

Danfoss-S45	11
1 Contents	13
2 General Information	18
2.1 Overview	18
2.2 Design	18
2.3 Benefits	18
2.4 Typical applications	19
2.5 The Series 45 product family	19
2.6 Load sensing open circuit system	21
2.7 Servo Control Orifice	22
2.7.1 Servo Control Orifice Principle	22
2.7.2 Servo Control Orifice Performance	23
2.7.3 Pacing Factor	24
2.8 Hydraulic Controls	24
2.8.1 Pressure compensated controls	24
2.8.1.1 Operation	24
2.8.1.2 Pressure compensated system characteristics	25
2.8.1.3 Typical applications for pressure compensated systems	25
2.8.2 Remote pressure compensated controls	25
2.8.2.1 Remote pressure compensated system characteristics	26
2.8.2.2 Typical applications for remote pressure compensated systems	27
2.8.3 Load sensing controls	27
2.8.3.1 LS control with bleed orifice	27
2.8.3.2 Integral PC function	28
2.8.3.3 Load sensing system characteristics	28
2.9 Electric Controls	28
2.9.1 Electric Proportional Controls (EPC)	28
2.9.1.1 PLUS+1® Compliance	28
2.9.1.2 Electric Proportional Control Principle	28
2.9.1.3 Electric Proportional Control Response/Recovery	29
2.9.1.4 Electric Proportional Control Characteristic – Normally Closed	30
2.9.1.5 Electric Proportional Control Characteristic – Normally Open	31
2.9.2 Electric On-Off Controls	33
2.9.2.1 PLUS+1 Compliance	33
2.9.2.2 Electric On-Off Control Principle	33
2.9.2.3 Electric On-Off Control Response/Recovery	34
2.9.2.4 Electric On-Off Control Performance vs. Ambient Temperature Characteristic	34
2.9.2.5 Electric On-Off Control Characteristic – Normally Closed	35
2.9.2.6 Electric On/Off Control Characteristic – Normally Open	36
2.9.3 Electric dump valve PC/LS controls	37
2.9.4 Electronic Torque Limiting Controls (ETL)	37
2.9.4.1 PLUS+1 Compliance	37

2.9.4.2	Electric Torque Limiting Control Principle	38
2.9.4.3	Electronic Torque Limiting Control Characteristic	39
2.9.5	Fan Drive Control (FDC)	39
2.9.5.1	PLUS+1 Compliance	39
2.9.5.2	Fan Drive Control Principle	41
2.9.5.3	Fan Drive Control System Characteristics	41
2.9.5.4	Unintended Applications for Fan Drive Control Systems	42
2.9.5.5	Fan Drive Control characteristic - Normally Closed	42
2.9.5.6	Solenoid data – Normally closed	43
2.9.5.7	Fan Drive Control configuration	45
2.9.5.8	NC Fan Drive Control 3D Views	45
2.10	Angle Sensor	45
2.10.1	PLUS+1 Compliance	45
2.10.2	Angle Sensor Principle	46
2.10.3	Angle Sensor Characteristics	46
2.10.3.1	J & F-Frame (45-90cc) Angle Sensor Identification Convention:	47
2.10.3.2	E-Frame (100-147cc) Angle Sensor Identification Convention:	47
2.10.4	Angle sensor electrical specifications	50
2.10.5	Angle Sensor Calibration	50
2.10.6	Angle Sensor Functionality	50
2.11	Charge Pump Circuits	50
2.11.1	Example Circuit #1	50
2.11.2	Example Circuit #2	51
2.12	Operating parameters	52
2.12.1	Fluids	52
2.12.2	Viscosity	52
2.12.3	Temperature	52
2.12.4	Inlet pressure	53
2.12.5	Case pressure	53
2.12.6	Pressure ratings	54
2.12.7	Speed ratings	54
2.12.8	Duty cycle and pump life	54
2.12.9	Speed, flow, and inlet pressure	55
2.13	Design parameters	56
2.13.1	Installation	56
2.13.2	Filtration	56
2.13.3	Reservoir	56
2.13.4	Fluid velocity	56
2.13.5	Shaft loads	57
2.13.6	Bearing life	57
2.13.7	Mounting flange loads	58
2.13.8	Estimating overhung load moments	58
2.13.9	Auxiliary mounting pads	59
2.13.10	Input shaft torque ratings	59
2.13.11	Understanding and minimizing system noise	60

2.13.12	Understanding and minimizing system instability	60
2.13.13	LS System Over-Signaling	60
2.14	Sizing equations	61
3	Frame K2	62
3.1	Design	62
3.2	Technical Specifications	63
3.3	Order Code	63
3.4	Performance K2-25C	69
3.5	Performance K2-30C	70
3.6	Performance K2-38C	71
3.7	Performance K2-40C	72
3.8	Performance K2-45C	73
3.9	Hydraulic Controls	74
3.9.1	Pressure Compensated Controls	74
3.9.2	Remote Pressure Compensated Controls	75
3.9.3	Load Sensing Pressure Compensated Controls	76
3.9.4	Load Sensing Control with Bleed Orifice /Pressure Compensated	77
3.10	Electric Controls	78
3.10.1	Connectors	78
3.10.2	Continuous Duty Operating Range	78
3.10.3	Solenoid Data - Normally Closed	78
3.10.4	Solenoid Data - Normally Open	78
3.10.5	Normally Closed Electric On/Off with Pressure Compensation Controls	79
3.10.6	Normally Open Electric On/Off with Pressure Compensation Controls	79
3.10.7	Normally Closed Electric Proportional with Pressure Compensation Controls	81
3.10.8	Normally Open Electric Proportional with Pressure Compensation Controls	82
3.10.9	Normally Closed Fan Drive Control	83
3.11	Input Shafts	84
3.12	Installation Drawings	86
3.12.1	Axial Ported Endcap	86
3.12.2	Axial Ported Endcap O-ring Boss Ports Installation Dimensions	87
3.12.3	Radial Ported Endcap Split Flange Ports	88
3.12.4	Radial Ported Endcap O-ring Boss Ports	89
3.12.5	Radial Ported Endcap Installation Dimensions	90
3.12.6	Front Mounting Flange - SAE-B two bolt	90
3.12.7	Auxiliary Mounting Pads	91
3.12.7.1	SAE-A auxiliary mounting pad	91
3.12.7.2	SAE-B auxiliary mounting pad	91
3.12.7.3	SAE-A Fixed flange	92
3.12.7.4	Auxiliary Mounting Pad - Running Cover	92
3.12.7.5	Electric solenoid, left side	93
3.12.7.6	Fan drive control	93
3.13	Displacement Limiter	93
4	Frames L and K	95
4.1	Design	95

4.2	Technical Specifications	96
4.3	Order code	96
4.4	Performance L25C	102
4.5	Performance L30D	103
4.6	Performance K38C	104
4.7	Performance K45D	105
4.8	Hydraulic Controls	106
4.8.1	Pressure Compensated Controls	106
4.8.2	Remote Pressure Compensated Controls	106
4.8.3	Load Sensing/Pressure Compensated Controls	107
4.8.4	Load Sensing Control with Bleed Orifice /Pressure Compensated	108
4.9	Electric Controls	109
4.9.1	Connector	109
4.9.2	Continuous Duty Operating Range	110
4.9.3	Solenoid Data - Normally Closed	110
4.9.4	Solenoid Data - Normally Open	110
4.9.5	Normally Closed Electric On/Off with Pressure Compensation Controls	110
4.9.6	Normally Open Electric On/Off with Pressure Compensation Controls	111
4.9.7	Normally Closed Electric Proportional Controls with PC and LS Compensation	112
4.9.8	Normally Open Electric Proportional Controls with PC and LS Compensation	114
4.10	Input shafts	116
4.11	Installation drawings	117
4.11.1	Axial Ported Endcap	117
4.11.2	Axial Ported Endcap Installation Dimensions	118
4.11.3	Radial Ported Endcap Split Flange Ports	118
4.11.4	Radial Ported Endcap O-ring Boss Ports	119
4.11.5	Radial Ported Endcap Rear View	119
4.11.6	Radial Ported Endcap Installation Dimensions	120
4.11.7	Front Mounting Flange - SAE-B two bolt	120
4.11.8	Auxiliary Mounting Pads	121
4.11.8.1	SAE-A auxiliary mounting pad	121
4.11.8.2	SAE-B auxiliary mounting pad	121
4.11.8.3	Auxiliary Mounting Pad - Running Cover	122
4.11.9	Electric Solenoid, Left Side	122
4.11.10	Electric Solenoid, Right Side	122
4.12	Displacement limiter	123
5	Frame J	124
5.1	Design	124
5.2	Technical Specifications	125
5.3	Order code	125
5.4	Performance J45B	136
5.5	Performance J51B	137
5.6	Performance J60B	138
5.7	Performance J65C	139
5.8	Performance J75C	140

5.9	Hydraulic Controls	141
5.9.1	Pressure Compensated Controls	141
5.9.2	Remote Pressure Compensated Controls	142
5.9.3	Load sensing/Pressure compensated Controls	143
5.9.4	Load sensing Control with Bleed Orifice/ Pressure Compensated	144
5.10	Electric Controls	145
5.10.1	Connectors	145
5.10.2	Continuous Duty Operating Range	145
5.10.3	Solenoid Data - Normally Closed	145
5.10.4	Solenoid Data - Normally Open	145
5.10.5	Fan Drive Control Solenoid Data - Normally Closed	146
5.10.6	Normally Closed Electric On/Off with Pressure Compensation Controls	146
5.10.7	Normally Open Electric On/Off with Pressure Compensation Controls	147
5.10.8	Normally Closed Electric Proportional with Pressure Compensation Controls	148
5.10.9	Normally Open Electric Proportional with Pressure Compensation Controls	149
5.10.10	Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls	151
5.10.11	Normally Closed Fan Drive Control	152
5.11	Input shafts	153
5.12	Installation drawings	156
5.12.1	Axial Ported Endcap	156
5.12.2	Axial Ported Endcap Installation Dimensions	157
5.12.3	Right Fan Drive Control	158
5.12.4	Radial Ported Endcap Split Flange Ports	158
5.12.5	Radial Ported Endcap Rear View	159
5.12.6	Radial Ported Endcap Installation Dimensions	160
5.12.7	Right Angle Sensor Position Installation Dimensions	161
5.12.8	Front Mounting Flange	162
5.12.9	Auxiliary mounting pads	163
5.12.9.1	SAE-A auxiliary mounting pad (integrated)	163
5.12.9.2	SAE-A auxiliary mounting pad (non-integral)	164
5.12.9.3	SAE-B auxiliary mounting pad	165
5.12.9.4	SAE-C auxiliary mounting pad	165
5.12.9.5	Running cover	166
5.12.10	Radial Endcap Clockwise	166
5.12.11	Radial Endcap Counterclockwise	167
5.12.12	Axial Endcap Clockwise	167
5.12.13	Axial Endcap Counterclockwise	167
5.13	Displacement limiter	168
6	Frame F	169
6.1	Design	169
6.2	Technical Specifications	170
6.3	Order code	170
6.4	Performance F74B	176
6.5	Performance F90C	177

6.6	Hydraulic Controls	178
6.6.1	Pressure Compensated Controls	178
6.6.2	Remote Pressure Compensated Controls	178
6.6.3	Load Sensing/Pressure Compensated Controls	179
6.6.4	Load Sensing Control with Bleed Orifice/Pressure Compensated	180
6.7	Electric Controls	181
6.7.1	Connectors	181
6.7.2	Continuous Duty Operating Range	182
6.7.3	Solenoid Data - Normally Closed	182
6.7.4	Solenoid Data - Normally Open	182
6.7.5	Fan Drive Control Solenoid Data - Normally Closed	182
6.7.6	Normally Closed Electric On/Off with Pressure Compensation Controls	182
6.7.7	Normally Open Electric On/Off with Pressure Compensation Controls	183
6.7.8	Normally Closed Electric Proportional with Pressure Compensation Controls	184
6.7.9	Normally Open Electric Proportional with Pressure Compensation Controls	185
6.7.10	Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls	187
6.7.11	Normally Closed Fan Drive Control	188
6.8	Input shafts	189
6.9	Installation drawings	190
6.9.1	Axial Ported Endcap	190
6.9.2	Axial Ported Endcap Installation Dimensions	190
6.9.3	Right Fan Drive Control	191
6.9.4	Radial Ported Endcap Split Flange Ports	191
6.9.5	Radial Ported Endcap Rear View	192
6.9.6	Radial Ported Endcap Installation Dimensions	193
6.9.7	Right Angle Sensor Position Installation Dimensions	194
6.9.8	Front Mounting Flange	195
6.9.9	Radial Endcap Clockwise	197
6.9.10	Radial Endcap Counterclockwise	198
6.9.11	Axial Endcap Clockwise	198
6.9.12	Axial Endcap Counterclockwise	198
6.10	Displacement limiter	198
7	Frame E	200
7.1	Design	200
7.2	Technical Specifications	201
7.3	Order code	201
7.4	Performance E100B	208
7.5	Performance E130B	209
7.6	Performance E147C	210
7.7	Hydraulic Controls	211
7.7.1	Pressure Compensated Controls	211
7.7.2	Remote Pressure Compensated Controls	211
7.7.3	Load Sensing/Pressure Compensated	212
7.7.4	Load Sensing Control with Bleed Orifice/Pressure Compensated	213
7.8	Electric Controls	214

7.8.1	Connectors	214
7.8.2	Continuous Duty Operating Range	215
7.8.3	Solenoid Data - Normally Closed	215
7.8.4	Solenoid Data - Normally Open	215
7.8.5	Normally Closed Electric On/Off with Pressure Compensation Controls	215
7.8.6	Normally Open Electric On/Off with Pressure Compensation Controls	216
7.8.7	Normally Closed Electric Proportional with Pressure Compensation Controls	217
7.8.8	Normally Open Electric Proportional with Pressure Compensation Controls	219
7.8.9	Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls	220
7.9	Input shafts	222
7.10	Installation drawings	223
7.10.1	Axial Ported Endcap	223
7.10.2	Axial Ported Endcap Installation Dimensions	224
7.10.3	Radial Ported Endcap Installation Dimensions	225
7.10.4	Right Angle Sensor Position Installation Dimensions	226
7.10.5	Radial Ported Endcap Rear View	227
7.10.6	Radial Ported Endcap Split Flange Ports	227
7.10.7	Front Mounting Flange	228
7.10.8	Endcap Dimensions	229
7.10.9	Auxiliary mounting pads	230
7.11	Displacement Limiters	232
	Danfoss-D1P	235
1	Contents	237
2	General Information	240
2.1	Overview	240
2.2	Features and benefits	240
2.3	Typical applications	240
2.4	Design	241
3	Technical Specifications	243
3.1	Pump specifications	243
3.2	Fluid specifications	244
3.3	D1P 260 angle sensor	245
3.3.1	Angle sensor principle	245
3.3.2	Location	245
3.3.3	Angle sensor characteristics	246
3.3.4	Angle sensor electrical specifications	247
3.3.5	Angle sensor calibration	247
3.3.6	Angle sensor functionality	248
4	Model Code	249
4.1	Model code	249
4.2	Displacement, rotation and product version	250
4.3	Control types	250
4.4	Input shaft options	251
4.5	Mounting flange options	251
4.6	End cap and main port options	251

4.7	Auxiliary mounting flange options	252
4.8	Power control settings	252
4.9	Pressure compensated control settings	253
4.10	Load sensing control settings	253
4.11	Hydraulic displacement control setting	253
4.12	Maximum and minimum displacement settings	253
4.13	Minimum displacement settings	253
4.14	Special hardware and features	254
4.15	Tandem pump information	255
5	Parameters	256
5.1	Pressure	256
5.2	Speed	256
5.3	Performance	257
5.3.1	Input power	257
5.3.2	Output flow	259
5.3.3	Efficiency	260
5.4	Fluid	261
5.4.1	Viscosity	261
5.4.2	Temperature	261
5.4.3	Fluid velocity	261
5.5	Shaft torque ratings	262
5.6	Shaft load	262
5.7	Mounting flange loads	262
5.8	Auxiliary mounting pads	262
5.9	Estimating overhung load moments	263
5.10	Understanding and minimizing system noise	264
5.11	Installation	264
5.12	Filtration	264
5.13	Reservoir	265
5.14	Sizing Equations	265
6	Control Type	266
6.1	NPN (Pressure Compensated Control)	266
6.2	NPSN (Pressure Compensated Control + Load Sensing Control)	268
6.3	NPNR (Pressure Compensated Control + Remote Pressure Compensated Control)	270
6.4	TPSN (Power Control + Pressure Compensated Control + Load Sensing Control)	272
6.5	NNES (Electric Displacement Control + Load Sensing Control)	274
6.5.1	Solenoid Specification	276
6.5.2	Standard EDC Valve	277
6.5.3	NNES Priority	277
6.6	TPE2/TPE5 (Power Control + Pressure Compensated Control + Electric Displacement Control)	278
6.6.1	TPE2/TPE5 Priority	278
6.7	NPE2/NPE0 (Pressure Compensated Control + Electric Displacement Control)	279
7	Installation Drawings	280

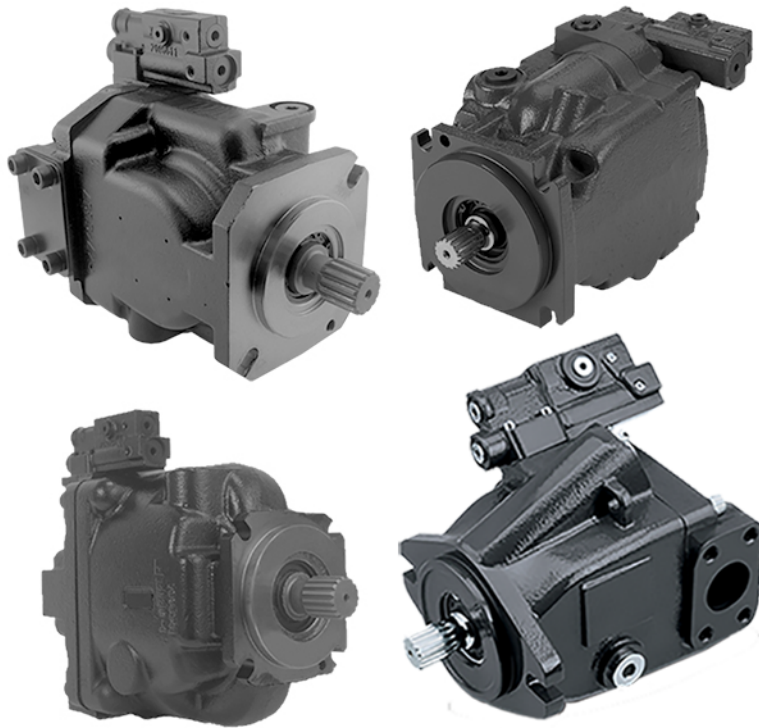
7.1	Size 130/145	280
7.1.1	Dimensions (mm) and port descriptions	280
7.1.1.1	Size 130/145: TPSN w/o Charge Pump	280
7.1.1.2	Size 130/145: TPE5 w/o Charge Pump	282
7.1.1.3	Size 130/145: TPSN w/ Charge pump	284
7.1.1.4	Size 130/145: TPE5 w/ Charge Pump	286
7.1.2	Input shaft	288
7.1.2.1	Shaft specifications	288
7.1.3	Aux mounting flange	290
7.1.3.1	Size 130/145: Option NN (No Coupling)	290
7.1.3.2	Size 130/145: Option A1 (SAE-A, 9 teeth)	290
7.1.3.3	Size 130/145: Option A2 (SAE-A, 11 teeth)	291
7.1.3.4	Size 130/145: Option B1 (SAE-B, 13 teeth)	292
7.1.3.5	Size 130/145: Option B2 (SAE-B, 15 teeth)	292
7.1.3.6	Size 130/145: Option BA (SAE-B, 13 teeth)	293
7.1.3.7	Size 130/145: Option C5 (SAE-C, 14 teeth)	293
7.1.3.8	Size 130/145: Option D5 (SAE-D, 24 teeth)	294
7.2	Size 193	295
7.2.1	Dimensions (mm) and port descriptions	295
7.2.1.1	Size 193: TPE2 w/ Charge Pump	295
7.2.1.2	Size 193: TPSN w/ Charge Pump	297
7.2.2	Input shaft	299
7.2.2.1	Shaft specifications	299
7.2.3	Aux mounting flange	302
7.2.3.1	Size 193: Option NN (No Coupling)	302
7.2.3.2	Size 193: Option A1 (SAE-A, 9 teeth)	302
7.2.3.3	Size 193: Option A3 (SAE-A, 13 teeth)	303
7.2.3.4	Size 193: Option B1 (SAE-B, 13 teeth)	303
7.2.3.5	Size 193: Option B2 (SAE-B, 15 teeth)	304
7.2.3.6	Size 193: Option BA (SAE-B, 13 teeth)	305
7.2.3.7	Size 193: Option BB (SAE-B, 13 teeth)	306
7.2.3.8	Size 193: Option C5 (SAE-C, 14 teeth)	307
7.2.3.9	Size 193: Option C9 (SAE-C, 13 teeth)	307
7.2.3.10	Size 193: Option D2 (SAE-D, 13 teeth)	308
7.2.3.11	Size 193: Option D5 (SAE-D, 24 teeth)	308
7.2.3.12	Size 193: Option E2 (SAE-E, 24 teeth)	309
7.3	Size 260	310
7.3.1	Dimensions (mm) and port descriptions	310
7.3.1.1	Size 260: TPE2 w/ Charge Pump	310
7.3.1.2	Size 260: TPSN w/ Charge Pump	312
7.3.2	Input shaft	314
7.3.2.1	Shaft specifications	314
7.3.3	Aux mounting flange	317
7.3.3.1	Size 260: Option A1 (SAE-A, 9 teeth)	317
7.3.3.2	Size 260: Option A3 (SAE-A, 13 teeth)	317

7.3.3.3	Size 260: Option B1 (SAE-B, 13 teeth)	318
7.3.3.4	Size 260: Option B2 (SAE-B, 15 teeth)	318
7.3.3.5	Size 260: Option BA (SAE-B, 13 teeth)	319
7.3.3.6	Size 260: Option BB (SAE-B, 13 teeth)	320
7.3.3.7	Size 260: Option C5 (SAE-C, 14 teeth)	321
7.3.3.8	Size 260: Option C9 (SAE-C, 13 teeth)	322
7.3.3.9	Size 260: Option D2 (SAE-D, 13 teeth)	322
7.3.3.10	Size 260: Option D5 (SAE-D, 24 teeth)	323
7.3.3.11	Size 260: Option E2 (SAE-E, 24 teeth)	323
7.3.3.12	Size 260: Option E3 (SAE-E, 28 teeth)	324
7.4	Inlet pressure gauge port	325
8	Additional Information	327
8.1	Tandem with Danfoss pumps	327
8.2	Tandem pump torque	327
8.3	Tightening torque	328
9	Installation Notes	329
9.1	Below reservoir (standard)	329
9.2	Above reservoir	330
9.3	Reservoir installation	331
10	Displacement Limiter	332
10.1	Displacement limiter setting	332

Technical Information

Series 45

Axial Piston Open Circuit Pumps



Revision history

Table of revisions

Date	Changed	Rev
January 2022	Clarified importance of relief valve for system protection; added mounting flange technical data to frame F	1201
April 2021	Added K2 040C displacement performance graphs	1104
June 2020	Changed document number from 'BC00000019' and '520L0519' to 'BC152886483703'	1103
October 2019	Added K2 040C displacement technical data	1001
July 2019	Removed excess content	0903
June 2019	Removed M1 ports from K2 schematics and other minor changes	0902
March 2018	Minor updates	0901
September 2017	Corrected performance curves for K2 Pumps	0812
August 2017	Corrected typo	0811
April 2017	Update the TOC	0810
March 2017	add K2 Frame	0809
July 2016	Fan Drive Control configuration-corrected G and H model code tables	0808
July 2016	Fan Drive Control configuration-included G and H model code tables	0807
June 2016	Various edits - Fan Drive Control	0806
April 2016	Various edits - Fan Drive Control	0805
March 2016	Add Fan Drive Control	0804
March 2015	Add E Frame ETL control and Angle Sensor	HC
October 2014	Add ETL control and Angle Sensor	HB
July 2014	Danfoss layout	HA

Contents

General Information

Overview.....	8
Design.....	8
Benefits.....	8
Typical applications.....	9
The Series 45 product family.....	9
Load sensing open circuit system.....	11
Servo Control Orifice.....	12
Servo Control Orifice Principle.....	12
Servo Control Orifice Performance.....	13
Pacing Factor.....	14
Hydraulic Controls.....	14
Pressure compensated controls.....	14
Operation.....	14
Pressure compensated system characteristics.....	15
Typical applications for pressure compensated systems.....	15
Remote pressure compensated controls.....	15
Remote pressure compensated system characteristics.....	16
Typical applications for remote pressure compensated systems.....	17
Load sensing controls.....	17
LS control with bleed orifice.....	17
Integral PC function.....	18
Load sensing system characteristics.....	18
Electric Controls.....	18
Electric Proportional Controls (EPC).....	18
PLUS+1® Compliance.....	18
Electric Proportional Control Principle.....	18
Electric Proportional Control Response/Recovery.....	19
Electric Proportional Control Characteristic – Normally Closed.....	20
Electric Proportional Control Characteristic – Normally Open.....	21
Electric On-Off Controls.....	23
PLUS+1 Compliance.....	23
Electric On-Off Control Principle.....	23
Electric On-Off Control Response/Recovery.....	24
Electric On-Off Control Performance vs. Ambient Temperature Characteristic.....	24
Electric On-Off Control Characteristic – Normally Closed.....	25
Electric On/Off Control Characteristic – Normally Open.....	26
Electric dump valve PC/LS controls.....	27
Electronic Torque Limiting Controls (ETL).....	27
PLUS+1 Compliance.....	27
Electric Torque Limiting Control Principle.....	28
Electronic Torque Limiting Control Characteristic.....	29
Fan Drive Control (FDC).....	29
PLUS+1 Compliance.....	29
Fan Drive Control Principle.....	31
Fan Drive Control System Characteristics.....	31
Unintended Applications for Fan Drive Control Systems.....	32
Fan Drive Control characteristic - Normally Closed.....	32
Solenoid data – Normally closed.....	33
Fan Drive Control configuration.....	35
NC Fan Drive Control 3D Views.....	35
Angle Sensor.....	35
PLUS+1 Compliance.....	35
Angle Sensor Principle.....	36
Angle Sensor Characteristics.....	36
J & F-Frame (45-90cc) Angle Sensor Identification Convention:.....	37
E-Frame (100-147cc) Angle Sensor Identification Convention:.....	37
Angle sensor electrical specifications.....	40
Angle Sensor Calibration.....	40

Contents

Angle Sensor Functionality.....	40
Charge Pump Circuits.....	40
Example Circuit #1.....	40
Example Circuit #2.....	41
Operating parameters.....	42
Fluids.....	42
Viscosity.....	42
Temperature.....	42
Inlet pressure.....	43
Case pressure.....	43
Pressure ratings.....	44
Speed ratings.....	44
Duty cycle and pump life.....	44
Speed, flow, and inlet pressure.....	45
Design parameters.....	46
Installation.....	46
Filtration.....	46
Reservoir.....	46
Fluid velocity.....	46
Shaft loads.....	47
Bearing life.....	47
Mounting flange loads.....	48
Estimating overhung load moments.....	48
Auxiliary mounting pads.....	49
Input shaft torque ratings.....	49
Understanding and minimizing system noise.....	50
Understanding and minimizing system instability.....	50
LS System Over-Signaling.....	50
Sizing equations.....	51

Frame K2

Design.....	52
Technical Specifications.....	53
Order Code.....	53
Performance K2-25C.....	59
Performance K2-30C.....	60
Performance K2-38C.....	61
Performance K2-40C.....	62
Performance K2-45C.....	63
Hydraulic Controls.....	64
Pressure Compensated Controls.....	64
Remote Pressure Compensated Controls.....	65
Load Sensing Pressure Compensated Controls.....	66
Load Sensing Control with Bleed Orifice /Pressure Compensated.....	67
Electric Controls.....	68
Connectors.....	68
Continuous Duty Operating Range.....	68
Solenoid Data - Normally Closed.....	68
Solenoid Data - Normally Open.....	68
Normally Closed Electric On/Off with Pressure Compensation Controls.....	69
Normally Open Electric On/Off with Pressure Compensation Controls.....	69
Normally Closed Electric Proportional with Pressure Compensation Controls.....	71
Normally Open Electric Proportional with Pressure Compensation Controls.....	72
Normally Closed Fan Drive Control.....	73
Input Shafts.....	74
Installation Drawings.....	76
Axial Ported Endcap.....	76
Axial Ported Endcap O-ring Boss Ports Installation Dimensions.....	77
Radial Ported Endcap Split Flange Ports.....	78
Radial Ported Endcap O-ring Boss Ports.....	79

Contents

Radial Ported Endcap Installation Dimensions.....	80
Front Mounting Flange - SAE-B two bolt.....	80
Auxiliary Mounting Pads.....	81
SAE-A auxiliary mounting pad.....	81
SAE-B auxiliary mounting pad.....	81
SAE-A Fixed flange.....	82
Auxiliary Mounting Pad - Running Cover.....	82
Electric solenoid, left side.....	83
Fan drive control.....	83
Displacement Limiter.....	83

Frames L and K

Design.....	85
Technical Specifications.....	86
Order code.....	86
Performance L25C.....	92
Performance L30D.....	93
Performance K38C.....	94
Performance K45D.....	95
Hydraulic Controls.....	96
Pressure Compensated Controls.....	96
Remote Pressure Compensated Controls.....	96
Load Sensing/Pressure Compensated Controls.....	97
Load Sensing Control with Bleed Orifice /Pressure Compensated.....	98
Electric Controls.....	99
Connector.....	99
Continuous Duty Operating Range.....	100
Solenoid Data - Normally Closed.....	100
Solenoid Data - Normally Open.....	100
Normally Closed Electric On/Off with Pressure Compensation Controls.....	100
Normally Open Electric On/Off with Pressure Compensation Controls.....	101
Normally Closed Electric Proportional Controls with PC and LS Compensation.....	102
Normally Open Electric Proportional Controls with PC and LS Compensation.....	104
Input shafts.....	106
Installation drawings.....	107
Axial Ported Endcap.....	107
Axial Ported Endcap Installation Dimensions.....	108
Radial Ported Endcap Split Flange Ports.....	108
Radial Ported Endcap O-ring Boss Ports.....	109
Radial Ported Endcap Rear View.....	109
Radial Ported Endcap Installation Dimensions.....	110
Front Mounting Flange - SAE-B two bolt.....	110
Auxiliary Mounting Pads.....	111
SAE-A auxiliary mounting pad.....	111
SAE-B auxiliary mounting pad.....	111
Auxiliary Mounting Pad - Running Cover.....	112
Electric Solenoid, Left Side.....	112
Electric Solenoid, Right Side.....	112
Displacement limiter.....	113

Frame J

Design.....	114
Technical Specifications.....	115
Order code.....	115
Performance J45B.....	126
Performance J51B.....	127
Performance J60B.....	128
Performance J65C.....	129
Performance J75C.....	130
Hydraulic Controls.....	131

Contents

Pressure Compensated Controls.....	131
Remote Pressure Compensated Controls.....	132
Load sensing/Pressure compensated Controls.....	133
Load sensing Control with Bleed Orifice/ Pressure Compensated.....	134
Electric Controls.....	135
Connectors.....	135
Continuous Duty Operating Range.....	135
Solenoid Data - Normally Closed.....	135
Solenoid Data - Normally Open.....	135
Fan Drive Control Solenoid Data - Normally Closed.....	136
Normally Closed Electric On/Off with Pressure Compensation Controls.....	136
Normally Open Electric On/Off with Pressure Compensation Controls.....	137
Normally Closed Electric Proportional with Pressure Compensation Controls.....	138
Normally Open Electric Proportional with Pressure Compensation Controls.....	139
Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls.....	141
Normally Closed Fan Drive Control	142
Input shafts.....	143
Installation drawings.....	146
Axial Ported Endcap.....	146
Axial Ported Endcap Installation Dimensions.....	147
Right Fan Drive Control.....	148
Radial Ported Endcap Split Flange Ports.....	148
Radial Ported Endcap Rear View.....	149
Radial Ported Endcap Installation Dimensions.....	150
Right Angle Sensor Position Installation Dimensions.....	151
Front Mounting Flange.....	152
Auxiliary mounting pads.....	153
SAE-A auxiliary mounting pad (integrated).....	153
SAE-A auxiliary mounting pad (non-integral).....	154
SAE-B auxiliary mounting pad.....	155
SAE-C auxiliary mounting pad.....	155
Running cover.....	156
Radial Endcap Clockwise.....	156
Radial Endcap Counterclockwise.....	157
Axial Endcap Clockwise.....	157
Axial Endcap Counterclockwise.....	157
Displacement limiter.....	158

Frame F

Design.....	159
Technical Specifications.....	160
Order code.....	160
Performance F74B.....	166
Performance F90C.....	167
Hydraulic Controls.....	168
Pressure Compensated Controls.....	168
Remote Pressure Compensated Controls.....	168
Load Sensing/Pressure Compensated Controls.....	169
Load Sensing Control with Bleed Orifice/Pressure Compensated.....	170
Electric Controls.....	171
Connectors.....	171
Continuous Duty Operating Range.....	172
Solenoid Data - Normally Closed.....	172
Solenoid Data - Normally Open.....	172
Fan Drive Control Solenoid Data - Normally Closed.....	172
Normally Closed Electric On/Off with Pressure Compensation Controls.....	172
Normally Open Electric On/Off with Pressure Compensation Controls.....	173
Normally Closed Electric Proportional with Pressure Compensation Controls.....	174
Normally Open Electric Proportional with Pressure Compensation Controls.....	175
Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls.....	177

Contents

Normally Closed Fan Drive Control.....	178
Input shafts.....	179
Installation drawings.....	180
Axial Ported Endcap.....	180
Axial Ported Endcap Installation Dimensions.....	180
Right Fan Drive Control.....	181
Radial Ported Endcap Split Flange Ports.....	181
Radial Ported Endcap Rear View.....	182
Radial Ported Endcap Installation Dimensions.....	183
Right Angle Sensor Position Installation Dimensions.....	184
Front Mounting Flange.....	185
Radial Endcap Clockwise.....	187
Radial Endcap Counterclockwise.....	188
Axial Endcap Clockwise.....	188
Axial Endcap Counterclockwise.....	188
Displacement limiter.....	188

Frame E

Design.....	190
Technical Specifications.....	191
Order code.....	191
Performance E100B.....	198
Performance E130B.....	199
Performance E147C.....	200
Hydraulic Controls.....	201
Pressure Compensated Controls.....	201
Remote Pressure Compensated Controls.....	201
Load Sensing/Pressure Compensated.....	202
Load Sensing Control with Bleed Orifice/Pressure Compensated.....	203
Electric Controls.....	204
Connectors.....	204
Continuous Duty Operating Range.....	205
Solenoid Data - Normally Closed.....	205
Solenoid Data - Normally Open.....	205
Normally Closed Electric On/Off with Pressure Compensation Controls.....	205
Normally Open Electric On/Off with Pressure Compensation Controls.....	206
Normally Closed Electric Proportional with Pressure Compensation Controls.....	207
Normally Open Electric Proportional with Pressure Compensation Controls.....	209
Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls.....	210
Input shafts.....	212
Installation drawings.....	213
Axial Ported Endcap.....	213
Axial Ported Endcap Installation Dimensions.....	214
Radial Ported Endcap Installation Dimensions.....	215
Right Angle Sensor Position Installation Dimensions.....	216
Radial Ported Endcap Rear View.....	217
Radial Ported Endcap Split Flange Ports.....	217
Front Mounting Flange.....	218
Endcap Dimensions.....	219
Auxiliary mounting pads.....	220
Displacement Limiters.....	222

General Information

Overview

Series 45 is a complete family of high performance variable displacement, axial piston pumps. Each frame is designed to exceed the demanding work function requirements of the mobile equipment marketplace. Each frame within the Series 45 family is uniquely designed to optimize performance, size, and cost.

Design

High Performance

- Displacements from 25 cm³ - 147 cm³ [1.53 - 8.97 in³/rev]
- Speeds up to 3600 rpm
- Pressures up to 310 bar [4495 psi]
- Variety of control system options including load sensing and pressure compensated

Latest Technology

- Customer-driven using quality function deployment (QFD) and design for manufacturability (DFM) techniques
- Optimized design maximizes efficiency and quiet operation
- Computer-modeled castings to optimize inlet conditions for maximum pump speed
- Compact package size minimizing installation space requirements
- Heavy-duty tapered roller bearings for long life
- Single piece rigid housing to reduce noise and leak paths
- Integrated controls for high speed response and system stability

Reliability

- Designed to rigorous standards
- Proven in both laboratory and field
- Manufactured to rigid quality standards
- Long service life
- Significantly fewer parts
- No gasket joints
- Robust input shaft bearings to handle large external shaft loads
- Integrated gauge ports for monitoring operating conditions

Benefits

Reduced Installation Costs

- Through-drive capability for multi-circuit systems
- Range of mounting flanges, shafts and porting options for ease of installation
- Compact size minimizes installation space requirements
- Help meet engine emission standards
- Reduce engine size by managing power usage more effectively

Reduce Operating Costs

- Optimize machine power usage to maximize fuel economy
- Simple design reduces service requirements
- Heavy duty taper roller shaft bearings provide long service life

General Information

Increased Customer Satisfaction

- Reduced noise for operator comfort
- High performance increases productivity

Reduced Heat Load on Cooling System

- High efficiency reduces hydraulic heat generation
- Allows for smaller cooling packages

Typical applications

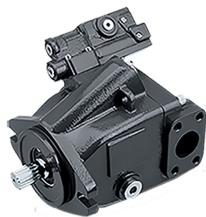
- Cranes
- Telescopic handlers
- Forklift trucks
- Wheel loaders
- Sweepers
- Backhoe loaders
- Forestry and agricultural machinery
- Fan drives
- Paving Machines
- Mining Equipment
- Mowers
- Dozers
- Drilling Machines
- Mini-Excavators
- Other Applications

The Series 45 product family

Basic units

The series 45 family of open circuit, variable piston pumps, offers a range of displacements from 25 to 147 cm³/rev [1.53 to 8.97 in³/rev]. With maximum speeds up to 3600 rpm and continuous operating pressures up to 310 bar [4495 psi], product selection is easily tailored to the flow and pressure requirements of individual applications.

K2 Frame



J Frame



F Frame



E Frame



General Information

General performance specifications

Pump		Displacement		Speed			Pressure				Theoretical flow (at rated speed)		Mounting
				Continuous	Max.	Min.	Cont.		Max.				
Frame	Model	cm ³	in ³	min ⁻¹ (rpm)	min ⁻¹ (rpm)	min ⁻¹ (rpm)	bar	psi	bar	psi	US gal/min	l/min	Flange
Frame L	L25C	25	1.53	3200	3600	500	260	3770	350	5075	21.0	80.0	SAE B - 2 bolt
	L30D	30	1.83	3200	3600	500	210	3045	300	4350	25.4	96.0	SAE B - 2 bolt
Frame K	K38C	38	2.32	2650	2800	500	260	3770	350	5075	26.6	100.7	SAE B - 2 bolt
	K45D	45	2.75	2650	2800	500	210	3045	300	4350	31.5	119.3	SAE B - 2 bolt
Frame K2	K2-25C	25	1.53	3450	3750	500	260	3771	350	5076	22.8	86.3	SAE B - 2 bolt
	K2-30C	30	1.83	3200	3450	500					25.4	96.0	SAE B - 2 bolt
	K2-38C	38	2.32	2900	3050	500					29.1	110.2	SAE B - 2 bolt
	K2-40C	40	2.44	3100	3200	500					34.5	124	SAE B - 2 bolt
	K2-45C	45	2.75	2900	3050	500					34.5	130.5	SAE B - 2 bolt
Frame J	J45B	45	2.75	2800	3360	500	310	4495	400	5800	33.3	126.0	SAE B 2-bolt SAE C 2 and 4-bolt
	J51B	51	3.11	2700	3240	500	310	4495	400	5800	36.4	137.7	SAE B 2-bolt SAE C 2 and 4-bolt
	J60B	60	3.66	2600	3120	500	310	4495	400	5800	41.2	156.0	SAE B 2-bolt SAE C 2 and 4-bolt
	J65C	65	3.97	2500	3000	500	260	3770	350	5075	42.9	162.6	SAE B 2-bolt SAE C 2 and 4-bolt
	J75C	75	4.58	2400	2880	500	260	3770	350	5075	47.5	180.0	SAE B 2-bolt SAE C 2 and 4-bolt
Frame F	F74B	74	4.52	2400	2800	500	310	4495	400	5800	46.9	177.6	SAE B 2-bolt SAE C 4-bolt
	F90C	90	5.49	2200	2600	500	260	3770	350	5075	52.3	198	SAE B 2-bolt SAE C 4-bol

General Information

General performance specifications (continued)

Pump		Displacement		Speed			Pressure				Theoretical flow (at rated speed)		Mounting
				Continu- ous	Max.	Min.	Cont.		Max.				
Frame	Model	cm ³	in ³	min ⁻¹ (rpm)	min ⁻¹ (rpm)	min ⁻¹ (rpm)	bar	psi	bar	psi	US gal/min	l/min	Flange
Frame E	E100B	100	6.10	2450	2880	500	310	4495	400	5800	64.7	245.0	SAE C 4-bolt
	E130B	130	7.93	2200	2600	500	310	4495	400	5800	75.5	286.0	SAE C 4-bolt
	E147C	147	8.97	2100	2475	500	260	3770	350	5075	81.5	308.7	SAE C 4-bolt

Load sensing open circuit system

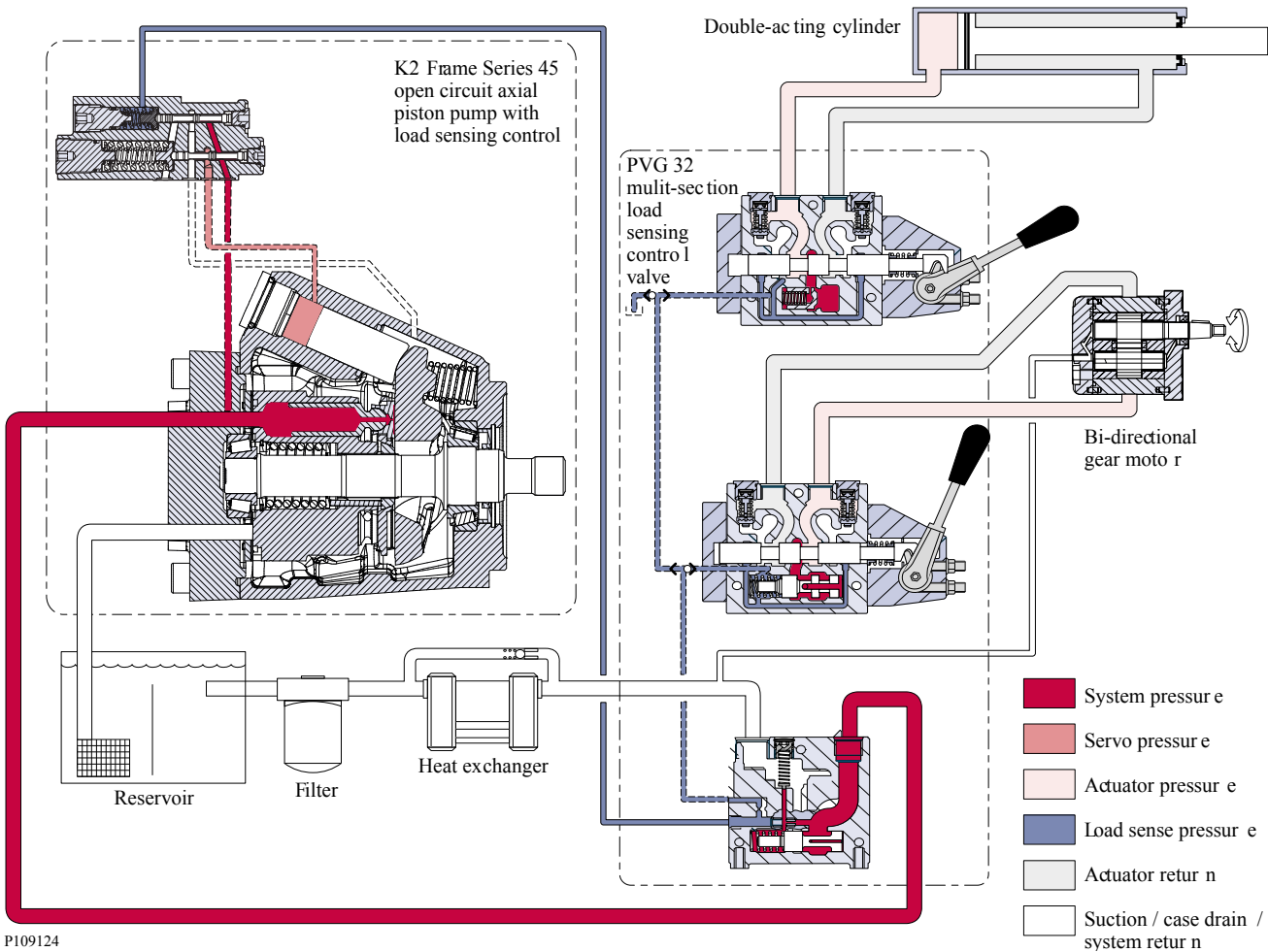
The pump receives fluid directly from the reservoir through the inlet line. A screen in the inlet line protects the pump from large contaminants. The pump outlet feeds directional control valves such as PVG-32's, hydraulic integrated circuits (HIC), and other types of control valves. The PVG valve directs pump flow to cylinders, motors and other work functions. A heat exchanger cools the fluid returning from the valve. A filter cleans the fluid before it returns to the reservoir.

Flow in the circuit determines the speed of the actuators. The position of the PVG valve determines the flow demand. A hydraulic pressure signal (LS signal) communicates demand to the pump control. The pump control monitors the pressure differential between pump outlet and the LS signal, and regulates servo pressure to control the swashplate angle. Swashplate angle determines pump flow.

Actuator load determines system pressure. The pump control monitors system pressure and will decrease the swashplate angle to reduce flow if system pressure reaches the PC setting. A secondary system relief valve in the PVG valve acts as a back-up to control system pressure.

General Information

Pictorial circuit diagram

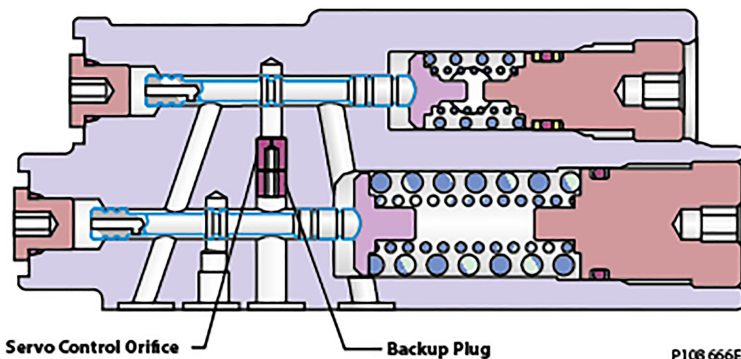


P109124

Servo Control Orifice

Servo Control Orifice Principle

Series 45 controls offer an optional servo control orifice (not available with Pressure Compensation only Controls) available to aid in tuning system performance. The optional servo control orifice restricts flow to and from the servo system in the pump, effectively pacing the motion of the servo system.



P108666E

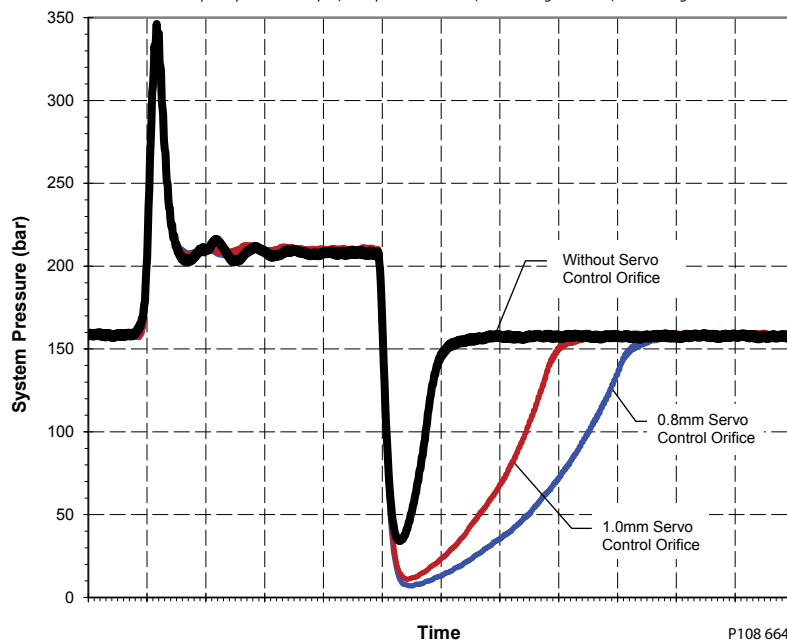
General Information

Servo Control Orifice Performance

The use of the Servo Control Orifice will provide additional pacing to the pump, while the response of the pump to pressure spikes remains unaffected. The Pressure Compensation Function response and recovery, as well as the Load Sense Function response and recovery are shown below, and outline the relative impact in response and recovery of the Servo Control Orifices. Note that these graphs are meant as a generic comparison only, and that unique effects on response and recovery behavior for each specific frame are shown later in this section.

