Base Load Power Hub (BLPH)

RESTRICTION ORIFICE

CALCULATION SHEETS

Document Number: 1724001690-IN-CA-00005

Document Class: 2

03	19/02/2025	Accepted for Construction (AFC)	MZ	GA	GO
02	20/01/2025	Accepted for Construction (AFC)	MZ	GA	GO
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00	03/10/2024	Issue for Review (IFR)	MZ	GA	GO
Rev.	Date	Description	Prepared	Reviewed	Approved

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)
02	Accepted for Construction (AFC)
03	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-005	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	:/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

CHOKED/CRITICAL FLOW CONDITIONS

BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-007	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	:/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-010	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	:/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-013	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	:/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-016	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-019	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

---------- Flow ----------

Flow Rate	2047.00	kg/h
Pipe Reynolds Number	669032.	

---------- Measurements ----------

Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC

---------- Fluid Properties @ dry conditions ----------

Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	

----------Factors----------

Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	

---------- Design Information ----------

Pipe Diameter(D)	108.20400	mm@20. degC
Bore Diameter (d)	21.53988	mm@20. degC
Beta	0.19907	@20. degC
Orifice Minimum Thickness (tPE)	21.5399	mm
Pipeline Velocity V	24.71	m/s
Overall Pressure Loss	14.0885	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-022	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:HYDROGEN_GAS	Sales Order:	/
Fluid Ref.	:ENTER HYDROGEN_GAS	Service	:HYDROGEN GAS
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	119.000	kg/h
Pipe Reynolds Number	157946.	
Measurements		
Pressure (Upstream pG1)	30.0000	bar(g)
Pressure (Downstream pG2)	15.9115	bar(g)
Choking Pressure Ratio pf2/pf1	0.5457	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	2.5021	kg/m^3
Specific Gravity, G	0.0691	
Molecular Weight (Mw)	2.0000	
Compressibilty (Zf)	1.0000	
Viscosity	0.0100	cP
Isentropic Exponent(Cp/Cv)	1.3000	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6673	
Design Information		
Pipe Diameter(D)	26.64460	mm@20. degC
Bore Diameter (d)	5.19351	mm@20. degC
Beta	0.19492	@20. degC
Orifice Minimum Thickness (tPE)	5.1935	mm
Pipeline Velocity V	23.69	m/s
Overall Pressure Loss	14.0885	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:25-RO-024	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:Nitrogen	Sales Order:	:/
Fluid Ref.	:MBWR State Equation	Service	:NITROGEN
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	30.0000	kg/h
Pipe Reynolds Number	22145.	
Measurements		
Pressure (Upstream pG1)	2.0000	bar(g)
Pressure (Downstream pG2)	0.5770	bar(g)
Choking Pressure Ratio pf2/pf1	0.5277	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	3.4072	kg/m^3
Specific Gravity, G	0.9672	
Molecular Weight (Mw)	28.0134	
Compressibilty (Zf)	0.9994	
Viscosity	0.0180	cP
Isentropic Exponent(Cp/Cv)	1.4032	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6855	
Design Information		
Pipe Diameter(D)	26.64460	mm@20. degC
Bore Diameter (d)	4.26669	mm@20. degC
Beta	0.16013	@20. degC
Orifice Minimum Thickness (tPE)	4.2667	mm
Pipeline Velocity V	4.39	m/s
Overall Pressure Loss	1.4230	bar

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BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:50-RO-001	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:SEA_WATER	Sales Order:	:/
Fluid Ref.	:ENTER SEA_WATER	Service	:SEA WATER
Pipe	:316 Stainless Steel	Primary	:Super Duplex
Meter	:Pipe Taps, Restrictive Orifice	Taps	:2 1/2 & 8 D
Coeff Eq	:Stolz	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Max/Design/Normal		
Flow Rate	0.850000	litre/h(Flow Volume)
Differential	4.6000	Bar
Pipe Reynolds Number	12.	
Measurements		
Pressure pG	5.6000	bar(g)
Barometric	1.0133	bar(a)
Temperature (Flowing)	22.0000	degC
Fluid Properties		
Density (Flowing)	1025.00000	kg/m^3
Viscosity	1.00000	cP
Factors		
Sizing Factor(SM)	0.00001	@ Normal Flow
Discharge Coefficient(C)	0.59593	@ Normal Flow
Pipe Thermal Expansion(FaD)	1.00003	
Bore Thermal Expansion(Fad)	1.00003	
Design Information		
Pipe Diameter(D)	26.64460	mm@20.degC
Bore Diameter	0.12976	mm@20. degC
Plate thickness-Flange Mounted Plate	3.1750	mm@20. degC
Beta	0.00487	@20. degC
Pipeline Velocity (Max)	0.00	m/s
Overall Pressure Loss(Max)	4.6000	bar

