196	0.0192
<b>60</b>	0.0167	0.0164	0.0160
<b>70</b>	0.0143	0.0140	0.0137
<b>80</b>	0.0125	0.0123	0.0120
<b>90</b>	0.0111	0.0109	0.0106
<b>100</b>	0.0100	0.0098	0.0096
<b>110</b>	0.0091	0.0089	0.0087
<b>120</b>	0.0084	0.0082	0.0080
<b>130</b>	0.0077	0.0075	0.0074



## Passive Fire Protection (PFP) rated Aerogel Insulation Specifications (ArmaGel HTF)

### Code and Standard

ASTM C1728	Standard Specification for Flexible Aerogel Insulation
ASTM C303	Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
ASTM C177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus
ASTM C411	Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation
ASTM C1104	Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
ASTM C1101	Standard Test Methods for Classifying the Flexibility or Rigidity of Mineral Fiber Blanket and Board Insulation
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM C356	Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
ASTM C1763	Standard Test Method for Water Absorption by Immersion of Thermal Insulation Materials
ASTM C165	Standard Test Method for Measuring Compressive Properties of Thermal Insulations
ASTM C795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C692	Standard Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel
ASTM 1617	Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
ASTM C1338	Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
UL1709	Standard for Safety - Rapid Rise Fire Tests of Protection Materials for Structural Steel
UL 2431	Standard for Safety - Durability of Fire Resistive Coatings and Materials
ISO 22899-1	Determination of the resistance to jet fires of passive fire protection materials
API 521	Pressure-relieving and Depressuring Systems



## Insulation Materials

### 2.1.PFP rated flexible Aerogel Insulation Blanket for Thermal insulation and/or Passive Fire Protection applications

PFP rated flexible aerogel insulation blanket is made of non-woven fibre blanket infused with amorphous silica aerogel.

PFP rated flexible aerogel insulation shall comply to the requirements of ASTM C1728, Type III, Grade 1, Category A, as listed in table 1.

Table 1: Technical Specification for PFP rated flexible Aerogel Insulation

Material Properties	ValueTest	Standard
Blanket Thickness	10mm	ASTM C303
Density	180 kg/m <sup>3</sup>	ASTM C303
Thermal Conductivity	0.021 W/(m.K) @ 24°C 0.022 W/(m.K) @ 38°C 0.023 W/(m.K) @ 93°C 0.025 W/(m.K) @ 149°C 0.029 W/(m.K) @ 204°C 0.032 W/(m.K) @ 260°C 0.036 W/(m.K) @ 316°C 0.043 W/(m.K) @ 371°C	ASTM C177
Maximum Service Temperature	650°C	ASTM C447
Hot Surface Performance	Pass	ASTM C411
Water Vapour Sorption	≤ 5% by weight	ASTM C1104
Flexibility	Flexible	ASTM C1101
Surface Burning Characteristic	Flame Spread Index ≤5, Smoke Developed Index ≤10	ASTM E84
Linear Shrinkage	< 2% in width & length	ASTM C356
Water absorption	Pass	ASTM C1763
Compressive strength	≥ 3 psi (20.7 kPa) @ 10% compression	ASTM C165
Stress Corrosion Performance for Use on Austenitic Stainless Steel	Pass	ASTM C795
Corrosiveness to steel	MLCR < that of 5-ppm chloride solution	ASTM C1617
Fungal resistance	No growth	ASTM C1338
Hydrophobic	Yes	



## Fire tests and assessments

Fire Standards/Assessments	Results/Assessments	Remarks
UL1709	<p>Shall achieve 120 minutes Hydrocarbon Pool Fire Resistance Shall achieve 180 minutes Hydrocarbon Pool Fire Integrity</p> <p>The fire test certification shall mirror the intended application i.e. for single skin steel protection such as pipes, vessels, spheres, vessel skirts etc the fire test certification shall reflect fire testing on circular hollow sections (pipes). For applications on wide flange steel profiles, the fire test certification shall reflect fire testing on wide flange steel profiles.</p>	<p>The system shall have an official UL-listing and a third party certification body type approval.</p> <p>The system fire testing shall include butt-joint designs of the blankets. The blankets shall be installed using binding wire only, in accordance with the UL-listing. The blanket layers shall be covered by a jacketing system, in accordance with the UL-listing.</p>
UL2431	<p>The performance loss as a result of the UL2431 environmental exposures shall not exceed 5% for any of the exposures for Classification Category I-A.</p>	<p>The UL2431 compliance shall be included in the UL-listing.</p>
ISO 22899-1	<p>Shall achieve up to 180 minutes Jet Fire Resistance. Shall achieve 180 minutes Jet Fire Integrity.</p> <p>The erosion factor for UL1709 pool fire designs versus ISO22899-1 jet fire designs shall equal 1 for critical steel temperatures &gt;350°C.</p>	<p>The system shall have a third party certification body type approval. The blankets shall be installed using binding wire only on all layers. Only the penultimate blanket layer shall be installed using alternating binding wire and bands. The blanket layers shall be covered by a jacketing system, in accordance with the type approval.</p>
API 521	<p>F-factor Assessment shall be available based on both (i) the thermal conductivity of the insulation at the mean temperature between 904°C and the process temperature expected at the relieving conditions, and (ii) the mean thermal conductivity value across the stipulated temperature range.</p>	
Numerical modelling	<p>The fire performance of the system shall be verified by a third party certification body, endorsing manufacturers finite element modelling beyond the as-tested scope.</p>	
Design Tables	<p>For thickness determination of the PFP rated Aerogel Insulation Blanket, Design Tables shall be provided by the manufacturer covering fire ratings of 15, 30, 60, 90, 120, 180 minutes, and critical steel temperatures of 200, 300, 400, 427, 500, 538, 600, 650 °C.</p>	<p>These design tables shall be verified and endorsed by an independent third party certification body.</p>



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## ABOUT ARMACELL

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As the inventor of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With more than 3,300 employees and 25 production plants in 19 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for acoustic and lightweight applications, recycled PET products, next-generation aerogel technology and passive fire protection systems.

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