**Relative Servo Control Orifice Performance
 Generic PC Response and Recovery**

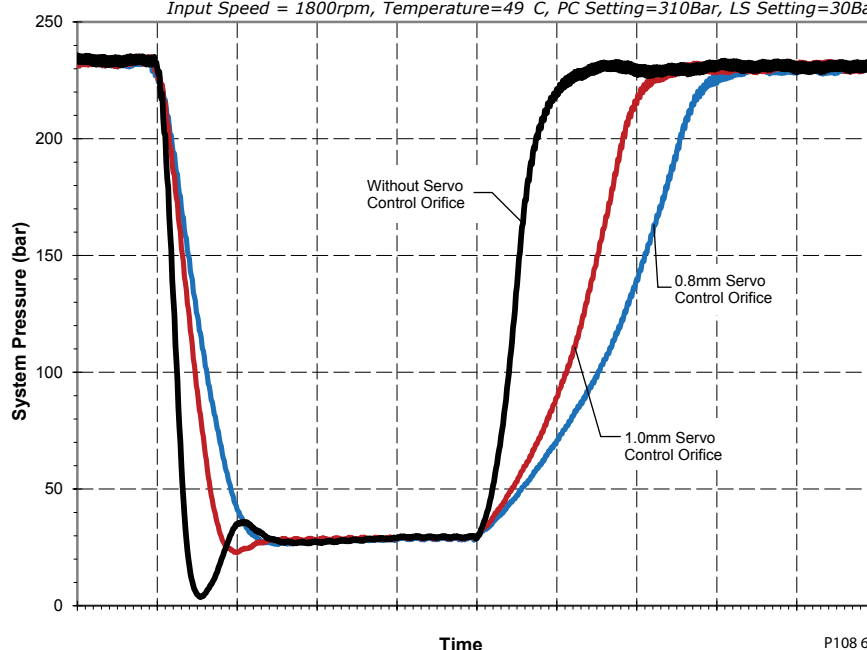
Input Speed=1800rpm, Temperature=49°C, PC Setting=210Bar, LS Setting=20Bar



P108 664E

**Relative Servo Control Orifice Performance
 Generic LS Response and Recovery**

Input Speed = 1800rpm, Temperature=49 C, PC Setting=310Bar, LS Setting=30Bar



P108 665E

General Information

We recommend that systems experiencing instability use a Servo Control Orifice. Start with the largest size orifice available, and work down to the smaller size until the system is satisfactorily tuned. All Fan-Drive systems should start with a 0.8mm Servo Control Orifice if possible. Systems including motors are more likely to require the Servo Control Orifice option.

Pacing Factor

Use of a Servo Control Orifice adds a pacing factor to each Series 45 Frame, impacting the behavior of the pumps reactivity. This pacing factor can be multiplied by the specific Frame/Displacement/Control selection's response and recovery times, to determine the final paced response and recovery times. Unique response and recovery times can be found in each frame-specific chapter, in the desired control section. The paced response and recovery relationship is shown below.

Response (Damped)= Response (Specific Disp.Control) *Pacing Factor

Recovery (Damped)= Recovery (Specific Disp.Control) *Pacing Factor

Pacing Factors are unique to each orifice size, and can impact each frame differently. Below are the Pacing Factors for each Servo Control Orifice Size by frame.

Frame	Pacing Factors - Servo Control Orifice							
	1.0 mm Servo Control Orifice				0.8 mm Servo Control Orifice			
	PC Response	PC Recovery	LS Response	LS Recovery	PC Response	PC Recovery	LS Response	LS Recovery
E-Frame*	1 (No Effect)	2.3	2.0	2.0	1 (No Effect)	3.2	2.6	2.6
F-Frame*		2.3	2.0	2.0		3.2	2.6	2.6
J-Frame*		2.3	2.0	2.0		3.2	2.6	2.6
K2-Frame		2.3	2.0	2.0		3.2	2.6	2.6
K-Frame**		2.3	2.3	2.3		3.7	3.1	3.1
L-Frame**		2.3	2.3	2.3		3.7	3.1	3.1

* PC Response from 160 bar to 210 bar, PC Recovery from 210 bar to 160 bar at 1800 rpm; LS Response from 230 bar to 30 bar, LS Recovery from 30 bar to 230 bar at 1800 rpm.

** ** PC Response from 160 bar to 210 bar, PC Recovery from 210 bar to 160 bar at 1800 rpm; LS Response from 160 bar to 20 bar, LS Recovery from 20 bar to 160 bar at 1800 rpm.

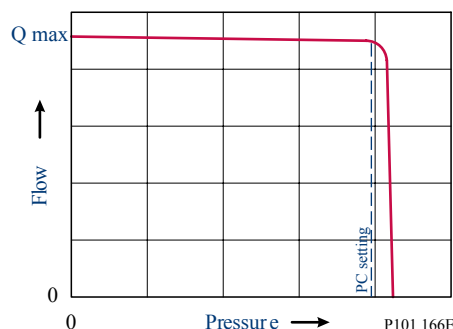
Hydraulic Controls

Pressure compensated controls

Operation

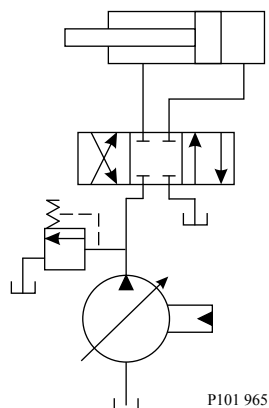
The PC control maintains constant system pressure in the hydraulic circuit by varying the output flow of the pump. Used with a closed center control valve, the pump remains in high pressure standby mode at the PC setting with zero flow until the function is actuated. This condition is often called a **dead head** condition.

Typical operating curve



General Information

Simple closed-center circuit



Once the closed center valve is opened, the PC control senses the immediate drop in system pressure and increases pump flow by increasing the swashplate angle. The pump continues to increase flow until system pressure reaches the PC setting. If system pressure exceeds the PC setting, the PC control reduces the swashplate angle to maintain system pressure by reducing flow. The PC control continues to monitor system pressure and changes swashplate angle to match the output flow with the work function pressure requirements.

If the demand for flow exceeds the capacity of the pump, the PC control directs the pump to maximum displacement. In this condition, actual system pressure depends on the actuator load.

Each section includes control schematic diagrams, setting ranges, and response / recovery times for each control available. *Response* is the time (in milliseconds) for the pump to reach zero displacement when commanded by the control. *Recovery* is the time (in milliseconds) for the pump to reach full displacement when commanded by the control. Actual times can vary depending on application conditions.

⚠ Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install a relief valve may lead to system damage and/or injury.

Pressure compensated system characteristics

- Constant pressure and variable flow
- High pressure standby mode when flow is not needed
- System flow adjusts to meet system requirements
- Single pump can provide flow to multiple work functions
- Quick response to system flow and pressure requirements

Typical applications for pressure compensated systems

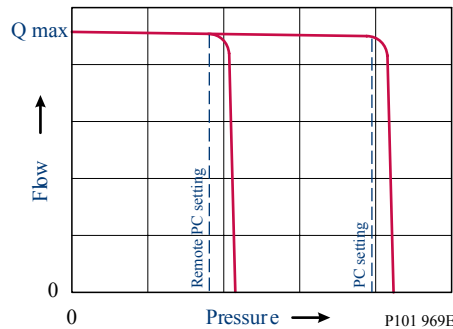
- Constant force cylinders (bailers, compactors, refuse trucks)
- On/off fan drives
- Drill rigs
- Sweepers
- Trenchers

Remote pressure compensated controls

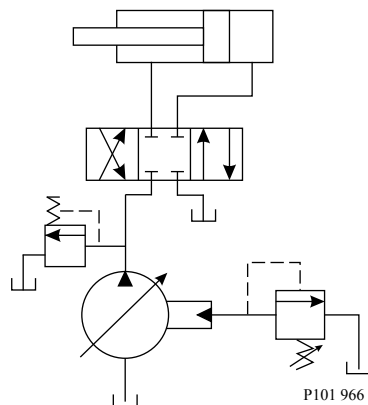
The remote PC control is a two-stage control that allows multiple PC settings. Remote PC controls are commonly used in applications requiring low and high pressure PC operation.

General Information

Typical operating curve



Closed center circuit with remote PC



The remote PC control uses a pilot line connected to an external hydraulic valve. The external valve changes pressure in the pilot line, causing the PC control to operate at a lower pressure. When the pilot line is vented to reservoir, the pump maintains pressure at the load sense setting. When pilot flow is blocked, the pump maintains pressure at the PC setting. An on-off solenoid valve can be used in the pilot line to create a low-pressure standby mode. A proportional solenoid valve, coupled with a microprocessor control, can produce an infinite range of operating pressures between the low pressure standby setting and the PC setting.

⚠ Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install a relief valve may lead to system damage and/or injury.

Each section includes control schematic diagrams, setting ranges, and response / recovery times for each control available. *Response* is the time (in milliseconds) for the pump to reach zero displacement when commanded by the control. *Recovery* is the time (in milliseconds) for the pump to reach full displacement when commanded by the control. Actual times can vary depending on application conditions.

Size the external valve and plumbing for a pilot flow of 3.8 l/min [1 US gal/min].

Remote pressure compensated system characteristics

- Constant pressure and variable flow
- High or low pressure standby mode when flow is not needed
- System flow adjusts to meet system requirements
- Single pump can provide flow to multiple work functions
- Quick response to system flow and pressure requirements

General Information

Typical applications for remote pressure compensated systems

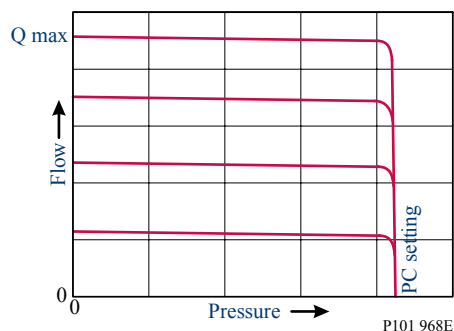
- Modulating fan drives
- Anti-stall control with engine speed feedback
- Front wheel assist
- Road rollers
- Combine harvesters
- Wood chippers

Load sensing controls

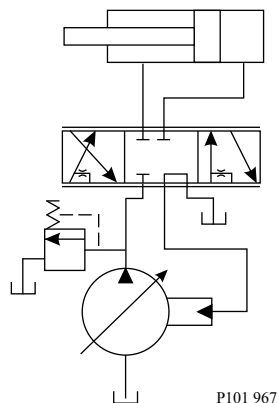
Operation

The LS control matches system requirements for both pressure and flow in the circuit regardless of the working pressure. Used with a closed center control valve, the pump remains in low-pressure standby mode with zero flow until the valve is opened. The LS setting determines standby pressure.

Typical operating curve



Load sensing circuit



Most load sensing systems use parallel, closed center, control valves with special porting that allows the highest work function pressure (LS signal) to feed back to the LS control. Margin pressure is the difference between system pressure and the LS signal pressure. The LS control monitors margin pressure to read system demand. A drop in margin pressure means the system needs more flow. A rise in margin pressure tells the LS control to decrease flow.

LS control with bleed orifice

The load sense signal line requires a bleed orifice to prevent high-pressure lockup of the pump control. Most load-sensing control valves include this orifice. An optional internal bleed orifice is available, for use with control valves that do not internally bleed the LS signal to tank.

General Information

Integral PC function

The LS control also performs as a PC control, decreasing pump flow when system pressure reaches the PC setting. The pressure compensating function has priority over the load sensing function.

⚠ Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install a relief valve may lead to system damage and/or injury.

Load sensing system characteristics

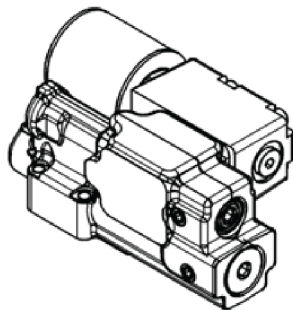
- Variable pressure and flow
- Low pressure standby mode when flow is not needed
- System flow adjusted to meet system requirements
- Lower torque requirements during engine start-up
- Single pump can supply flow and regulate pressure for multiple circuits
- Quick response to system flow and pressure requirements

Electric Controls

Electric Proportional Controls (EPC)

PLUS+1° Compliance

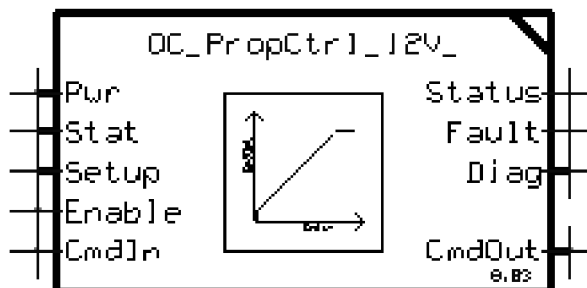
All Series 45 Electric controls have met and passed the Danfoss PLUS+1° compliance standard testing, and as such, this Series 45 control is PLUS+1° compliant. PLUS+1° compliance blocks are available on the Danfoss website, within the PLUS+1° Guide section.



Electric Proportional Control Principle

The Electric Proportional Control consists of a proportional solenoid integrated into a Remote Pressure Compensated control. This control allows the pump to be operated at any pressure limit between the Load Sense and Pressure Compensation settings by varying the current sent to the solenoid.

General Information



[Reference individual frame sections for the margin \(LS\) setting vs low pressure standby relationship.](#)

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. This relationship is available in the electric proportional controls section for each frame.

[For fan-drive systems, and systems with motors, use a minimum 15bar LS setting to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20bar LS setting is recommended as a starting point for all new applications.](#)

Electric Proportional Control Response/Recovery

S45 Electric Proportional Controls require the use of a servo control orifice, and are available with two possible servo control orifice options. The servo control orifice is used to enhance system stability, as well as dampen the pump reactivity. A smaller orifice diameter will add dampening to the pump reactivity, while a larger orifice will allow quicker pump reaction. Fan-Drive applications, as well as systems with the pump supplying motors, are recommended to use the 0.8mm diameter orifice to enhance system stability.

Module "G" Options for Electric Proportional Controls		
Frame	"E" - 0.8mm Orifice	"F" - 1.0mm Orifice
All Frames	•	•

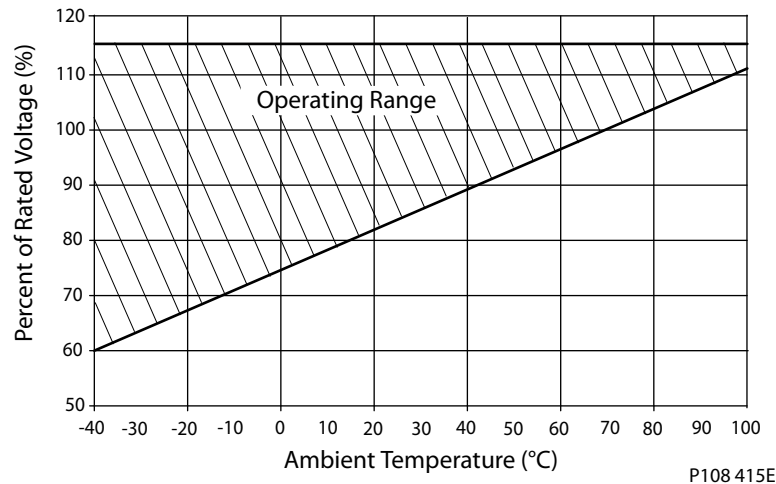
Specific Electric Proportional Control Response/Recovery times are shown for the available servo control orifice options in the control section within each specific frame section. These times represent the response from 100bar to 200bar, and recovery from 200bar to 100bar. As the upper pressure approaches the PC setting, the PC function will begin to assist in clipping pressure overshoots during the pump's response, and will decrease the response times of the pump to equal those of the PC response.

Electric Proportional Control Pressure vs. Flow Characteristic

The Electric Proportional Controls continuous duty operating temperature range is shown below; this guideline should be followed as well as the maximum current limitations. Note that rated voltage refers to either a 12V or 24V coil. Under high temperature conditions, current required to operate the solenoid increases.

General Information

Continuous Duty Operating Temperature

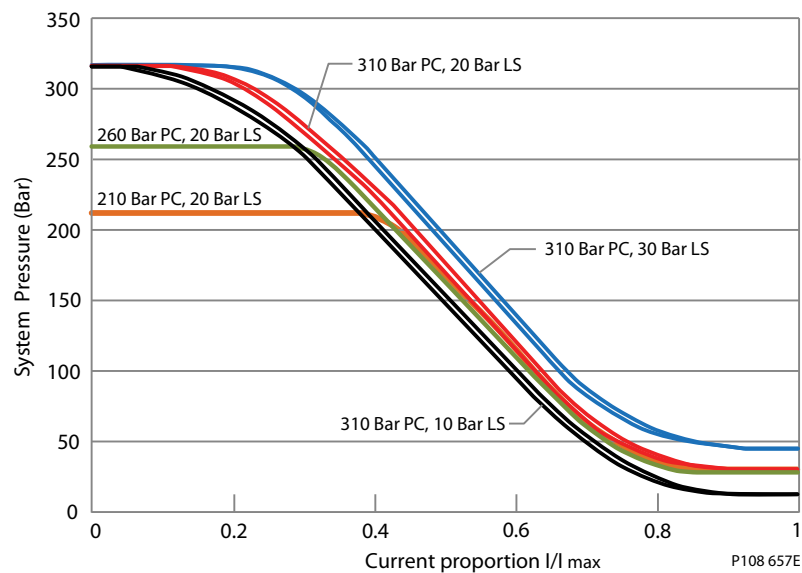


Electric Proportional Control Characteristic – Normally Closed

When an electric current is sent to the Normally Closed configuration control, the pump pressure decreases proportional to an increase in current. When the load in the system changes, the pump will adjust its displacement to maintain the pressure demanded by the controlling current. This control is especially useful for fan-drives, due to the direct relationship between fan-speed and pump pressure.

Due to the nature of Electric Proportional Controls, the relationship between current and pump pressure is unique for each individual PC/LS pressure setting combination. The relationship between different PC settings and different LS settings on the Pressure vs. Current Characteristic curve are shown below. The hydraulic schematic for the Normally Closed Electric Proportional control is shown below as well.

Operating Pressure vs. Input Current (N.C. EPC)



Solenoid Data – Normally Closed

Voltage	12V	24V
Maximum Current	1800 mA	920 mA
Inrush Current	1700 mA	800 mA

General Information

Solenoid Data – Normally Closed (continued)

Voltage	12V	24V
Coil Resistance @ 20°C [70°F]	7.1 Ω	28.5 Ω
PWM Range	200-300 Hz	
PWM Frequency (preferred)	250 Hz	
IP Rating (IEC 60529 DIN 40050-9)	IP67	IP67
IP Rating (IEC 60529 DIN 40050-9) with mating connector	IP69K	IP69K
Operating Temperature	Consistent with Pump Limits: -40°C (-40°F) to 104°C (220°F)	

The available Normally Closed Electric Proportional Controls for the Series 45 are shown below. The allowable Pressure Compensator (PC) and Load Sense (LS) pressure settings are provided for each frame in their respective sections.

Electric Proportional Controls Options – Normally Closed		Frame					
Code	Description	L	K	K2	J	F	E
AH	Electric Proportional Pressure Control w/Pressure Comp. (NC, 12VDC) Left			•	•	•	•
AL	Electric Proportional Pressure Control w/Pressure Comp. (NC, 24VDC) Left			•	•	•	•
AV	Electric Proportional Pressure Control w/Pressure Comp. (NC, 12VDC) Right				•	•	•
AK	Electric Proportional Pressure Control w/Pressure Comp. (NC, 24VDC) Right				•	•	•
BH	Electric Proportional Pressure Control w/Pressure Comp. (NC, 12VDC) [>280 bar] Left				•	•	•
BL	Electric Proportional Pressure Control w/Pressure Comp. (NC, 24VDC) [>280 bar] Left				•	•	•
BM	Electric Proportional Pressure Control w/Pressure Comp. (NC, 12VDC) [>280 bar] Right				•	•	•
BK	Electric Proportional Pressure Control w/Pressure Comp. (NC, 24VDC) [>280 bar] Right				•	•	•
EM	Electric Proportional Pressure Control w/Pressure Comp. (NC, 12VDC)	•	•				
EN	Electric Proportional Pressure Control w/Pressure Comp. (NC, 24VDC)	•	•				

Notes:

1. Left = E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial
2. Right = E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial
3. K/L Frame Controls are not rotation dependent
4. K2 Frame electric controls are limited only for Left orientation and up to 260 Bar

Electric Proportional Control Characteristic – Normally Open

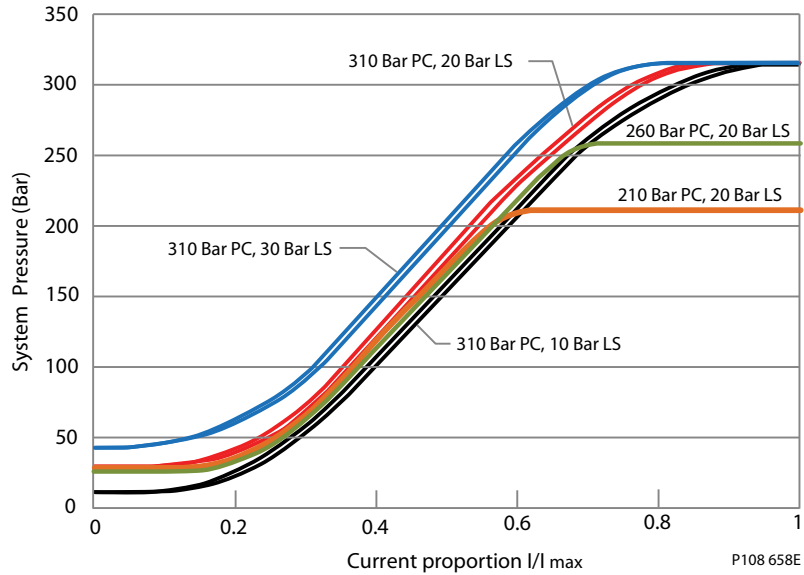
When an electric current is sent to the normally open configuration control, the pump pressure increases proportional to an increase in current. When the load in the system changes, the pump will adjust its displacement to maintain the pressure demanded by the controlling current. This control is especially useful for fan-drives, due to the direct relationship between fan-speed and pump pressure.

Due to the nature of Electric Proportional Controls, the relationship between current and pump pressure is unique for each individual PC/LS pressure setting combination. The relationship between different PC

General Information

settings and different LS settings on the Pressure vs. Current Characteristic curve are shown below. The hydraulic schematic for the Normally Open Electric Proportional control is shown below as well.

Operating Pressure vs. Input Current (N.O. EPC)



Solenoid Data – Normally Open

Voltage	12V	24V
Maximum Current	1500 mA	665 mA
Inrush Current	1700 mA	800 mA
Coil Resistance @ 20°C [70°F]	7.1 Ω	28.5 Ω
PWM Range	200-300 Hz	
PWM Frequency (preferred)	250 Hz	
IP Rating (IEC 60529 DIN 40050-9)	IP67	IP67
IP Rating (IEC 60529 DIN 40050-9) with mating connector	IP69K	IP69K
Operating Temperature	Consistent with Pump Limits: -40°C (-40°F) to 104°C (220°F)	

The available Normally Open Electric Proportional Controls for the Series 45 are shown below. The allowable Pressure Compensator (PC) and Load Sense (LS) pressure settings are provided for each frame in their respective sections. Note that for Electric Proportional Controls, the Load Sense setting describes the Low Pressure Standby value, not margin.

Electric Proportional Controls Options – Normally Open		Frame					
Code	Description	L	K	K2	J	F	E
AX	Electric Proportional Pressure Control w/Pressure Comp. (NO, 12VDC) Left			•	•	•	•
CL	Electric Proportional Pressure Control w/Pressure Comp. (NO, 24VDC) Left			•	•	•	•
AW	Electric Proportional Pressure Control w/Pressure Comp. (NO, 12VDC) Right				•	•	•
CK	Electric Proportional Pressure Control w/Pressure Comp. (NO, 24VDC) Right				•	•	•
BX	Electric Proportional Pressure Control w/Pressure Comp. (NO, 12VDC) [>280 bar] Left				•	•	•

General Information

Electric Proportional Controls Options – Normally Open		Frame					
DL	Electric Proportional Pressure Control w/Pressure Comp. (NO, 24VDC) [>280 bar] Left				•	•	•
BW	Electric Proportional Pressure Control w/Pressure Comp. (NO, 12VDC) [>280 bar] Right				•	•	•
DK	Electric Proportional Pressure Control w/Pressure Comp. (NO, 24VDC) [>280 bar] Right				•	•	•
EK	Electric Proportional Pressure Control w/Pressure Comp. (NO, 12VDC)	•	•				
EL	Electric Proportional Pressure Control w/Pressure Comp. (NO, 24VDC)	•	•				

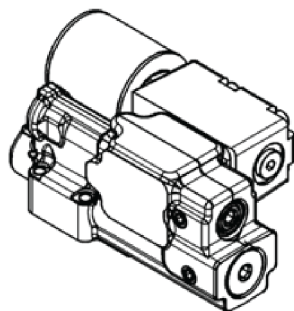
Notes:

1. Left = E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial
2. Right = E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial
3. K/L Frame Controls are not rotation dependent
4. K2 Frame electric controls are limited only for Left orientation and up to 260 Bar

Electric On-Off Controls

PLUS+1 Compliance

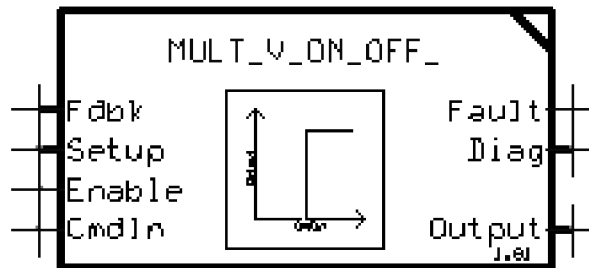
All Series 45 Electric controls have met and passed the Danfoss PLUS+1 compliance standard testing, and as such, this Series 45 control is PLUS+1 compliant. PLUS+1 compliance blocks are available on the Danfoss website, within the PLUS+1 Guide section.



Electric On-Off Control Principle

The Electric On/Off Control consists of an On/Off solenoid integrated into a Remote Pressure Compensated control. This control allows the pump to be operated at either the Load Sense pressure setting when “On”, or the Pressure Compensation pressure setting when “Off”.

General Information



For fan-drive systems, and systems with motors, use a minimum 15bar LS setting to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20bar LS setting is recommended as a starting point for all new applications.

Electric On-Off Control Response/Recovery

S45 Electric On/Off Controls are available with two servo control orifice options, as well as without an orifice. The servo control orifice is used to enhance system stability, as well as dampen the pump reactivity. A smaller orifice diameter will add dampening to the pump reactivity, while a larger orifice will allow quicker pump reaction.

Module "G" Options for Electric On/Off Controls			
Frame	"E" - 0.8mm Orifice	"F" - 1.0mm Orifice	"N" - No Orifice
All Frames	•	•	•

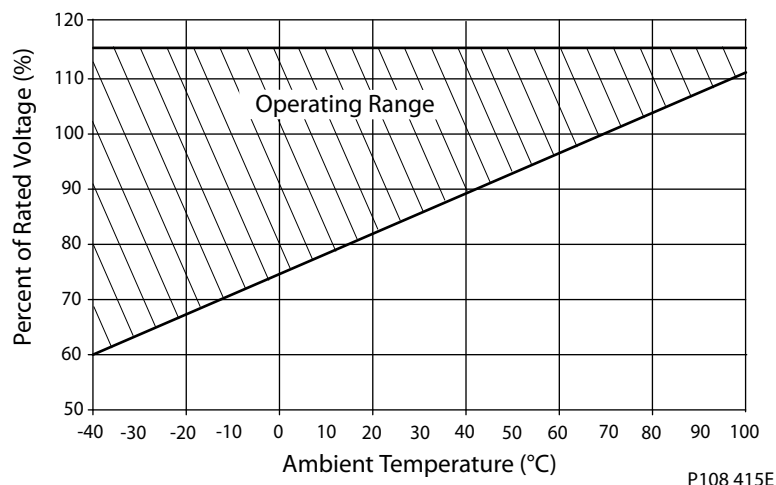
Specific Electric On/Off Control Response/Recovery times are shown for the available servo control orifice options in the control section within each specific frame section. These times represent the response from 75% of rated continuous pressure to 100% of rated continuous pressure, and recovery from 100% of rated continuous pressure to 75% of rated continuous pressure for N.C. configuration per SAE J745 (vice-versa for N.O). As the system pressure approaches the PC setting, the PC function will begin to assist in clipping pressure overshoots during the pump's response, and will decrease the response times of the pump to equal those of the PC response.

Electric On-Off Control Performance vs. Ambient Temperature Characteristic

The Electric On/Off Controls continuous duty operating temperature range is shown below; this guideline should be followed as well as the maximum current limitations. Note that rated voltage refers to either a 12V or 24V coil. Under high temperature conditions the PWM duty cycle to operate the solenoid increases.

General Information

Continuous Duty Operating Temperature



P108 415E

Electric On-Off Control Characteristic – Normally Closed

The normally closed configuration On/Off control directs the pump to its Pressure Compensation pressure setting when no current is applied. When the required electric current is sent to the normally closed configuration control the pump pressure decreases to the Low-Pressure Standby setting. This control does not have Load Sense functionality, but rather acts as a Pressure Compensation control when not energized, or is directed to its low-pressure standby when energized. This control is especially useful for machine startups, as the pump can be directed to its Low-Pressure Standby setting during startup to reduce the load on engine starters.

The available Normally Closed Electric On/Off Controls for the Series 45 are shown below. The allowable Pressure Compensator (PC) and Load Sense (LS) pressure settings are provided for each frame in their respective sections.

Electric On/Off Controls Options – Normally Closed		Frame					
Code	Description	L	K	K2	J	F	E
AR	Electric On/Off Pressure Control w/Pressure Comp. (NC,12VDC) Left			•	•	•	•
CR	Electric On/Off Pressure Control w/Pressure Comp. (NC,24VDC) Left			•	•	•	•
AG	Electric On/Off Pressure Control w/Pressure Comp. (NC,12VDC) Right				•	•	•
AY	Electric On/Off Pressure Control w/Pressure Comp. (NC,24VDC) Right				•	•	•
BR	Electric On/Off Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Left				•	•	•
DR	Electric On/Off Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Left				•	•	•
BE	Electric On/Off Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Right				•	•	•
BG	Electric On/Off Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Right				•	•	•
EB	Electric On/Off Pressure Control w/Pressure Comp. (NC,12VDC)	•	•				
EE	Electric On/Off Pressure Control w/Pressure Comp. (NC,24VDC)	•	•				

Notes:

General Information

1. Left = E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial
2. Right = E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial
3. K/L Frame Controls are not rotation dependent
4. K2 Frame electric controls are limited only for Left orientation and up to 260 Bar

Electric On/Off Control Characteristic – Normally Open

The Normally Open configuration On/Off control directs the pump to its Low-Pressure Standby setting when no current is applied. When the required electric current (end current) is sent to the Normally Open configuration control, the pump pressure increases to the Pressure Compensation pressure setting. This control does not have Load Sense functionality, but rather acts as a Pressure Compensation control when energized, or is directed to its Low-Pressure Standby when de-energized. This control is especially useful for machine startups, as the pump can be directed to its Low Pressure Standby setting during startup to reduce the load on engine starters.

Solenoid Data – Normally Open

Voltage	12V	24V
Maximum Current	1500 mA	665 mA
Inrush Current	1700 mA	800 mA
Coil Resistance @ 20°C [70°F]	7.1 Ω	28.5 Ω
PWM Range	200-300 Hz	
PWM Frequency (preferred)	250 Hz	
IP Rating (IEC 60529 DIN 40050-9)	IP67	IP67
IP Rating (IEC 60529 DIN 40050-9) with mating connector	IP69K	IP69K
Operating Temperature	Consistent with Pump Limits: -40°C (-40°F) to 104°C (220°F)	

The available Normally Open Electric On/Off Controls for the Series 45 Frame E are shown below, with the allowable Pressure Compensator (PC) pressure range provided for each control. All Electric On/Off Controls are available with the 10-40bar Load Sense (LS) setting range.

Electric On/Off Controls Options – Normally Open		Frame					
Code	Description	L	K	K2	J	F	E
AN	Electric On/Off Pressure Control w/Pressure Comp. (NO,12VDC) Left			•	•	•	•
CN	Electric On/Off Pressure Control w/Pressure Comp. (NO,24VDC) Left			•	•	•	•
AF	Electric On/Off Pressure Control w/Pressure Comp. (NO,12VDC) Right				•	•	•
AT	Electric On/Off Pressure Control w/Pressure Comp. (NO,24VDC) Right				•	•	•
BN	Electric On/Off Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Left				•	•	•
DN	Electric On/Off Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Left				•	•	•
BF	Electric On/Off Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Right				•	•	•
DF	Electric On/Off Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Right				•	•	•
EA	Electric On/Off Pressure Control w/Pressure Comp. (NO,12VDC)	•	•				
EG	Electric On/Off Pressure Control w/Pressure Comp. (NO,24VDC)	•	•				

General Information

Notes:

1. Left = E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial
2. Right = E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial
3. K/L Frame Controls are not rotation dependent
4. K2 Frame electric controls are limited only for Left orientation and up to 260 Bar

Electric dump valve PC/LS controls

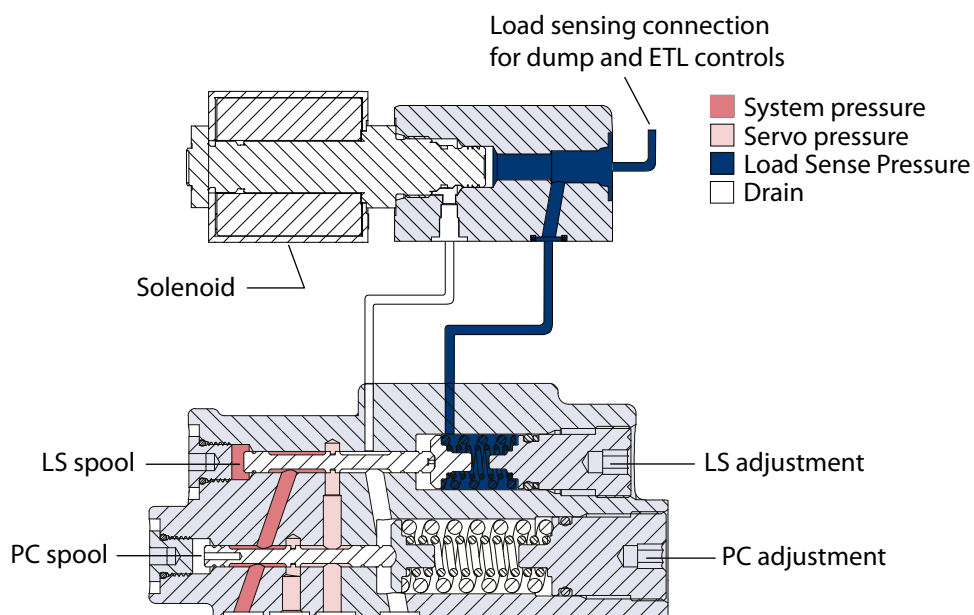
The electric dump valve pressure-compensated/load sense control allows the pump to operate as a PC/LS type control under normal operating conditions. The solenoid dump valve overrides the LS control, allowing the pump to operate in a Low-Pressure Standby mode. This function provides reduced horsepower and torque loss in certain situations. It may be particularly useful to reduce loads on a system during engine start.

When closed, the solenoid valve allows the control to act as a PC/LS control. When open, the solenoid valve allows flow from the incoming load sense pressure to dump to case. This reduces the pressure in the LS spring cavity, shifting the LS spool, and allows the pump to de-stroke to the Low-Pressure Standby condition. This control is for applications needing a PC/LS control with the ability to switch to Low-Pressure Standby electronically. The solenoid valve is available in a normally closed and open configuration.

[For high cycling or power management applications, ensure to limit margin pressures to 60 bar or less for optimal control component life.](#)

Refer to [LS System Over-Signaling](#) on page 50 for more details.

Electric Dump Control (frames E, F and J)



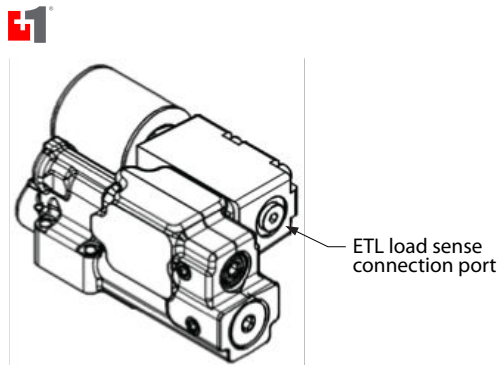
P108589

Electronic Torque Limiting Controls (ETL)

PLUS+1 Compliance

All controls for this product have met and passed the Danfoss PLUS+1[®] compliance standard testing, and as such, this product control is PLUS+1[®] Compliant. PLUS+1[®] compliance blocks (software) are available on the Danfoss website, |

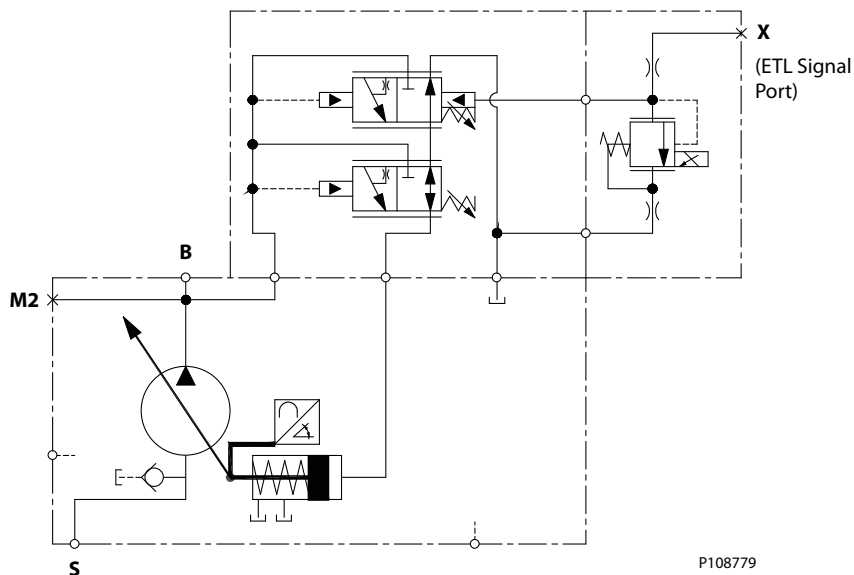
General Information



Electric Torque Limiting Control Principle

The Electronic Torque Limiting control consists of a normally closed proportional relief valve (PRV) integrated into a Pressure Compensated/Load Sensing control. This control operates as a PC/LS control, with the additional ability to limit load sense pressure using the integrated PRV by varying the current to the solenoid. When combined with an angle sensor, this control allows for a PC/LS control with electronic torque limiting.

J-frame pump with integrated ETL control



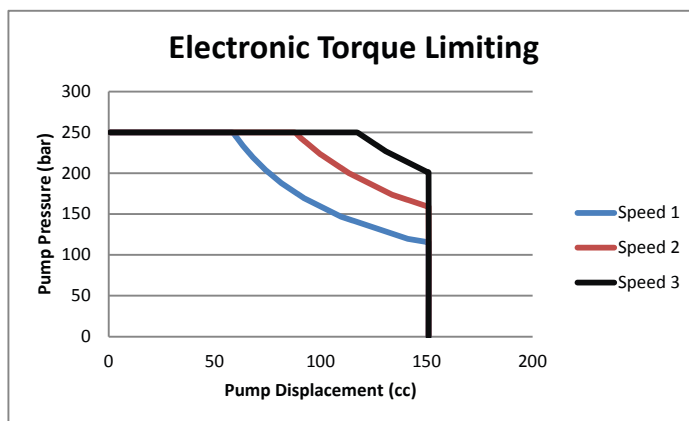
Pump torque consumption is a function of pump outlet pressure, pump displacement, and pump mechanical efficiency. When pump mechanical efficiency is considered constant, the pump torque can be limited when pump displacement is known and pump pressure is controlled. As pump displacement increases, the pump outlet pressure can be limited using the PRV to result in a constant torque limit. Pump outlet pressure is equal to the load sense pressure, which is limited with the PRV, plus the margin pressure setting of the pump.

$$Torque = \frac{Pump\ Outlet\ Pressure\ (bar) * Pump\ Displacement\ (\frac{cc}{rev})}{62.8 * Pump\ Mechanical\ Efficiency\ (\%)}$$

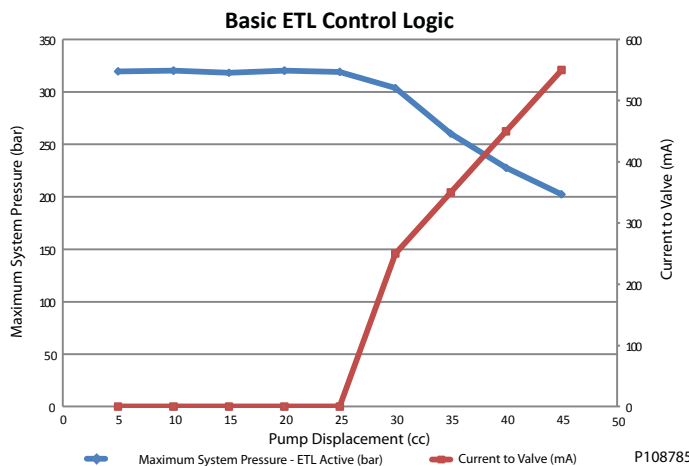
General Information

Electronic Torque Limiting Control Characteristic

The Electronic Torque Limiting control allows users to limit pump torque consumption electronically by combining a pressure limiting PRV and angle sensor. This torque limit can be changed with varying engine speeds (as shown in the Electronic Torque Limiting graph below), allowing the use of full engine torque at all engine speeds and increasing machine productivity. A microcontroller is required to store engine torque vs speed, receive the pump angle sensor signal, and then calculate and output the pump outlet pressure limit. The basic torque limiting control logic for a single engine speed is shown below. Danfoss offers a PLUS+1 subsystem application block for the Electronic Torque Limiting control option in combination with keyed MC012-112 microcontroller hardware. The part number for the keyed MC012-112 microcontroller is 11157484. Refer to graph *Operating Pressure vs. Input Current (N.C. EPC)* on page 20 for pressure vs. current information.



P108783



P108785

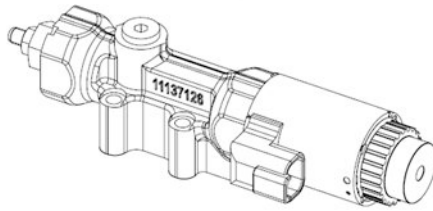
Fan Drive Control (FDC)

PLUS+1 Compliance

All Series 45 Electric controls have met and passed the Danfoss PLUS+1 compliance standard testing, and as such, this Series 45 control is PLUS+1 compliant. PLUS+1 compliance blocks (software) are available on the Danfoss website, within the PLUS+1 Guide section.



General Information

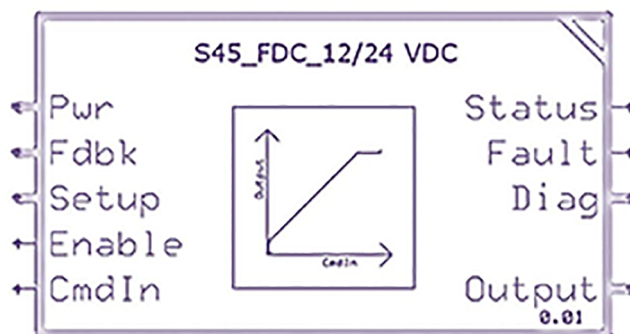


General Information

Fan Drive Control Principle

The Fan Drive Control is a unique electrically actuated pressure control solution that consists of a normally closed proportional solenoid and one dual diameter spool sliding in the control housing. System pressure acts on an area between the two spool diameters of the spool lands. This hydraulic force is balanced with forces of springs and the solenoid when the spool is in the metering position. When no current is sent to the solenoid it operates the pump at or below the PC setting which is adjusted mechanically with the adjustor screw and lock nut. Increasing the control current proportionally reduces the pump's outlet pressure until a minimum standby pressure is reached.

Control Block 12V and 24V



The minimum system pressure is given by swashplate moments of the pump and by servo system leakages which produce a pressure drop across the control. In addition, fan motor type and fan inertia impact minimum system pressure.

The Normally Closed Fan Drive Control coupled with a microprocessor allows the pump to operate at an infinite range of operating pressures between a minimum system pressure and PC setting.

⚠ Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install a relief valve may lead to system damage and/or injury.

⚠ Warning

The Fan Drive Control is intended for fan drive systems only! Use in other systems could result in system component damage or unintended machine movement. The Fan Drive Control is not intended to serve at the primary system pressure relief. Loss of the input signal to this control will cause the pump to produce maximum flow.

Fan Drive Control System Characteristics

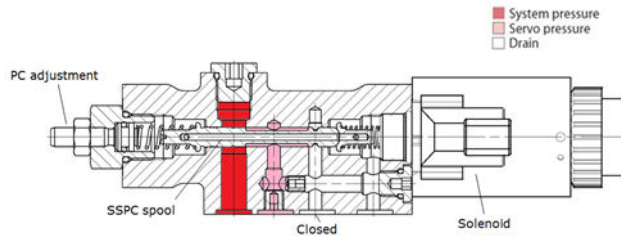
- Constant pressure and variable flow
- High or low system pressure mode based on fan cooling demand
- System flow adjusts to meet system requirements

General Information

Unintended Applications for Fan Drive Control Systems

- Applications with frequent PC events (system pressure overshoots)
- Adjustable Load Sensing systems

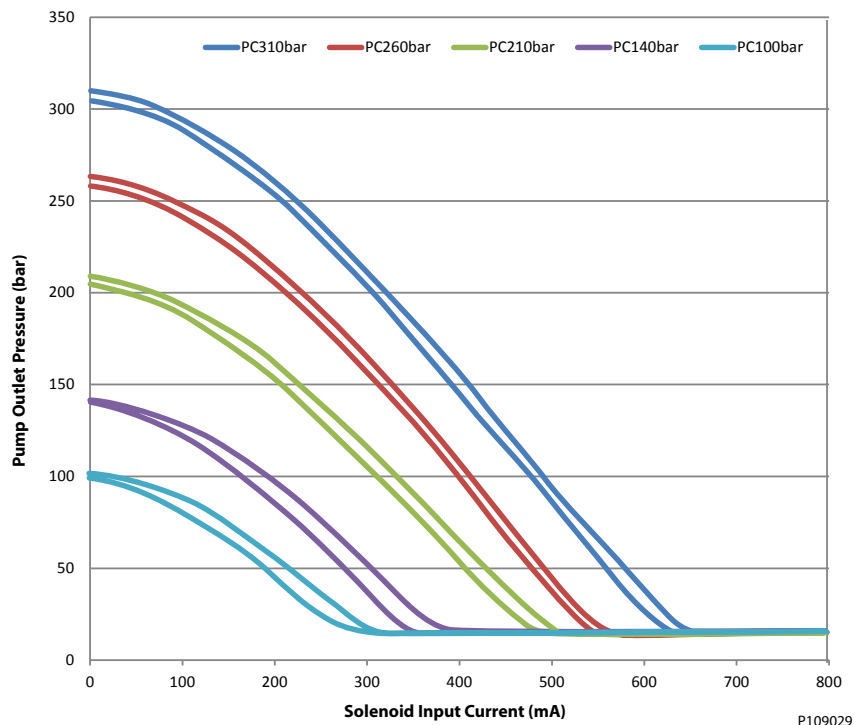
Fan Drive Control Cross Section



Fan Drive Control characteristic - Normally Closed

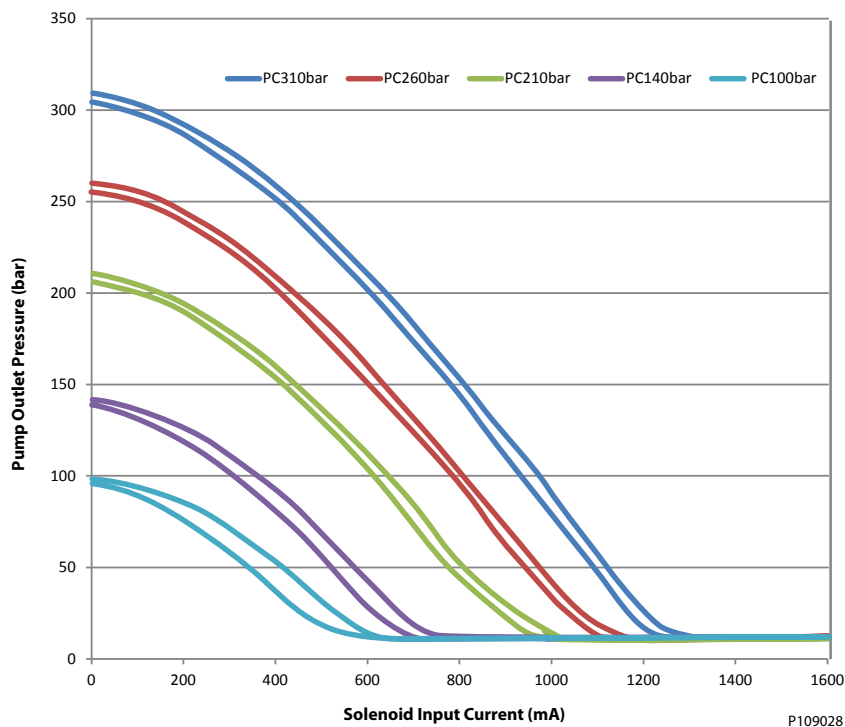
When an electric current is sent to the Normally Closed Fan Drive Control, pump outlet pressure decreases proportionally to the increase in current. When the load in the system changes, the pump will adjust its displacement to maintain the pressure demanded by the controlling current. This predictable control is especially useful for fan-drive systems, due to the direct relationship between fan-speed and pump pressure. Due to the nature of the Fan Drive Control, the relationship between current and pump pressure is unique for each individual PC pressure setting combination. The relationship between pump outlet pressure and control input current (for a 24V coil) is shown for various PC settings below. The hydraulic schematic for the Normally Closed Fan Drive Control is shown below as well.

Pump Outlet Pressure vs. control input current 24V Normally closed FDC (at 100Hz PWM)



General Information

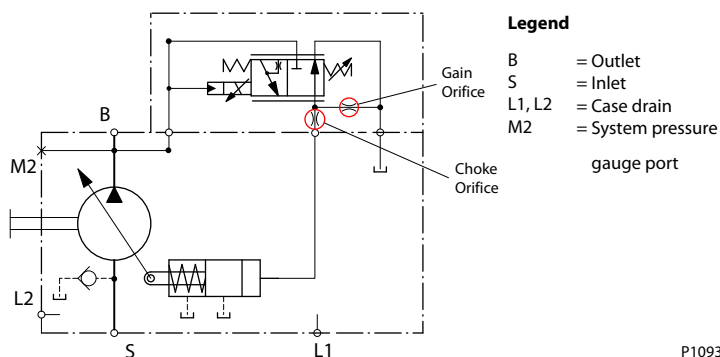
Pump Outlet Pressure vs. control input current 12V Normally closed FDC (at 100Hz PWM)



Attaining remarkably low system pressures is possible with the Fan Drive Control. The minimum system pressure is greatly dependent on individual system parameters such as fan motor type and fan size. This feature is highly desirable in low cooling demand conditions to keep fan speed as slow as possible.