Meter is starting to cavitate

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:50-RO-002	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:SEA_WATER	Sales Order:	:/
Fluid Ref.	:ENTER SEA_WATER	Service	:SEA WATER
Pipe	:316 Stainless Steel	Primary	:Super Duplex
Meter	:Pipe Taps, Restrictive Orifice	Taps	:2 1/2 & 8 D
Coeff Eq	:Stolz	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Max/Design/Normal		
Flow Rate	0.850000	litre/h(Flow Volume)
Differential	4.6000	Bar
Pipe Reynolds Number	12.	
Measurements		
Pressure pG	5.6000	bar(g)
Barometric	1.0133	bar(a)
Temperature (Flowing)	22.0000	degC
Fluid Properties		
Density (Flowing)	1025.00000	kg/m^3
Viscosity	1.00000	cP
Factors		
Sizing Factor(SM)	0.00001	@ Normal Flow
Discharge Coefficient(C)	0.59593	@ Normal Flow
Pipe Thermal Expansion(FaD)	1.00003	
Bore Thermal Expansion(Fad)	1.00003	
Design Information		
Pipe Diameter(D)	26.64460	mm@20.degC
Bore Diameter	0.12976	mm@20. degC
Plate thickness-Flange Mounted Plate	3.1750	mm@20. degC
Beta	0.00487	@20. degC
Pipeline Velocity (Max)	0.00	m/s
Overall Pressure Loss(Max)	4.6000	bar

Meter is starting to cavitate

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Customer:	ROSETTI MARINO	JOB	:4791_OS
TAG	:80-RO-001	Doc	:1724001690-IN-CA-00005-03
TAGFluid	:Nitrogen	Sales Order:	:/
Fluid Ref.	:MBWR State Equation	Service	:NITROGEN
Pipe	:316 Stainless Steel	Primary	:316 Stainless Steel
Meter	:Orifice:Choked Flow	Taps	:Upstream
Coeff Eq	:Ward-Smith	Calculation	:SIZE
Preparer	:THORAT	Printed	:19/02/2025

Flow		
Flow Rate	30.0000	kg/h
Pipe Reynolds Number	22145.	
Measurements		
Pressure (Upstream pG1)	2.0000	bar(g)
Pressure (Downstream pG2)	0.5770	bar(g)
Choking Pressure Ratio pf2/pf1	0.5277	
Barometric	1.0133	bar(a)
Temperature Flowing	25.0000	degC
Fluid Properties @ dry conditions		
Density Flowing	3.4072	kg/m^3
Specific Gravity, G	0.9672	
Molecular Weight (Mw)	28.0134	
Compressibilty (Zf)	0.9994	
Viscosity	0.0180	cP
Isentropic Exponent(Cp/Cv)	1.4032	
Factors		
Discharge Coefficient(C)	0.8392	
Pipe Thermal Expansion (FaD)	1.0001	
Critical Flow Function (Ycr)	0.6855	
Design Information		
Pipe Diameter(D)	26.64460	mm@20. degC
Bore Diameter (d)	4.26669	mm@20. degC
Beta	0.16013	@20. degC
Orifice Minimum Thickness (tPE)	4.2667	mm
Pipeline Velocity V	4.39	m/s
Overall Pressure Loss	1.4230	bar

CHOKED/CRITICAL FLOW CONDITIONS

BORE DIAMETER AND THICKNESS AS DISPLAYED ON THE GAD TABLE

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