Virtually eliminated control deadband increases controllability and reduces power loss. Control current resolution is greatly improved.

S45 pump with integrated FDC control Schematic



Solenoid data – Normally closed

Solenoid Data – Normally Closed

	12V	24V
Connector on solenoid	Deutsch DT04-2P	
Mating Connector (not included)	Deutsch DT06-2S	

General Information

Solenoid Data – Normally Closed (continued)

	12V	24V
Identification by color of nut	Black	Blue
Nominal current	1650 mA	840 mA
Maximum Control Current	1800 mA	920 mA
Environmental rating	IP67 without mating connector, IP69K with mating connector	
Maximum output driver current	2.0 Amps	
PLUS+1 dither frequency	Not recommended	
Useable PWM Frequency Range	50-200 Hz	
Recommended PWM Frequency	200 Hz	
Nominal Resistance at 20°C	3.66 Ω	14.2 Ω
Inductivity (pin at stroke end)	33 mH	140 mH
Minimum voltage	9.5 Vdc	19.0 Vdc
Maximum power	17.9 Watts	18.1 Watts

The Fan Drive Control is designed as a current driven control. It requires a PWM- input signal.

General Information

Fan Drive Control configuration

The available Normally Closed Fan Drive Controls for Series 45 are shown below. The allowable Pressure Compensator (PC) pressure settings are provided for each frame.

C module—Control

Fan Drive Control Options		Frame					
Code	Description	L	K	K2	J	F	E
SA	Fan Drive Control (12Vdc), 100-210 Bar, Left			•	•	•	
SB	Fan Drive Control (24Vdc), 100-210 Bar, Left			•	•	•	
SC	Fan Drive Control (12Vdc), 220-310 Bar, Left			•	•	•	
SD	Fan Drive Control (24Vdc), 220-310 Bar, Left			•	•	•	
SE	Fan Drive Control (12Vdc), 100-210 Bar, Right				•	•	
SF	Fan Drive Control (24Vdc), 100-210 Bar, Right				•	•	
SG	Fan Drive Control (12Vdc), 220-310 Bar, Right				•	•	
SH	Fan Drive Control (24Vdc), 220-310 Bar, Right				•	•	

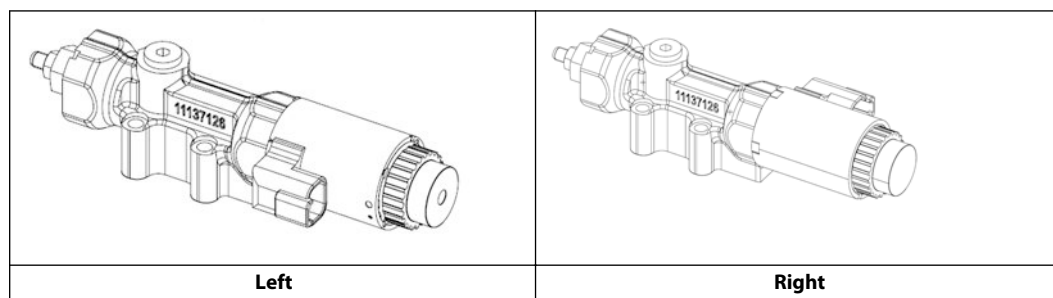
G module options—Choke Orifice

Fan Drive Control options	Choke Orifice size
G	0.8 mm (0.031 in)
F	1.0 mm (0.039 in)

H module options—Gain Orifice

Fan Drive Control options	Gain Orifice Size
E	1.2 mm (0.047 in)

NC Fan Drive Control 3D Views



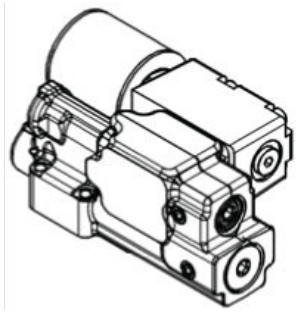
Angle Sensor

PLUS+1 Compliance

The Electric Angle Sensor has met and passed the Danfoss PLUS+1 compliance standard testing, and as such, this Angle Sensor is PLUS+1 compliant. PLUS+1 compliance blocks are available on the Danfoss website, within the PLUS+1 Guide section.

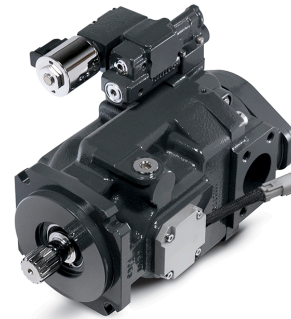
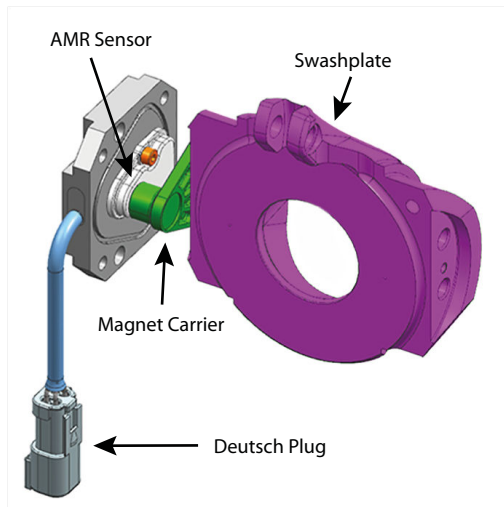


General Information



Angle Sensor Principle

The Series 45 Angle Sensor option allows users to measure the angle of pump displacement. The angle sensor is an electronic sensor mounted to the housing of the pump, which reads the pump stroke angle based on the swashplate position. Interfacing with the angle sensor is achieved through a 4-pin Deutsch DTM04-4P receptacle attached to a flexible connection cable (for a mating connector, use Deutsch® plug DTM06-4S). The sensor is mounted to the pump within an aluminum housing to prevent magnetic interference.



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Angle Sensor Characteristics

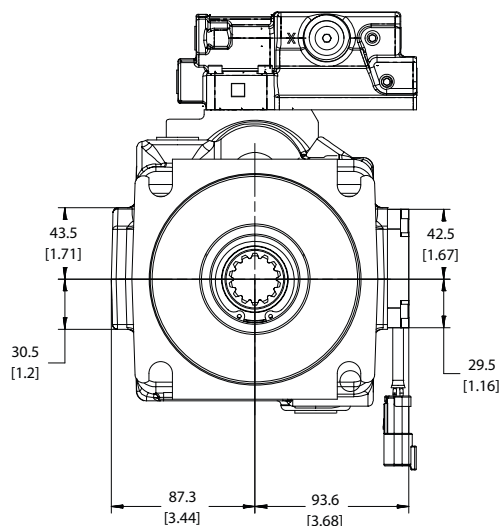
The angle sensor package incorporates two sensor signals (primary & secondary), within a single sensor housing. This allows for improved accuracy and troubleshooting. For the 'Angle Sensor – Right' order code in the K module, the sensor is positioned according to the following conventions:

Code	Description	Frame				
		L	K	J	F	E
K Module - Housing						
A1R	SAE-C Flange 4-bolt, SAE O-ring boss ports, Single seal, Angle Sensor				•	
A2R	SAE-C Flange 4-bolt, SAE O-ring boss ports, Single seal, Angle Sensor			•		•
AFR	SAE-C Flange 2-bolt @45°, SAE O-ring boss ports, Single Seal, Angle Sensor			•		
M Module – Special Hardware						
ANS	Angle Sensor Hardware			•	•	•

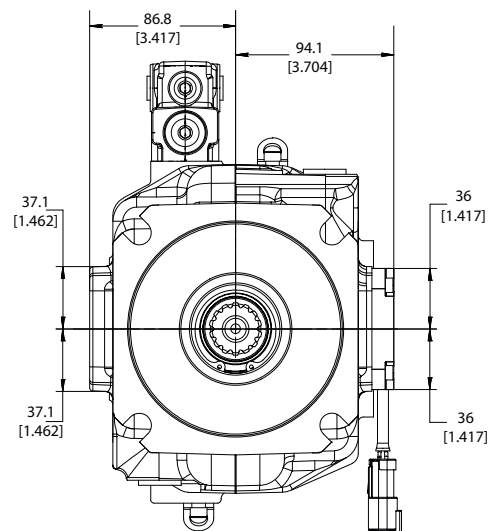
General Information

J & F-Frame (45-90cc) Angle Sensor Identification Convention:

When looking at the input shaft with the control on the ‘top’ side, the angle sensor will be viewed on the right hand side. This convention is true for both Clockwise and Counter-clockwise rotation J & F-Frames.



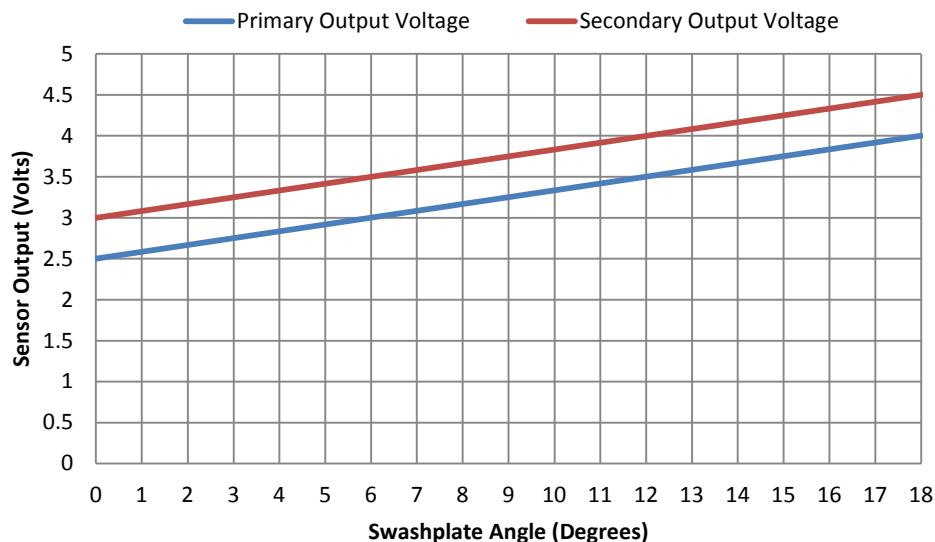
J Frame Angle Sensor Position



F Frame Angle Sensor Position

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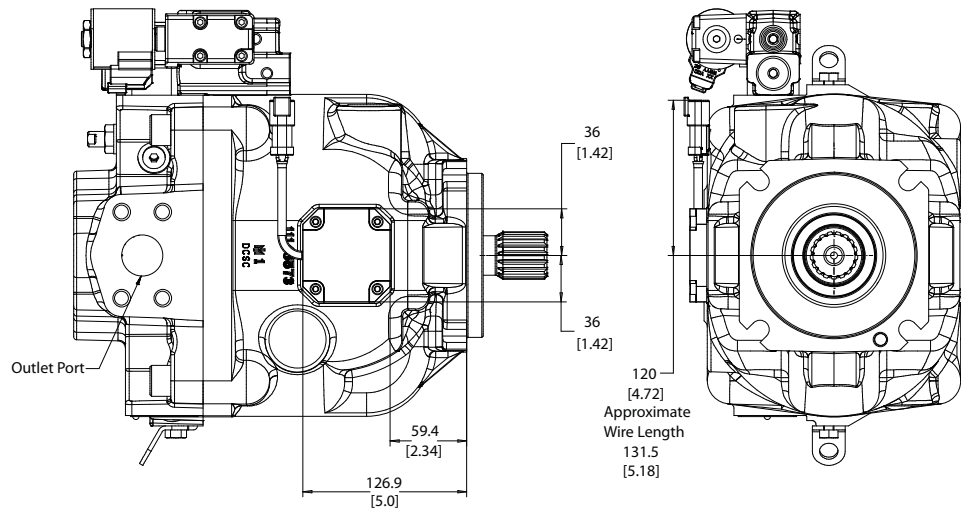
This sensor location yields a unique voltage versus swashplate angle characteristic curve which is the same for both Clockwise and Counter-clockwise rotation J & F-frames. Although each pair of curves will be unique for individual pumps, a general example of what to expect is provided below for J & F units with the ‘Right’ angle sensor position.



E-Frame (100-147cc) Angle Sensor Identification Convention:

The location convention for the E-Frame angle sensor is different from that of the J & F-Frame due to a difference in design of the endcap and servo systems. When looking at the input shaft, the angle sensor will be positioned on the same side as the outlet port of the endcap. The outlet port of the endcap is always the smaller of the inlet and outlet ports, indicated below. This is the ‘right side’ order code location, even though it appears on the left hand side from a frontal view.

General Information



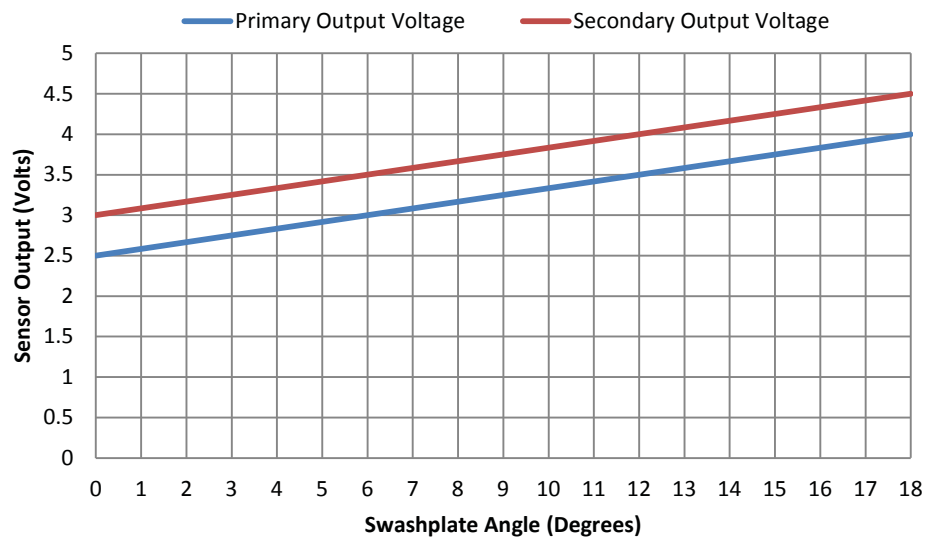
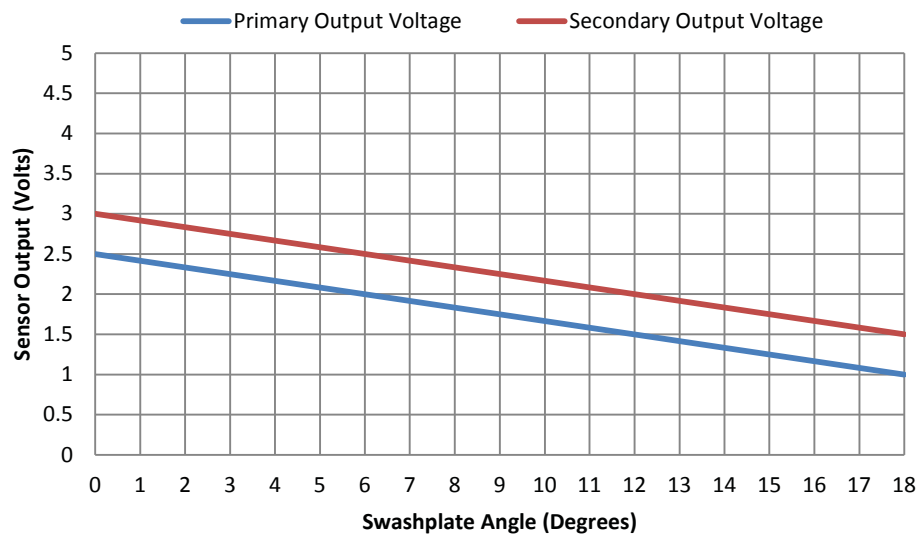
E Frame Angle Sensor Position

P108821

Clockwise rotation E-frames appear with the control on the top side in this view. Counter-clockwise rotation E-Frames appear with the control on the bottom side in this view.

This sensor location yields a unique voltage versus swashplate angle characteristic curve which is different for Clockwise and Counter-clockwise rotation E-frames. Although each pair of curves will be unique for individual pumps, a general example of what to expect is provided below for both Clockwise and Counter-clockwise rotation units with the **Right** angle sensor position.

General Information



General Information

Angle sensor electrical specifications

Electrical specifications

Description	Minimum	Typical	Maximum	Unit	Note
Supply (V+)	4.75	5	5.25	Vdc	Sensor is ratiometric in the voltage range
Supply protection	—	—	28	Vdc	Sensor will switch off above 5.5 V
Supply current drawn	—	22	25	mA	Sensor supply at 5 V
Output short circuit current (VDD to SIG 1/2 and GND to SIG 1/2)	—	—	7.5	mA	Additional 7.5 mA for each sensor signal, total sensor $7.5 \times 2 + 22 = 37$ mA typical for FSO
Resolution	—	0.03	—	degree	11 bit output channel
Hysteresis	—	—	—	—	Design of sensor eliminates any mechanical hysteresis
Environment temperature range	-40 (-40)	80 (176)	104 (220)	°C (°F)	If temperature limits are exceeded, the sensor will function at a reduced level of performance
Operating temperature range	20 (68)	50 (122)	95 (203)	°C (°F)	Temperature of oil
Storage temperature	-40 (-40)	—	125 (257)	°C (°F)	—
Refresh rate of the sensor	—	—	100	µs	Internal ADC refresh rate

Angle Sensor Calibration

A 2-point calibration of the sensor is recommended, with points measured at pump standby, and maximum pump stroke. Maximum pump stroke can be achieved when the pump input shaft is not being turned, as Series 45 pumps are biased to maximum displacement. In some cases the pump may need to be turned momentarily to ensure the pump is in the maximum displacement position; this can be achieved through a momentary switching of the engine starter on/off.

Angle Sensor Functionality

The Series 45 angle sensor option is intended for functionality such as electronic torque limiting, duty cycle measurement, troubleshooting, etc. The angle sensor is PLUS+1 compliant with an available hardware compliance block.

Angle Sensor Intended Functionality:

- Electronic Torque Limiting
- Duty Cycle Recording
- Troubleshooting

Angle Sensor Unsupported Functionality:

- Displacement/Flow Control

Charge Pump Circuits

This section includes two general circuits for providing charge pressure to Series 45 pumps.

Example Circuit #1

Example Circuit #1 shows a generic open circuit charging layout.

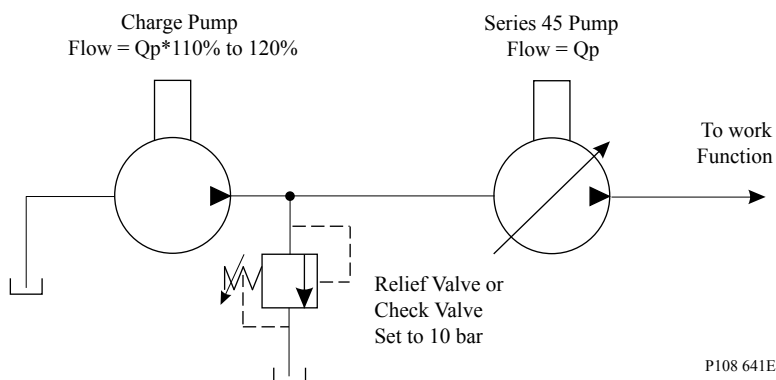
In applications where the Series 45 pump does not have the required inlet pressure available, an external charge pump may be used to increase the inlet pressure to an acceptable level. Scenarios in which this may occur include a layout with the pump above the reservoir, high altitude conditions, etc.

For circuit type #1, follow these recommendations:

General Information

- Size the charge pump so that its flow is 10 to 20% greater than the Series 45 flow rate at worst case conditions
- Include a relief valve or check valve, as shown, between the charge pump and S45 pump with an initial pressure setting of up to 10 bar; if aeration at the inlet of the S45 pump is still present, increase the relief/cracking pressure up to 20 bar (maximum).

Generic open circuit



Example Circuit #2

Example Circuit #2 shows a semi-closed circuit charging layout.

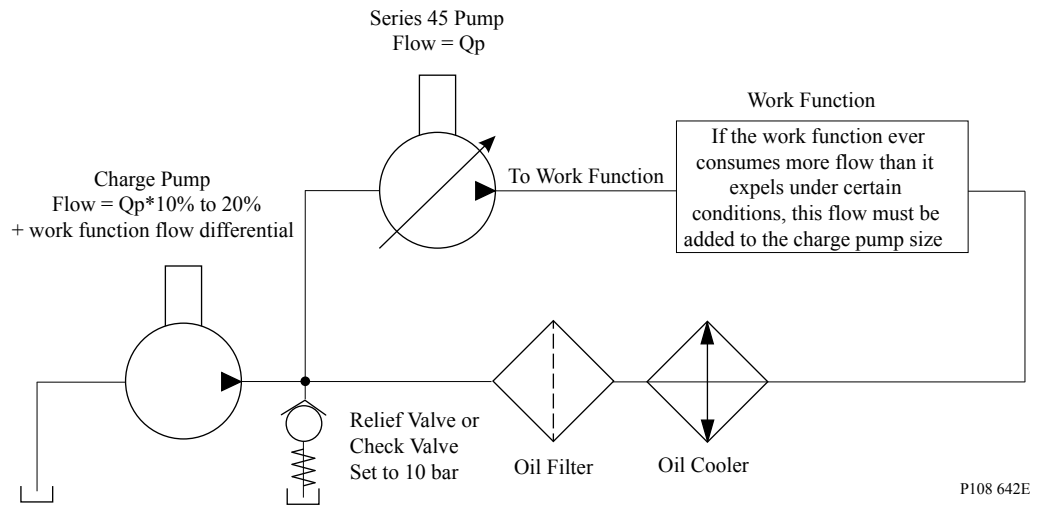
In applications where the Series 45 pump does not have the required inlet pressure available, an external charge pump may be used to increase the inlet pressure to an acceptable level. Scenarios in which this may occur include a layout with the pump above the reservoir, high altitude conditions, etc.

For circuit type #2, follow these recommendations:

- Determine if the work function ever consumes more flow than it expels (for example: double acting or single acting cylinders). If so, determine the maximum flow differential in/out of the work function.
- Size the charge pump so that its flow is 10-20% of the Series 45 pump flow at worst case conditions, and increase this size by any work function flow differential which may occur.
- An inline oil cooler may be required for this type of circuit.
- Include an oil filter after the oil cooler; this ensures that any sediment in the oil cooler that may be dislodged due to vibration or any other reason is caught in the filter.
- Include a relief valve or check valve between the charge pump and S45 pump with an initial pressure setting of up to 10 bar; if aeration at the inlet of the S45 pump is still present, increase the relief/cracking pressure up to 20 bar (maximum).

General Information

Semi-closed circuit



Operating parameters

Fluids

Ratings and performance data for Series 45 products are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These include premium turbine oils, API CD engine oils per SAE J183, M2C33F or G automatic transmission fluids (ATF), Dexron II (ATF) meeting Allison C-3 or Caterpillar T0-2 requirements, and certain specialty agricultural tractor fluids. For more information on hydraulic fluid selection, see Danfoss publication **BC152886484524** Hydraulic Fluids and Lubricants, Technical Information, and **520L0465** Experience with Biodegradable Hydraulic Fluids, Technical Information.

Viscosity

Fluid viscosity limits

Condition		mm ² /s (cSt)	SUS
v min.	continuous	9	58
	intermittent	6.4	47
v max.	continuous	110	500
	intermittent (cold start)	1000	4700

Maintain fluid viscosity within the recommended range for maximum efficiency and pump life.

Minimum Viscosity – This should only occur during brief occasions of maximum ambient temperature and severe duty cycle operation.

Maximum Viscosity – This should only occur at cold start. Pump performance will be reduced. Limit speeds until the system warms up.

Temperature

Oil temperature limits are defined at the pump's case drain. As a rule of thumb, under steady state conditions the case drain temperature is approximately 20 - 25 degrees Centegrade higher than the pump's inlet oil temperature.

General Information

Frame L, K, J, F, & E Temperature Limits

Minimum (intermittent, cold start)	- 40° C [- 40° F]
Continuous	82° C [180° F]
Maximum Intermittent	104° C [220° F]

Frame L, K, J, F, & E Maximum Temperature limits are based on material properties. Don't exceed it. Measure temperature at the case drain of the pump.

K2 Frame Temperature Limits

Minimum (intermittent, cold start)	- 40° C [- 40° F]
Continuous	104° C [219° F]
Maximum Intermittent	115° C [239° F]

Frame K2 Maximum temperature limits are higher than other frame sizes & based on improved swashplate bearing material capabilities. Continuous operation at the Maximum Intermittent Temperature is possible with K2 if fluid viscosity requirements are maintained. *Minimum temperature* for all frame sizes relates to the physical properties of the component materials. Cold oil will not affect the durability of the pump components. However, it may affect the ability of the pump to provide flow and transmit power.

Ensure fluid temperature and viscosity limits are concurrently satisfied.

Inlet pressure

Inlet pressure limits

Minimum (continuous)	0.8 bar absolute [6.7 in. Hg vac.] (at reduced maximum speed)
Minimum (cold start)	0.5 bar absolute [15.1 in. Hg vac.]

Maintain inlet pressure within the limits shown in the table. Refer to Inlet pressure vs. speed charts for each displacement.

Case pressure

Case pressure limits

Maximum (continuous)	0.5 bar [7 psi] above inlet
Intermittent (cold start)	2 bar [29 psi] above inlet

Maintain case pressure within the limits shown in the table. The housing must always be filled with hydraulic fluid.

Caution

Operating outside of inlet and case pressure limits will damage the pump. To minimize this risk, use full size inlet and case drain plumbing, and limit line lengths.

General Information

Pressure ratings

The specification tables in each section give maximum pressure ratings for each displacement. Not all displacements within a given frame operate under the same pressure limits. Definitions of the operating pressure limits appear below.

Continuous working pressure is the average, regularly occurring operating pressure. Operating at or below this pressure should yield satisfactory product life. For all applications, the load should move below this pressure. This corresponds to the maximum allowable PC setting.

Maximum (peak) working pressure is the highest intermittent pressure allowed. Maximum machine load should never exceed this pressure, and pressure overshoots should not exceed this pressure. *See [Duty cycle and pump life](#).

Speed ratings

The specification tables in each section give minimum, maximum, and rated speeds for each displacement. Not all displacements within a given frame operate under the same speed limits. Definitions of these speed limits appear below.

Rated speed is the fastest recommended operating speed at full displacement and 1 bar abs. [0 in Hg vac] inlet pressure. Operating at or below this speed should yield satisfactory product life.

Maximum speed is the highest recommended operating speed at full power conditions. Operating at or beyond maximum speed requires positive inlet pressure and/or a reduction of pump outlet flow. Refer to Inlet pressure vs. speed charts for each displacement.

Minimum speed is the lowest operating speed allowed. Operating below this speed will not yield satisfactory performance.

Duty cycle and pump life

Knowing the operating conditions of your application is the best way to ensure proper pump selection. With accurate duty cycle information, your Danfoss representative can assist in calculating expected pump life.

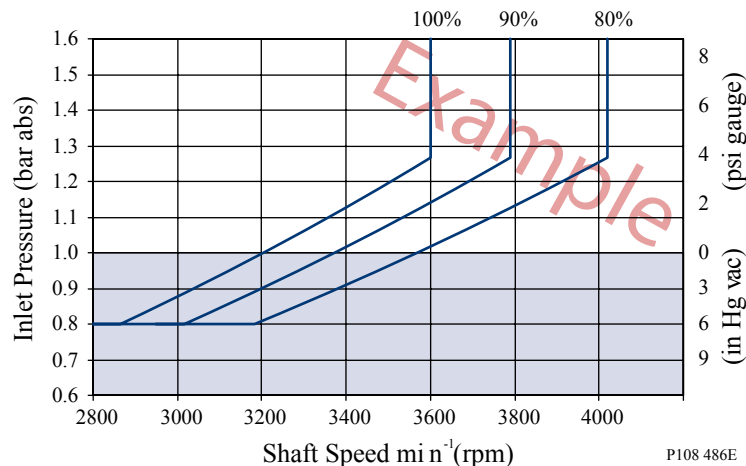
General Information

Speed, flow, and inlet pressure

Inlet pressure vs. speed charts in each section show the relationship between speed, flow, and inlet pressure for each displacement. Use these charts to ensure your application operates within the prescribed range.

The charts define the area of inlet pressures and speeds allowed for a given displacement. Operating at lower displacements allows greater speed or lower inlet pressure.

Sample inlet pressure vs. speed chart



Operating limit at 80% displacement

Operating limit at 90% displacement

Operating limit at 100% displacement

General Information

Design parameters

Installation

Series 45 pumps may be installed in any position. To optimize inlet conditions, install the pump at an elevation below the minimum reservoir fluid level. Design inlet plumbing to maintain inlet pressure within prescribed limits (see [Inlet pressure](#) limits)

Fill the pump housing and inlet line with clean fluid during installation. Connect the case drain line to the uppermost drain port (L1 or L2) to keep the housing full during operation.

To allow unrestricted flow to the reservoir, use a dedicated drain line. Connect it below the minimum reservoir fluid level and as far away from the reservoir outlet as possible. Use plumbing adequate to maintain case pressure within prescribed limits (see [Case pressure](#) limits,).

Filtration

To prevent damage to the pump, including premature wear, fluid entering the pump inlet must be free of contaminants. Series 45 pumps require system filtration capable of maintaining fluid cleanliness at ISO 4406-1999 class 22/18/13 or better.

Danfoss does not recommend suction line filtration. Suction line filtration can cause high inlet vacuum, which limits pump operating speed. Instead we recommend a 125 µm (150 mesh) screen in the reservoir covering the pump inlet. This protects the pump from coarse particle ingestion.

Return line filtration is the preferred method for open circuit systems. Consider these factors when selecting a system filter:

- Cleanliness specifications
- Contaminant ingress rates
- Flow capacity
- Desired maintenance interval

Typically, a filter with a beta ratio of $\beta_{10} = 10$ is adequate. However, because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. For more information, see Danfoss publication **BC152886482150** Design Guidelines for Hydraulic Fluid Cleanliness.

Reservoir

The reservoir provides clean fluid, dissipates heat, and removes entrained air from the hydraulic fluid. It allows for fluid volume changes associated with fluid expansion and cylinder differential volumes. Minimum reservoir capacity depends on the volume needed to perform these functions. Typically, a capacity of one to three times the pump flow (per minute) is satisfactory.

Locate the reservoir outlet (suction line) near the bottom, allowing clearance for settling foreign particles. Place the reservoir inlet (return lines) below the lowest expected fluid level, as far away from the outlet as possible.

Fluid velocity

Choose piping sizes and configurations sufficient to maintain optimum fluid velocity, and minimize pressure drops. This reduces noise, pressure drops, and overheating. It maximizes system life and performance.

Recommended fluid velocities

System lines	6 to 9 m/sec [20 to 30 ft/sec]
Suction line	1 to 2 m/sec [4 to 6 ft/sec]
Case drain	3 to 5 m/sec [10 to 15 ft/sec]

Typical guidelines; obey all pressure ratings.

General Information

Velocity equations

SI units

Q = flow (l/min)

A = area (mm²)

Velocity = (16.67•Q)/A (m/sec)

US units

Q = flow (US gal/min)

A = area (in²)

Velocity = (0.321•Q)/A (ft/sec)

Shaft loads

Series 45 pumps have tapered roller bearings capable of accepting external radial and thrust (axial) loads. The external radial shaft load limits are a function of the load position, orientation, and the operating conditions of the pump.

The maximum allowable radial load (R_e) is based on the maximum external moment (M_e) and the distance (L) from the mounting flange to the load. Compute radial loads using the formula below. Tables in each section give maximum external moment (M_e) and thrust (axial) load (T_{in} , T_{out}) limits for each pump frame size and displacement.

Radial load formula

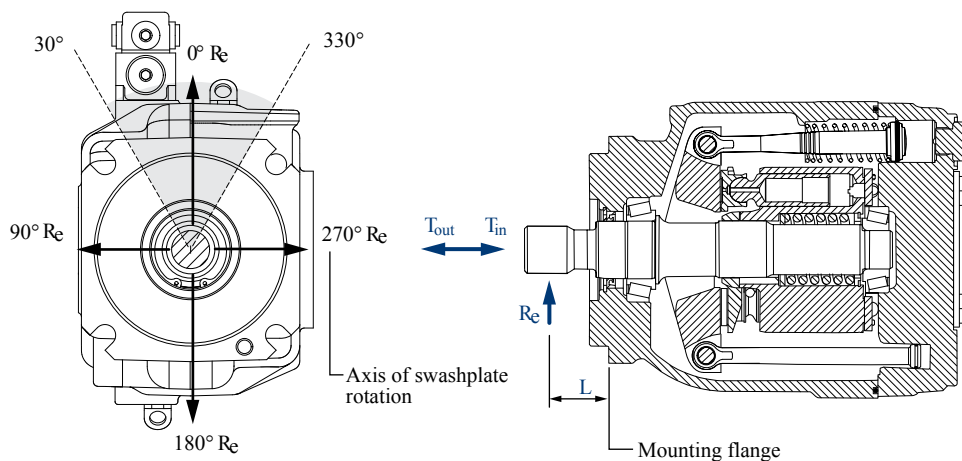
$$M_e = R_e \cdot L$$

L = Distance from mounting flange to point of load

M_e = Maximum external moment

R_e = Maximum radial side load

Shaft load orientation



P101 080E

Bearing life

All shaft loads affect bearing life. In applications where external shaft loads can not be avoided, maximize bearing life by orientating the load between the 30° and 330° positions, as shown. Tapered input shafts or clamp-type couplings are recommended for applications with radial shaft loads.

General Information

Mounting flange loads

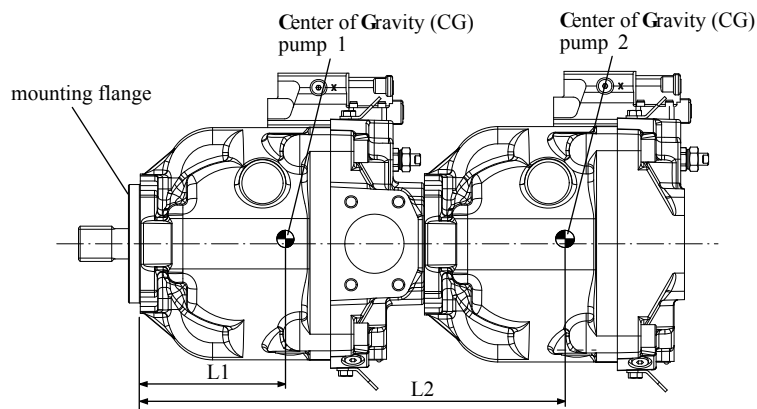
Adding auxiliary pumps and/or subjecting pumps to high shock loads may overload the pump mounting flange. Tables in each section give allowable continuous and shock load moments for each frame size. Applications with loads outside allowable limits require additional pump support.

- Shock load moment (M_s) is the result of an instantaneous jolt to the system.
- Continuous load moments (M_c) are generated by the typical vibratory movement of the application.

Estimating overhung load moments

Use the equations below to estimate the overhung load moments for multiple pump mounting. See installation drawings in each section to find the distance from the mounting flange to the center of gravity for each frame size. Refer to the technical specifications in each section to find pump weight.

Overhung load example



P101 081E

Shock load formula

$$M_s = G_s \cdot K \cdot (W_1 \cdot L_1 + W_2 \cdot L_2 + \dots + W_n \cdot L_n)$$

Continuous load formula

$$M_c = G_c \cdot K \cdot (W_1 \cdot L_1 + W_2 \cdot L_2 + \dots + W_n \cdot L_n)$$

SI units

M_s = Shock load moment (N·m)

M_c = Continuous (vibratory) load moment (N·m)

G_s = Acceleration due to external shock (G's)

G_c = Acceleration due to continuous vibration (G's)

K = Conversion factor = 0.00981

W_n = Mass of nth pump (kg)

L_n = Distance from mounting flange to nth pump CG (mm)

US units

M_s = Shock load moment (lbf·in)

M_c = Continuous (vibratory) load moment (lbf·in)

G_s = Acceleration due to external shock (G's)

G_c = Acceleration due to continuous vibration (G's)

K = Conversion factor = 1

W_n = Weight of nth pump (lb)

General Information

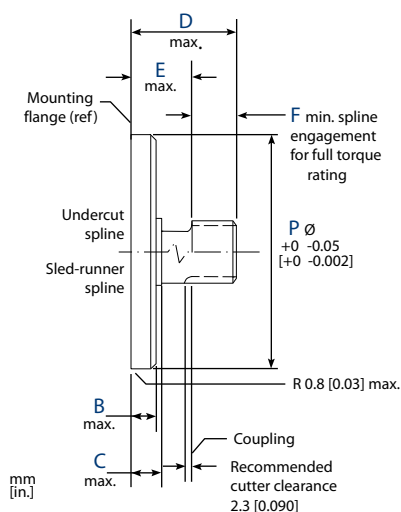
L_n = Distance from mounting flange to nth pump CG (in)

Auxiliary mounting pads

Auxiliary mounting pads are available for all radial ported Series 45 pumps. Since the auxiliary pad operates under case pressure, use an O-ring to seal the auxiliary pump mounting flange to the pad. Oil from the main pump case lubricates the drive coupling.

- All mounting pads meet SAE J744 Specifications.
- The combination of auxiliary shaft torque and main pump torque must not exceed the maximum pump input shaft rating. Tables in each section give input shaft torque ratings for each frame size.
- Applications subject to severe vibratory or shock loading may require additional support to prevent mounting flange damage. Tables in each section give allowable continuous and shock load moments for each frame size.
- The drawing and table below give mating pump dimensions for each size mount. Refer to installation drawings in each section for auxiliary mounting pad dimensions.

Mating pump specifications



Dimensions

	SAE A	SAE B	SAE C
P	82.55 [3.250]	101.60 [4.000]	127.00 [5.000]
B	6.35 [0.250]	9.65 [0.380]	12.70 [0.500]
C	12.70 [0.500]	15.20 [0.600]	23.37 [0.920]
D	58.20 [2.290]	53.10 [2.090]	55.60 [2.190]
E	15.00 [0.590]	17.50 [0.690]	30.50 [1.200]
F	13.50 [0.530]	14.20 [0.560]	18.30 [0.720]

Input shaft torque ratings

Input shaft tables in each section give maximum torque ratings for available input shafts. Ensure that your application respects these limits.

General Information

Maximum torque ratings are based on shaft strength. Do not exceed them.

Coupling arrangements that are not oil-flooded provide a reduced torque rating. Contact your Danfoss representative for proper torque ratings if your application involves non oil-flooded couplings.

Danfoss recommends mating splines adhere to ANSI B92.1-Class 6e. Danfoss external splines are class 5 fillet root side fit. Tolerance classes 5 and 6e have the same minimum effective space width and maximum effective tooth thickness limits to ensure interchangeability between mating parts. Tables in each section give full spline dimensions and data.

Understanding and minimizing system noise

Charts in each section give sound levels for each frame size and displacement. Sound level data are collected at various operating speeds and pressures in a semi-anechoic chamber. Many factors contribute to the overall noise level of any application. Below is some information to help understand the nature of noise in fluid power systems, and some suggestions to help minimize it.

Noise is transmitted in fluid power systems in two ways: as fluid borne noise, and structure borne noise.

Fluid-borne noise (pressure ripple or pulsation) is created as pumping elements discharge oil into the pump outlet. It is affected by the compressibility of the oil, and the pump's ability to transition pumping elements from high to low pressure. Pulsations travel through the hydraulic lines at the speed of sound (about 1400 m/s [4600 ft/sec] in oil) until there is a change (such as an elbow) in the line. Thus, amplitude varies with overall line length and position.

Structure-borne noise is transmitted wherever the pump casing connects to the rest of the system. The way system components respond to excitation depends on their size, form, material, and mounting.

System lines and pump mounting can amplify pump noise. Follow these suggestions to help minimize noise in your application:

- Use flexible hoses.
- Limit system line length.
- If possible, optimize system line position to minimize noise.
- If you must use steel plumbing, clamp the lines.
- If you add additional support, use rubber mounts.
- Test for resonants in the operating range, if possible avoid them.

Understanding and minimizing system instability

Knowing the operating conditions and system setup of your application is the best way to ensure a stable system. All fan-drive circuits should use a choke orifice to ensure system stability. With accurate system information, your Danfoss representative can assist you in the selection of a servo control orifice.

LS System Over-Signaling

To optimize the life and performance of Series 45 products using Load Sensing controls, it is important to ensure the margin pressure signal at the pump's control is conditioned in a way which does not damage the control's internal components.

Caution

Excessive component wear may occur when margin pressures > 60 bar are imposed on the LS spool. Reduce margin pressures to 60 bar or less.

Margin pressure defines the physical movement of the LS spool and subsequent modulation of pump flow to the system and is defined by:

$$P_{\text{Margin}} = P_{\text{System}} - P_{\text{Load Sense}} \quad \text{Margin Pressure}$$

General Information

LS System Over-Signaling results when the actual margin pressure magnitude exceeds the minimum pressure required to shift the LS spool. It is important to limit excessive margin pressures in transient system conditions to ensure satisfactory control component life.

For more information on LS System Over-signaling please contact your Danfoss Representative.

Sizing equations

Use these equations to help select the right pump size, displacement and power requirements for your application

	Based on SI units		Based on US units
<i>Flow</i>	Output flow Q = $\frac{V_g \cdot n \cdot \eta_v}{1000}$ (l/min)		Output flow Q = $\frac{V_g \cdot n \cdot \eta_v}{231}$ (US gal/min)
<i>Torque</i>	Input torque M = $\frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$ (N·m)		Input torque M = $\frac{V_g \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$ (lbf·in)
<i>Power</i>	Input power P = $\frac{M \cdot n \cdot \pi}{30\,000} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$ (kW)		Input power P = $\frac{M \cdot n \cdot \pi}{198\,000} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$ (hp)

Variables

SI units [US units]

V_g	Displacement per revolution cm ³ /rev [in ³ /rev]
p_o	Outlet pressure bar [psi]
p_i	Inlet pressure bar [psi]
Δp	p _o - p _i (system pressure) bar [psi]
n	Speed min ⁻¹ (rpm)
η_v	Volumetric efficiency
η_m	Mechanical efficiency
η_t	Overall efficiency (η _v · η _m)

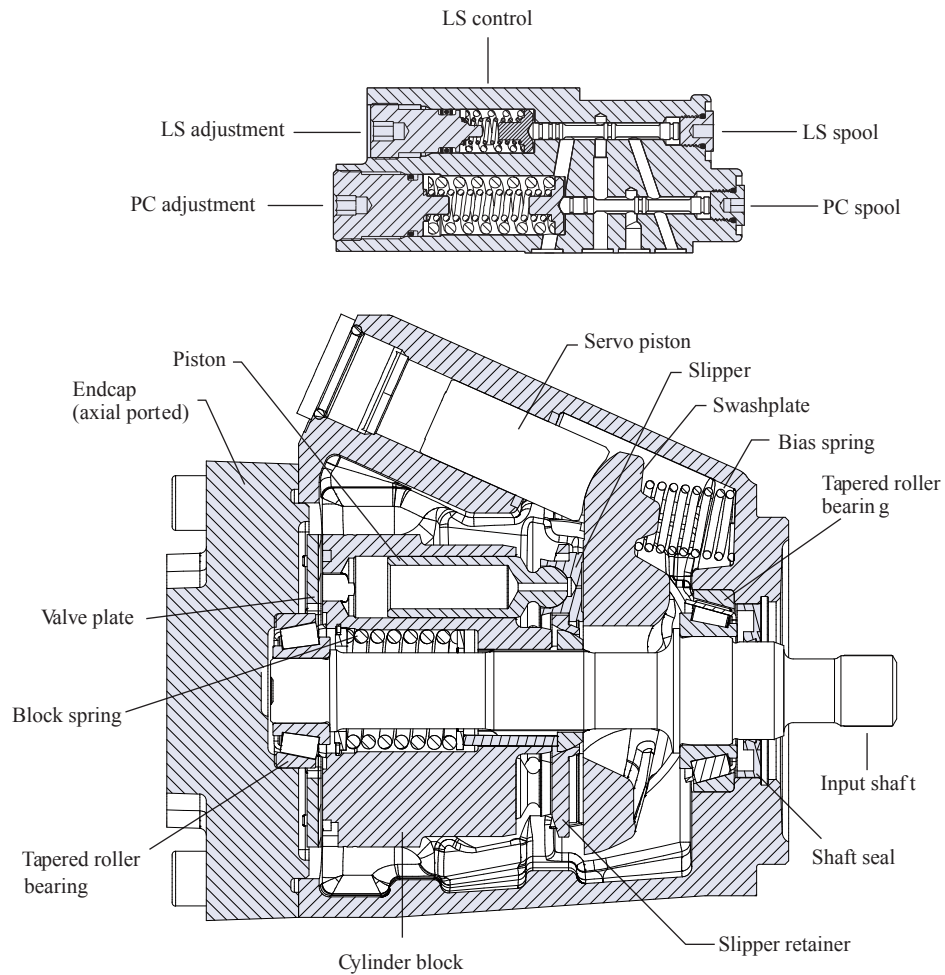
Frame K2

Design

Series 45 Frame K2 pumps have a single servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. A bias spring and internal forces increase swashplate angle. The servo piston decreases swashplate angle. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swashplate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a viton lip-seal protects against shaft leaks.

An adjustable one spool (PC only, not shown) or two spool (LS and remote PC) control senses system pressure and load pressure (LS controls). The control ports system pressure to the servo piston, adjusting swashplate angle to control pump output flow.

Frame K2 cross section



P109073

Frame K2

Technical Specifications

Description		Unit	K2 Frame				
			25C	30C	38C	40C	45C
Maximum Displacement		cm ³ [in ³]	25 [1.53]	30 [1.83]	38 [2.32]	40 [2.44]	45 [2.75]
Working Input Speed	Minimum	min ⁻¹ (rpm)	500	500	500	500	500
	Continuous		3450	3200	2900	3100	2900
	Maximum		3750	3450	3050	3200	3050
Working Pressure	Continuous	bar [psi]	260 [3771]				
	Maximum		350 [5075]				
Flow at rated speed (theoretical)		l/min [US gal/min]	86.3 [22.8]	96.0 [25.4]	110.2 [29.1]	124 [32.8]	130.5 [34.5]
Input torque at maximum displacement (theoretical) at 49° C [120°F]		N•m/bar [lbf•in/1000 psi]	0.398 [243]	0.477 [291]	0.605 [369]	0.636 [389]	0.716 [438]
Mass moment of inertia of internal rotating components		kg•m ² [slug•ft ²]	0.00184 [0.00135]	0.00184 [0.00135]	0.00184 [0.00135]	0.00203 [0.00150]	0.00203 [0.00150]
Weight - Axial ports		kg [lb]	16 [35]				
Weight - Radial ports (no through drive)			17 [37]				
External Shaft Loads	External moment (Me)	N•m [lbf•in]	61 [540]	61 [540]	76 [673]	76 [673]	76 [673]
	Thrust in (Tin), out (Tout)	N [lbf]	1000 [225]	1000 [225]	1200 [270]	1200 [270]	1200 [270]
Mounting flange load moments	Vibratory (continuous)	N•m [lbf•in]	1005 [8895]				
	Shock (maximum)		3550 [31420]				

Order Code

Code description

Code	Description
R	Product Frame, Variable Open Circuit Pump
S	Rotation
P	Displacement
C	Control Type
D	Pressure Compensator Setting
E	Load Sense Setting
F	Not Used
G	Choke Orifice
H	Gain Orifice
J	Input Shaft/Auxiliary Mount/Endcap
K	Shaft Seal/Front Mounting Flange/Housing Ports
L	Displacement Limiter
M	Special Hardware
N	Special Features

R Frame

		K2 Frame				
		025C	030C	038C	040C	045C
K2	K2 Frame, variable displacement open circuit pump	•	•	•	•	•

Frame K2

S Rotation

		K2 Frame				
		025C	030C	038C	040C	045C
L	Left Hand (counterclockwise)	•	•	•	•	•
R	Right Hand (clockwise)	•	•	•	•	•

P Displacement

025C	25 cm ³ /rev [1.53 in ³ /rev]	•				
030C	30 cm ³ /rev [1.83 in ³ /rev]		•			
038C	38 cm ³ /rev [2.32 in ³ /rev]			•		
040C	40 cm ³ /rev [2.44 in ³ /rev]				•	
045C	45 cm ³ /rev [2.75 in ³ /rev]					•

C Control type

		K2 Frame				
		025C	030C	038C	040C	045C
PC	Pressure Compensator	•	•	•	•	•
RP	Remote Pressure Compensator	•	•	•	•	•
LB	Load Sensing/Pressure Comp. w/Bleed Orifice	•	•	•	•	•
LS	Load Sensing/Pressure Comp.	•	•	•	•	•
FB	Electric Dump valve (On/Off) w/Load sensing / Pressure comp. (NC,12VDC), Left	•	•	•	•	•
AH	Electric Proportional Pressure Control w/ Pressure comp. (NC,12VDC), Left	•	•	•	•	•
AL	Electric Proportional Pressure Control w/ Pressure comp. (NC,24VDC), Left	•	•	•	•	•
AX	Electric Proportional Pressure Control w/ Pressure comp. (NO,12VDC), Left	•	•	•	•	•
CL	Electric Proportional Pressure Control w/ Pressure comp. (NO,24VDC), Left	•	•	•	•	•
AR	Electric On/Off Pressure Control w/Pressure comp. (NC,12VDC), Left	•	•	•	•	•
CR	Electric On/Off Pressure Control w/Pressure comp. (NC,24VDC), Left	•	•	•	•	•
AN	Electric On/Off Pressure Control w/Pressure comp. (NO,12VDC), Left	•	•	•	•	•
CN	Electric On/Off Pressure Control w/Pressure comp. (NO,24VDC), Left	•	•	•	•	•
SA	Fan drive control (12Vdc),100-210 Bar, Left	•	•	•	•	•
SB	Fan drive control (24Vdc),100-210 Bar, Left	•	•	•	•	•
SC	Fan drive control (12Vdc),220-260 Bar, Left	•	•	•	•	•
SD	Fan drive control (24Vdc),220-260 Bar, Left	•	•	•	•	•

D PC setting (2 digit code, 10 bar increments)

Example	25 = 250 bar (3625 psi)					
10-26	100 to 260 bar [1450 to 3771 psi]	•	•	•	•	•

Frame K2

E Load sensing setting (2 digit code, 1 bar increments)

		K2 Frame				
		025C	030C	038C	040C	045C
Example	20 = 20 bar (290 psi)					
10-40	10 to 40 bar [145 to 580 psi]	•	•	•	•	•
NN	Not applicable (pressure compensated only controls)	•	•	•	•	•

F Not used

NN	Not applicable	•	•	•	•	•
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G Servo Control Orifice

N	None (standard)	•	•	•	•	•
E	0.8 mm diameter - Electrical proportional controls only	•	•	•	•	•
F	1.0 mm diameter - Electrical proportional controls only	•	•	•	•	•
R	0.8 mm diameter - FDC only	•	•	•	•	•
S	1.0 mm diameter - FDC only	•	•	•	•	•

H Gain Orifice

3	0.7 mm diameter	•	•	•	•	•
E	Gain orifice FDC only, 1.2mm diameter	•	•	•	•	•

J Input Shaft

C2	13 tooth, 16/32 pitch
C3	15 tooth, 16/32 pitch
K1	0.875 inch straight keyed
K2	0.875 inch straight keyed (long)
T1	1.0 inch tapered

Auxiliary Mount/Endcap Style

Code	Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description
MF	None	Axial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
MP	None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.25 inch port M10 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)
NA	None	Axial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M42 threads) Outlet - ISO O-Ring boss port (M33 threads)
MG	None	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
NS	None	Radial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M48 threads) Outlet - ISO O-Ring boss port (M33 threads)

Frame K2

Auxiliary Mount/Endcap Style (continued)

Code	Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description
MR	None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)
RG	Running Cover	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
RR	Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)
AB	SAE-A 9 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M48 threads) Outlet - ISO O-Ring boss port (M33 threads)
AG	SAE-A, 9 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
AK	Integrated SAE-A, 9 teeth, M10 threads	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)
FB	Integrated SAE-A, 9 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M48 threads) Outlet - ISO O-Ring boss port (M33 threads)
FG	Integrated SAE-A, 9 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
EK	SAE-A, 9 teeth, M10 threads	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)
TK	SAE-A, 11 teeth, M10 threads	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)
GG	SAE-A, 11 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
GT	SAE-A, 11 teeth, M10 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M48 threads) Outlet - ISO O-Ring boss port (M33 threads)
BG	SAE-B, 13 teeth, M12 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
BB	SAE-B, 13 teeth, M12 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - ISO O-Ring boss port (M48 threads) Outlet - ISO O-Ring boss port (M33 threads)
DR	SAE-B, 13 teeth, M12 threads	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)

Frame K2

Auxiliary Mount/Endcap Style (continued)

Code	Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description
VG	SAE-BB, 15 teeth, M12 threads	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)
VK	SAE-BB, 15 teeth, M12 threads	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)

J Input Shaft/Auxiliary Mount/Endcap

Available Combinations

	K2 Frame				
	025C	030C	038C	040C	045C
C2MF	•	•	•	•	•
C2MG	•	•	•	•	•
C2MP	•	•	•	•	•
C2MR	•	•	•	•	•
C2TK	•	•	•	•	•
C3AB	•	•	•	•	•
C3DR	•	•	•	•	•
C3MF	•	•	•	•	•
C3MG	•	•	•	•	•
C3MP	•	•	•	•	•
C3MR	•	•	•	•	•
K1RG	•	•	•	•	•
C2NA	•	•	•	•	•
C3NA	•	•	•	•	•
C2NS	•	•	•	•	•
C3NS	•	•	•	•	•
C2RR	•	•	•	•	•
C3RR	•	•	•	•	•
C2EK	•	•	•	•	•
C3EK	•	•	•	•	•
C3TK	•	•	•	•	•
C2DR	•	•	•	•	•
C2VK	•	•	•	•	•
C3VK	•	•	•	•	•
C2AK	•	•	•	•	•
C3AK	•	•	•	•	•
C3FG	•	•	•	•	•
C2AB	•	•	•	•	•
C2BB	•	•	•	•	•
C3BB	•	•	•	•	•
C2GT	•	•	•	•	•

Frame K2

	K2 Frame				
	025C	030C	038C	040C	045C
C3GT	•	•	•	•	•
C2RG	•	•	•	•	•
C3RG	•	•	•	•	•
C2AG	•	•	•	•	•
C3AG	•	•	•	•	•
C2GG	•	•	•	•	•
C3GG	•	•	•	•	•
C2BG	•	•	•	•	•
C3BG	•	•	•	•	•
C2VG	•	•	•	•	•
C3VG	•	•	•	•	•
C3FB	•	•	•	•	•
C2FB	•	•	•	•	•
C2FG	•	•	•	•	•
K1AG	•	•	•	•	•
K1MF	•	•	•	•	•
K2MF	•	•	•	•	•
K2MG	•	•	•	•	•
K2MR	•	•	•	•	•
K2RG	•	•	•	•	•

K Shaft seal

		K2 Frame				
		025C	030C	038C	040C	045C
A	Single (Viton [FKM])	•	•	•	•	•

K Mounting flange and housing port style

6	SAE-B Flange 2-bolt/SAE O-ring boss ports [7/8-14]	•	•	•	•	•
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K Not used

N	Not applicable	•	•	•	•	•
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L Displacement limiter

PLB	None (plugged)	•	•	•	•	•
AAA	Adjustable, factory set at max angle	•	•	•	•	•

M Special hardware

NNN	None	•	•	•	•	•
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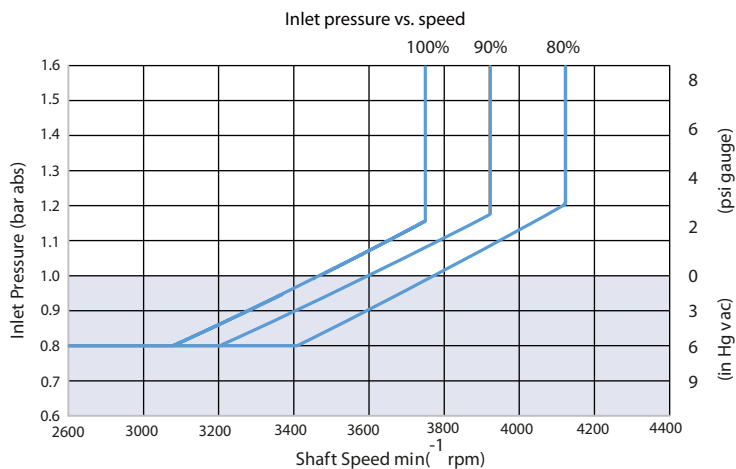
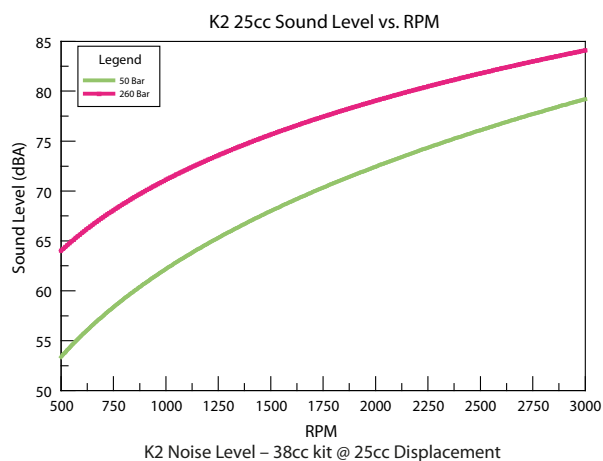
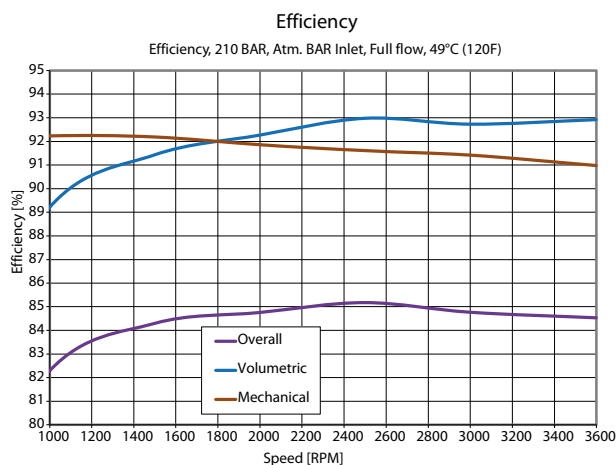
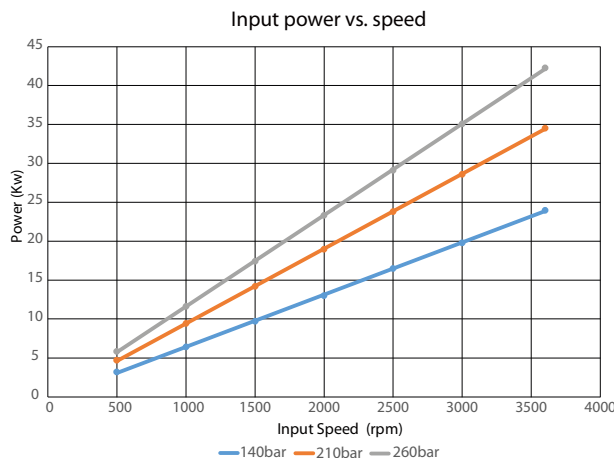
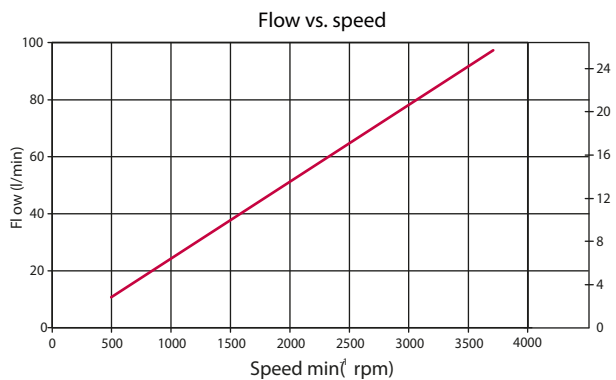
N Special features

NNN	None	•	•	•	•	•
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Frame K2

Performance K2-25C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

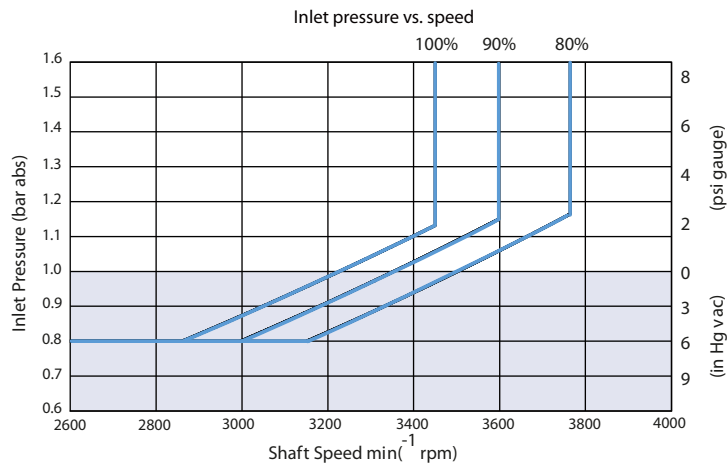
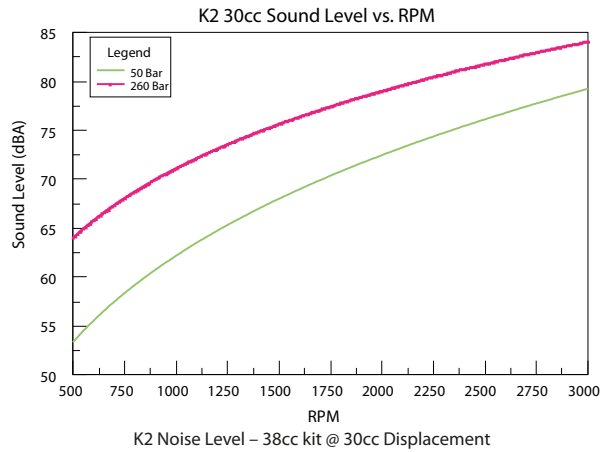
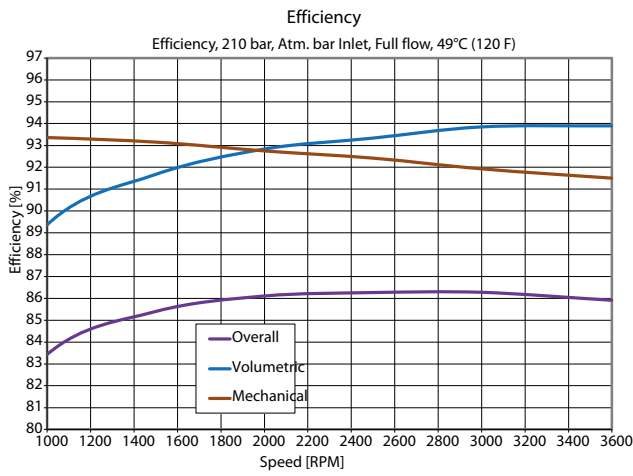
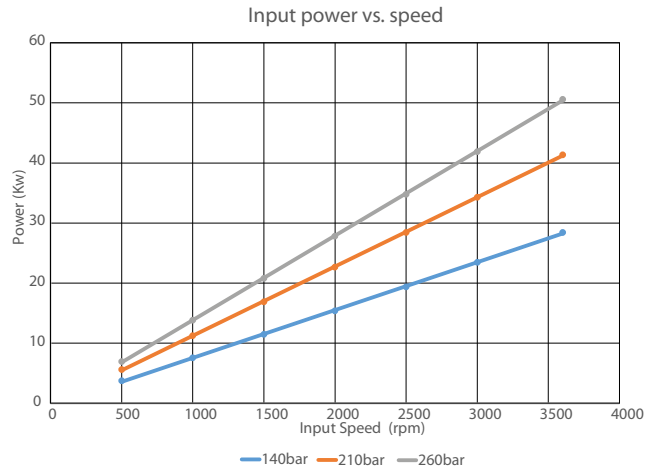
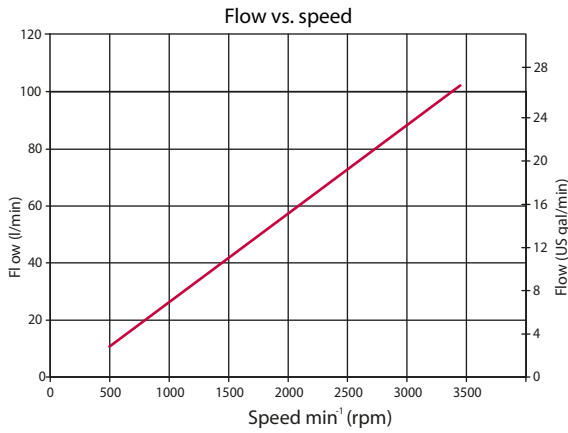


P109103

Frame K2

Performance K2-30C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

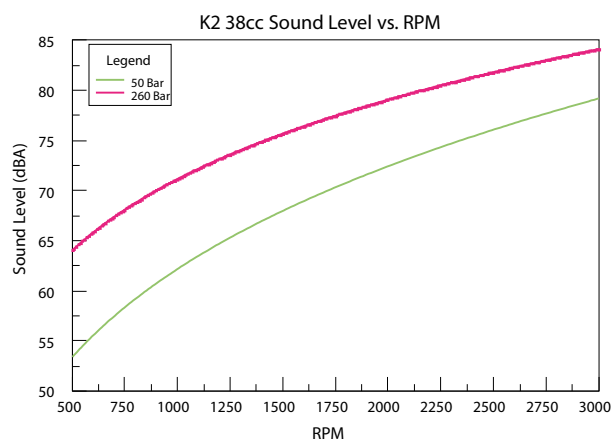
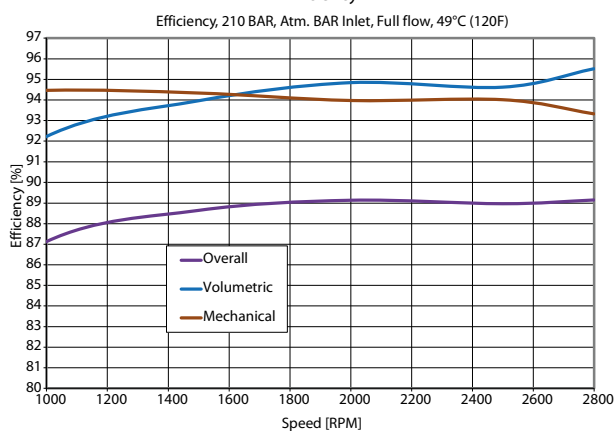
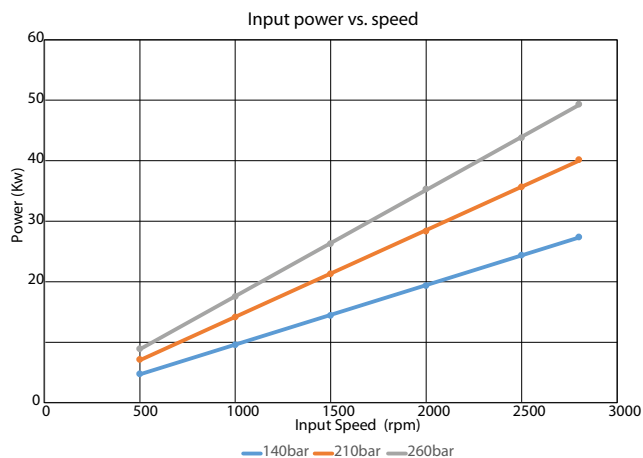
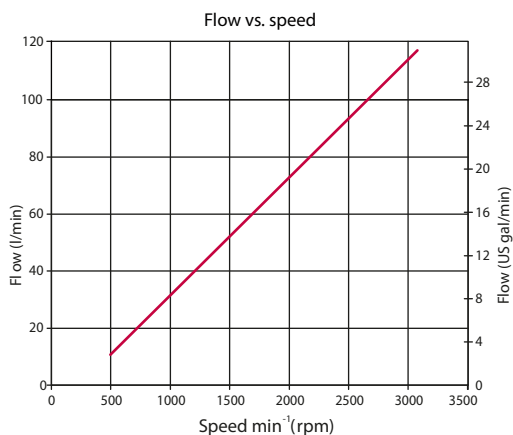


P109104

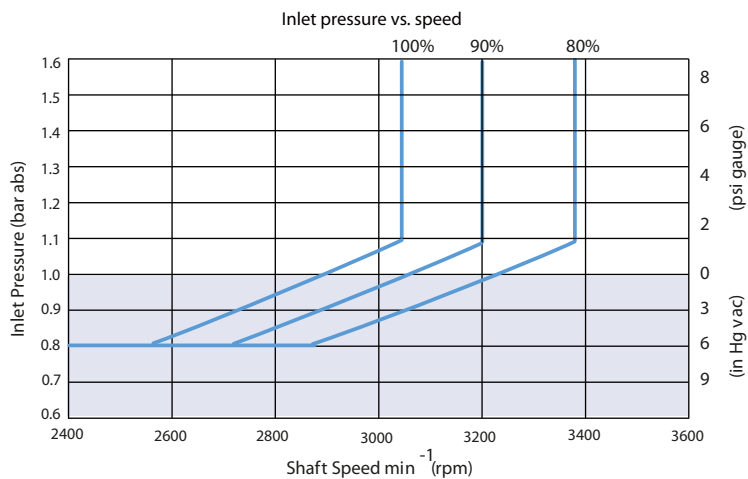
Frame K2

Performance K2-38C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



K2 Noise Level – 38cc kit @ 38cc Displacement

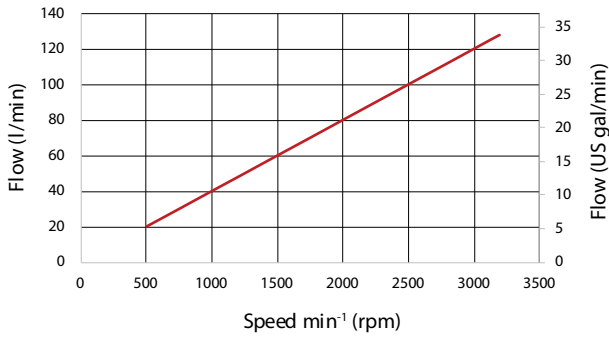


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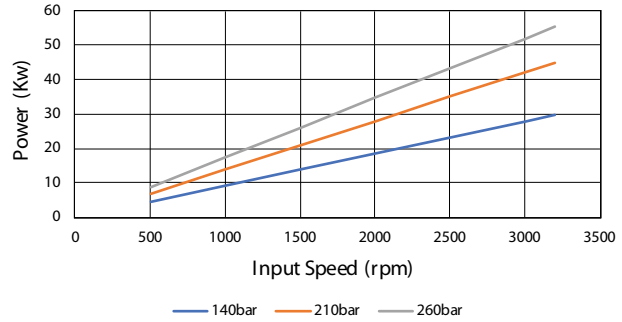
Frame K2

Performance K2-40C

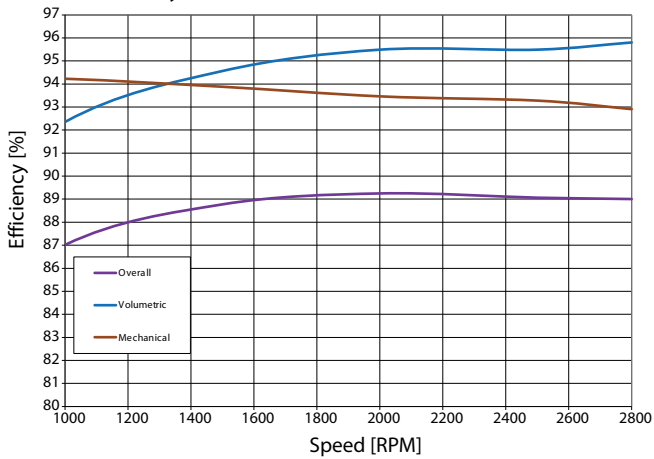
Flow vs. speed



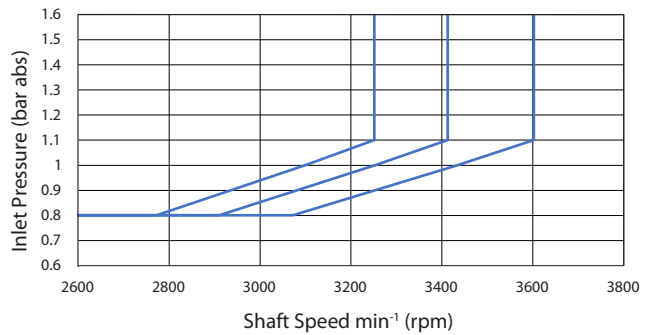
Input power vs. speed



Efficiency, 210 BAR, Atm. BAR Inlet, Full flow, 49° C (120° F)



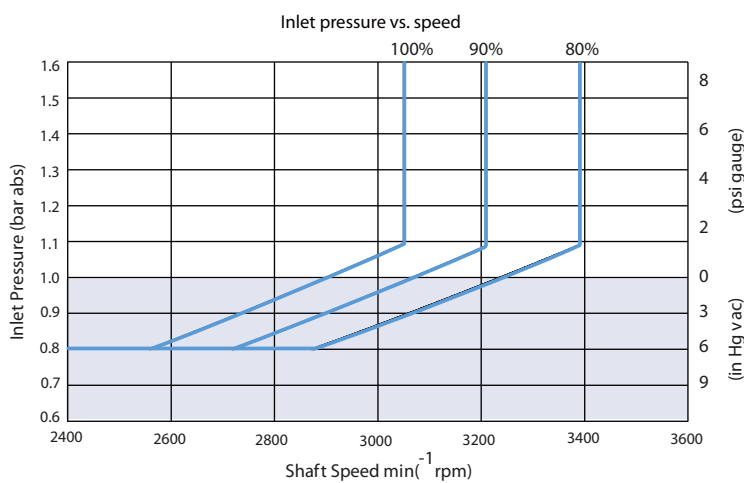
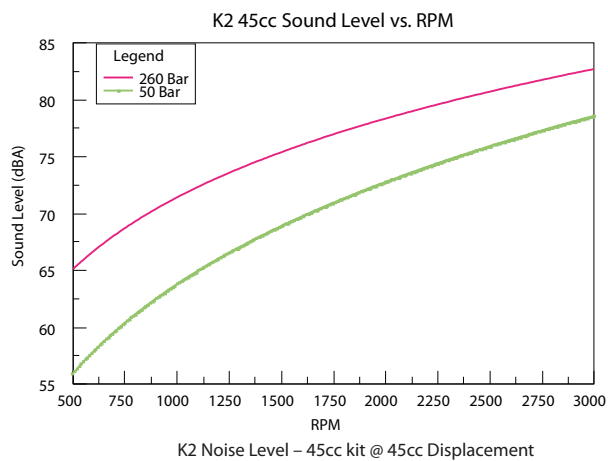
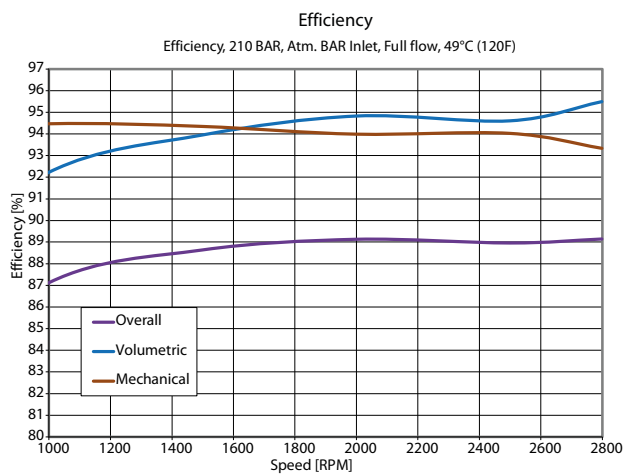
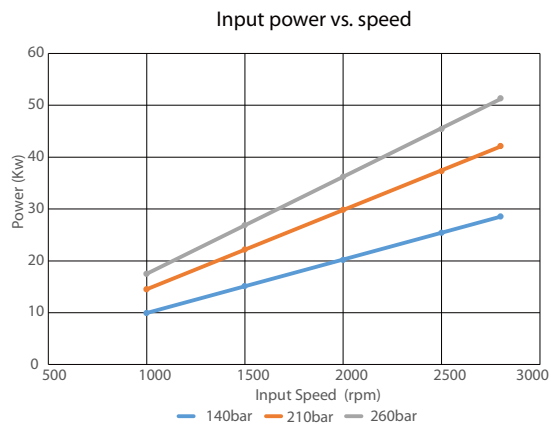
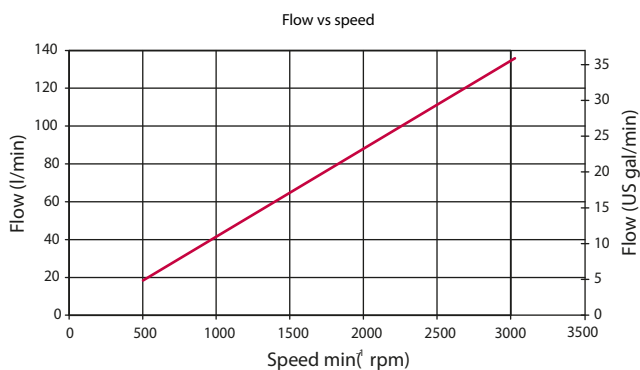
Inlet pressure vs. speed



Frame K2

Performance K2-45C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



Frame K2

Hydraulic Controls

Pressure Compensated Controls

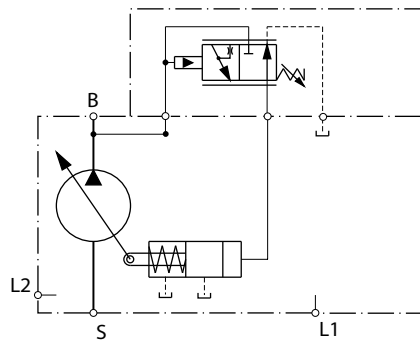
Response/Recovery Times

(msec)	Response	Recovery
25C	40	172
30C	44	152
40C	49	138
38C	49	138
45C	49	138

PC Setting range

Model	Bar	Psi
25C	100-260	1450-3771
30C		
38C		
40C		
45C		

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** Remote PC port

Frame K2

Remote Pressure Compensated Controls

Response/Recovery Times

(msec)	Response	Recovery
25C	40	172
35C	44	152
38C	49	138
40C	49	138
45C	49	138

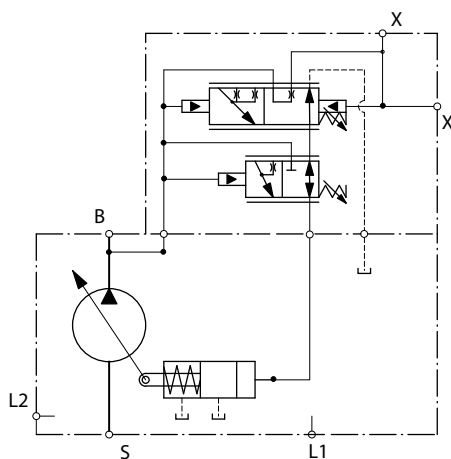
PC Setting Range

Model	RP
25C	100-260 bar [1450-3770 psi]
30C	100-260 bar [1450-3770 psi]
38C	100-260 bar [1450-3770 psi]
40C	100-260 bar [1450-3770 bar]
45C	100-260 bar [1450-3770 bar]

LS Setting range

Model	bar	psi
All	10-40	145-580

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain

Frame K2

Load Sensing Pressure Compensated Controls

Response/Recovery Times

(msec)	Response	Recovery
25C	40	172
30C	44	152
38C	49	138
40C	49	138
45C	49	138

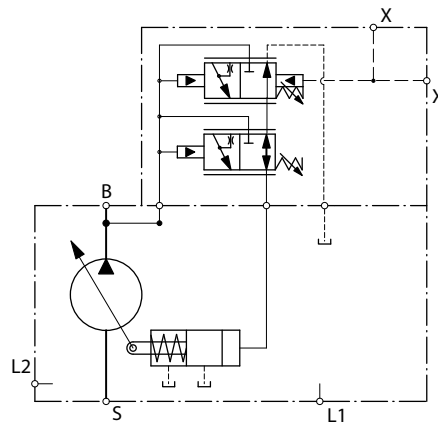
PC control setting range

Code	Bar	psi
25C	100-260	1450-3771
30C		
38C		
40C		
45C		

LS setting range

Model	bar	psi
All	10-40	145-580

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** LS Signal port

Frame K2

Load Sensing Control with Bleed Orifice /Pressure Compensated

Response/Recovery Times

(msec)	Response	Recovery
25C	40	172
30C	44	152
38C	49	138
40C	49	138
45C	49	138

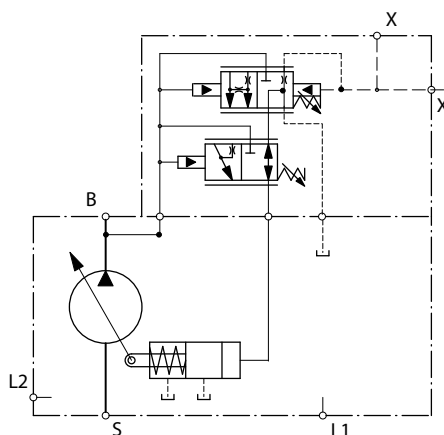
PC control setting range

Code	Bar	psi
25C	100-260	1450-3771
30C		
38C		
40C		
45C		

LS setting range

Model	bar	psi
All	10-40	145-580

Schematic



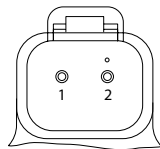
- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** LS signal port

Frame K2

Electric Controls

Connectors

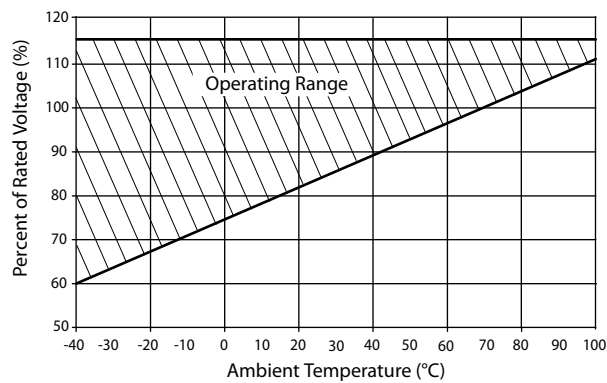
Description	Quantity	Ordering Number
Mating Connector	1	Deutsch® DT06-2S
Wedge Lock	1	Deutsch® W25
Socket Contact (16 and 18 AWG)	2	Deutsch® 0462-201-16141
Danfoss mating connector kit	1	K29657



P003 480

Continuous Duty Operating Range

Continuous duty operating range



Solenoid Data - Normally Closed

Voltage	12V	24V
Threshold Control [mA] (310/260 bar PC setting, oil temp X)	200/400	100/200
End Current [mA] (20 bar LS setting, oil temp X)	1200	600

Solenoid Data - Normally Open

Voltage	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/310 bar PC setting, oil temp X)	1000/1100	500/550

Frame K2

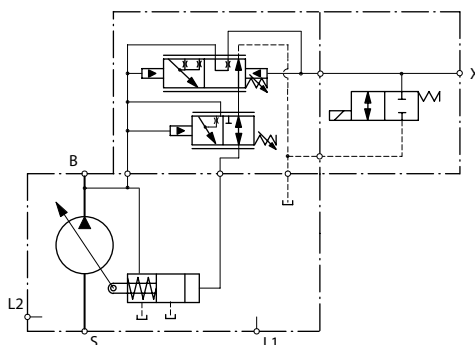
Normally Closed Electric On/Off with Pressure Compensation Controls

Voltage ¹	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/310 bar PC setting, oil temp X)	1000/1100	500/550

¹ Without servo control orifice

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** Load sense port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

PC setting range

Frame	AR (12V)	CR (24V)
25C	100-260 bar [1450-3770] psi	100-260 bar [1450-3770] psi
30C		
38C		
40C		
45C		

Normally Open Electric On/Off with Pressure Compensation Controls

Response/Recovery times

(msec)	Response ¹	Recovery
25C	40	172
30C	44	152

Frame K2

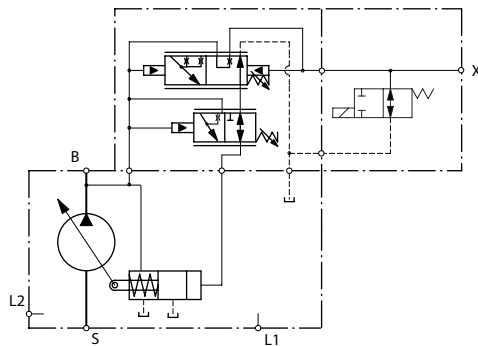
Response/Recovery times (continued)

(msec)	Response ¹	Recovery
38C	49	138
40C	49	138
45C	49	138

¹ Response and recovery times are calculated without servo control orifice

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** Load sense port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

PC setting range

Frame	AN (12V)	CN (24V)
25C	100-260 bar [1450-3770] psi	100-260 bar [1450-3770] psi
30C		
38C		
40C		
45C		

Frame K2

Normally Closed Electric Proportional with Pressure Compensation Controls

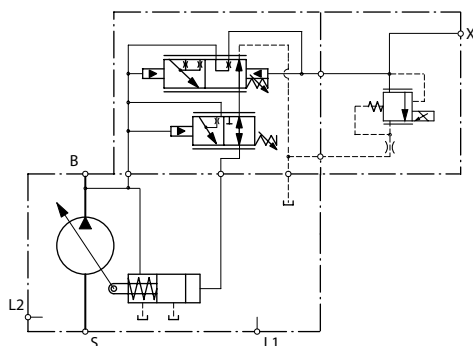
Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
25C	85	518	79	358
30C	85	518	79	358
38C	85	518	79	358
40C	78	490	75	340
45C	78	490	75	340

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** Load sense port

PC setting range

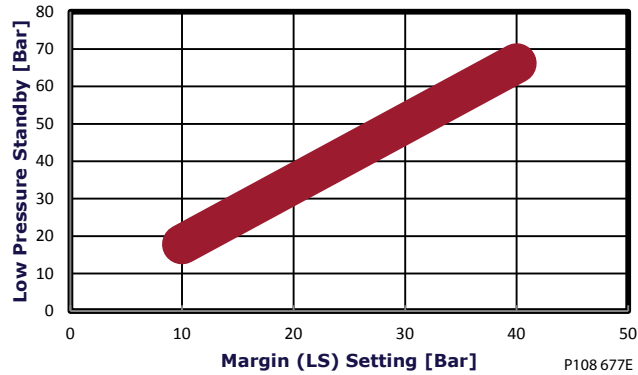
Frame	AH (12V)	AL (24V)
25C	100-260 bar [1450-3770] psi	100-260 bar [1450-3770] psi
30C		
38C		
40C		
45C		

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

Frame K2

**Frames E, F, J Electric Proportional Control
Low Pressure Standby**



Normally Open Electric Proportional with Pressure Compensation Controls

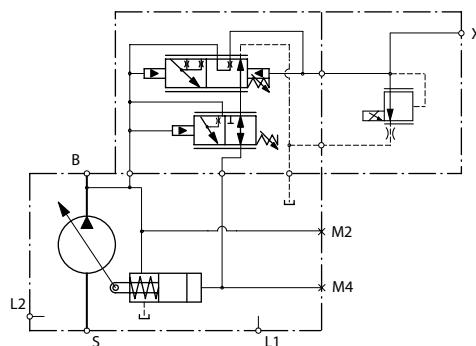
Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
25C	84	521	78	368
30C	84	521	78	368
38C	84	521	78	368
40C	81	498	74	343
45C	81	498	74	343

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Schematic



- B** Outlet
- S** Inlet
- L1, L2** Case drain
- X** Load sense port

Frame K2

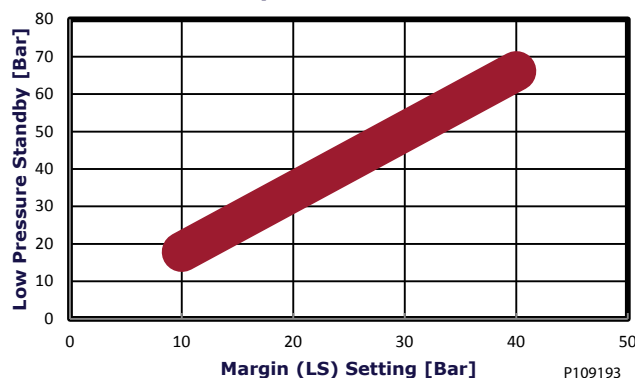
PC setting range

Frame	AX (12V)	CL (24V)
25C	100-260 bar [1450-3770] psi	100-260 bar [1450-3770] psi
30C		
38C		
40C		
45C		

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

**Frames E, F, J, K2 Electric Proportional Control
 Low Pressure Standby**



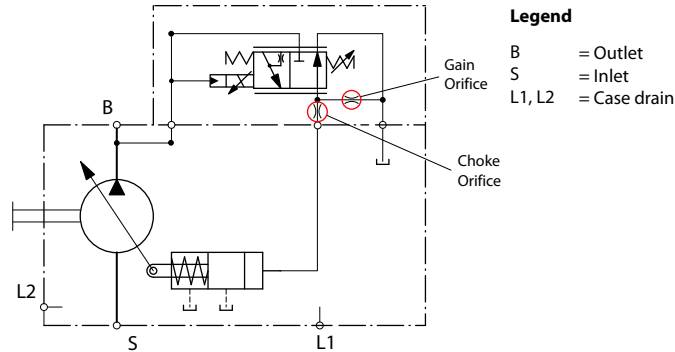
Normally Closed Fan Drive Control

PC setting range

Frame	SA (12V)	SC (12V)	SB (24V)	SD (24V)
25C	100-210 bar [1450-3045] psi	220-260 bar [3190-3771] psi	100-210 bar [1450-3045] psi	220-260 bar [3190-3771] psi
30C				
38C				
40C				
45C				

Frame K2

Fan Drive Control Schematic



- B** = Outlet
S = Inlet
L1, L2 = Case drain

Input Shafts

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
C2	13 tooth spline 16/32 pitch (ANSI B92.1 1970 - Class 6e)	288 [2546]	<p>13 TOOTH 16/32 PITCH 30° PRESSURE ANGLE 20.638 [0.813] PITCH DIA FILLET ROOT SIDE FIT COMPATIBLE WITH ANSI B92.1-1970 CLASS 6e ALSO MATES WITH FLAT ROOT SIDE FIT</p> <p>Ø18.82 [0.74] MAX</p> <p>8 ± 0.475 [0.31 ± 0.02]</p> <p>15.2 ± 0.5 [0.6 ± 0.02]</p> <p>33 [1.3]</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p> <p>P101993E</p>
C3	15 tooth spline 16/32 pitch (ANSI B92.1 1970 - Class 6e)	404 [3575]	<p>15 TOOTH 16/32 PITCH 30° PRESSURE ANGLE 23.813 [0.938] PITCH DIA FILLET ROOT SIDE FIT COMPATIBLE WITH ANSI B92.1-1970 CLASS 6e ALSO MATES WITH FLAT ROOT SIDE FIT</p> <p>Ø21.92 MAX [0.863]</p> <p>8 ± 0.475 [0.31 ± 0.02]</p> <p>23.35 ± 0.5 [0.92 ± 0.02]</p> <p>38 [1.5]</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p> <p>P101994E</p>

Frame K2

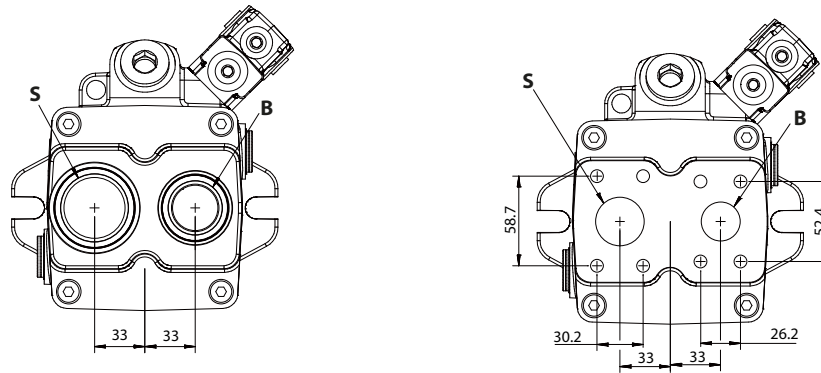
Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
K1	Ø 22.23 mm [0.875 in] 33 mm [1.3 in]	305 [2700]	<p>P101 997E</p>
K2	Ø 22.23 mm [0.875 in] 63 mm [2.48 in] long	305 [2700]	<p>P101 998E</p>

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

Frame K2

Installation Drawings

Axial Ported Endcap



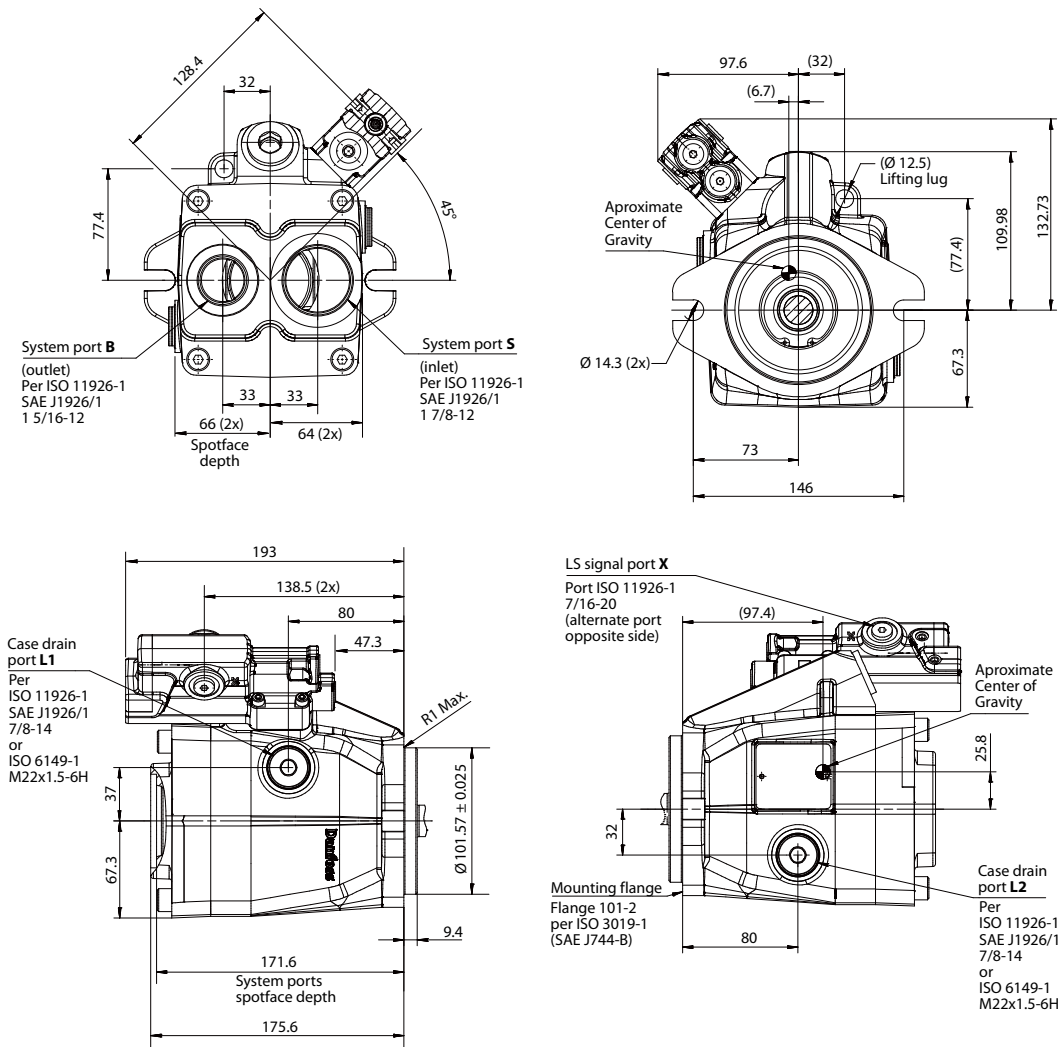
P109081

Code	Description	Port
S	System port (inlet), CW rotation shown	O-ring boss per ISO 6149-1, M48x2-6H or M42x2-6H Ø 31.8 (Axial endcaps) or Ø 38.1 (Radial endcaps)- Split flange per ISO 6162-1, M10x1.5-6H 18 full thread depth (Axial) or M12x1.75-6H 22.5 full thread depth (Radial)
B	System port (outlet), CW rotation shown	O-ring boss per ISO 6149-1, M33x2-6H or M27x2-6H Ø 25.4 - Split flange per ISO 6162-1, M10x1.5-6H 18 full thread depth

Frame K2

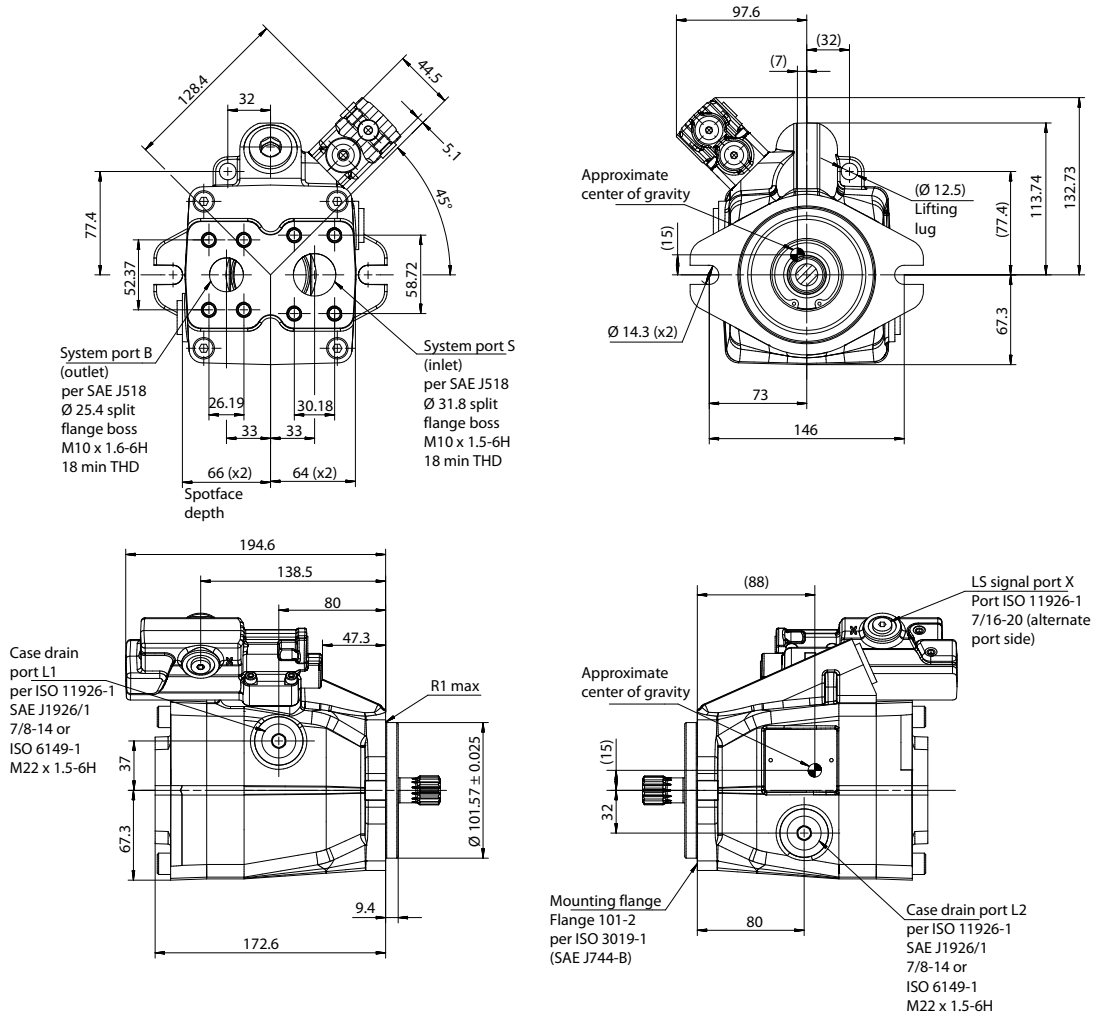
Axial Ported Endcap O-ring Boss Ports Installation Dimensions

K2 with axial endcap and LS control

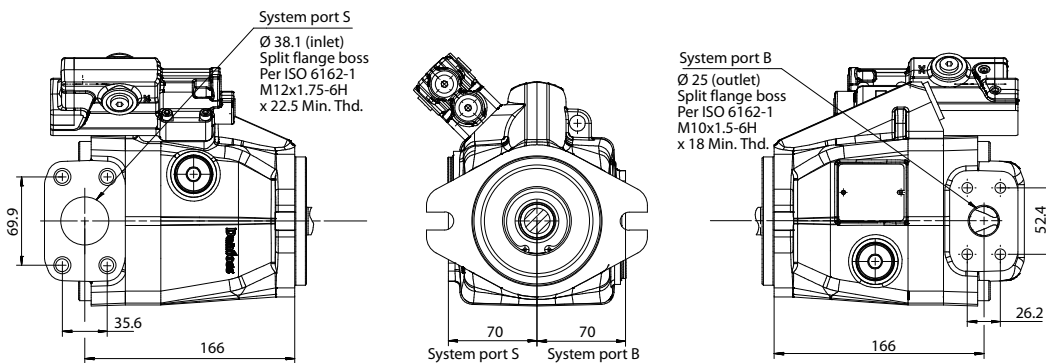


Frame K2

K2 split flange axial endcap and LS control



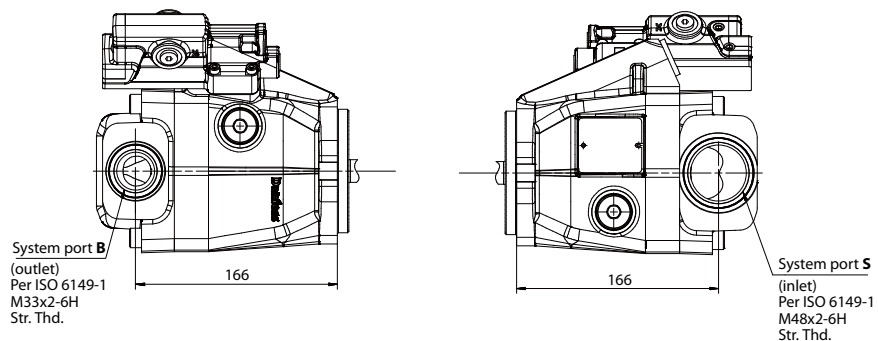
Radial Ported Endcap Split Flange Ports



Radial endcap - CCW rotation

Frame K2

Radial Ported Endcap O-ring Boss Ports

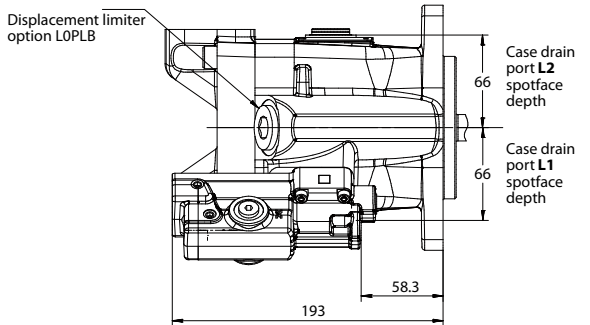


Radial endcap - CW rotation

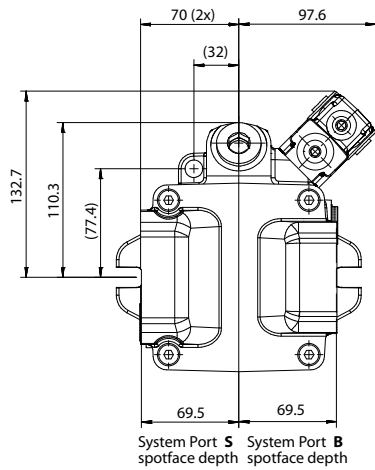
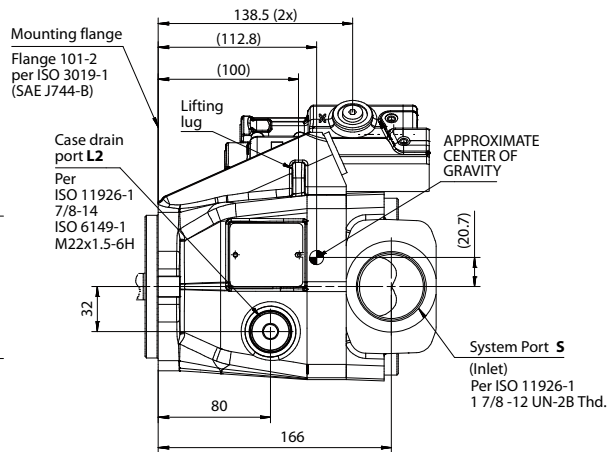
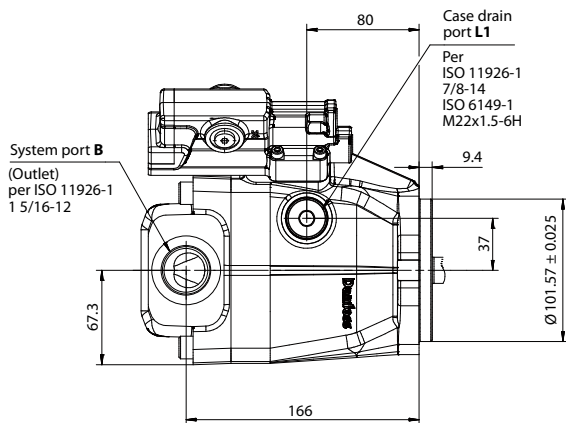
P109088

Frame K2

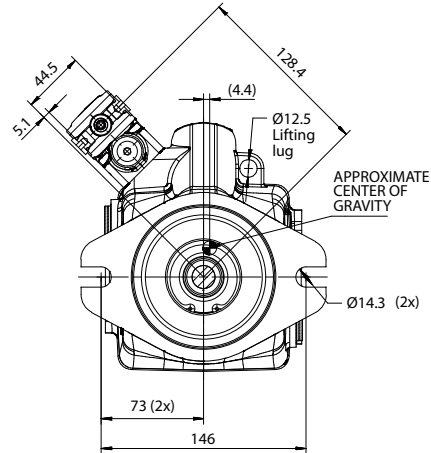
Radial Ported Endcap Installation Dimensions



Pump with radial endcap - non through drive



CW rotation with O-ring boss ports



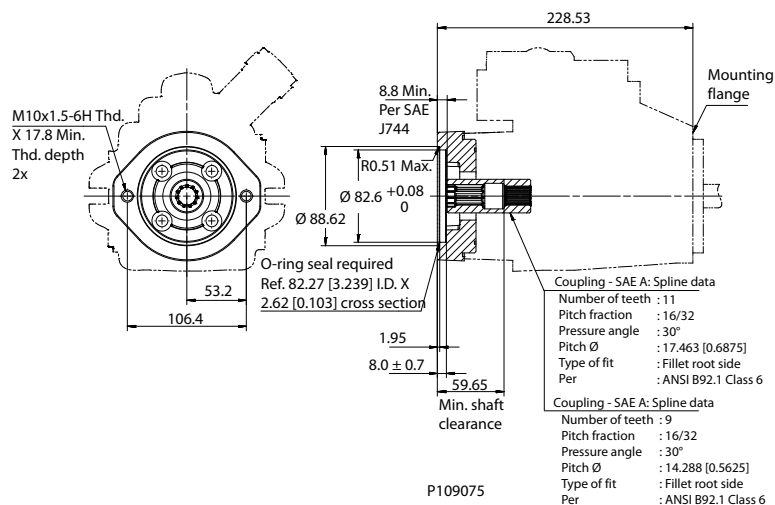
P109094

Front Mounting Flange - SAE-B two bolt

Frame K2

Auxiliary Mounting Pads

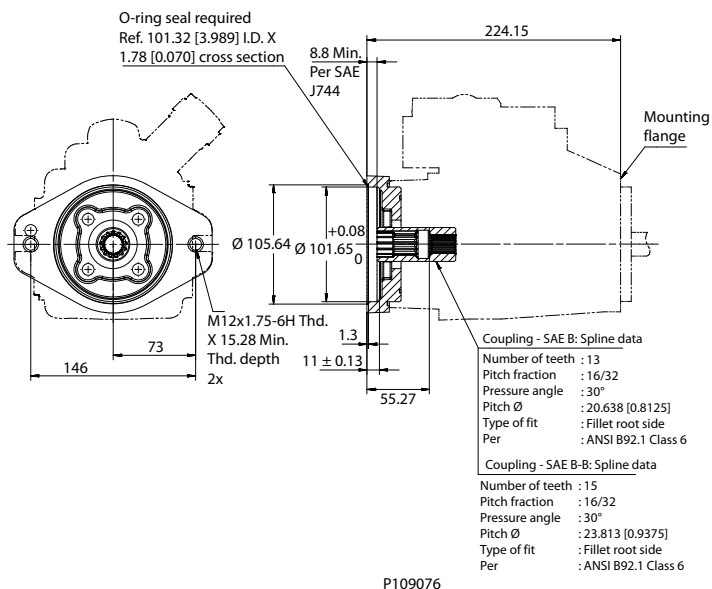
SAE-A auxiliary mounting pad



Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	12.6 mm [0.50 in]	13.5 mm [0.53 in]
Maximum torque	107 N•m [950 lbf•in]	147 N•m [1300 lbf•in]

SAE-B auxiliary mounting pad

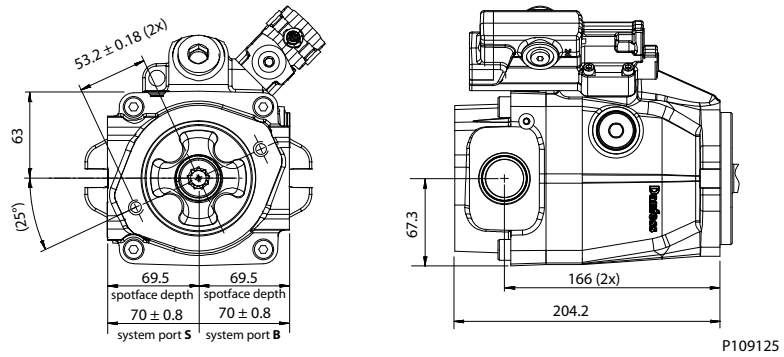


Frame K2

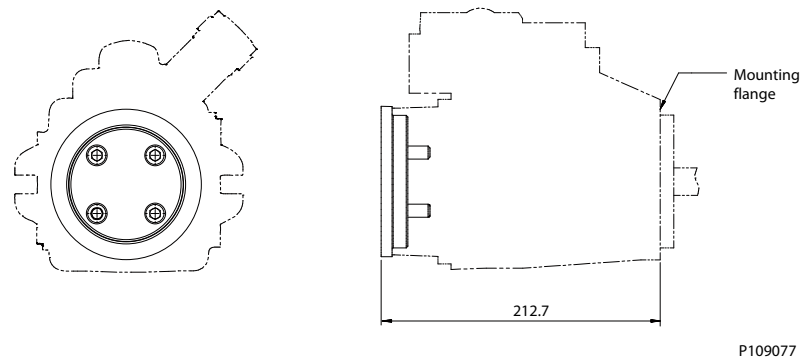
Specifications

Coupling	13-tooth	15-tooth
Spline minimum engagement	13.2 mm [0.52 in]	16.1 mm [0.63 in]
Maximum torque	171 N•m [1512 lbf•in]	171 N•m [1512 lbf•in]

SAE-A Fixed flange

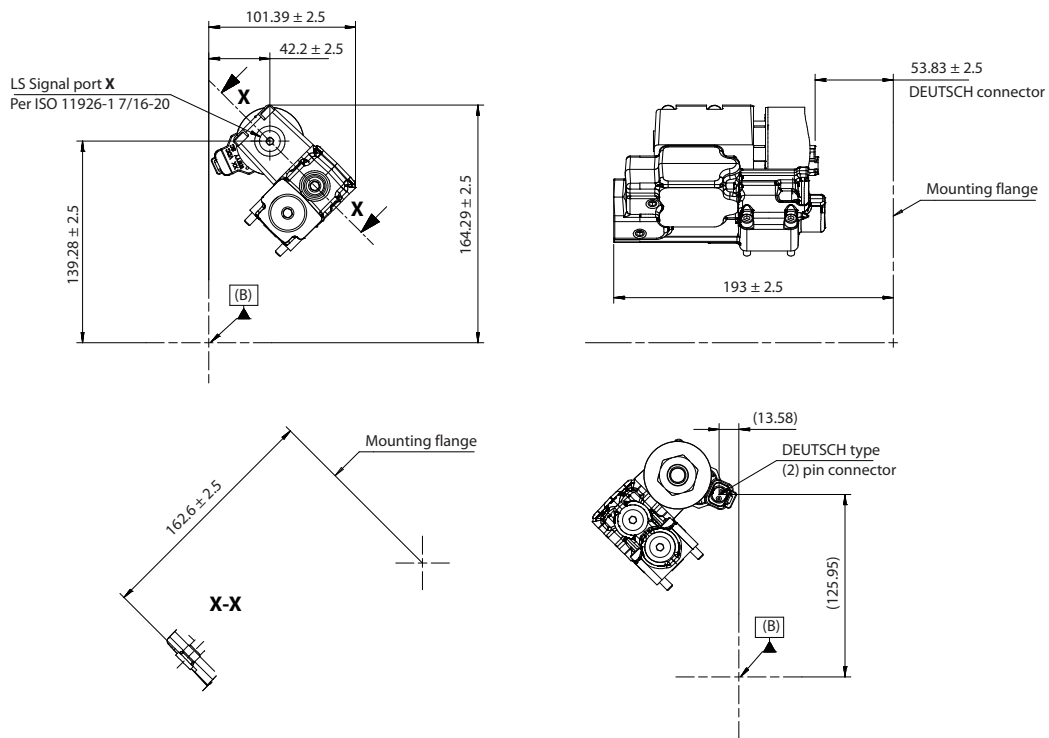


Auxiliary Mounting Pad - Running Cover



Frame K2

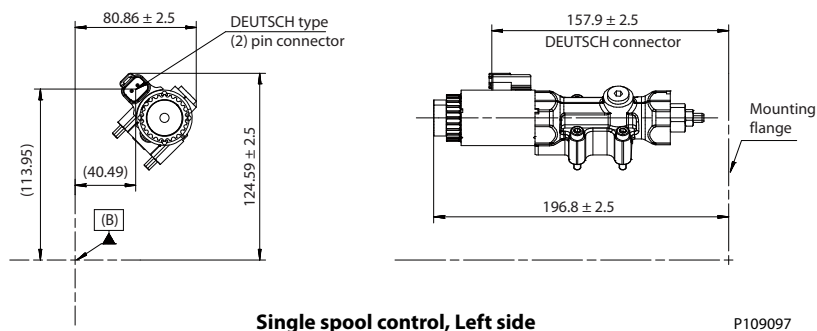
Electric solenoid, left side



Single spool control, Left side

P109096

Fan drive control



Single spool control, Left side

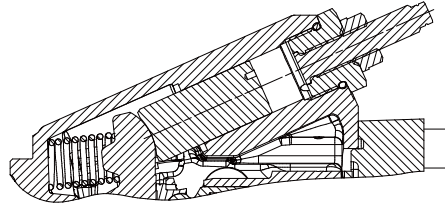
P109097

Displacement Limiter

K2 Frame open circuit pumps are available with an optional adjustable displacement limiter. This adjustable stop limits the pump's maximum displacement.

Frame K2

Cross-Section



P109150

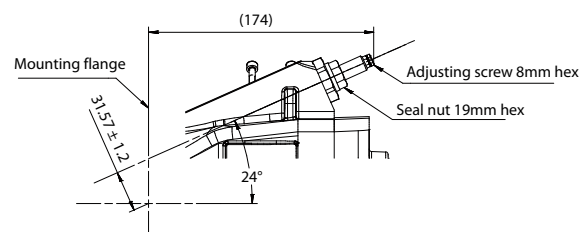
Setting range

K2-25C	0 to 25 cm ³ [0 to 1.53 in ³]
K2-30C	0 to 30 cm ³ [0 to 1.83 in ³]
K2-38C	0 to 38 cm ³ [0 to 2.32 in ³]
K2-45C	0 to 45 cm ³ [0 to 2.75 in ³]

Displacement per turn

K2-25C	3.86 cm ³ /rev [0.24 in ³ /rev]
K2-30D	3.86 cm ³ /rev [0.24 in ³ /rev]
K2-38C	3.86 cm ³ /rev [0.24 in ³ /rev]
K2-45D	4.64 cm ³ /rev [0.28 in ³ /rev]

Installation Dimensions



Displacement Limiter Option **LOAAA**

P109080

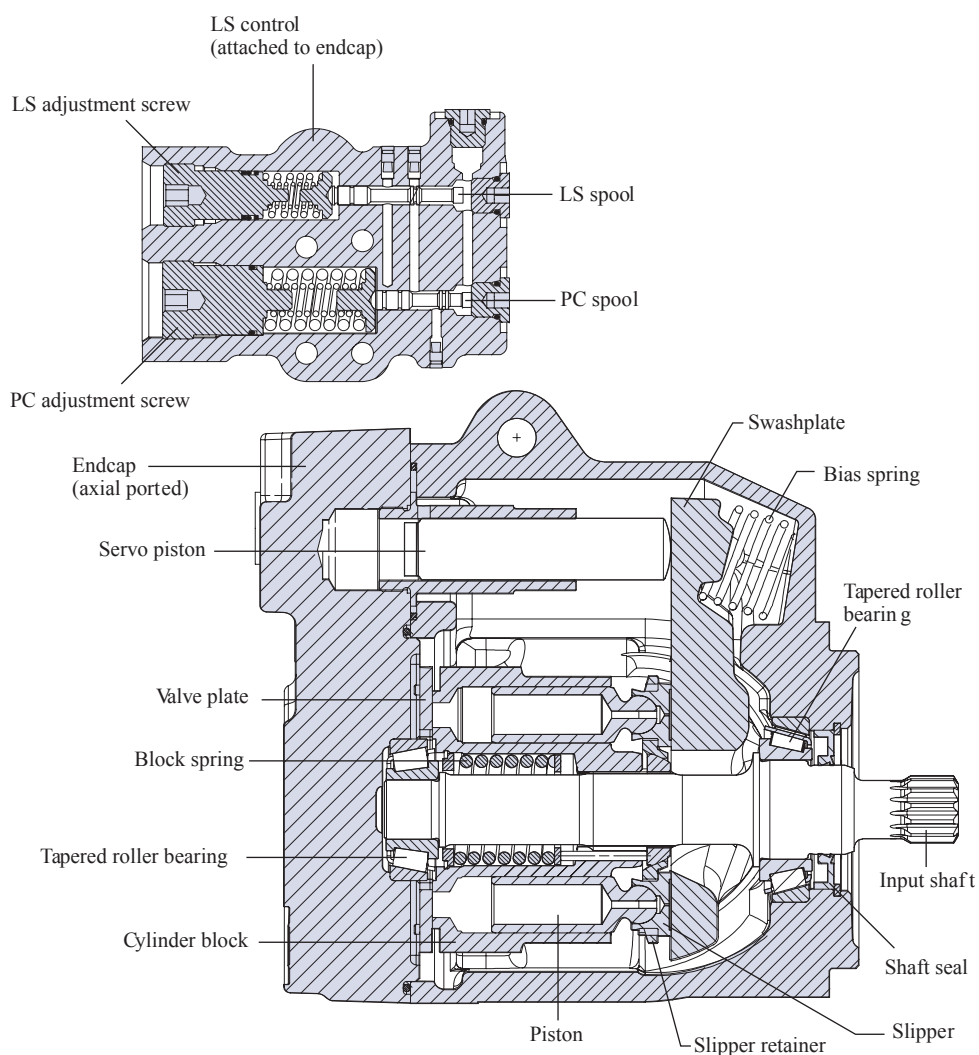
Frames L and K

Design

Series 45 Frame L and K pumps have a single servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. A bias spring and internal forces increase swashplate angle. The servo piston decreases swashplate angle. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swashplate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a viton lip-seal protects against shaft leaks.

An adjustable one spool (PC only, not shown) or two spool (LS and remote PC) control senses system pressure and load pressure (LS controls). The control ports system pressure to the servo piston, adjusting swashplate angle to control pump output flow.

Frame K/L cross section



P101 659E

Frames L and K

Technical Specifications

			L Frame		K Frame	
		Unit	L25C	L30D	K38C	K45D
Maximum Displacement		cm ³ [in ³]	25 [1.53]	30 [1.83]	38 [2.32]	45 [2.75]
Working Input Speed	Minimum	min -1 (rpm)	500	500	500	500
	Continuous		3200	3200	2650	2650
	Maximum		3600	3600	2800	2800
Working Pressure	Continuous	bar [psi]	260 [3770]	210 [3045]	260 [3770]	210 [3045]
	Maximum		350 [5075]	300 [4350]	350 [5075]	300 [4350]
Flow at rated speed (theoretical)		l/min [US gal/min]	80 [21]	96 [25.4]	100.7 [26.6]	119.3 [31.5]
Input torque at maximum displacement (theoretical) at 49° C [120°F]		N·m/bar [lbf·in/1000 psi]	0.398 [243]	0.477 [291]	0.605 [369]	0.716 [438]
Mass moment of inertia of internal rotating components		kg·m ² [slug·ft ²]	0.00169 [0.00125]	0.00161 [0.00119]	0.00184 [0.00135]	0.00203 [0.00150]
Weight - Axial ports		kg [lb]	19.0 [41.9]			
Weight - Radial ports			24.0 [52.9]			
External Shaft Loads	External moment (Me)	N·m [lbf·in]	61 [540]	61 [540]	76 [673]	76 [673]
	Thrust in (Tin), out (Tout)	N [lbf]	1000 [225]	1000 [225]	1200 [270]	1200 [270]
Mounting flange load moments	Vibratory (continuous)	N·m [lbf·in]	1005 [8895]			
	Shock (maximum)		3550 [31420]			

Order code

Code description

Code	Description
R	Product Frame, Variable Open Circuit Pump
S	Rotation
P	Displacement
C	Control Type
D	Pressure Compensator Setting
E	Load Sense Setting
F	Not Used
G	Choke Orifice
H	Gain Orifice
J	Input Shaft/Auxiliary Mount/Endcap
K	Shaft Seal/Front Mounting Flange/Housing Ports
L	Displacement Limiter
M	Special Hardware
N	Special Features

Frames L and K

R Frame

		L Frame		K Frame	
		025C	030D	038C	045D
KR	K Frame, variable displacement open circuit pump			•	•
LR	L Frame, variable displacement open circuit pump	•	•		

S Rotation

		L Frame		K Frame	
		025C	030D	038C	045D
L	Left Hand (counterclockwise)	•	•	•	•
R	Right Hand (clockwise)	•	•	•	•

P Displacement

025C	025 cm ³ /rev [1.53 in ³ /rev]	•			
030D	030 cm ³ /rev [1.83 in ³ /rev]		•		
038C	038 cm ³ /rev [2.32 in ³ /rev]			•	
045D	045 cm ³ /rev [2.75 in ³ /rev]				•

C Control type

		L Frame		K Frame	
		025C	030D	038C	045D
PC	Pressure Compensator	•	•	•	•
RP	Remote Pressure Compensator	•	•	•	•
LB	Load Sensing/Pressure Comp. w/Bleed Orifice	•	•	•	•
LS	Load Sensing/Pressure Compensator	•	•	•	•
EA	Electric On/Off w/Pressure Comp. (NO, 12VDC)	•	•	•	•
EG	Electric On/Off w/Pressure Comp. (NO, 24VDC)	•	•	•	•
EB	Electric On/Off w/Pressure Comp. (NC, 12VDC)	•	•	•	•
EE	Electric On/Off w/Pressure Comp. (NC, 24VDC)	•	•	•	•
EK	Electric Proportional Pressure Control w/ Pressure Comp. (NO,12VDC)	•	•	•	•
EL	Electric Proportional Pressure Control w/ Pressure Comp. (NO,24VDC)	•	•	•	•
EM	Electric Proportional Pressure Control w/ Pressure Comp. (NC,12VDC)	•	•	•	•
EN	Electric Proportional Pressure Control w/ Pressure Comp. (NC,24VDC)	•	•	•	•

D PC setting (2 digit code, 10 bar increments)

Example	25 = 250 bar (3625 psi)				
10–21	100 to 210 bar [1450 to 3045 psi]	•	•	•	•
22–26	220 to 260 bar [3190 to 3771 psi]	•		•	

Frames L and K

E Load sensing setting (2 digit code, 1 bar increments)

Example	20 = 20 bar (290 psi)				
12-36	12 to 36 bar [174 to 522 psi]	•	•	•	•
NN	Not applicable (pressure compensated only controls)	•	•	•	•

F Not used

		L Frame		K Frame	
		025C	030D	038C	045D
NN	Not applicable	•	•	•	•

G Servo Control Orifice

N	None (standard)	•	•	•	•
E	0.8 mm diameter - Electrical proportional controls only	•	•	•	•
F	1.0 mm diameter - Electrical proportional controls only	•	•	•	•
J	0.8 mm diameter - All other controls	•	•	•	•
K	1.0 mm diameter - All other controls	•	•	•	•

H Gain Orifice

3	1.0 mm diameter	•	•	•	•
---	-----------------	---	---	---	---

J Input Shaft

C2	13 tooth, 16/32 pitch
C3	15 tooth, 16/32 pitch
K1	0.875 inch straight keyed
K2	0.875 inch straight keyed (long)
T1	1.0 inch Taper

Auxiliary Mount/Endcap Style

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
None	Axial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Left Side	NF
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.25 inch port 0.4375 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Left Side	NM
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.25 inch port M10 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads) Control - Left Side	NP

Frames L and K

Auxiliary Mount/Endcap Style (continued)

None	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	NG
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Right Side	NK
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads) Control - Right Side	NR
Running Cover	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	RG
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Right Side	RK
SAE-A, 11 teeth	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	TG
SAE-A, 9 teeth	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	AG
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Right Side	AK
SAE-B, 13 teeth	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	BG
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Right Side	BK
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads) Control - Right Side	BR

Frames L and K

Auxiliary Mount/Endcap Style (continued)

SAE-BB, 15 teeth	Radial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads) Control - Right Side	VG
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (1.5 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) Control - Right Side	VK

J Input Shaft/Auxiliary Mount/Endcap

Available Combinations

	L Frame		K Frame	
	025C	030D	038C	045D
C2AG*	•	•	•	•
C2BG*	•	•	•	•
C2BK*	•	•	•	•
C2NF*	•	•	•	•
C2NG**	•	•	•	•
C2NK**	•	•	•	•
C2NM**			•	•
C2NP**			•	•
C2NR*			•	•
C2RG*	•	•	•	•
C2TG*	•	•	•	•
C3AG*	•	•	•	•
C3AK**			•	•
C3BG*	•	•	•	•
C3NF*	•	•	•	•
C3NG**	•	•	•	•
C3NK**			•	•
C3RG*	•	•	•	•

* PLB or AAA Displacement limiter options only

** KNB Displacement limiter options only

	L Frame		K Frame	
	025C	030D	038C	045D
C3TG*	•	•	•	•
C3VG*			•	•
K1AG*	•	•		
K1NF*	•	•	•	•
K1NG**	•	•	•	•
K1RG*	•	•		
K2AG*	•	•	•	•
K2BG*	•	•	•	•

Frames L and K

	L Frame		K Frame	
	025C	030D	038C	045D
K2NF*	•	•	•	•
K2NG**	•	•	•	•
K2NM**			•	•
K2RG*	•	•	•	•
T1BG*			•	•
T1NF*	•	•	•	•
T1NG**	•	•	•	•
T1RG*	•	•	•	•

K Shaft seal

		L Frame		K Frame	
		025C	030D	038C	045D
A	Single (Viton)	•	•	•	•

K Mounting flange and housing port style

		L Frame		K Frame	
		025C	030D	038C	045D
6	SAE-B Flange 2-bolt/SAE O-ring boss ports	•	•	•	•

K Not used

N	Not applicable	•	•	•	•
---	----------------	---	---	---	---

L Displacement limiter

AAA	Adjustable, factory set at max angle	•	•	•	•
KNB	None	•	•	•	•
PLB	None (plugged)	•	•	•	•

M Special hardware

NNN	None	•	•	•	•
-----	------	---	---	---	---

N Special features

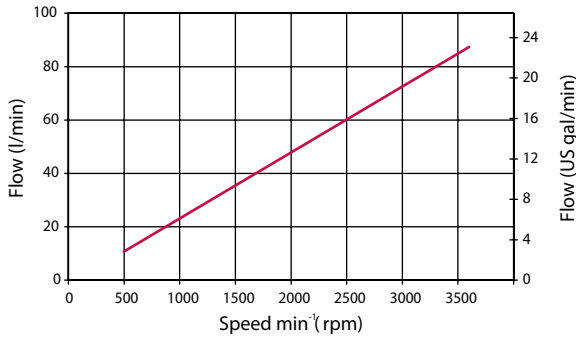
NNN	None	•	•	•	•
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Frames L and K

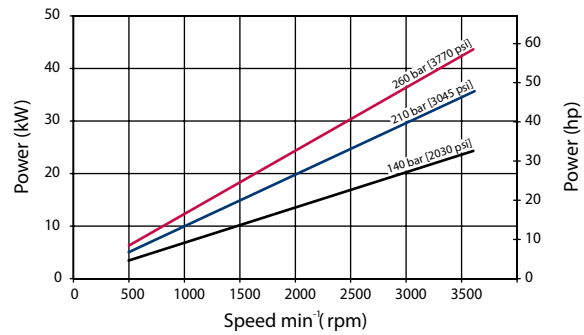
Performance L25C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

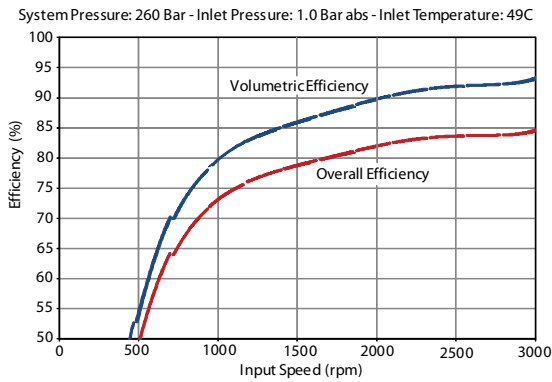
Flow vs. speed



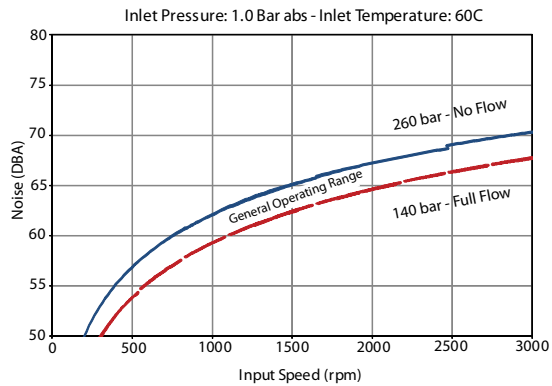
Input power vs. speed



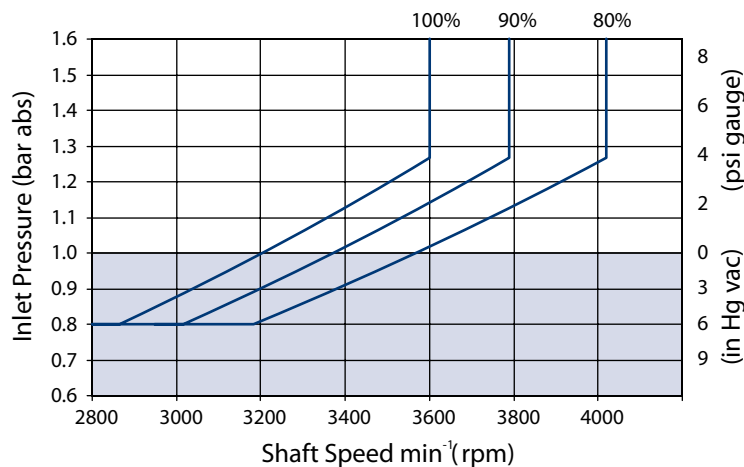
Efficiency



Noise



Inlet pressure vs. speed

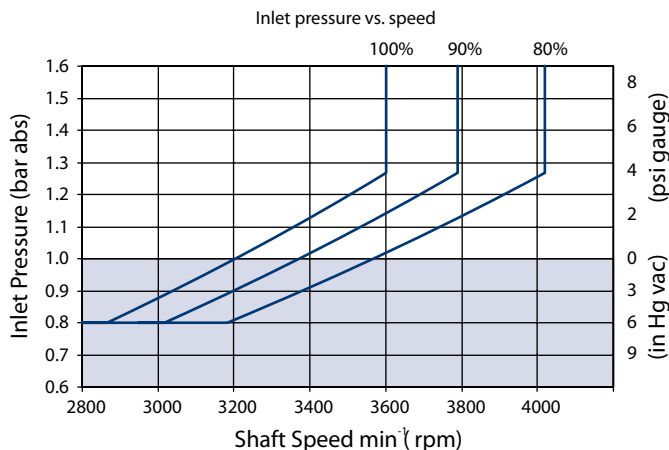
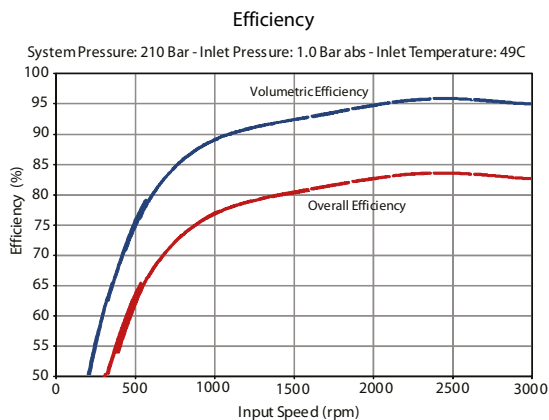
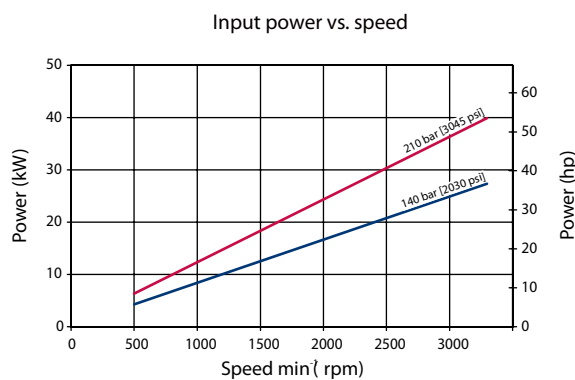
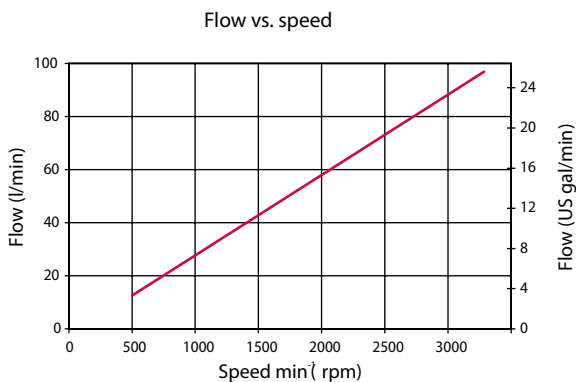


The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frames L and K

Performance L30D

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



The *Efficiency* chart shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Noise

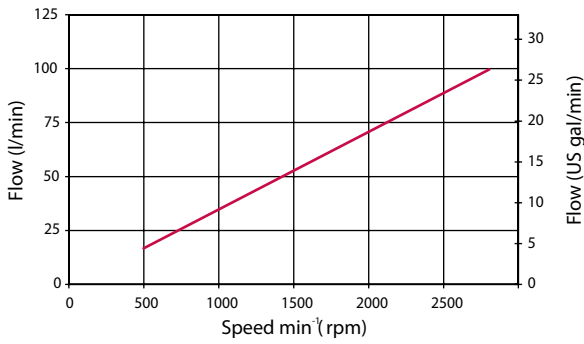
dB(A)	210 bar [3045 psi]	
	1800 min ⁻¹ (rpm)	Rated Speed
L30D	66	70

Frames L and K

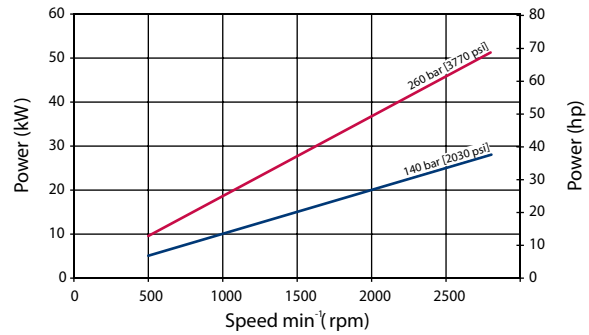
Performance K38C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

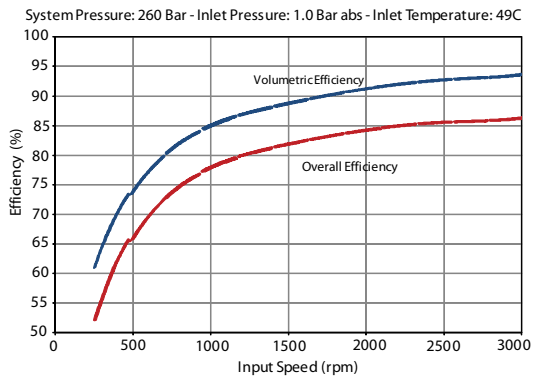
Flow vs. speed



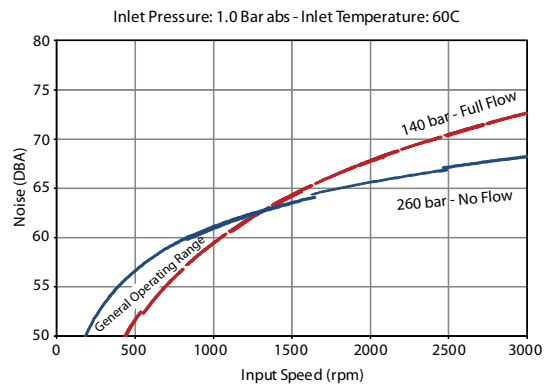
Input power vs. speed



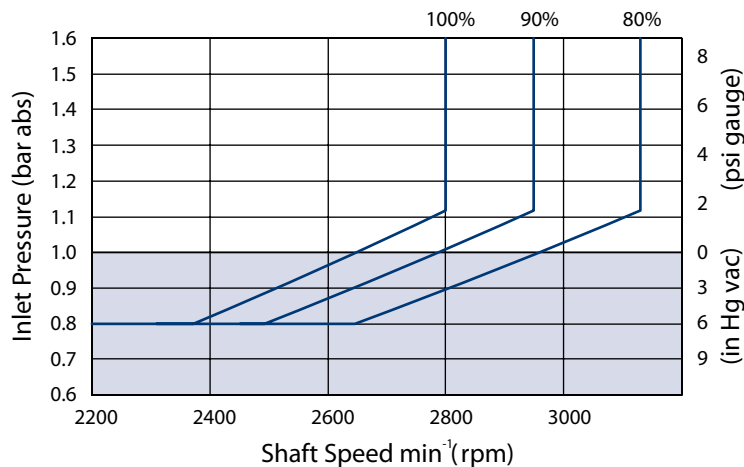
Efficiency



Noise



Inlet pressure vs. speed

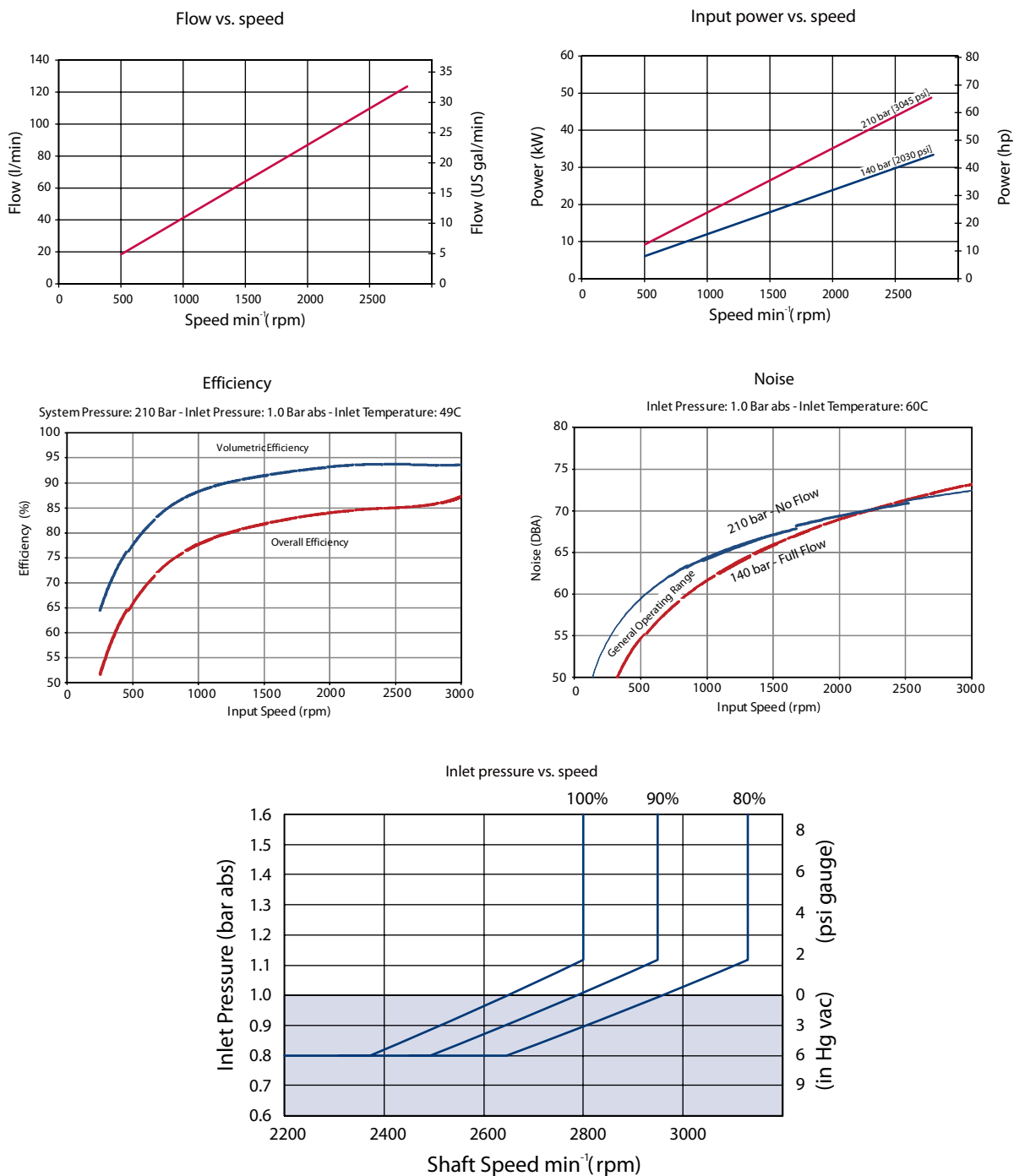


The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frames L and K

Performance K45D

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frames L and K

Hydraulic Controls

Pressure Compensated Controls

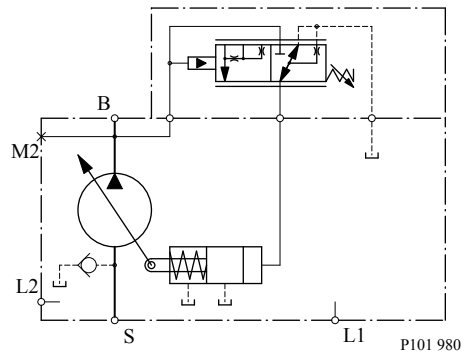
Response/Recovery Times

(ms)	Response	Recovery
L25C	30	90
L30D	30	100
K38C	30	105
K45D	30	110

PC Setting Range

Model	bar	psi
L25C	100–260	1450–3770
L30D	100–210	1450–3045
K38C	100–260	1450–3770
K45D	100–210	1450–3045

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

Remote Pressure Compensated Controls

Response/Recovery Times

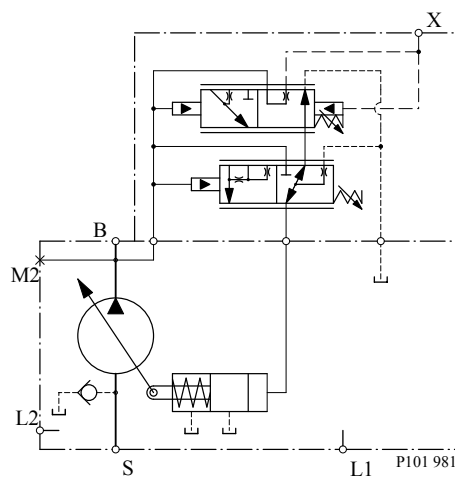
(ms)	Response	Recovery
L25C	30	90
L30D	30	100
K38C	30	105
K45D	30	110

Frames L and K

PC Setting Range

Model	bar	psi
L25C	100–260	1450–3770
L30D	100–210	1450–3045
K38C	100–260	1450–3770
K45D	100–210	1450–3045

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

X = Remote PC port

Load Sensing/Pressure Compensated Controls

Response/Recovery Times

(ms)	Response	Recovery
L25C	30	70
L30D	30	70
K38C	30	80
K45D	30	80

PC Setting Range

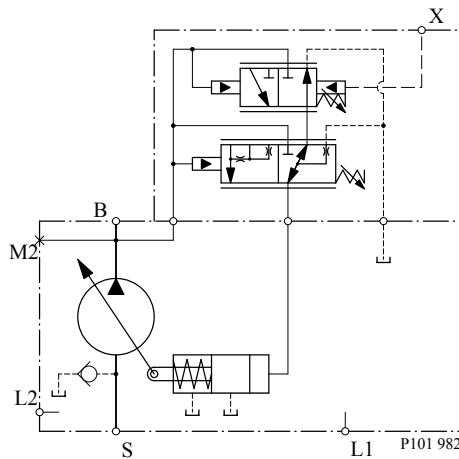
Model	bar	psi
L25C	100–260	1450–3770
L30D	100–210	1450–3045
K38C	100–260	1450–3770
K45D	100–210	1450–3045

Frames L and K

LS setting range

Model	bar	psi
All	12-40	174-580

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = LS signal port

Load Sensing Control with Bleed Orifice /Pressure Compensated

Response/Recovery Times

(ms)	Response	Recovery
L25C	30	70
L30D	30	70
K38C	30	80
K45D	30	80

PC Setting Range

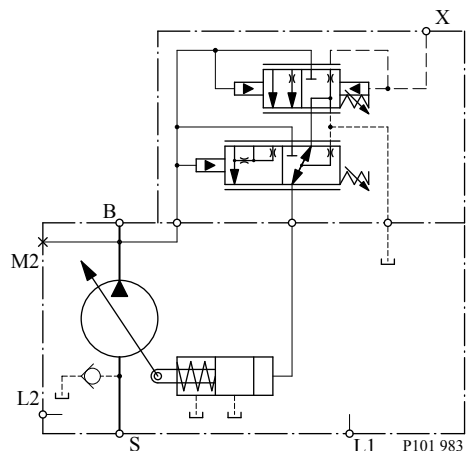
Model	bar	psi
L25C	100-260	1450-3770
L30D	100-210	1450-3045
K38C	100-260	1450-3770
K45D	100-210	1450-3045

LS setting range

Model	bar	psi
All	12-40	174-580

Frames L and K

LB Schematic

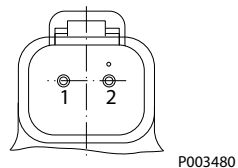


- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = LS signal port

Electric Controls

Connector

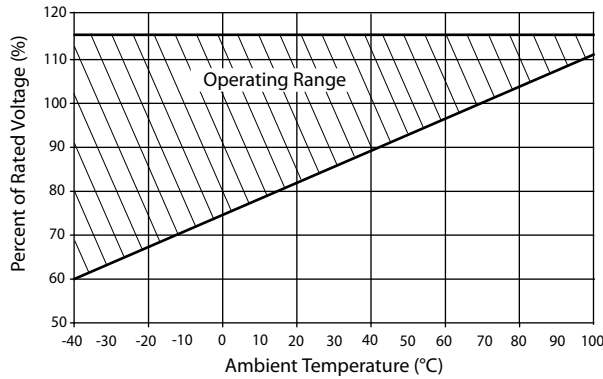
Description	Quantity	Ordering Number
Mating Connector	1	Deutsch® DT06-2S
Wedge Lock	1	Deutsch® W25
Socket Contact (16 and 18 AWG)	2	Deutsch® 0462-201-16141
Danfoss mating connector kit	1	K29657



Frames L and K

Continuous Duty Operating Range

Continuous duty operating range



Solenoid Data - Normally Closed

Voltage	12V	24V
Threshold Control [mA] (260/210 bar PC setting, oil temp X)	400/600	200/300
End Current [mA] (20 bar LS setting, oil temp X)	1200	600

Solenoid Data - Normally Open

Voltage	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/210 bar PC setting, oil temp X)	1000/1100	500/550

Hysteresis

Frame	Hysteresis
L25C, K38C	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)
L30D, K45D	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)

Normally Closed Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

(msec)	Response	Recovery
L25C	50	140
L30D	50	130
K38C	50	140
K45D	50	130

* Without servo control orifice: response/recovery from solenoid energized/de-energized.

Frames L and K

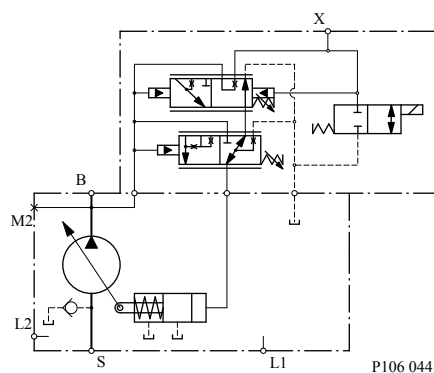
PC setting range

Frame	EB (12V)	EE (24V)
L25C	100-260 bar [1450-3370] psi	100-260 bar [1450-3370] psi
K38C		
L30D	100-210 bar [1450-3045] psi	100-210 bar [1450-3045] psi
K45D		

LS setting range

Model	bar	psi
All	12 - 40	[174 - 580]

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

X = Load Sense Port

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Normally Open Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

(msec)	Response	Recovery
L25C	50	140
L30D	50	130
K38C	50	140
K45D	50	130

* Without servo control orifice: response/recovery from solenoid energized/de-energized.

Frames L and K

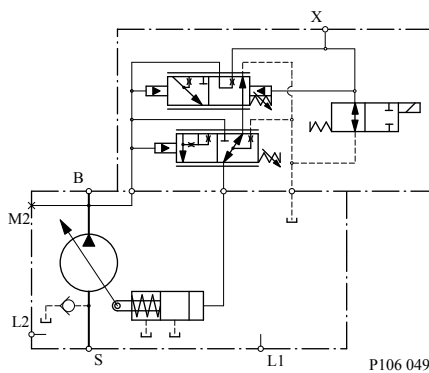
PC setting range

Frame	EA (12V)	EG (24V)
L25C	100-260 bar [1450-3370] psi	100-260 bar [1450-3370] psi
K38C		
L30D	100-210 bar [1450-3045] psi	100-210 bar [1450-3045] psi
K45D		

LS setting range

Model	bar	psi
All	12 - 40	[174 - 580]

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Normally Closed Electric Proportional Controls with PC and LS Compensation

Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
L25C	80	610	70	380
L30D	60	610	55	380
K38C	80	550	70	380
K45D	60	550	55	380

Frames L and K

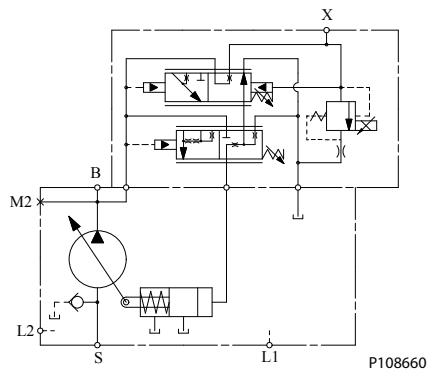
PC setting range

Frame	EM (12V)	EN (24V)
L25C	100-260 bar [1450-3370] psi	100-260 bar [1450-3370] psi
K38C		
L30D	100-210 bar [1450-3045] psi	100-210 bar [1450-3045] psi
K45D		

LS setting range

Model	bar	psi
All	12 - 40	[174 - 580]

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

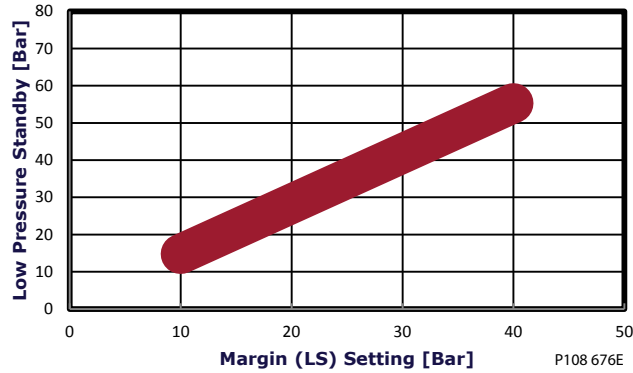
X = Load Sense Port

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

Frames L and K

**Frames K, L Electric Proportional Control
 Low Pressure Standby**



Normally Open Electric Proportional Controls with PC and LS Compensation

Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
L25C	80	610	70	380
L30D	60	610	55	380
K38C	80	550	70	380
K45D	60	550	55	380

PC setting range

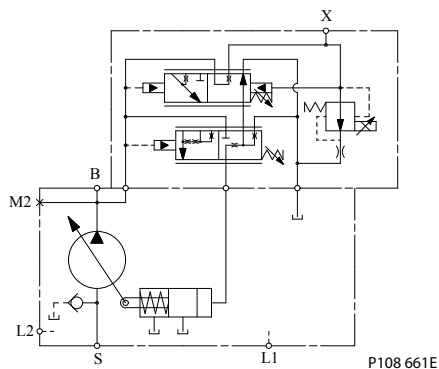
Frame	EK (12V)	EL (24V)
L25C	100-260 bar [1450-3370] psi	100-260 bar [1450-3370] psi
K38C		
L30D	100-210 bar [1450-3045] psi	100-210 bar [1450-3045] psi
K45D		

LS setting range

Model	bar	psi
All	12 - 40	[174 - 580]

Frames L and K

Schematic

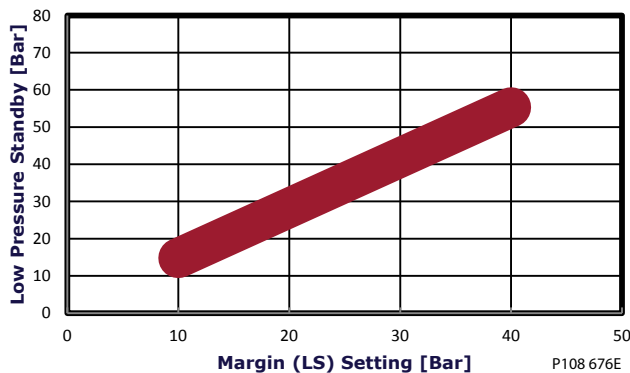


- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

**Frames K, L Electric Proportional Control
 Low Pressure Standby**



Frames L and K

Input shafts

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
C2	13 tooth spline 16/32 pitch (ANSI B92.1 1970 - Class 6e)	288 [2546]	<p>13 TOOTH 16/32 PITCH 30° PRESSURE ANGLE 20.638 [0.813] PITCH DIA FILLET ROOT SIDE FIT COMPATIBLE WITH ANSI B92.1-1970 CLASS 6e ALSO MATES WITH FLAT ROOT SIDE FIT</p> <p>Ø18.82 [0.74] MAX</p> <p>Ø21.72 ± 0.09 [0.855 ± 0.004]</p> <p>8 ± 0.475 [0.31 ± 0.02]</p> <p>15.2 ± 0.5 [0.6 ± 0.02]</p> <p>33 [1.3]</p> <p>P101993E</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p>
C3	15 tooth spline 16/32 pitch (ANSI B92.1 1970 - Class 6e)	404 [3575]	<p>15 TOOTH 16/32 PITCH 30° PRESSURE ANGLE 23.813 [0.938] PITCH DIA FILLET ROOT SIDE FIT COMPATIBLE WITH ANSI B92.1-1970 CLASS 6e ALSO MATES WITH FLAT ROOT SIDE FIT</p> <p>Ø21.92 MAX [0.863]</p> <p>Ø25.27 ± 0.12 [0.995 ± 0.005]</p> <p>8 ± 0.475 [0.31 ± 0.02]</p> <p>23.35 ± 0.5 [0.92 ± 0.02]</p> <p>38 [1.5]</p> <p>P101994E</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p>
T1	Ø 25.4 mm [1 in] 1:8 taper (SAE J501)	362 [3200]	<p>69.89 REF [2.75]</p> <p>25.4 [1]</p> <p>6.299^{+0.025}_{-0.000} [0.248^{+0.001}_{-0.000}]</p> <p>26.97 [1.06]</p> <p>22.225^{+0.254}_{-0.000} [0.875^{+0.010}_{-0.010}]</p> <p>WOODRUFF KEY</p> <p>Ø22.22 GAUGE [0.87]</p> <p>3/4-16UNF-2A THD</p> <p>125 TAPER PER METER COMPATIBLE WITH SAE J501 25.4 [1] NOMINAL SHAFT DIAMETER</p> <p>8 ± 0.8 [0.31 ± 0.03]</p> <p>34.92 ± 0.63 [1.375 ± 0.025]</p> <p>9.42 ± 0.3 [0.37 ± 0.01] GAUGE</p> <p>P101 996E</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p>

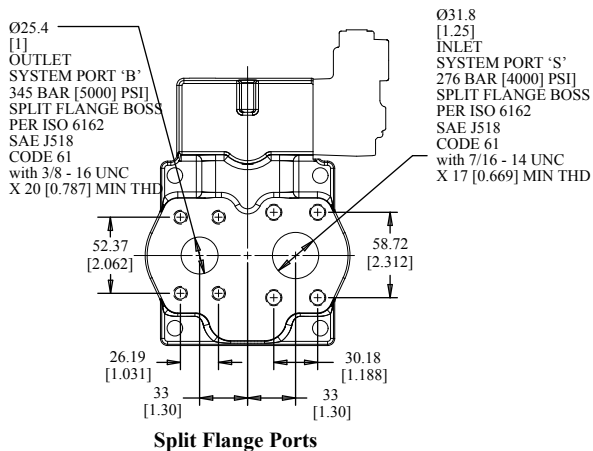
Frames L and K

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
K1	Ø 22.23 mm [0.875 in] 33 mm [1.3 in]	305 [2700]	
K2	Ø 22.23 mm [0.875 in] 63 mm [2.48 in] long	305 [2700]	

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

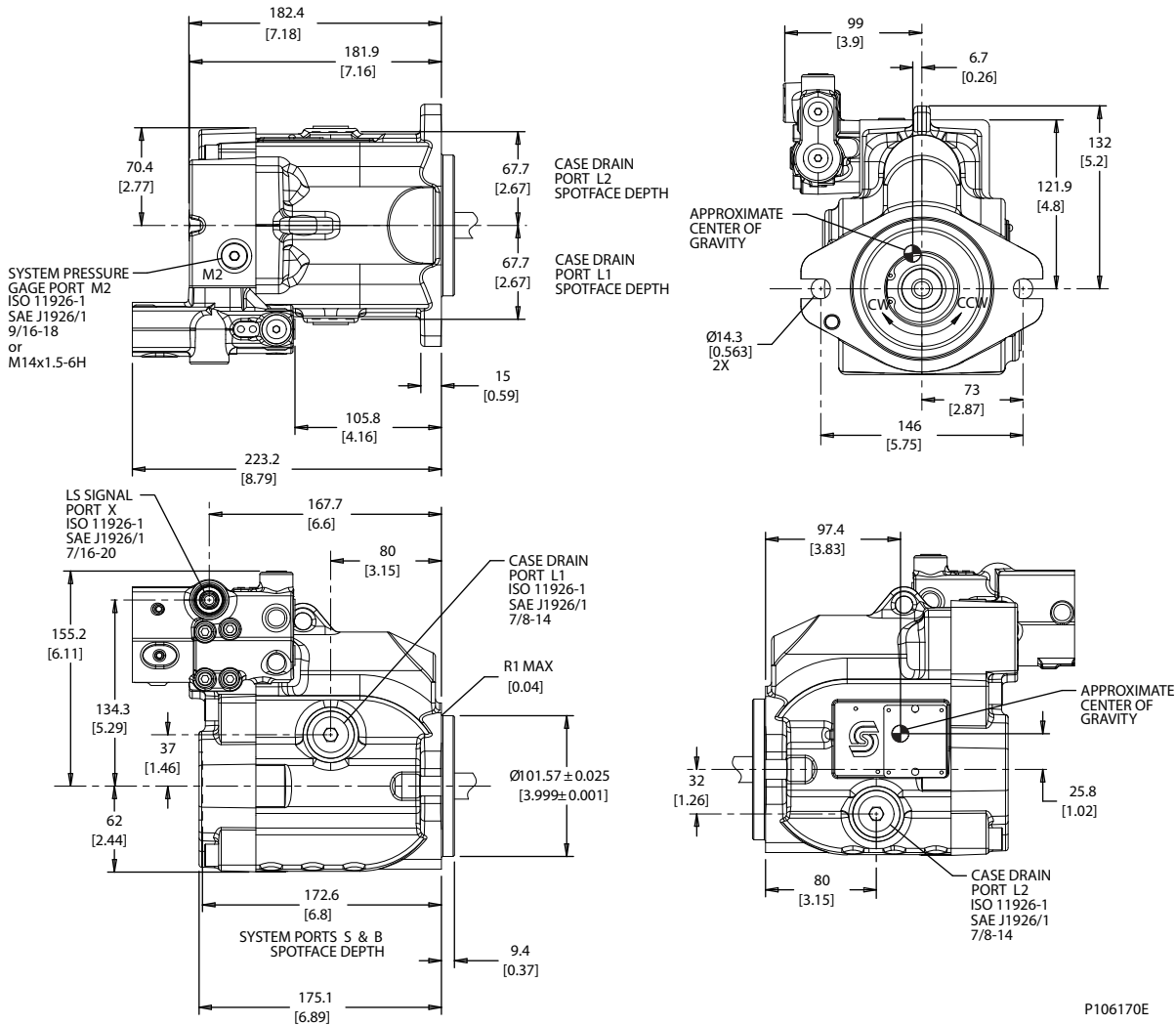
Installation drawings

Axial Ported Endcap

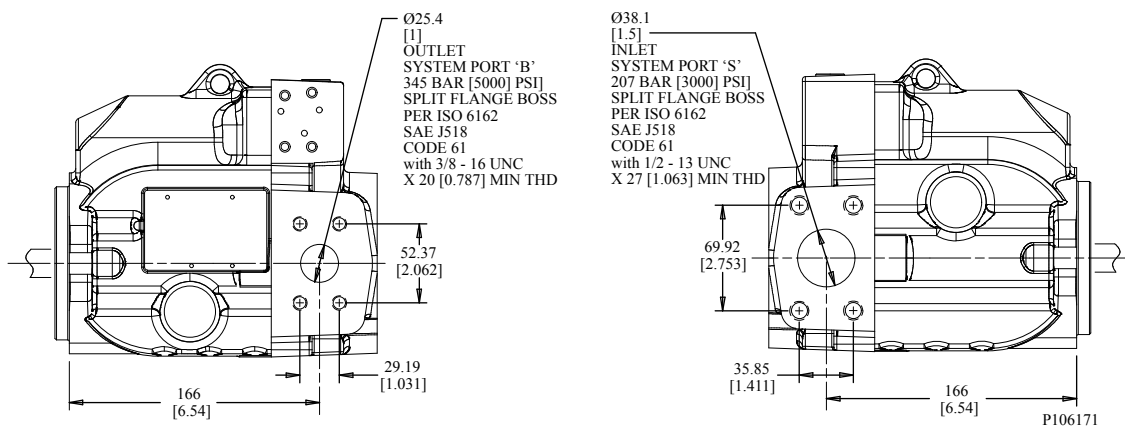


Frames L and K

Axial Ported Endcap Installation Dimensions

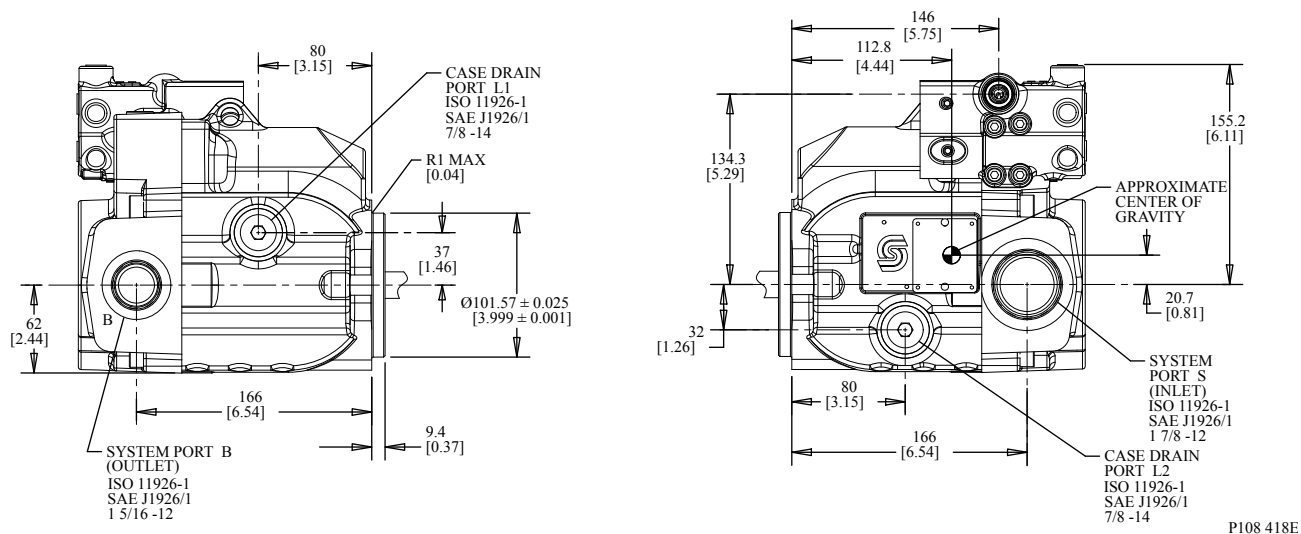


Radial Ported Endcap Split Flange Ports



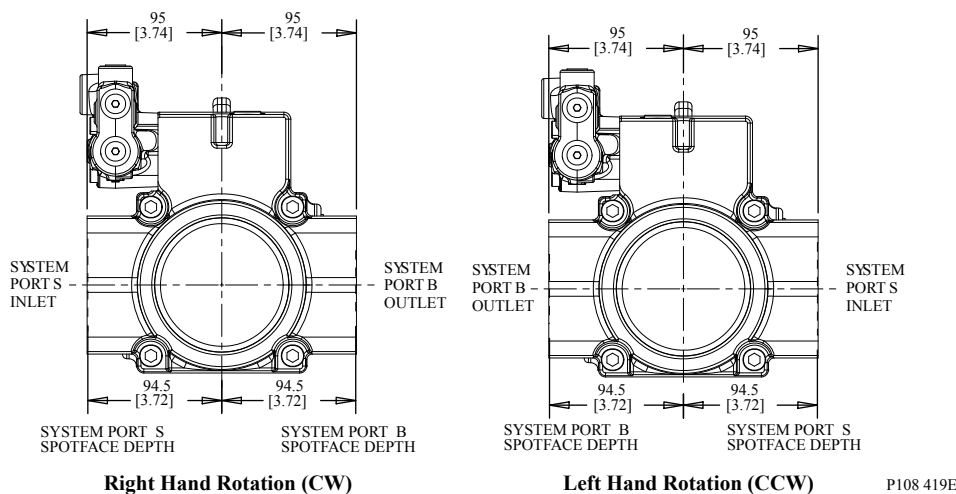
Frames L and K

Radial Ported Endcap O-ring Boss Ports



P108 418E

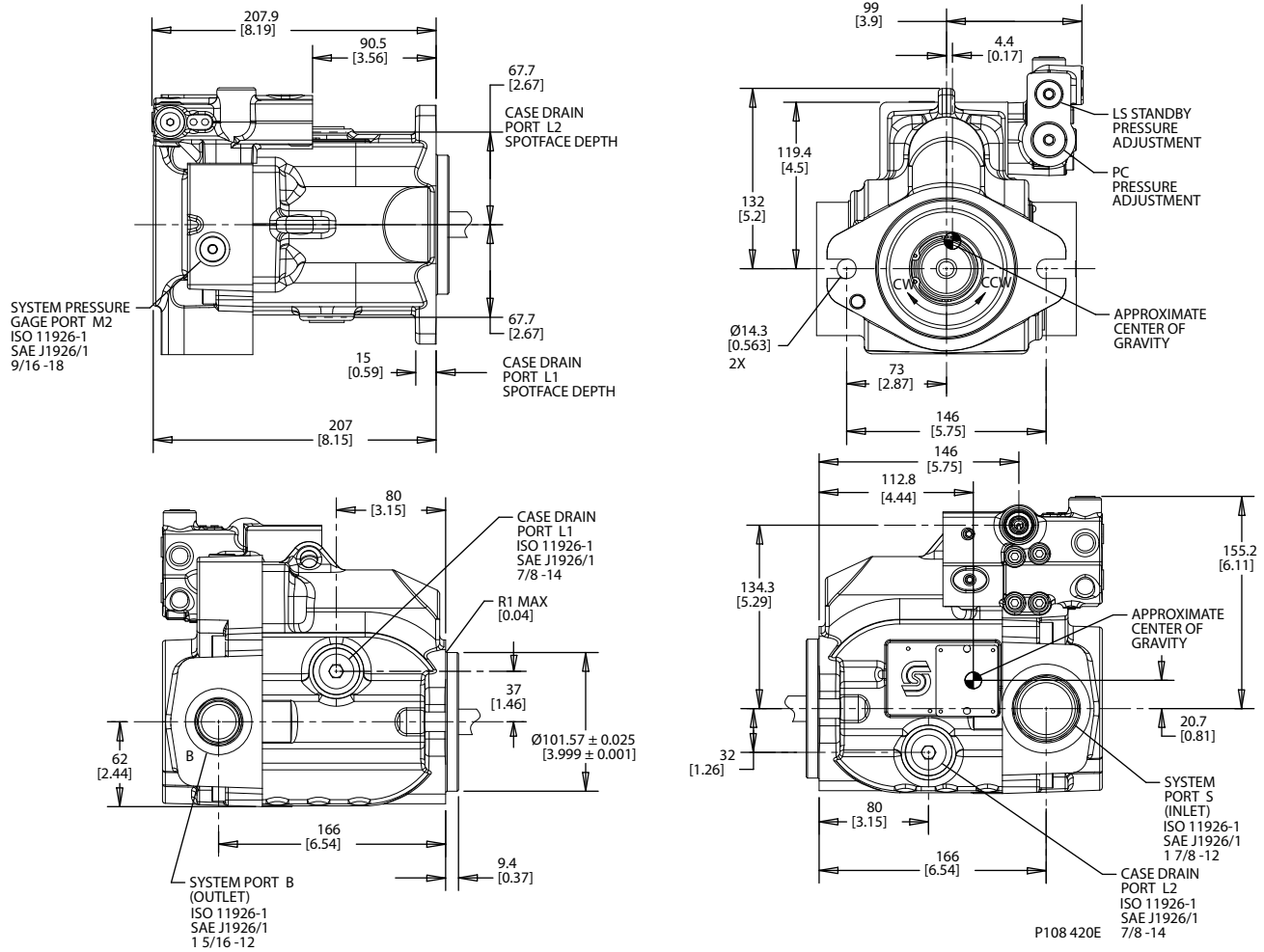
Radial Ported Endcap Rear View



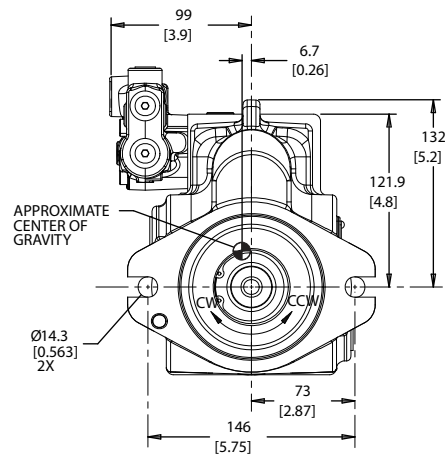
P108 419E

Frames L and K

Radial Ported Endcap Installation Dimensions



Front Mounting Flange - SAE-B two bolt

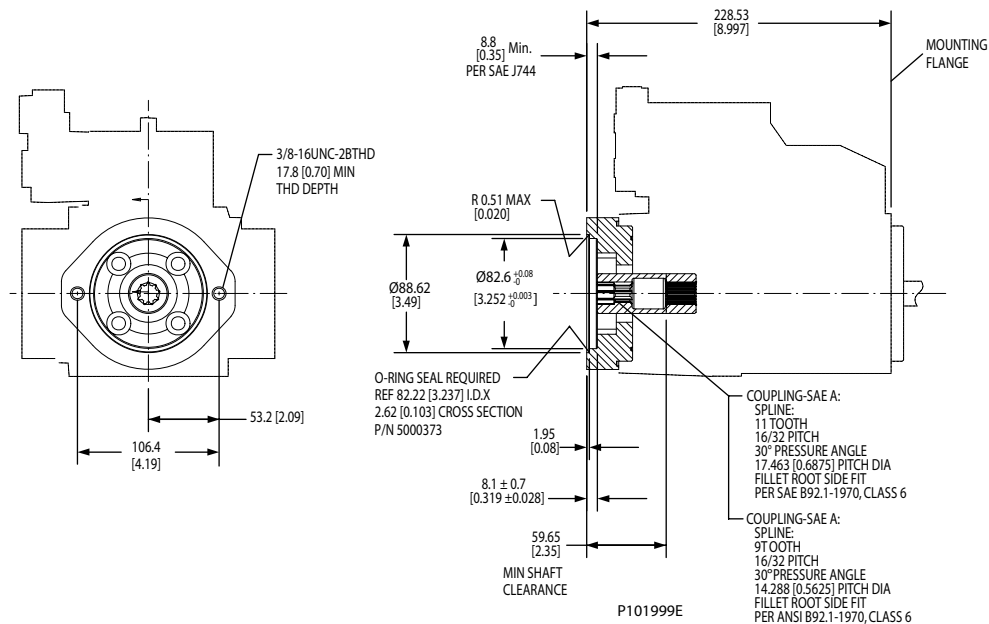


P108 421E

Frames L and K

Auxiliary Mounting Pads

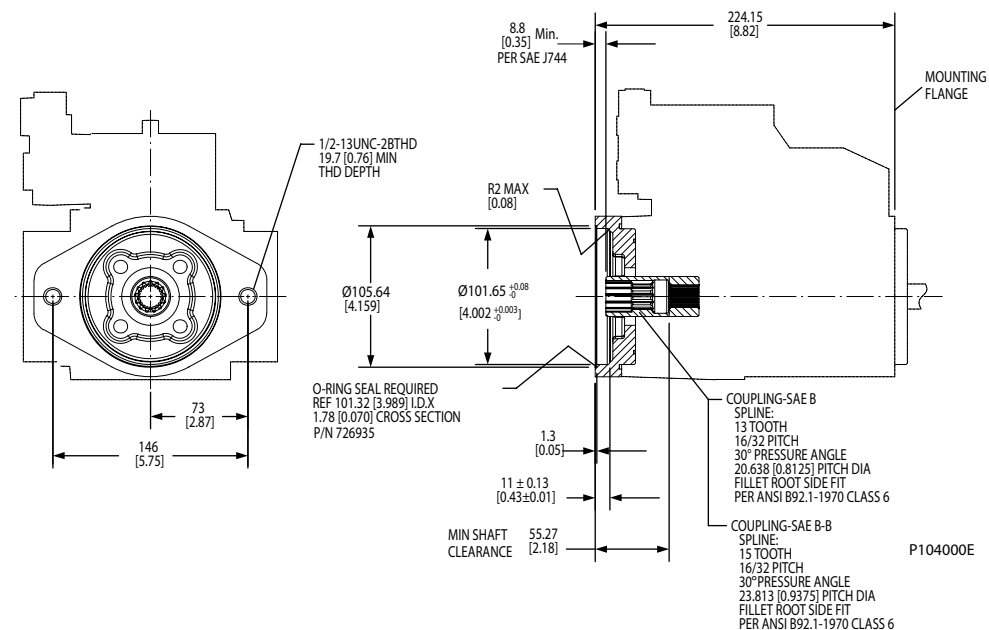
SAE-A auxiliary mounting pad



Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	12.6 mm [0.50 in]	13.5 mm [0.53 in]
Maximum torque	107 N•m [950 lbf•in]	147 N•m [1300 lbf•in]

SAE-B auxiliary mounting pad

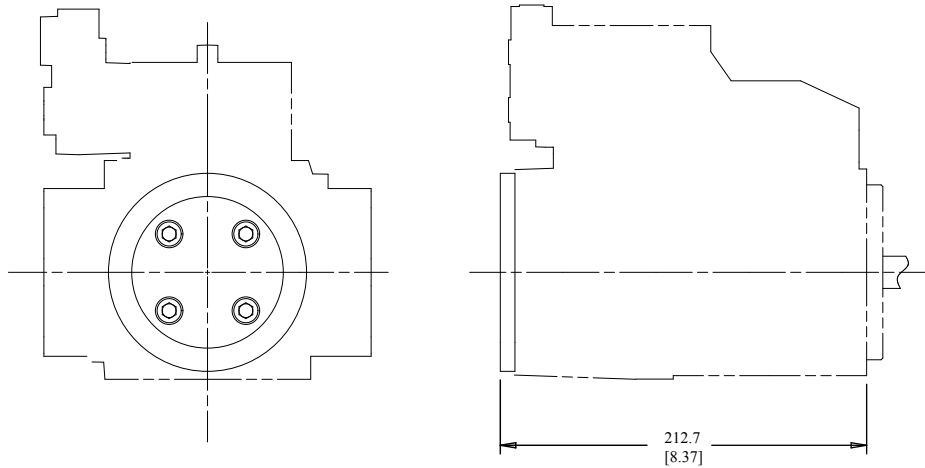


Frames L and K

Specifications

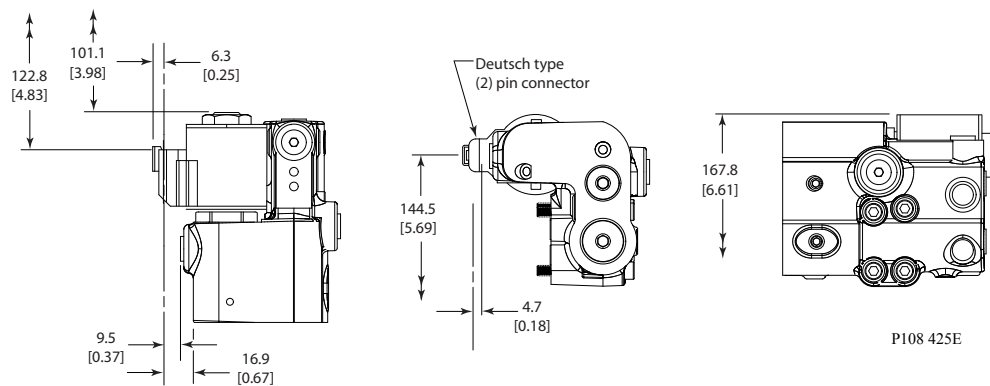
Coupling	13-tooth	15-tooth
Spline minimum engagement	13.2 mm [0.52 in]	16.1 mm [0.63 in]
Maximum torque	171 N•m [1512 lbf•in]	171 N•m [1512 lbf•in]

Auxiliary Mounting Pad - Running Cover



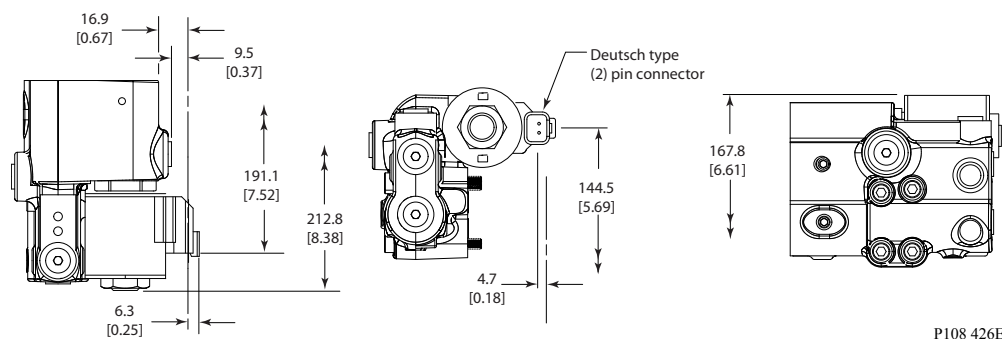
P106 077E

Electric Solenoid, Left Side



P108 425E

Electric Solenoid, Right Side



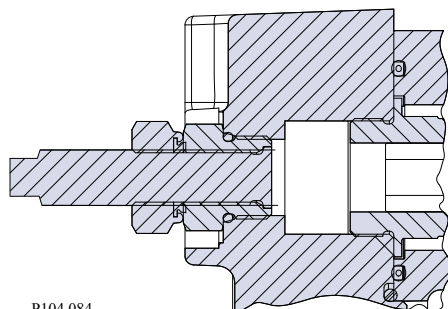
P108 426E

Frames L and K

Displacement limiter

L and K Frame open circuit pumps are available with an optional adjustable displacement limiter. This adjustable stop limits the pump's maximum displacement.

Cross-Section



P104 084

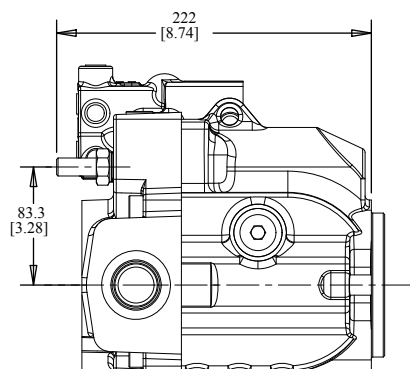
Setting range

L25C	0 to 25 cm ³ [0 to 1.53 in ³]
L30D	0 to 30 cm ³ [0 to 1.83 in ³]
K38C	0 to 38 cm ³ [0 to 2.32 in ³]
K45D	0 to 45 cm ³ [0 to 2.75 in ³]

Displacement per turn

L25C	1.20 cm ³ /rev [0.07 in ³ /rev]
L30D	1.43 cm ³ /rev [0.09 in ³ /rev]
K38C	1.81 cm ³ /rev [0.11 in ³ /rev]
K45D	2.15 cm ³ /rev [0.13 in ³ /rev]

Installation Dimensions



P104 065E

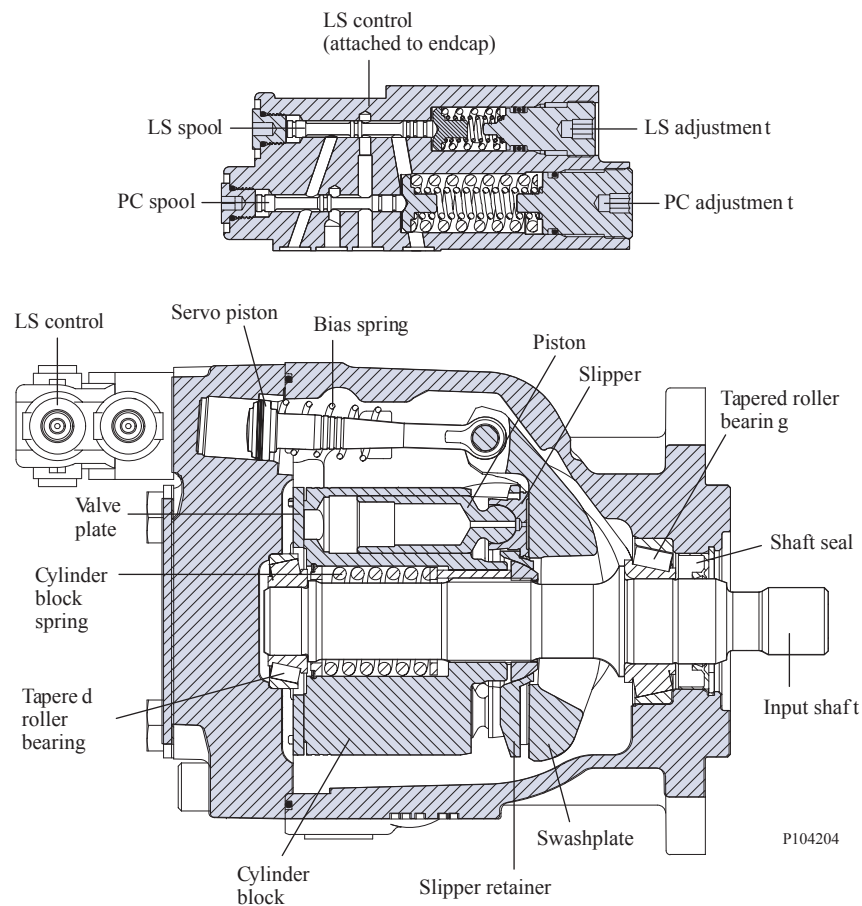
Frame J

Design

Series 45 Frame J pumps have a single servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. A bias spring and internal forces increase swashplate angle. The servo piston decreases swashplate angle. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swashplate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a viton lip-seal protects against shaft leaks.

An adjustable one spool (PC only, not shown) or two spool (LS and PC) control senses system pressure and load pressure (LS controls). The control ports system pressure to the servo piston to control pump output flow.

Frame J cross section



Frame J

Technical Specifications

			J Frame				
		Unit	S45B	S51B	S60B	S65C	S75C
Maximum Displacement		cm ³ [in ³]	45 [2.75]	51 [3.11]	60 [3.66]	65 [3.97]	75 [4.58]
Working Input Speed	Minimum	min -1 (rpm)	500	500	500	500	500
	Continuous		2800	2700	2600	2500	2400
	Maximum		3360	3240	3120	3000	2880
Working Pressure	Continuous	bar [psi]	310 [4500]	310 [4500]	310 [4500]	260 [3770]	260 [3770]
	Maximum		400 [5800]	400 [5800]	400 [5800]	350 [5075]	350 [5075]
Flow at rated speed (theoretical)		l/min [US gal/min]	126 [33.3]	138 [36.4]	156 [41.2]	162 [42.9]	180 [47.5]
Input torque at maximum displacement (theoretical) at 49° C [120°F]		N·m/bar [lbf·in/1000 psi]	0.717 [437.4]	0.812 [495.7]	0.955 [583.2]	1.035 [631.8]	1.194 [729]
Mass moment of inertia of internal rotating components		kg·m ² [slug·ft ²]	0.00455 [0.00336]	0.00455 [0.00336]	0.00455 [0.00336]	0.00433 [0.00319]	0.00433 [0.00319]
Weight	Axial ports	kg [lb]	23.1 [51.0]				
	Radial ports		27.3 [60.2]				
External Shaft Loads	External moment (Me)	N·m [lbf·in]	226 [2000]	226 [2000]	226 [2000]	226 [2000]	226 [2000]
	Thrust in (Tin), out (Tout)	N [lbf]	2200 [495]	2200 [495]	2200 [495]	2200 [495]	2200 [495]
Mounting flange load moments	Vibratory (continuous)	N·m [lbf·in]	SAE-C: 1500 [13300], SAE-B: 735 [6600]				
	Shock (maximum)		SAE-C: 5600 [49600], SAE-B: 2600 [23100]				

Order code

Code description

Code	Description
R	Product Frame, Variable Open Circuit Pump
S	Rotation
P	Displacement
C	Control Type
D	Pressure Compensator Setting
E	Load Sense Setting
F	Not Used
G	Choke Orifice
H	Gain Orifice
J	Input Shaft/Auxiliary Mount/Endcap
K	Shaft Seal/Front Mounting Flange/Housing Ports
L	Displacement Limiter
M	Special Hardware
N	Special Features

Frame J

R Product

		J Frame				
		S45B	S51B	S60B	S65C	S75C
JR	J Frame, variable displacement open circuit pump	•	•	•	•	•

S Rotation

L	Left Hand (counterclockwise)	•	•	•	•	•
R	Right Hand (clockwise)	•	•	•	•	•

P Displacement

S45B	045 cm ³ /rev [2.75 in ³ /rev]	•				
S51B	051 cm ³ /rev [3.11 in ³ /rev]		•			
S60B	060 cm ³ /rev [3.66 in ³ /rev]			•		
S65C	065 cm ³ /rev [3.97 in ³ /rev]				•	
S75C	075 cm ³ /rev [4.58 in ³ /rev]					•

C Control type

		J Frame				
		S45B	S51B	S60B	S65C	S75C
PC	Pressure Compensator	•	•	•	•	•
BC*	Pressure Compensator [>280 bar]	•	•	•		
RP	Remote Pressure Compensator	•	•	•	•	•
BP*	Remote Pressure Compensator [>280 bar]	•	•	•		
LS	Load Sensing/Pressure Comp.	•	•	•	•	•
BS*	Load Sensing/Pressure Comp. [>280 bar]	•	•	•		
LB	Load Sensing/Pressure Comp. with internal bleed orifice	•	•	•	•	•
BB*	Load Sensing/Pressure Comp. with internal bleed orifice [>280 bar]	•	•	•		
AN	Electric On/Off w/Pressure Comp. (NO, 12VDC) Left	•	•	•	•	•
CN	Electric On/Off w/Pressure Comp. (NO, 24VDC) Left	•	•	•	•	•
AR	Electric On/Off w/Pressure Comp. (NC, 12VDC) Left	•	•	•	•	•
CR	Electric On/Off w/Pressure Comp. (NC, 24VDC) Left	•	•	•	•	•
AF	Electric On/Off w/Pressure Comp. (NO, 12VDC) Right	•	•	•	•	•
AT	Electric On/Off w/Pressure Comp. (NO, 24VDC) Right	•	•	•	•	•
AG	Electric On/Off w/Pressure Comp. (NC, 12VDC) Right	•	•	•	•	•
AY	Electric On/Off w/Pressure Comp. (NC, 24VDC) Right	•	•	•	•	•
BN*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Left	•	•	•		

Frame J

C Control type (continued)

		J Frame				
		S45B	S51B	S60B	S65C	S75C
DN*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Left	•	•	•		
BR*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Left	•	•	•		
DR*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Left	•	•	•		
BF*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Right	•	•	•		
DF*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Right	•	•	•		
BE*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Right	•	•	•		
BG*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Right	•	•	•		
AX	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Left	•	•	•	•	•
CL	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Left	•	•	•	•	•
AH	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Left	•	•	•	•	•
AL	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Left	•	•	•	•	•
AW	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Right	•	•	•	•	•
CK	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Right	•	•	•	•	•
AV	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Right	•	•	•	•	•
AK	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Right	•	•	•	•	•
BX*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Left	•	•	•		
DL*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Left	•	•	•		
BH*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Left	•	•	•		
BL*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Left	•	•	•		
BW*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Right	•	•	•		
DK*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Right	•	•	•		
BM*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Right	•	•	•		
BK*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Right	•	•	•		

Frame J

C Control type (continued)

		J Frame				
		S45B	S51B	S60B	S65C	S75C
FA*	Electric On/Off Dump valve w/ Pressure Comp. + Load Sense (NC, 12VDC) Right	•	•	•		
FB*	Electric On/Off Dump valve w/ Pressure Comp. + Load Sense (NC, 12VDC) Left	•	•	•	•	•
FE*	Electric On/Off Dump valve w/ Pressure Comp. + Load Sense (NC, 24VDC), Left	•	•	•	•	•
FM*	Electric On/Off Dump valve w/ Pressure Comp. + Load Sense (NC, 24VDC), Right	•	•	•	•	•
TA	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Left	•	•	•	•	•
TB	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Left	•	•	•	•	•
TC	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Left	•	•	•	•	•
TD	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Left	•	•	•	•	•
TE	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Right	•	•	•	•	•
TF	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Right	•	•	•	•	•
TG	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Right	•	•	•	•	•
TH	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Right	•	•	•	•	•
SA	Pressure Comp (12 Vdc), 100-210 Bar - Left			•	•	•
SB	Pressure Comp (24 Vdc), 100-210 Bar - Left			•	•	•
SC	Pressure Comp (12 Vdc), 220-310 Bar - Left			•	•	•
SD	Pressure Comp (24 Vdc), 220-310 Bar - Left			•	•	•
SE	Pressure Comp (12 Vdc), 100-210 Bar - Right			•	•	•
SF	Pressure Comp (24 Vdc), 100-210 Bar - Right			•	•	•
SG	Pressure Comp (12 Vdc), 220-310 Bar - Right			•	•	•
SH	Pressure Comp (24 Vdc), 220-310 Bar - Right			•	•	•

* Not available on 65cc and 75cc pumps

Left - E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial

Right - E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial

Frame J

D PC setting (2 digit code, 10 bar increments)

		J Frame				
		S45B	S51B	S60B	S65C	S75C
Example	25 = 250 bar (3625 psi)					
10-26	100 to 260 bar [1450 to 3771 psi]	•	•	•	•	•
27-28	270 to 280 bar [3916 to 4061 psi]	•	•	•		
29-31	290-310 bar [4206 to 4496 psi]	•	•	•		

E Load sensing setting (2 digit code, 1 bar increments)

Example	20 = 20 bar (290 psi)					
10-40	10 to 40 bar [175 to 580 psi]	•	•	•	•	•
NN	Not applicable (pressure compensated only controls)	•	•	•	•	•

F Not used

NN	Not applicable	•	•	•	•	•
----	----------------	---	---	---	---	---

G Servo Control Orifice

N	None (standard)	•	•	•	•	•
E	0.8 mm diameter	•	•	•	•	•
F	1.0 mm diameter	•	•	•	•	•

H Gain Orifice

3	1.0 mm diameter (standard orifice)	•	•	•	•	•
C	0.8 mm diameter LS signal line orifice for ETL use (with standard orifice)	•	•	•	•	•

Additional LS signal line orifice size options are available for necessary system tuning requirements. Contact your Danfoss representative for further information.

J Input Shaft

C2	13 tooth, 16/32 pitch
C3	15 tooth, 16/32 pitch
S1	14 tooth 12/24 pitch
S5	14 tooth, 12/24 pitch, with 5/16-18 UNC Thread
K4	1.25 inch straight keyed
T0	1.25 inch tapered

Frame J

Auxiliary Mount/Endcap Style

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
None	Axial	O-Ring Boss	O-Ring Boss	Inlet - SAE O-Ring boss port (1.875 inch threads) Outlet - SAE O-Ring boss port (1.3125 inch threads)	NH
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	N9
None	Axial	Split Flange	Split Flange	Inlet- Code 61 Split Flange 4 Bolt (2 inch port, M12 threads) Outlet- code 61 Split Flange 4 Bolt (1 inch port, M10 threads)	NQ
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter	NZ
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	NE
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 metric threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 metric threads)	NX
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter, Large servo bore	NV
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	RE
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter	RF
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 metric threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 metric threads)	RX
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	TE
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) with integral SAE "A" Aux. pad (0.375 inch threads)	TY

Frame J

Auxiliary Mount/Endcap Style (continued)

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	TF
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 62 Split Flange Port 4 Bolt (1 inch port M10 threads) with integral SAE "A" Aux. pad (0.375 inch threads)	TZ
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	AE
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) with displacement limiter	AF
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) with integral SAE "A" Aux. pad (0.375 inch threads)	AY
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	AX
SAE-A 9T Metric M10	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	AZ
SAE-A 11T Rotated 90 Degrees	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads) with displacement limiter	GF
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	BE
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter	BF
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	BX

Frame J

Auxiliary Mount/Endcap Style (continued)

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange 4 Bolt (2 inch port, M12 threads) Outlet - Code 61 Split Flange 4 Bolt (1 inch port, M10 threads)	EX
SAE-B, 13T Rotated 90 Degrees	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	JE
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	VE
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter	VF
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	VX
SAE-BB, 15T Metric M12	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	VM
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads), Large servo bore	DX
SAE-C, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	CE
SAE-C, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads), w/ Disp. Limiter	CF
SAE-C, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port M12 threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port M10 threads)	CX

J Input Shaft/Auxiliary Mount/Endcap

Available Combinations

	J Frame				
	S45B	S51B	S60B	S65C	S75C
C2AE ¹	•	•	•	•	•
C2AY ¹	•	•	•	•	•
C2AF ¹	•	•	•	•	•

Frame J

	J Frame				
	S45B	S51B	S60B	S65C	S75C
C2AX ¹	•	•	•	•	•
C2BE ¹	•	•	•	•	•
C2BF ²	•	•	•	•	•
C2CE ¹	•	•	•	•	•
C2N9 ¹	•	•	•	•	•
C2NE ¹	•	•	•	•	•
C2NH ¹	•	•	•	•	•
C2NV ²	•	•	•	•	•
C2NZ ¹	•	•	•	•	•
C2RE ¹	•	•	•	•	•
C2RF ²	•	•	•	•	•
C2TE ¹	•	•	•	•	•
C2TF ²	•	•	•	•	•
C2TY ¹	•	•	•	•	•
C2VE ¹	•	•	•	•	•
C3AE ¹	•	•	•	•	•
C3AF ²	•	•	•	•	•
C3AY ¹	•	•	•	•	•
C3BE ¹	•	•	•	•	•
C3BF ²	•	•	•	•	•
C3CE ¹	•	•	•	•	•
C3DX ¹	•	•	•	•	•
C3GX ¹	•	•	•	•	•
C3N9 ¹	•	•	•	•	•
C3NE ¹	•	•	•	•	•
C3NH ¹	•	•	•	•	•
C3NV ²	•	•	•	•	•
C3NX ¹	•	•	•	•	•
C3NZ ¹	•	•	•	•	•
C3RE ¹	•	•	•	•	•
C3RF ²	•	•	•	•	•
C3TE ¹	•	•	•	•	•
C3TF ¹	•	•	•	•	•
C3TZ ¹	•	•	•	•	•
C3VE ¹	•	•	•	•	•
C3VF ¹	•	•	•	•	•
C3VM ¹	•	•	•	•	•
K4AE ¹	•	•	•	•	•
K4AF ²	•	•	•	•	•
K4AY ¹	•	•	•	•	•
K4BE ¹	•	•	•	•	•
K4BF ²	•	•	•	•	•
K4CE ¹	•	•	•	•	•
K4CF ²	•	•	•	•	•
K4N9 ¹	•	•	•	•	•

Frame J

	J Frame				
	S45B	S51B	S60B	S65C	S75C
K4NE ¹	•	•	•	•	•
K4NH ¹	•	•	•	•	•
K4NV ²	•	•	•	•	•
K4NZ ¹	•	•	•	•	•
K4RE ¹	•	•	•	•	•
S1AZ ¹	•	•	•	•	•
S1JE ¹	•	•	•	•	•
S5BE ¹	•	•	•	•	•
S5RX ¹	•	•	•	•	•

¹ NNN Displacement limiter options only

² FFF Displacement limiter options only

	J Frame				
	S45B	S51B	S60B	S65C	S75C
K4EX ¹	•	•	•	•	•
K4JE ¹	•	•	•	•	•
K4RF ²	•	•	•	•	•
K4TE ¹	•	•	•	•	•
K4VE ¹	•	•	•	•	•
S1AE ¹	•	•	•	•	•
S1AF ²	•	•	•	•	•
S1AY ¹	•	•	•	•	•
S1BE ¹	•	•	•	•	•
S1BF ²	•	•	•	•	•
S1CE ¹	•	•	•	•	•
S1CF ²	•	•	•	•	•
S1DX ¹	•	•	•	•	•
S1GF ²	•	•	•	•	•
S1N9 ¹	•	•	•	•	•
S1NE ¹	•	•	•	•	•
S1NH ¹	•	•	•	•	•
S1NQ ¹	•	•	•	•	•
S1NV ²	•	•	•	•	•
S1NX ¹	•	•	•	•	•
S1NZ ¹	•	•	•	•	•
S1RE ¹	•	•	•	•	•
S1RF ²	•	•	•	•	•
S1TE ¹	•	•	•	•	•
S1TF ²	•	•	•	•	•
S1VE ¹	•	•	•	•	•
S1VF ¹	•	•	•	•	•
T0AE ¹	•	•	•	•	•
T0BE ¹	•	•	•	•	•
T0BF ¹	•	•	•	•	•
T0CE ¹	•	•	•	•	•

Frame J

	J Frame				
	S45B	S51B	S60B	S65C	S75C
TON9 ¹	•	•	•	•	•
TONE ¹	•	•	•	•	•
TONH ¹	•	•	•	•	•
TONV ²	•	•	•	•	•
TONZ ¹	•	•	•	•	•
TORE ¹	•	•	•	•	•
TOTE ¹	•	•	•	•	•
TOVE ¹	•	•	•	•	•
TOVF ²	•	•	•	•	•

¹ NNN Displacement limiter options only

² FFF Displacement limiter options only

K Shaft seal

		J Frame				
		S45B	S51B	S60B	S65C	S75C
A	Single (Viton)	•	•	•	•	•

K Mounting flange and housing port style

2	SAE-C Flange 4-bolt/SAE O-ring boss port	•	•	•	•	•
8	SAE-B Flange 2-bolt/SAE O-ring boss ports	•	•	•	•	•
9	SAE-C Flange 2-bolt/SAE O-ring boss ports	•	•	•	•	•
F	F SAE-C Flange 2-bolt rotated 45° SAE O-ring boss ports	•	•	•	•	•

K Angle Sensor Housing

N	Not applicable	•	•	•	•	•
R	Angle Sensor Housing, Right Hand Side	•	•	•	•	•

L Displacement limiter

NNN	None	•	•	•	•	•
FFF	Adjustable, factory set at max angle	•	•	•	•	•

M Special hardware

JJJ	None	•	•	•	•	•
ANS	Angle Sensor Swashplate	•	•	•	•	•

N Special features

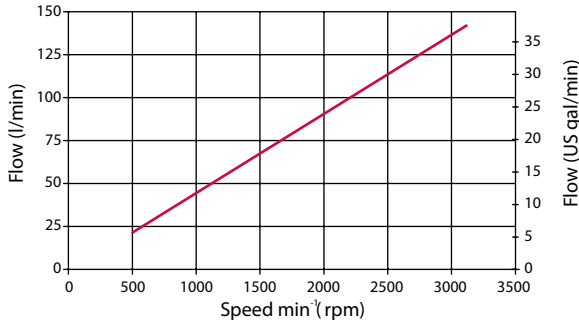
NNN	None	•	•	•	•	•
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Frame J

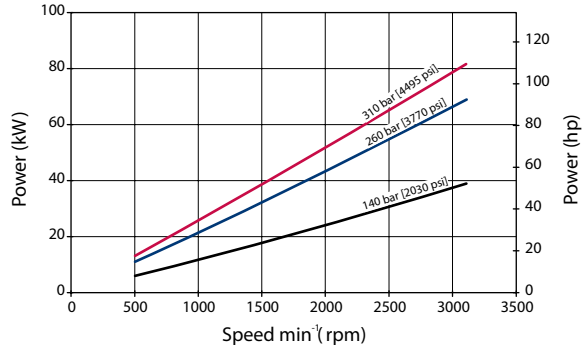
Performance J45B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

Flow vs. speed

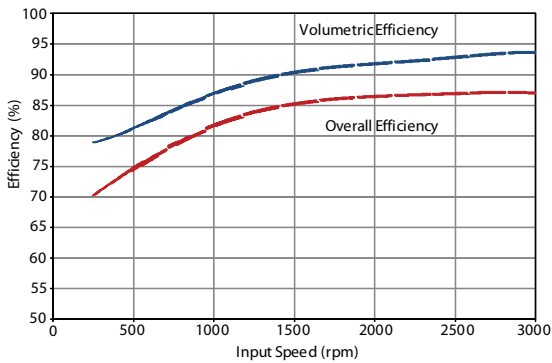


Input power vs. speed



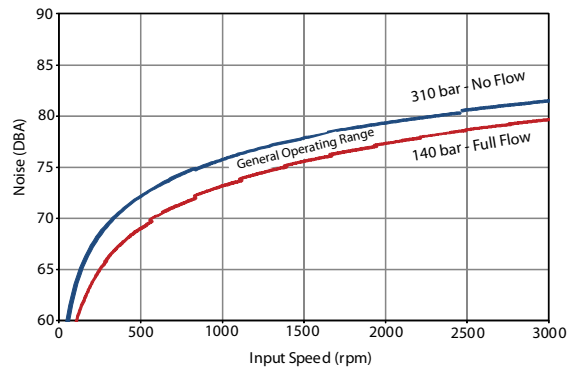
Efficiency

System Pressure: 310 Bar - Inlet Pressure: 1.0 Bar abs - Inlet Temperature: 49C

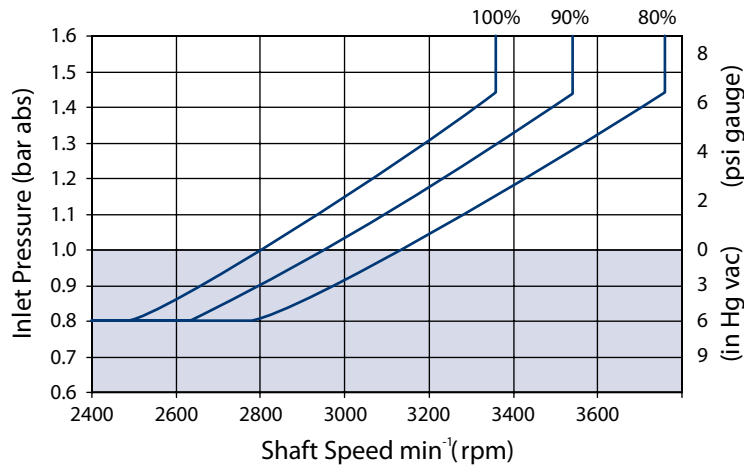


Noise

Inlet Pressure: 1.0 Bar abs - Inlet Temperature: 49C



Inlet pressure vs. speed

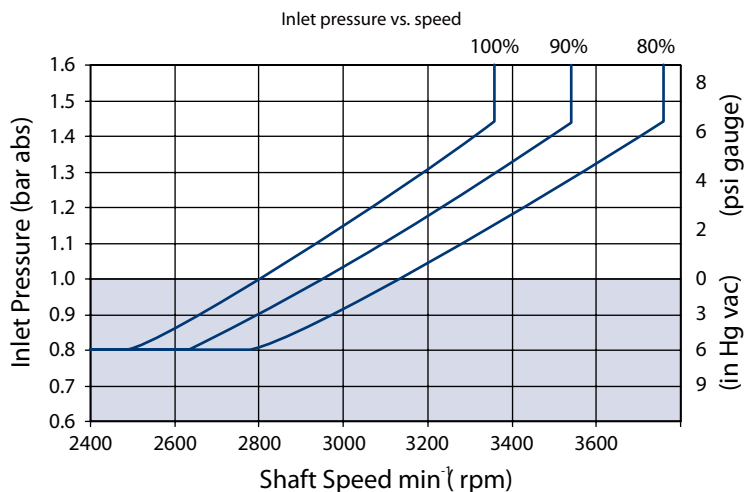
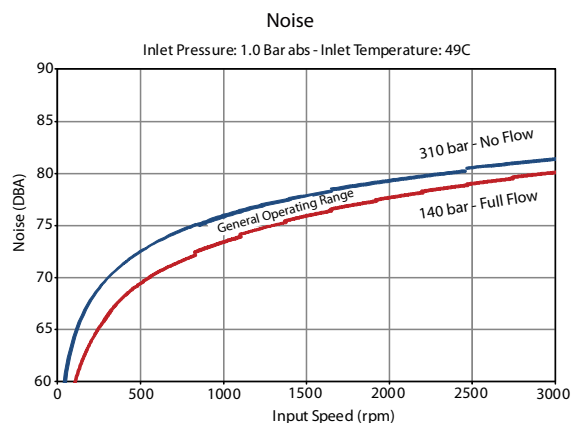
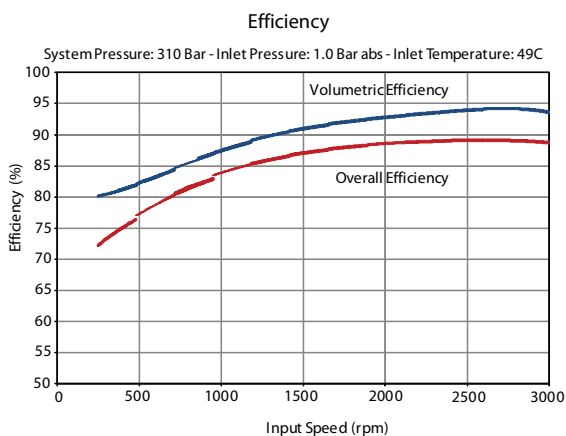
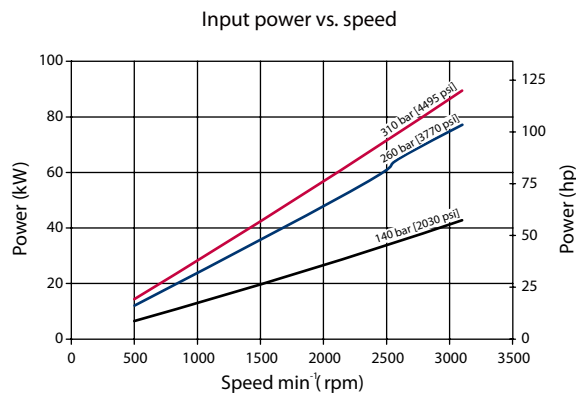
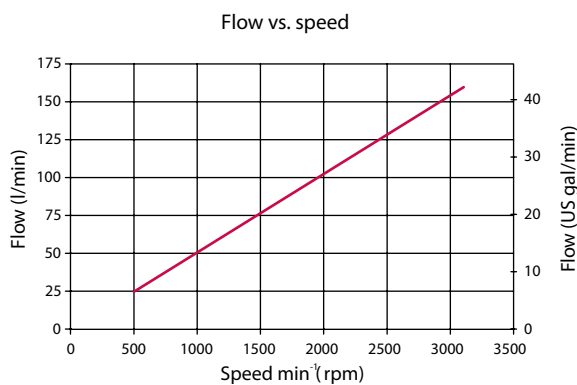


The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame J

Performance J51B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



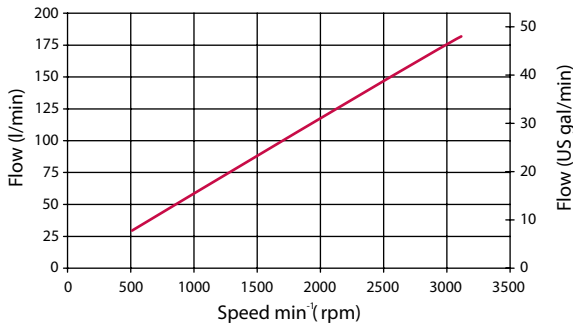
The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame J

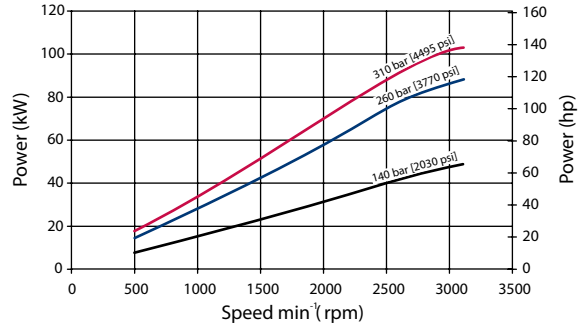
Performance J60B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

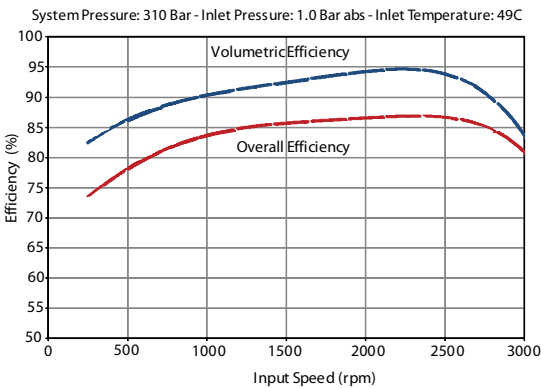
Flow vs. speed



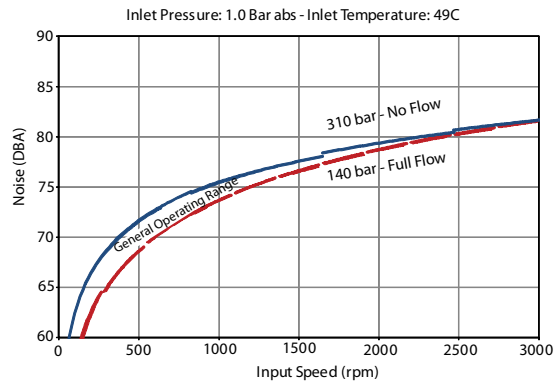
Input power vs. speed



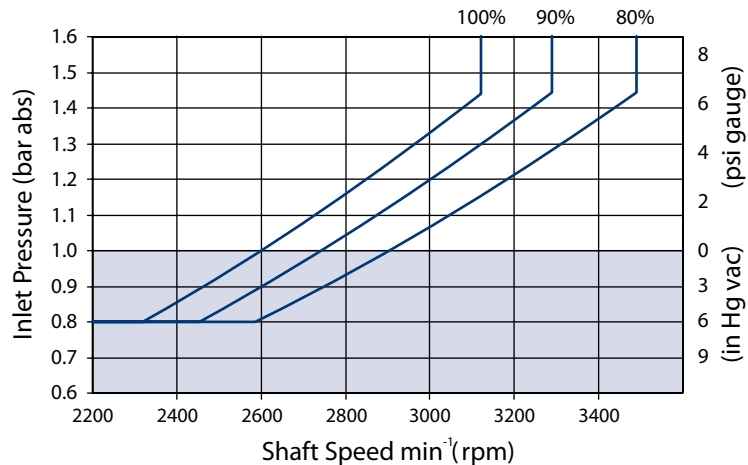
Efficiency



Noise



Inlet pressure vs. speed

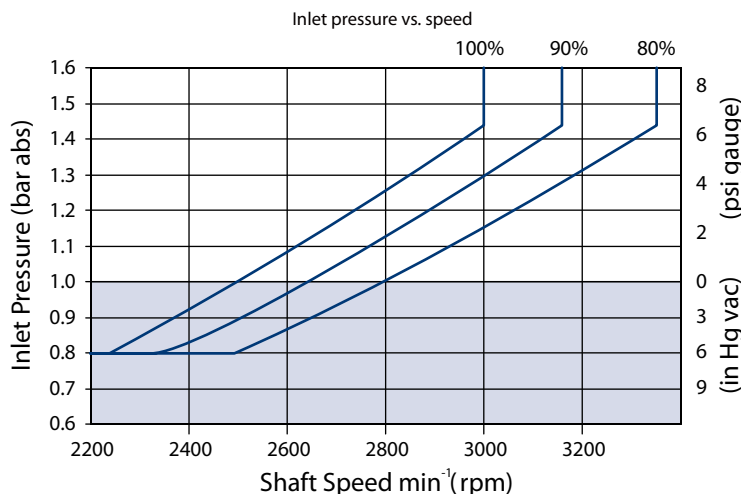
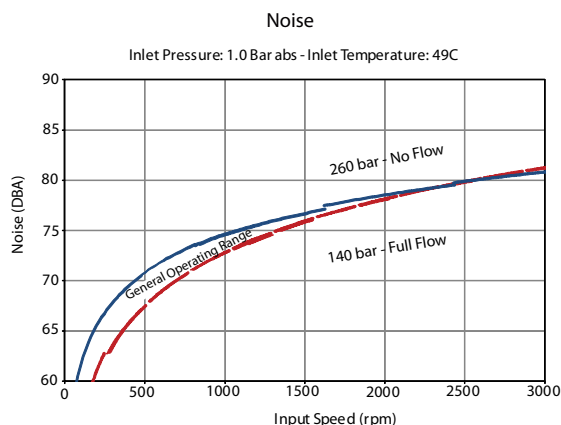
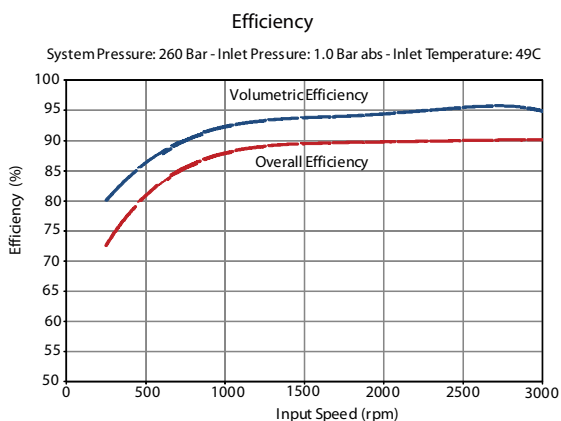
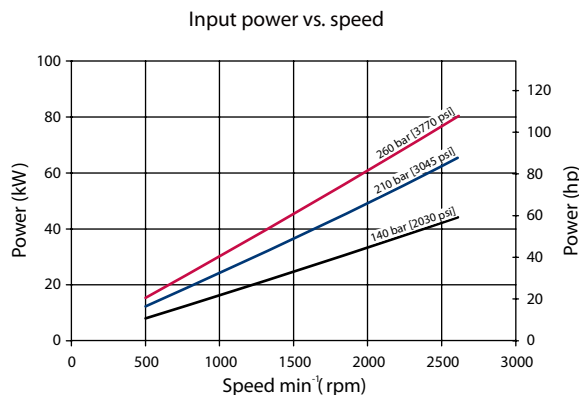
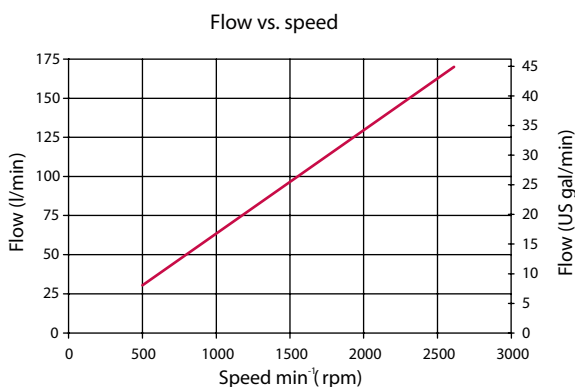


The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame J

Performance J65C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



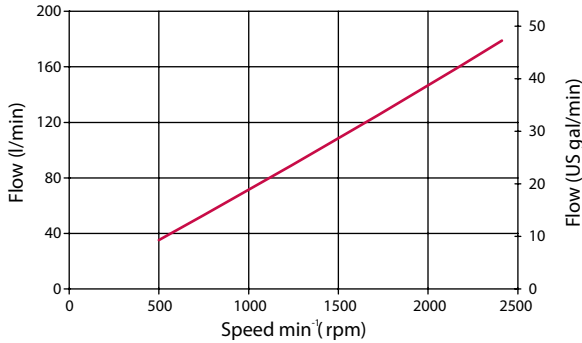
The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame J

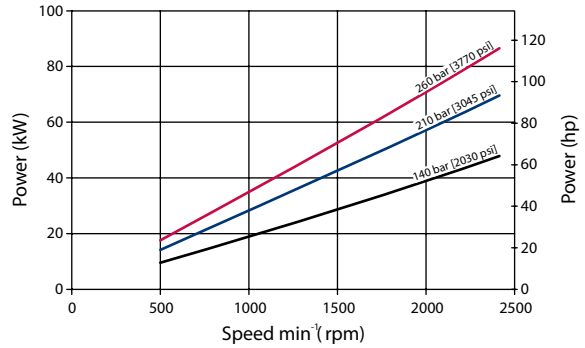
Performance J75C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

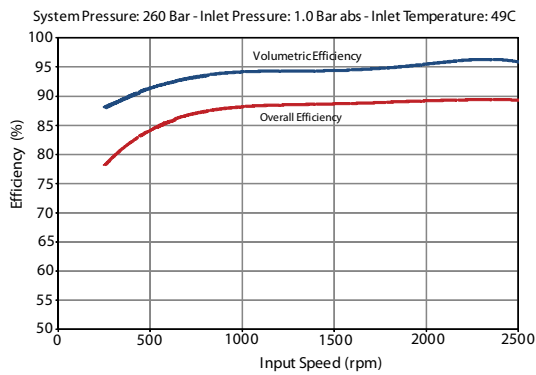
Flow vs. speed



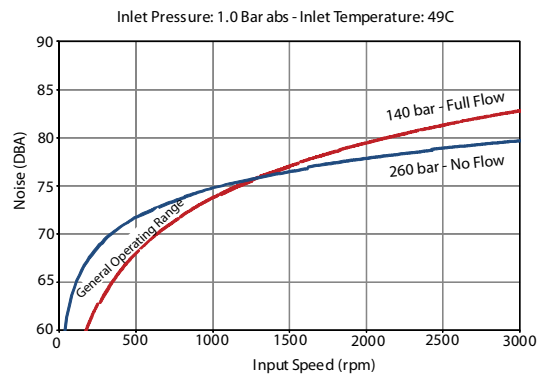
Input power vs. speed



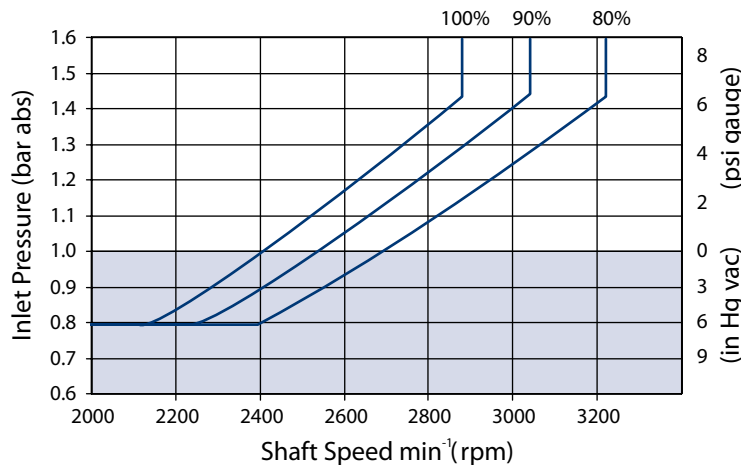
Efficiency



Noise



Inlet pressure vs. speed



The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame J

Hydraulic Controls

Pressure Compensated Controls

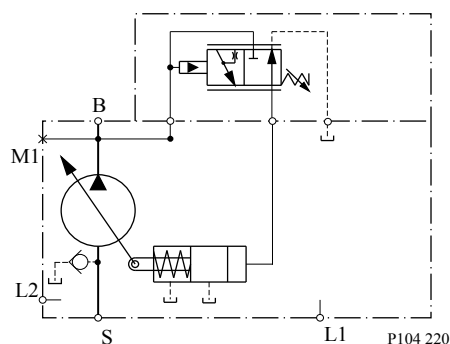
*Response/Recovery Times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65C	45	140
J75C	45	150

PC Setting range

Model	PC	BC
J45B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J51B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J60B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J65C	100-260 bar [1450-3770 bar]	N/A
J75C	100-260 bar [1450-3770 bar]	N/A

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M1* = System pressure gauge port

* M1 port is available on axially ported endcaps only

Frame J

Remote Pressure Compensated Controls

*Response/Recovery Times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65C	45	140
J75C	45	150

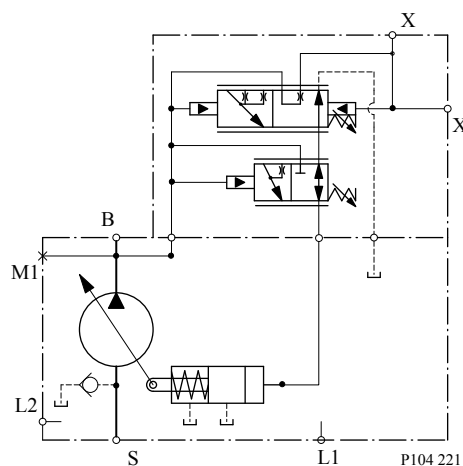
PC Setting Range

Model	RP	BP
J45B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J51B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J60B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J65C	100-260 bar [1450-3770 bar]	N/A
J75C	100-260 bar [1450-3770 bar]	N/A

LS Setting range

Model	bar	psi
All	10-40	145-580

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- X = Remote PC port
- M1* = System pressure gauge port

Frame J

* M1 port is available on axially ported endcaps only

Load sensing/Pressure compensated Controls

*Response/Recovery Times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65B	45	140
J75B	45	150

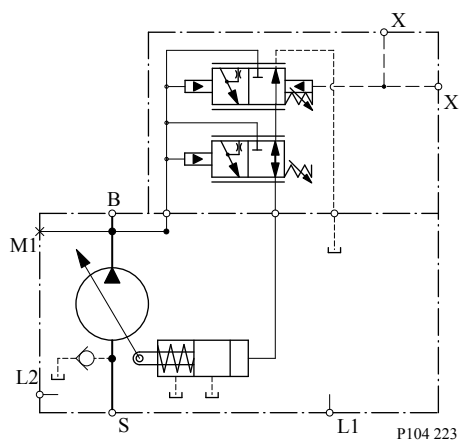
PC control setting range

Code	LS	BS
J45B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J51B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J60B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J65C,	100-260 bar [1450-3770 bar]	N/A
J75C	100-260 bar [1450-3770 bar]	N/A

LS setting range

Model	bar	psi
All	10-40	145-580

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

X = LS signal port

Frame J

M1* = System pressure gauge port

* M1 port is available on axially ported endcaps only

Load sensing Control with Bleed Orifice/ Pressure Compensated

*Response/Recovery Times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65B	45	140
J75B	45	150

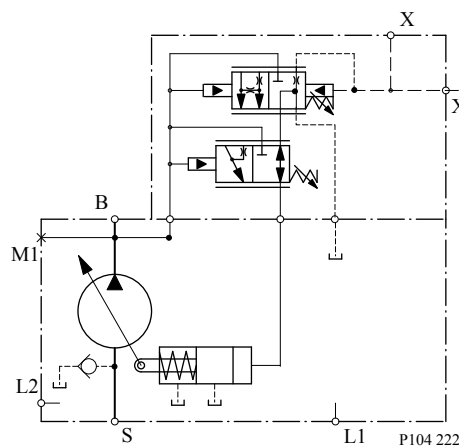
PC control setting range

Code	LB	BB
J45B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J51B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J60B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
J65C,	100-260 bar [1450-3770 bar]	N/A
J75C	100-260 bar [1450-3770 bar]	N/A

LS setting range

Model	bar	psi
All	10-40	145-580

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

Frame J

X = LS signal port

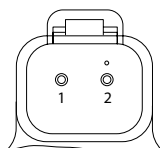
M1* = System pressure gauge port

* M1 port is available on axially ported endcaps only

Electric Controls

Connectors

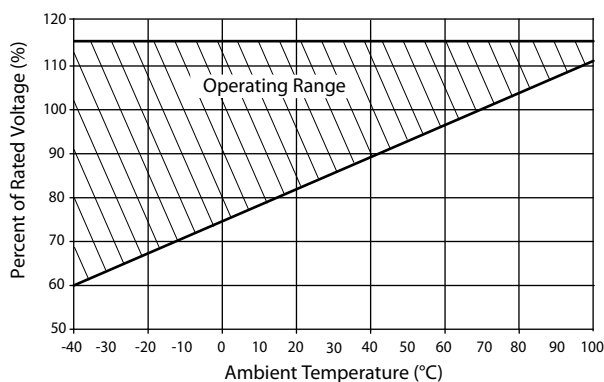
Description	Quantity	Ordering Number
Mating Connector	1	Deutsch® DT06-2S
Wedge Lock	1	Deutsch® W25
Socket Contact (16 and 18 AWG)	2	Deutsch® 0462-201-16141
Danfoss mating connector kit	1	K29657



P003 480

Continuous Duty Operating Range

Continuous duty operating range



Solenoid Data - Normally Closed

Voltage	12V	24V
Threshold Control [mA] (310/260 bar PC setting, oil temp X)	200/400	100/200
End Current [mA] (20 bar LS setting, oil temp X)	1200	600

Solenoid Data - Normally Open

Voltage	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/310 bar PC setting, oil temp X)	1000/1100	500/550

Frame J

Hysteresis

Frame	Hysteresis
J45B, J51B, J60B	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)
J65C, J75C	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)

Fan Drive Control Solenoid Data - Normally Closed

Voltage	12V	24V
Maximum Control Current [mA]	1800	920

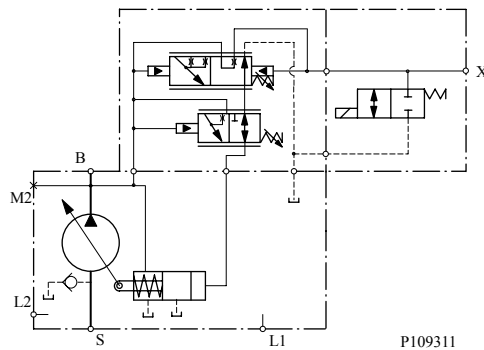
Normally Closed Electric On/Off with Pressure Compensation Controls

Response/Recovery times (without servo control orifice)

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65C	45	140
J75C	45	150

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Frame J

PC setting range

Frame	AG, AR (12V)	BE, BR (12V)	AY, CR (24V)	BG, DR (24V)
J45B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
J51B				
J60B				
J65C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available
J75C				

Normally Open Electric On/Off with Pressure Compensation Controls

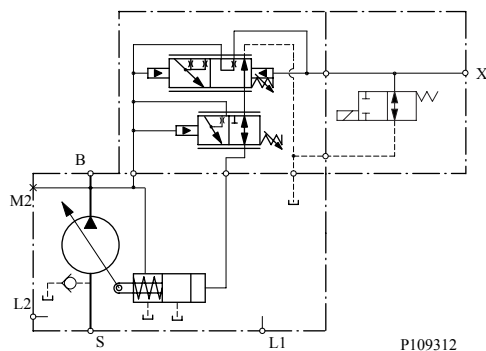
*Response/Recovery times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65C	45	140
J75C	45	150

* Without servo control orifice

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Frame J

PC setting range

Frame	AF, AN (12V)	BF, BN (12V)	AT, CN (24V)	DF, DN (24V)
J45B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
J51B				
J60B				
J65C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available
J75C				

Normally Closed Electric Proportional with Pressure Compensation Controls

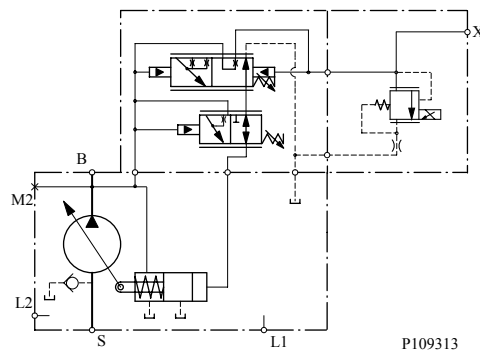
Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
J45B	33	425	33	325
J51B	33	455	33	325
J60B	39	515	39	395
J65C	45	425	45	325
J75C	45	455	45	350

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

Frame J

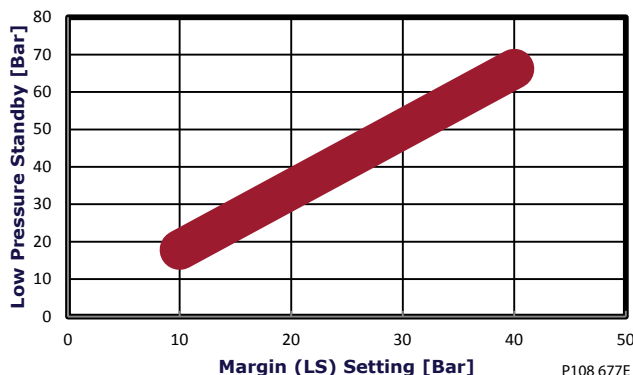
PC setting range

Frame	AH, AV (12V)	BH, BM (12V)	AK, AL (24V)	BK, BL (24V)
J45B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
J51B				
J60B				
J65C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available
J75C				

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

Frames E, F, J Electric Proportional Control Low Pressure Standby



Normally Open Electric Proportional with Pressure Compensation Controls

Response/Recovery times

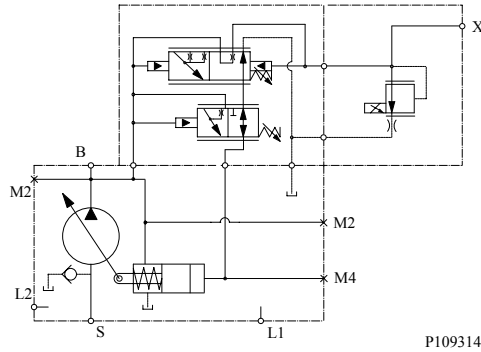
(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
J45B	33	425	33	325
J51B	33	455	33	325
J60B	39	515	39	395
J65C	45	425	45	325
J75C	45	455	45	350

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Frame J

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

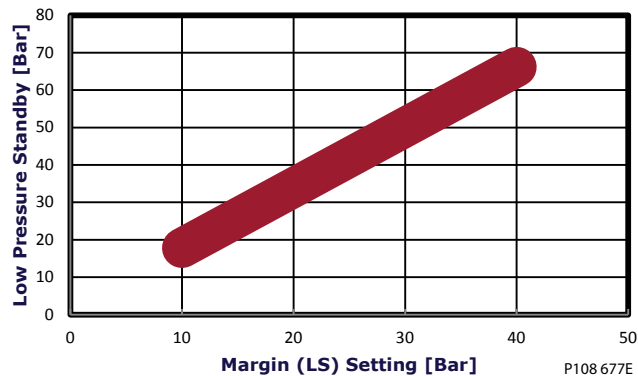
PC setting range

Frame	AW, AX (12V)	BW, BX (12V)	CK, CL (24V)	DK, DL (24V)
J45B	100-280 bar	290-310 bar	100-280 bar	290-310 bar
J51B	[1450-4060] psi	[4205-4495] psi	[1450-4060] psi	[4205-4495] psi
J60B				
J65C	100-260 bar	Not Available	100-260 bar	Not Available
J75C	[1450-3770] psi		[1450-3770] psi	

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

**Frames E, F, J Electric Proportional Control
 Low Pressure Standby**



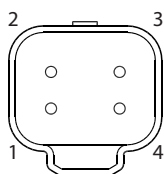
Frame J

Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls

*Response/Recovery Times**

(msec)	Response	Recovery
J45B	33	140
J51B	33	150
J60B	39	170
J65C	45	140
J75C	45	150

Pin location



P200 151

Pinout

Pin	Description
1	Supply -
2	Output signal 2 - Secondary Signal
3	Output signal 1 - Primary Signal
4	Supply +

PC setting range

Frame	TA, TE (12V)	TC, TG (12V)	TB, TF (24V)	TD, TH (24V)
J45B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
J51B				
J60B				
J65C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available
J75C				

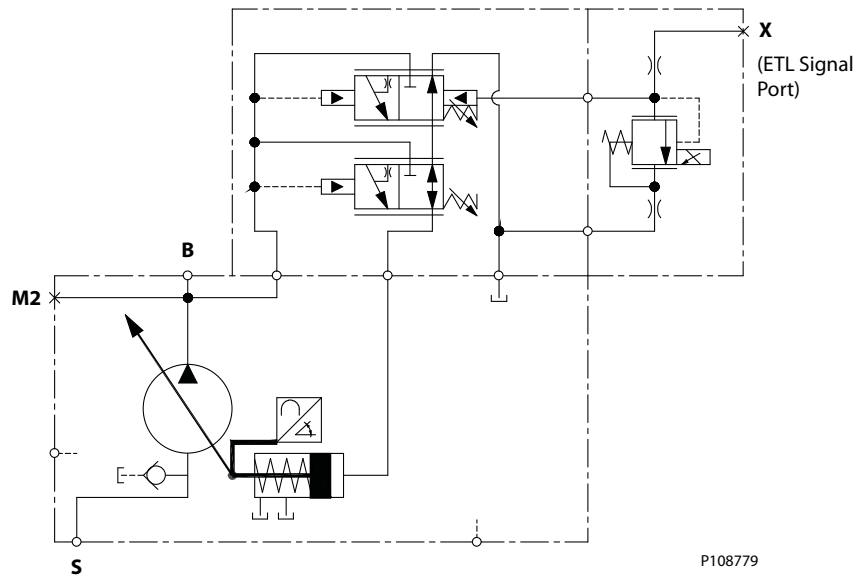
LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Frame J

J-frame pump with integrated ETL control

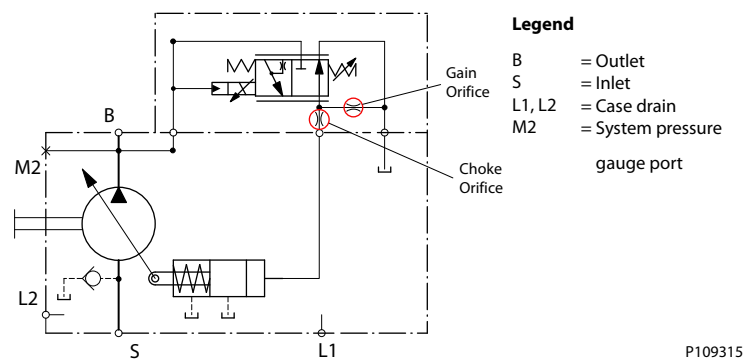


Normally Closed Fan Drive Control

PC setting range

Frame	SA, SE (12V)	SC, SG (12V)	SB, SF (24V)	SD, SH (24V)
J45B	100-210 bar [1450-3045]	220-310 bar [3190-4495]	100-210 bar [1450-3045]	220-310 bar [3190-4495]
J51B	psi	psi	psi	psi
J60B				
J65C	100-210 bar [1450-3045]	220-260 bar [3190-3771]	100-210 bar [1450-3045]	220-260 bar [3190-3771]
J75C	psi	psii	psi	psii

Fan Drive Control Schematic



Frame J

Input shafts

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
C2	13 tooth spline 16/32 pitch (ANSI B92.1B 1996 - Class 6e) For use with SAE-B	288 [2546]	<p style="text-align: right;">P104224</p>
C3	15 tooth spline 16/32 pitch (ANSI B92.1B 1996 - Class 6e) For use with SAE-B	404 [3575]	<p style="text-align: right;">P104225</p>

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

Frame J

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
S1	14 tooth spline 12/24 pitch (ANSI B92.1B 1996 - Class 6e)	800 [7080]	
S5	14 tooth spline 12/24 pitch (BNSI A92.1B 1996 - Class 6e)	800 [7080]	

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

Frame J

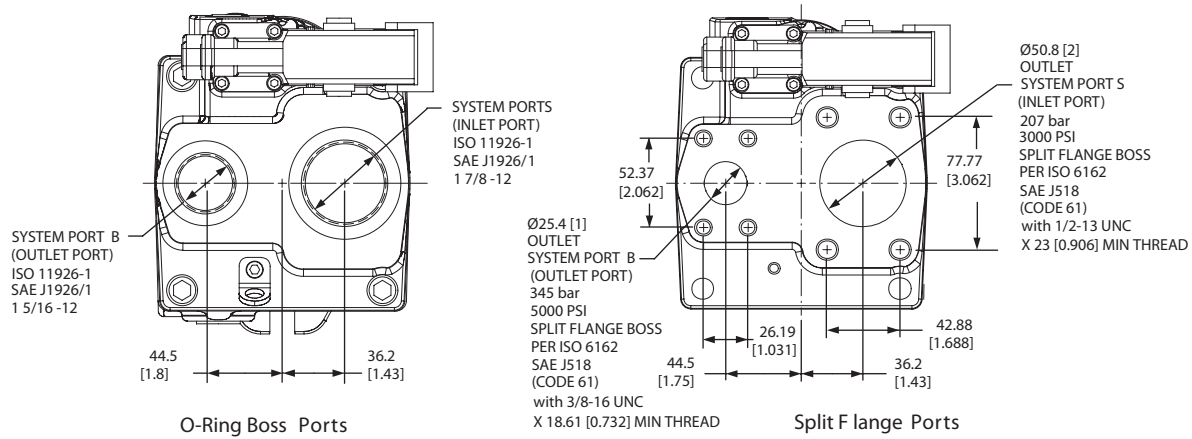
Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
K4	Ø 31.75 mm [1.25 in] straight key	655 [5797]	
TO	Ø 31.75 mm [1.25 in] 1:8 taper	734 [6495]	

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

Frame J

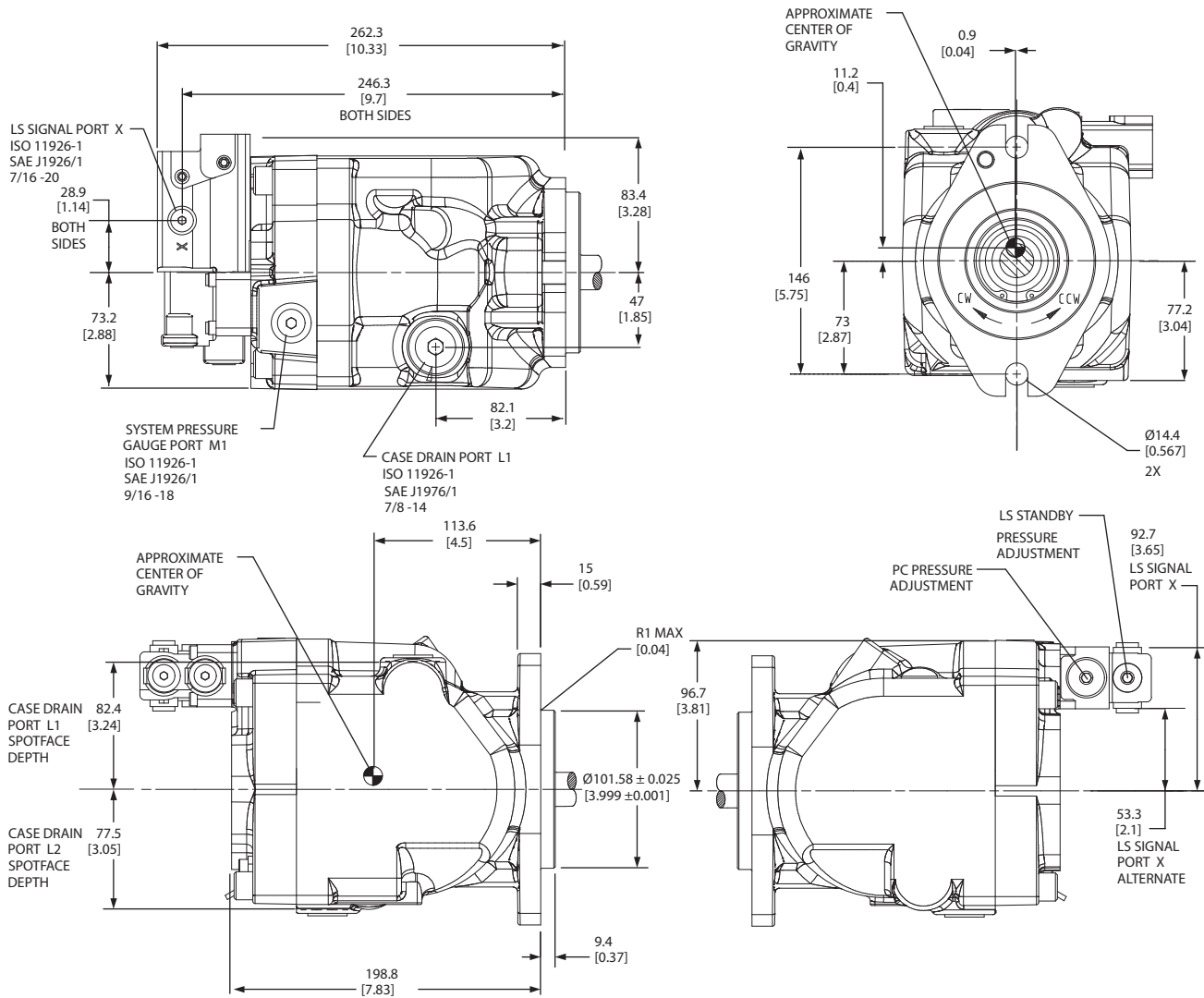
Installation drawings

Axial Ported Endcap



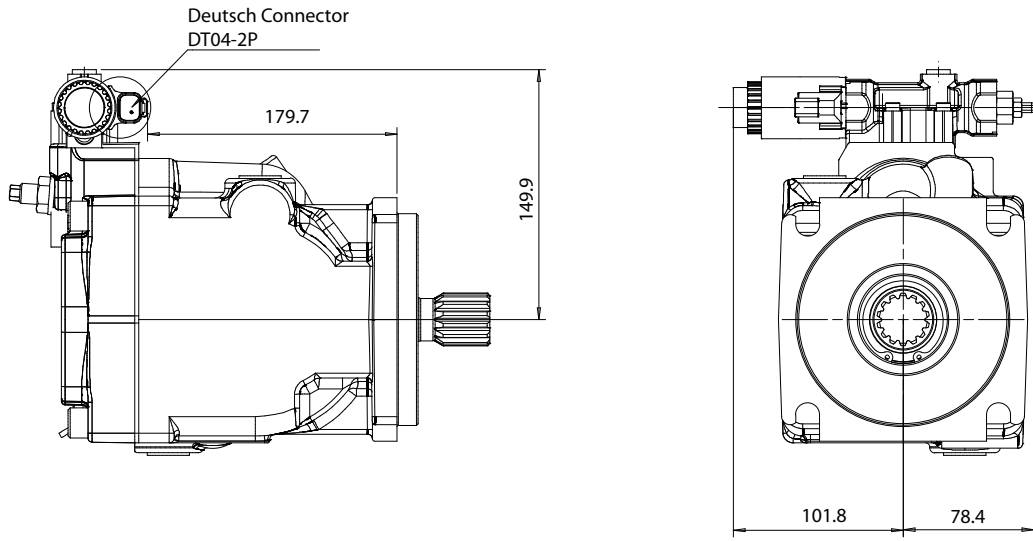
Frame J

Axial Ported Endcap Installation Dimensions



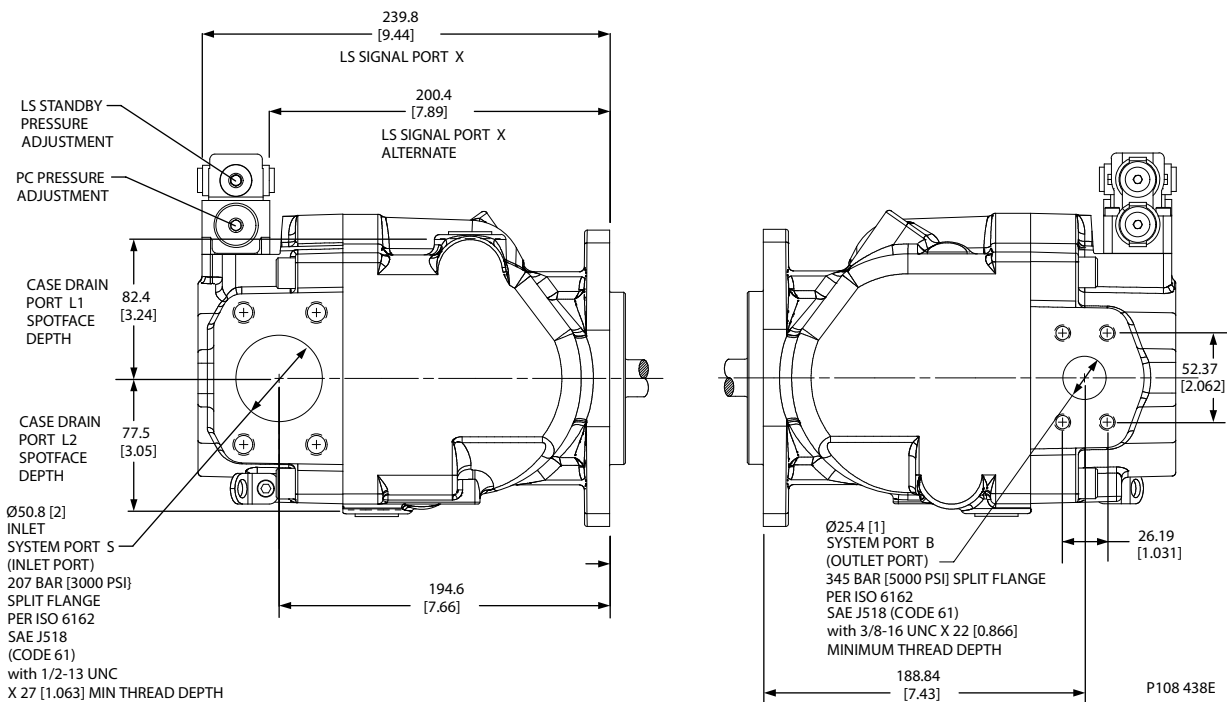
Frame J

Right Fan Drive Control



P109023

Radial Ported Endcap Split Flange Ports



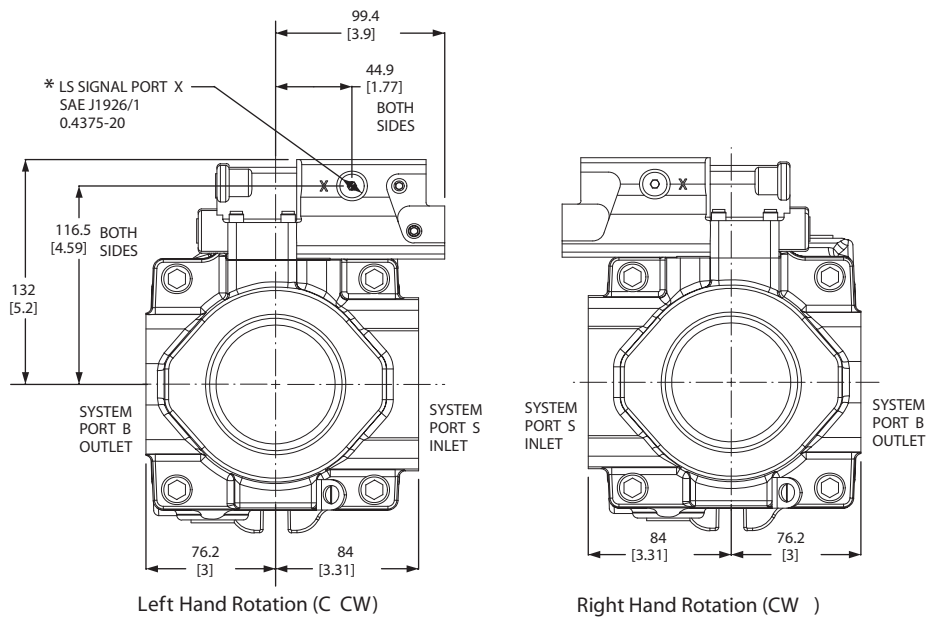
P108 438E

Frame J

Radial Ported Endcap Rear View

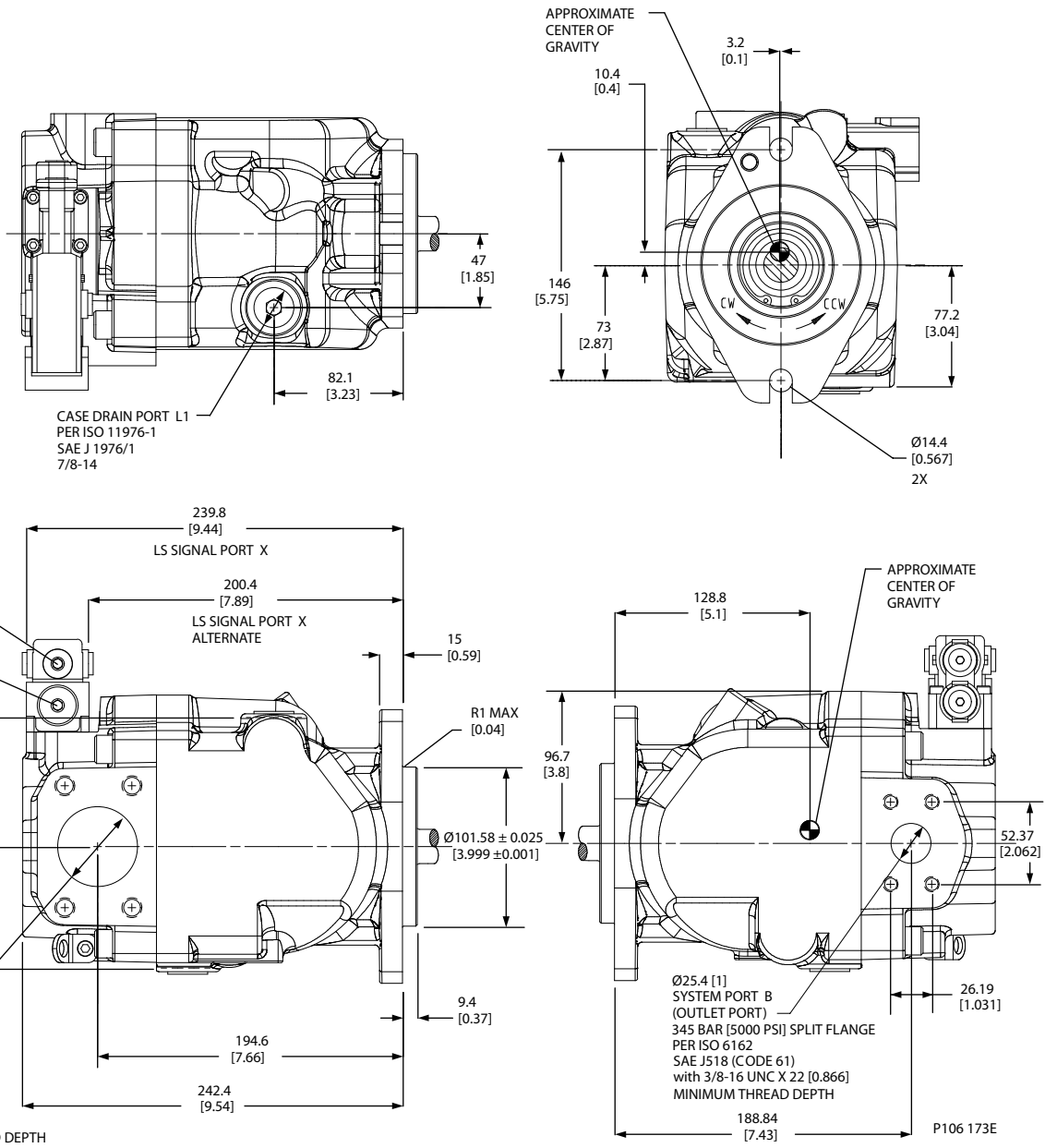
Radial ported endcap rear view

* Interference with internal components will occur
 if fitting depth in port X is greater than 11.8 mm [0.465 in]



Frame J

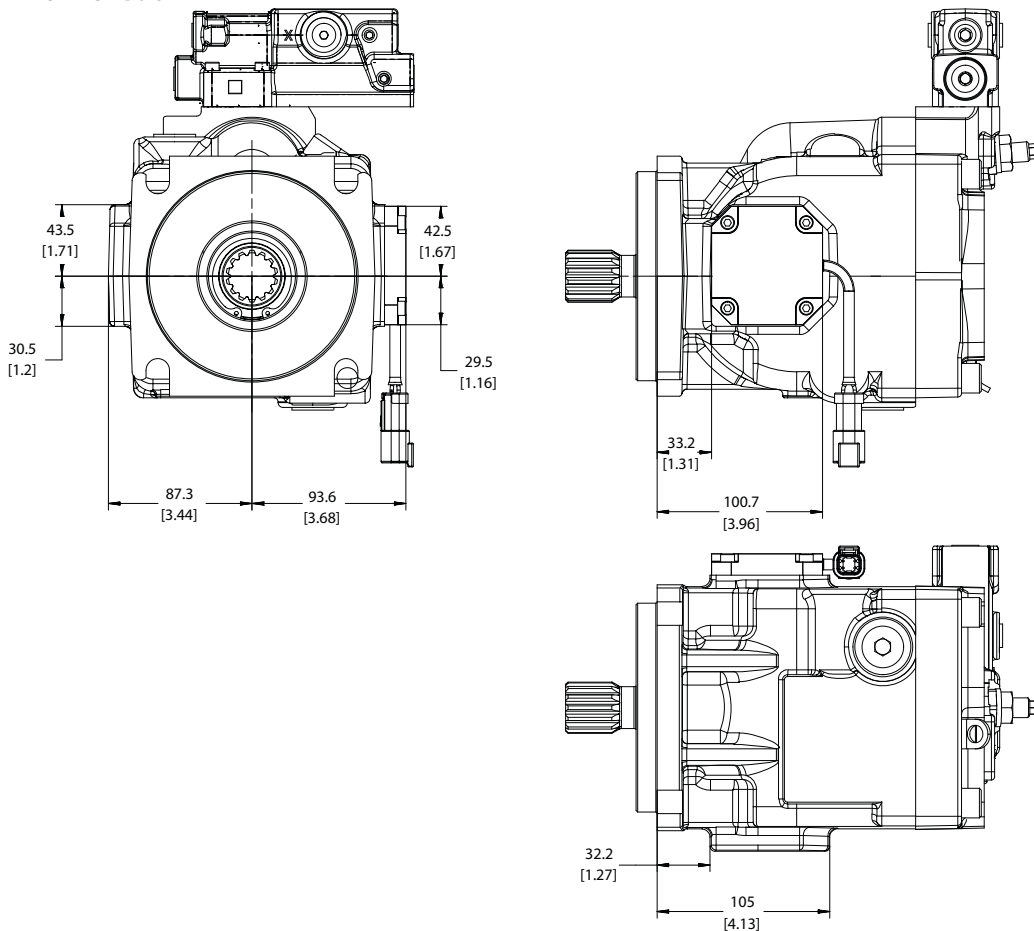
Radial Ported Endcap Installation Dimensions



Frame J

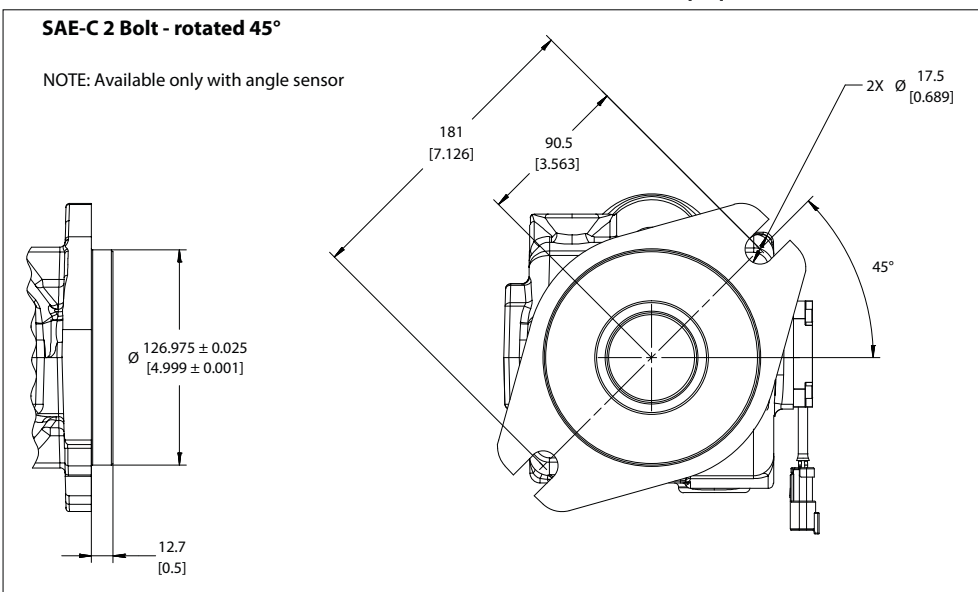
Right Angle Sensor Position Installation Dimensions

SAE-C 4 Bolt



SAE-C 2 Bolt - rotated 45°

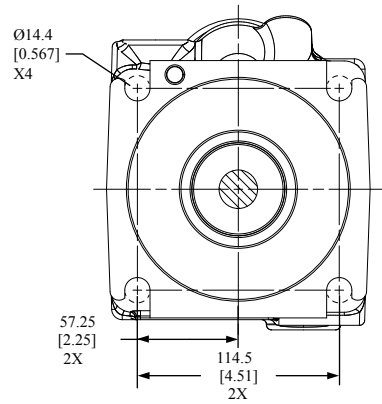
NOTE: Available only with angle sensor



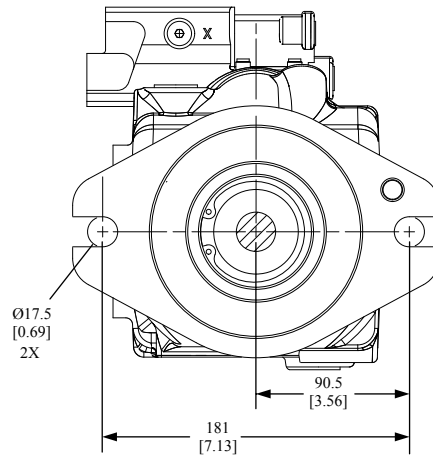
P108780

Frame J

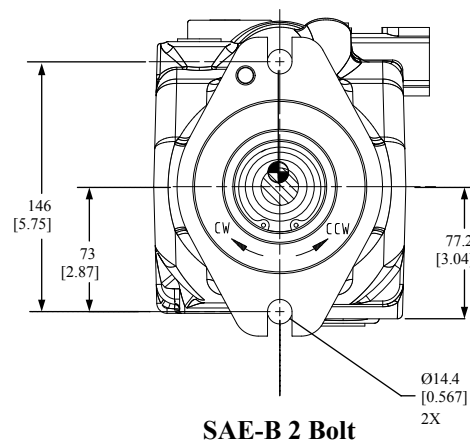
Front Mounting Flange



SAE-C 4 Bolt



SAE-C 2 Bolt



SAE-B 2 Bolt

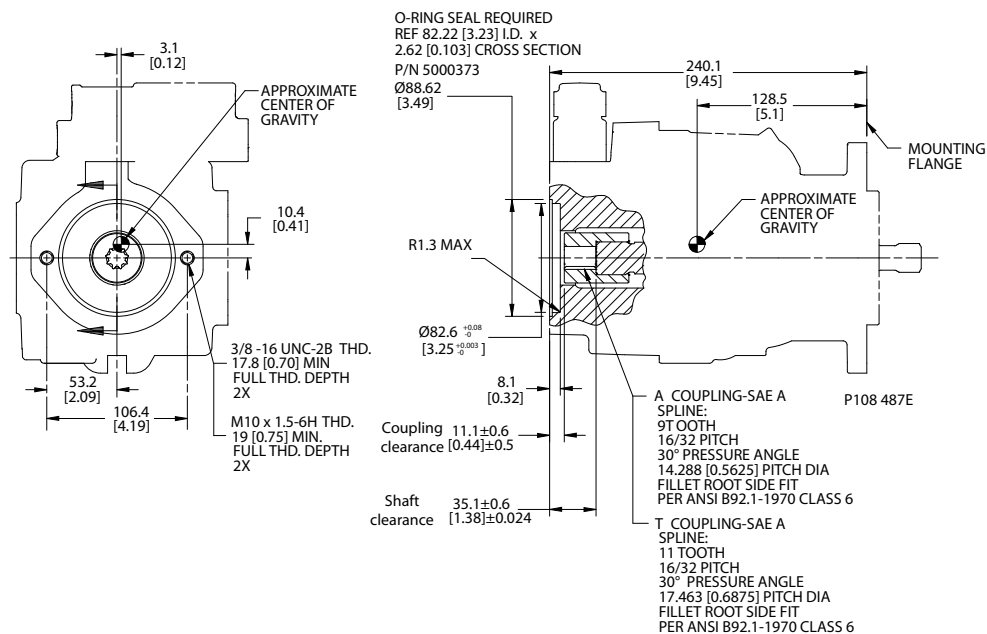
P108 440E

Frame J

Auxiliary mounting pads

SAE-A auxiliary mounting pad (integrated)

Dimensions



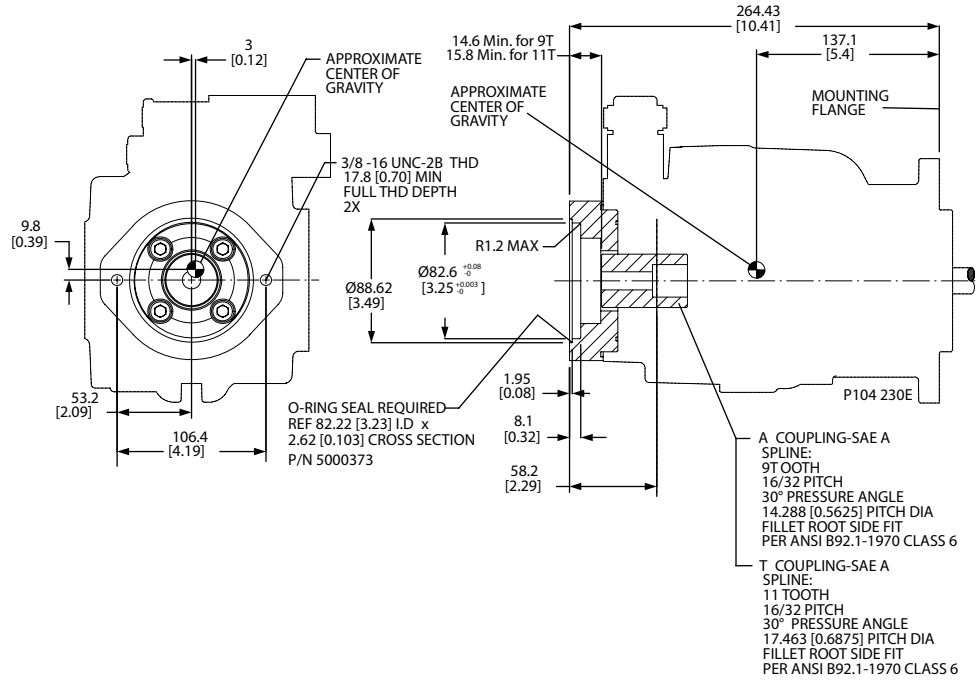
Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	13.5 mm [0.53 in]	15 mm [0.59 in]
Maximum torque	107 N·m [950 lbf·in]	147 N·m [1300 lbf·in]

Frame J

SAE-A auxiliary mounting pad (non-integral)

Dimensions



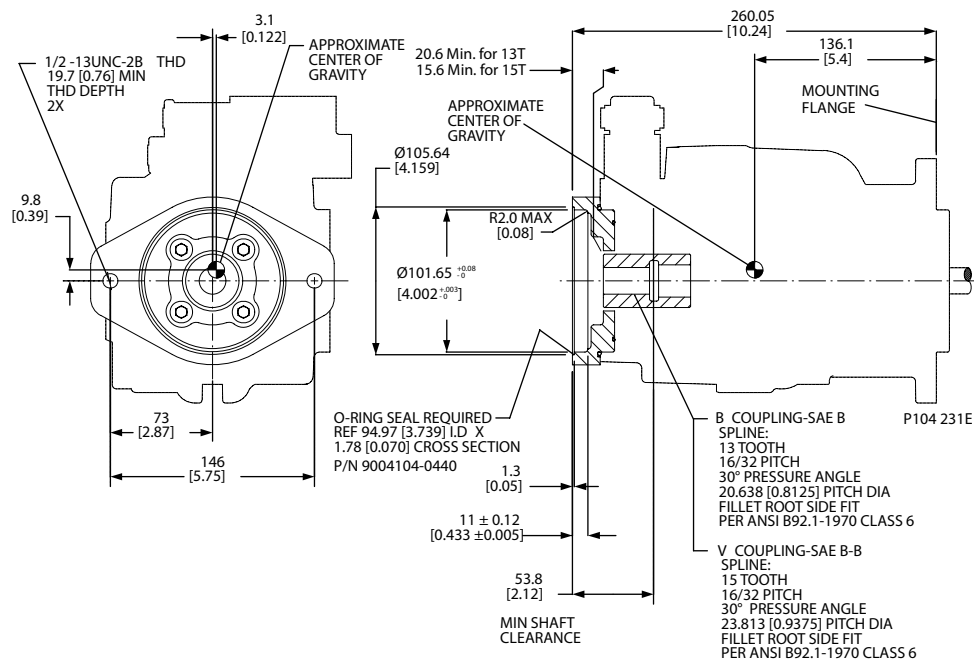
Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	13.5 mm [0.53 in]	15 mm [0.59 in]
Maximum torque	107 N•m [950 lbf•in]	147 N•m [1300 lbf•in]

Frame J

SAE-B auxiliary mounting pad

Dimensions

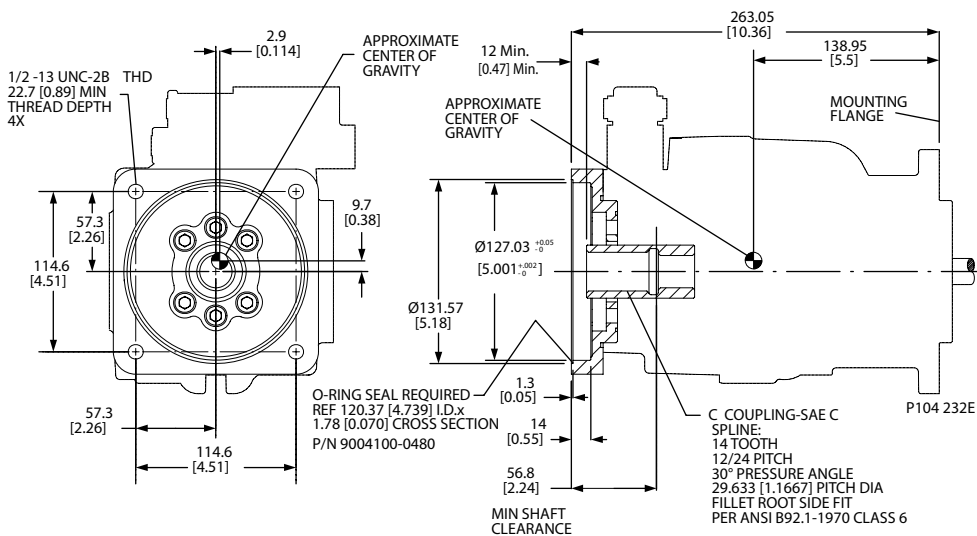


Specifications

Coupling	13-tooth	15-tooth
Spline minimum engagement	14.2 mm [0.56 in]	18.9 mm [0.74 in]
Maximum torque	249 N·m [2200 lbf·in]	339 N·m [3000 lbf·in]

SAE-C auxiliary mounting pad

Dimensions

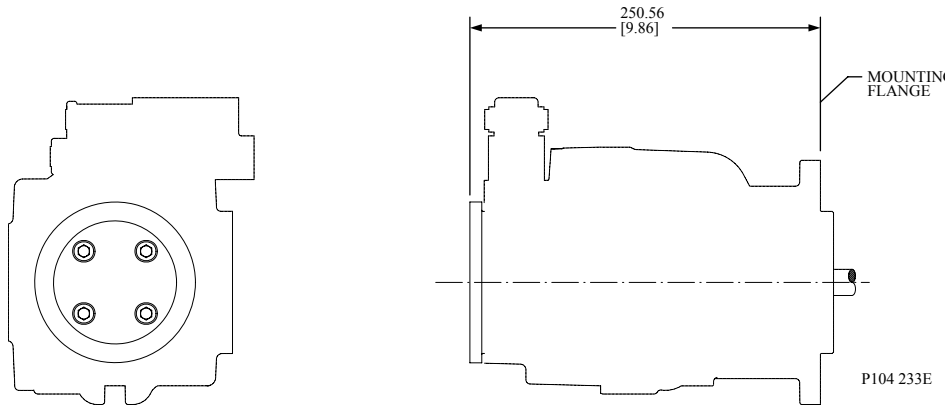


Frame J

Specifications

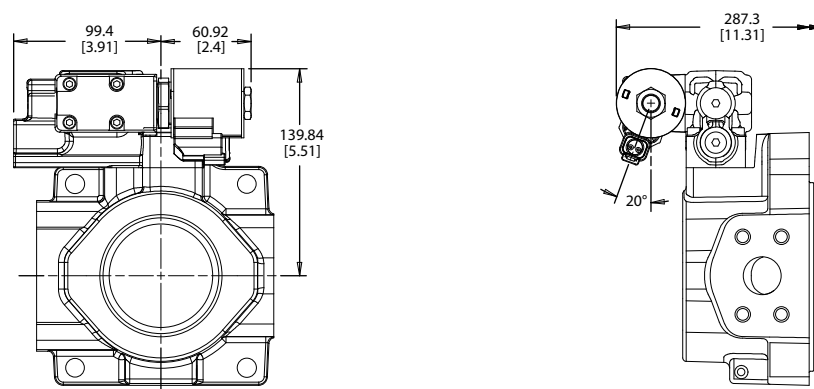
Coupling	14-tooth
Spline minimum engagement	18.3 mm [0.72 in]
Maximum torque	339 N·m [3000 lbf·in]

Running cover



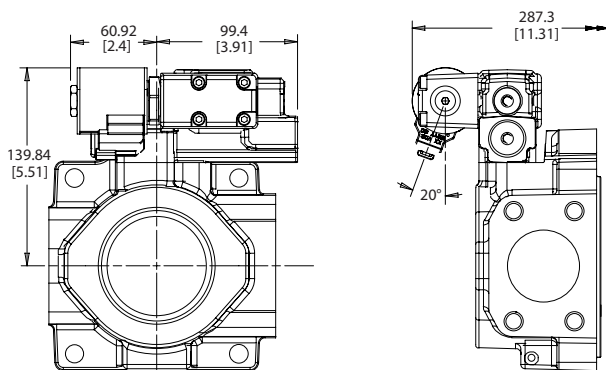
Radial Endcap Clockwise

Radial endcap counterclockwise



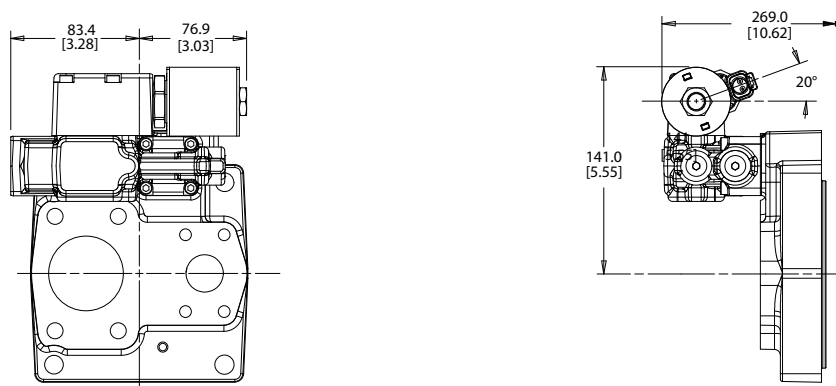
Frame J

Radial Endcap Counterclockwise



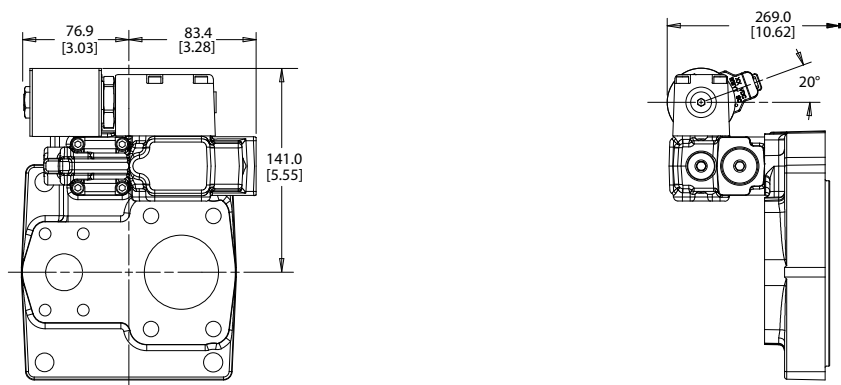
Axial Endcap Clockwise

Axial endcap clockwise



Axial Endcap Counterclockwise

Axial endcap counterclockwise



Frame J

Displacement limiter

J Frame open circuit pumps are available with an optional adjustable displacement limiter. This adjustable stop limits the pump's maximum displacement.

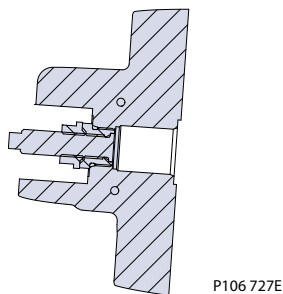
Setting range

J45B	8.4 to 45 cm ³ [0.51 to 2.75 in ³]
J51B	13.7 to 51 cm ³ [0.84 to 3.11 in ³]
J60B	16.8 to 60 cm ³ [1.03 to 3.66 in ³]
J65B	25.4 to 65 cm ³ [1.55 to 3.97 in ³]
J75B	28.4 to 75 cm ³ [1.73 to 4.58 in ³]

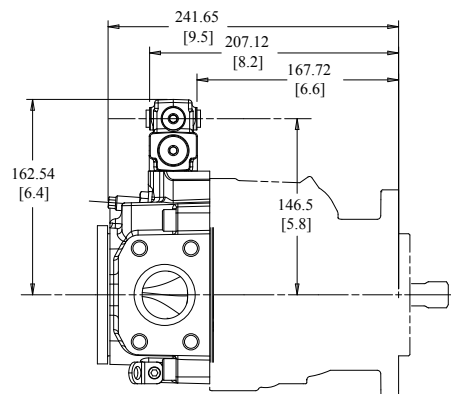
Displacement per turn

J45B	6.2 cm ³ /rev [0.38 in ³ /rev]
J51B	6.2 cm ³ /rev [0.38 in ³ /rev]
J60B	6.2 cm ³ /rev [0.38 in ³ /rev]
J65B	7.2 cm ³ /rev [0.44 in ³ /rev]
J75B	7.2 cm ³ /rev [0.44 in ³ /rev]

Displacement limiter cross-section



Displacement limiters are only available for endcap options V and W.



P106 728E



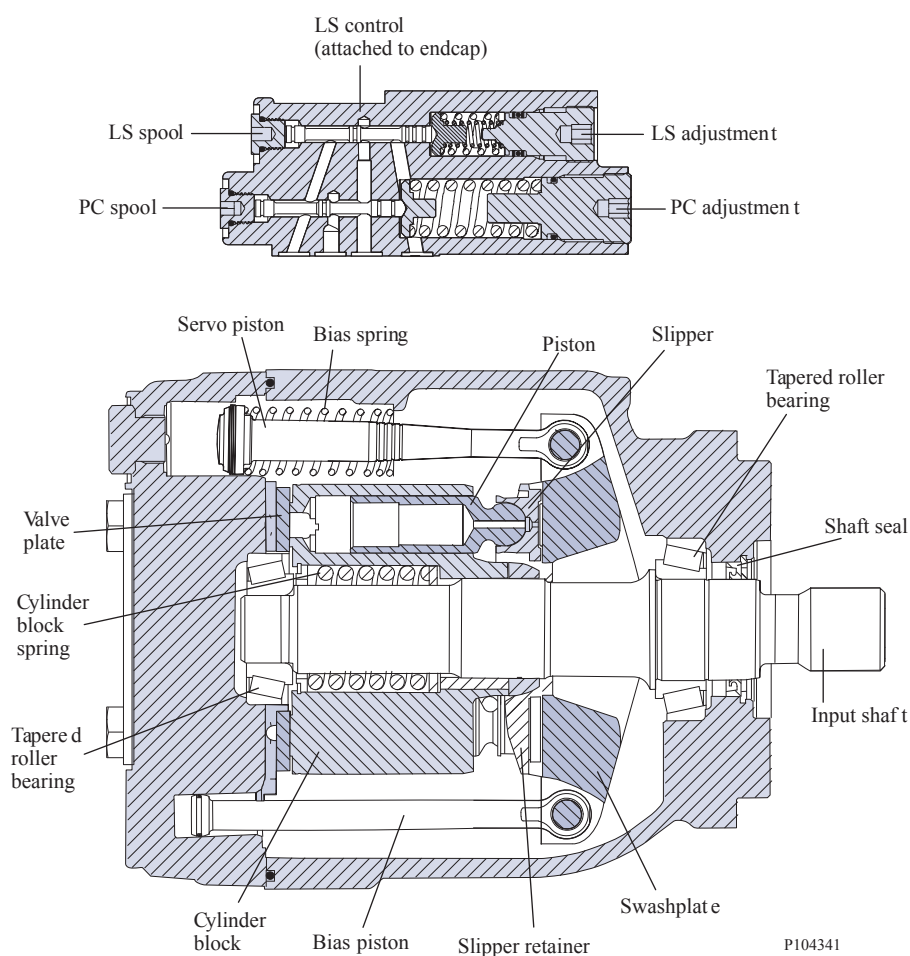
Frame F

Design

Series 45 Frame F pumps have a single servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. A bias spring and internal forces increase swashplate angle. The servo piston decreases swashplate angle. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swashplate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a viton lip-seal protects against shaft leaks.

An adjustable one spool (PC only, not shown) or two spool (LS and PC) control senses system pressure and load pressure (LS controls). The control ports system pressure to the servo piston to control pump output flow.

Frame F cross section



Frame F

Technical Specifications

Feature		Unit	F Frame	
			074B	090C
Maximum Displacement		cm ³ [in ³]	74 [4.52]	90 [5.49]
Working Input Speed	Minimum	min ⁻¹ (rpm)	500	500
	Continuous		2400	2200
	Maximum		2800	2600
Working Pressure	Continuous	bar [psi]	310 [4500]	260 [3770]
	Maximum		400 [5800]	350 [5075]
Flow at rated speed (theoretical)		l/min [US gal/min]	178 [46.9]	198 [52.3]
Input torque at maximum displacement (theoretical) at 49° C [120°F]		N•m/bar [lbf•in/1000 psi]	1.178 [719.3]	1.433 [874.8]
Mass moment of inertia of internal rotating components		kg•m ² [slug•ft ²]	0.0063 [0.00465]	0.0065 [0.00479]
Weight	Axial ports	kg [lb]	29.5 [65.0]	
	Radial ports		32.6 [71.9]	
External Shaft Loads	External moment (Me)	N•m [lbf•in]	300 [2655]	300 [2655]
	Thrust in (Tin), out (Tout)	N [lbf]	2900 [652]	2900 [652]
4-Bolt SAE-C mounting flange load moments	Vibratory (continuous)	N•m [lbf•in]	3730 [33 100]	
	Shock (maximum)		13220 [117 100]	
2-Bolt SAE-B mounting flange load moments	Vibratory (continuous)	N•m [lbf•in]	1700 [15000]	
	Shock (maximum)		5900 [52000]	

Order code

Code description

Code	Description
R	Product Frame, Variable Open Circuit Pump
S	Rotation
P	Displacement
C	Control Type
D	Pressure Compensator Setting
E	Load Sense Setting
F	Not Used
G	Choke Orifice
H	Gain Orifice
J	Input Shaft/Auxiliary Mount/Endcap
K	Shaft Seal/Front Mounting Flange/Housing Ports
L	Displacement Limiter
M	Special Hardware
N	Special Features

Frame F

R Product

		F Frame	
		074B	090C
FR	F Frame, variable displacement open circuit pump	•	•

S Rotation

L	Left Hand (counterclockwise)	•	•
R	Right Hand (clockwise)	•	•

R Displacement

074B	074 cm ³ /rev [4.52 in ³ /rev]	•	
090C	090 cm ³ /rev [5.49 in ³ /rev]		•

C Control type

		074B	090C
PC	Pressure Compensator	•	•
BC*	Pressure Compensator [>280 bar]	•	
RP	Remote Pressure Compensator	•	•
BP*	Remote Pressure Compensator [>280 bar]	•	
LS	Load Sensing/Pressure Comp.	•	•
BS*	Load Sensing/Pressure Comp. [>280 bar]	•	
LB	Load Sensing/Pressure Comp. with internal bleed orifice	•	•
BB*	Load Sensing/Pressure Comp. with internal bleed orifice [>280 bar]	•	
AN	Electric On/Off w/Pressure Comp. (NO, 12VDC) Left	•	•
CN	Electric On/Off w/Pressure Comp. (NO, 24VDC) Left	•	•
AR	Electric On/Off w/Pressure Comp. (NC, 12VDC) Left	•	•
CR	Electric On/Off w/Pressure Comp. (NC, 24VDC) Left	•	•
AF	Electric On/Off w/Pressure Comp. (NO, 12VDC) Right	•	•
AT	Electric On/Off w/Pressure Comp. (NO, 24VDC) Right	•	•
AG	Electric On/Off w/Pressure Comp. (NC, 12VDC) Right	•	•
AY	Electric On/Off w/Pressure Comp. (NC, 24VDC) Right	•	•
BN*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Left	•	
DN*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Left	•	
BR*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Left	•	
DR*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Left	•	
BF*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Right	•	
DF*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Right	•	
BE*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Right	•	
BG*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Right	•	
AX	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Left	•	•
CL	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Left		•
AH	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Left	•	•
AL	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Left	•	•

Frame F

C Control type (continued)

		074B	090C
AW	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Right	•	•
CK	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Right	•	•
AV	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Right	•	•
AK	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Right	•	•
BX*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Left	•	
DL*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Left	•	
BH*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Left	•	
BL*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Left	•	
BW*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Right	•	
DK*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Right	•	
BM*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Right	•	
BK*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Right	•	
FA*	Electric On/Off Dump valve w/Pressure Comp. + Load Sense (NC, 12VDC) Right	•	•
FB*	Electric On/Off Dump valve w/Pressure Comp. + Load Sense (NC, 12VDC) Left	•	•
FK	Load Sensing/Pressure Comp. (NC, 24VDC) Right	•	•
FL	Load Sensing/Pressure Comp. (NC, 24VDC) Left	•	•
FM		•	•
TA	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Left	•	•
TB	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Left	•	•
TC	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Left	•	•
TD	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Left	•	•
TE	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Right	•	•
TF	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Right	•	•
TG	Electric Torque Limiting w/Pressure Comp. (NC,12VDC) Right	•	•
TH	Electric Torque Limiting w/Pressure Comp. (NC,24VDC) Right	•	•
SA	Pressure Comp (12 Vdc), 100-210 Bar - Left	•	•
SB	Pressure Comp (24 Vdc), 100-210 Bar - Left	•	•
SC	Pressure Comp (12 Vdc), 220-310 Bar - Left	•	•
SD	Pressure Comp (24 Vdc), 220-310 Bar - Left	•	•
SE	Pressure Comp (12 Vdc), 100-210 Bar - Right	•	•
SF	Pressure Comp (24 Vdc), 100-210 Bar - Right	•	•
SG	Pressure Comp (12 Vdc), 220-310 Bar - Right	•	•
SH	Pressure Comp (24 Vdc), 220-310 Bar - Right	•	•

Left - E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial

Right - E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial

* Not available on 90cc pumps

DPC setting (2 digit code, 10 bar increments)

		F Frame	
		074B	090C
Example	25 = 250 bar (3625 psi)		
10-26	100 to 260 bar [1450 to 3771 psi]	•	•

Frame F

D PC setting (2 digit code, 10 bar increments) (continued)

		F Frame	
		074B	090C
27-28	270 to 280 bar [3916 to 4061 psi]	•	
29-31	290-310 bar [4206 to 4496 psi]	•	

E Load sensing setting (2 digit code, 1 bar increments)

Example	20 = 20 bar (290 psi)		
10-40	10 to 34 bar [145 to 508 psi]	•	•
NN	Not applicable (pressure compensated only controls)	•	•

F Not used

NN	Not applicable	•	•
----	----------------	---	---

G Servo Control Orifice

N	None (standard)	•	•
E	0.8 mm diameter	•	•
F	1.0 mm diameter	•	•

H Gain Orifice

3	1.0 mm diameter (standard orifice)	•	•
C	0.8 mm diameter LS signal line orifice for ETL use (with standard orifice)	•	•

Additional LS signal line orifice size options are available for necessary system tuning requirements. Contact your Danfoss representative for further information.

J Input Shaft

S1	14 tooth 12/24 pitch
S2	17 tooth, 12/24 pitch
K4	1.25 inch straight keyed

Auxiliary Mount/Endcap Style

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	N4
None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	N2
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	R2
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	A2
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	T2
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	B2

Frame F

Auxiliary Mount/Endcap Style (continued)

SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	V2
SAE-C, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2 inch port 0.5 inch threads) Outlet - Code 61 Split Flange Port 4 Bolt (1 inch port 0.375 inch threads)	C2

J Input Shaft/Auxiliary Mount/Endcap

Available Combinations

	F Frame	
	074B	090C
K4A2	•	•
K4B2	•	•
K4C2	•	•
K4N2	•	•
K4N4	•	•
K4R2	•	•
K4T2	•	•
K4V2	•	•
S1A2	•	•
S1B2	•	•
S1C2	•	•
S1N2	•	•
S1NB	•	•
S1N4	•	•
S1R2	•	•
S1T2	•	•
S1V2	•	•

	F Frame	
	074B	090C
S2A2	•	•
S2B2	•	•
S2C2	•	•
S2N2	•	•
S2N4	•	•
S2R2	•	•
S2T2	•	•
S2V2	•	•

K Shaft seal

		F Frame	
		074B	090C
A	Single (Viton)	•	•

Frame F

K Mounting flange and housing port style

1	SAE-C Flange 4-bolt/SAE O-ring boss ports (available with or without angle sensor)	•	•
3	SAE-B Flange 2-bolt/SAE O-ring boss ports (not available with angle sensor)	•	•
G	SAE-C Flange 4-bolt/Metric O-ring boss ports (not available with angle sensor)	•	•

K Angle Sensor Housing

N	Without angle sensor	•	•
R	Angle Sensor Housing, Right Hand Side	•	•

* When viewing pump from input shaft, control oriented on top

L Displacement limiter

NNN	None (plugged)	•	•
AAA	Adjustable, factory set at max angle	•	•

M Special hardware

NNN	None	•	•
ANS	Angle sensor hardware	•	•

N Special features

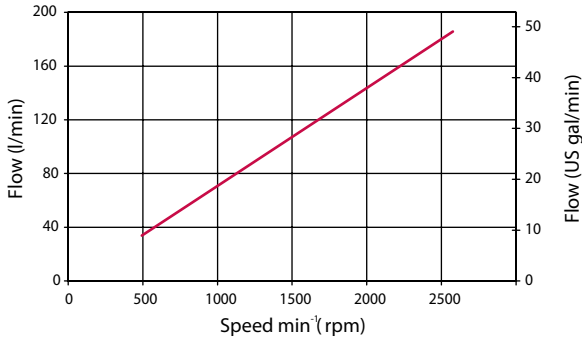
NNN	None	•	•
-----	------	---	---

Frame F

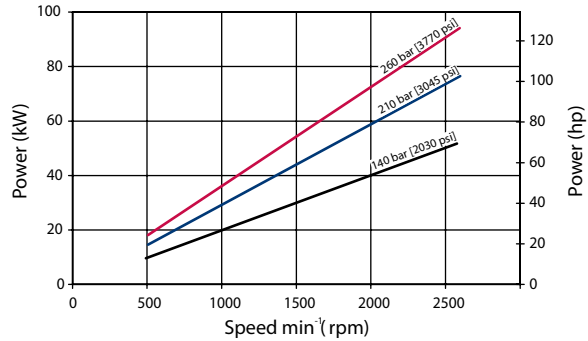
Performance F74B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

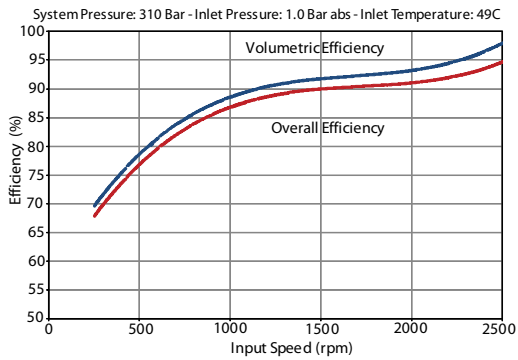
Flow vs. speed



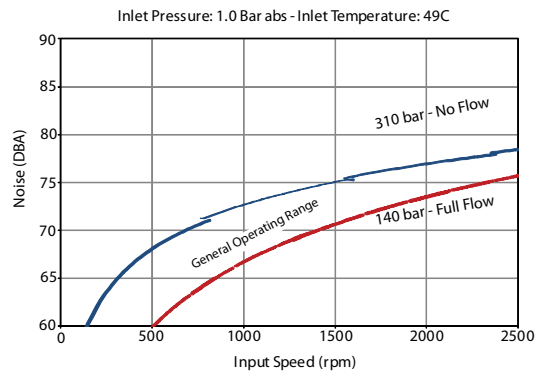
Input power vs. speed



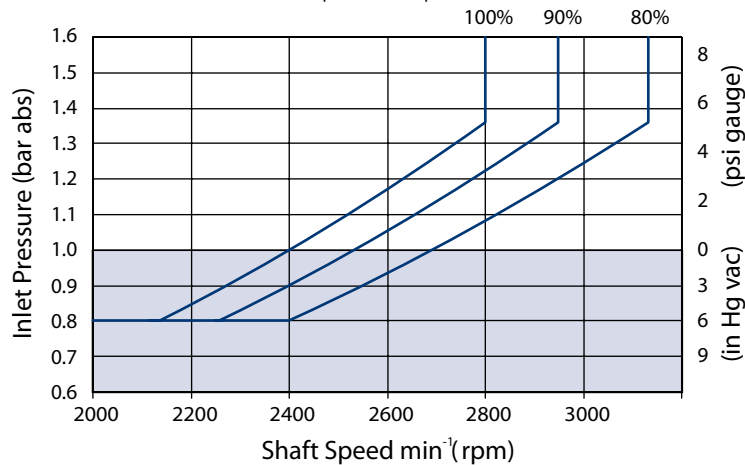
Efficiency



Noise



Inlet pressure vs. speed

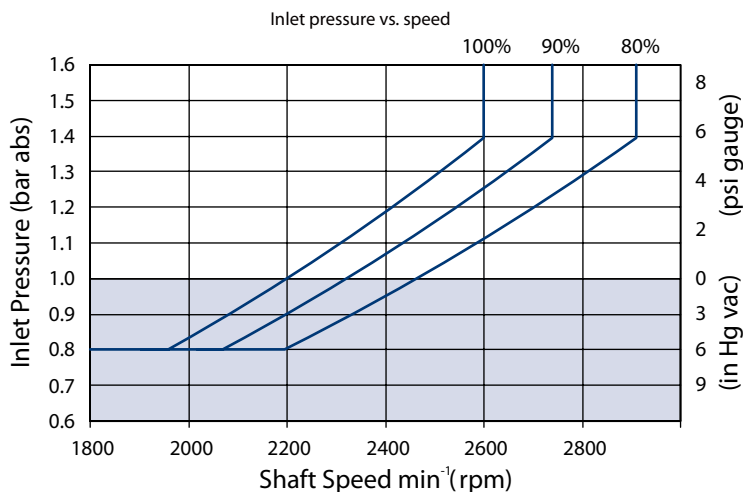
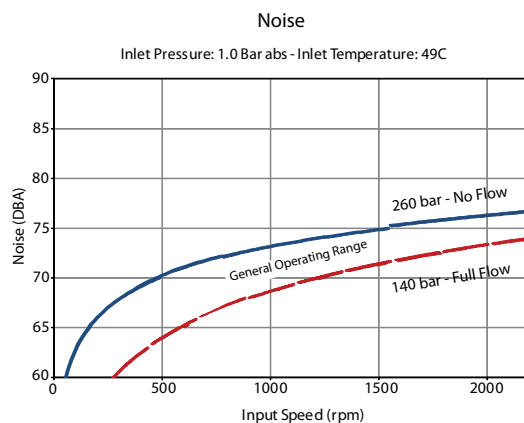
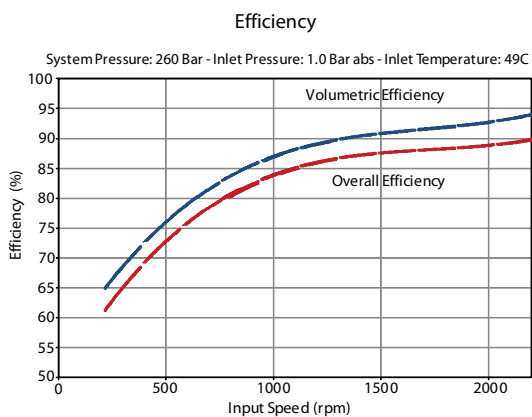
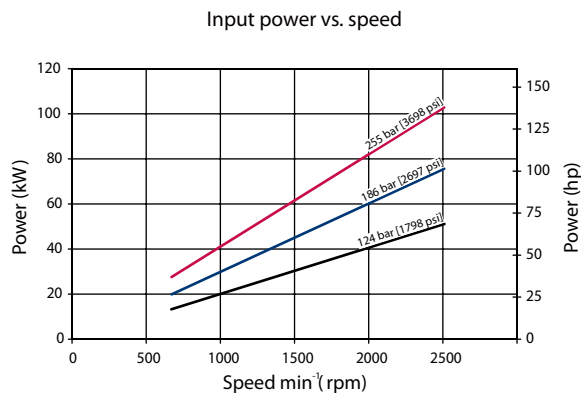
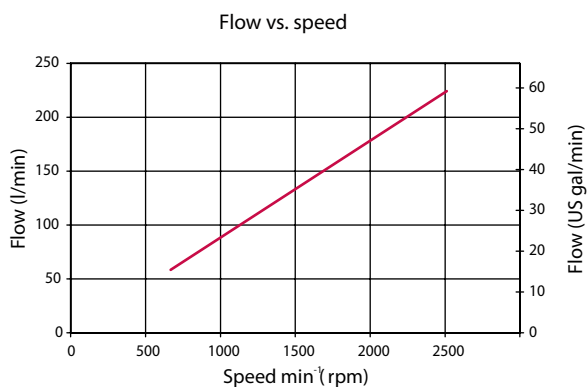


The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame F

Performance F90C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].



The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame F

Hydraulic Controls

Pressure Compensated Controls

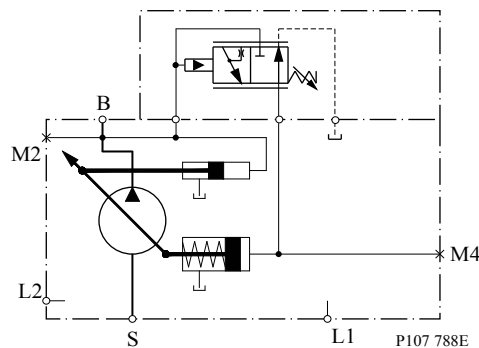
Response/recovery times

(msec)	Response	Recovery
F74B	35	120
F90C	35	135

PC setting range

Model	PC	BC
F74B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
F90C	100-260 bar [1450-3770 psi]	N/A

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

M4 = Servo pressure gauge port

Remote Pressure Compensated Controls

Response/recovery times

(msec)	Response	Recovery
F74B	35	120
F90C	35	135

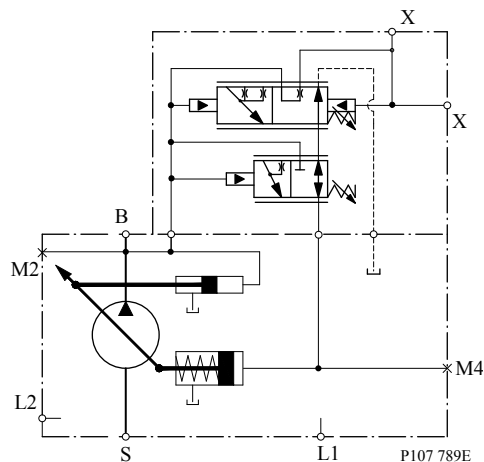
PC setting range

Model	RP	BP
F74B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
F90C	100-260 bar [1450-3770 psi]	N/A

Frame F

An LS Setting of 20 is required for this control

Remote PC schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

M4 = Servo pressure gauge port

X = Remote PC port

Load Sensing/Pressure Compensated Controls

*Response/recovery times**

(msec)	Response	Recovery
F74B	35	135
F90C	45	135

PC setting range

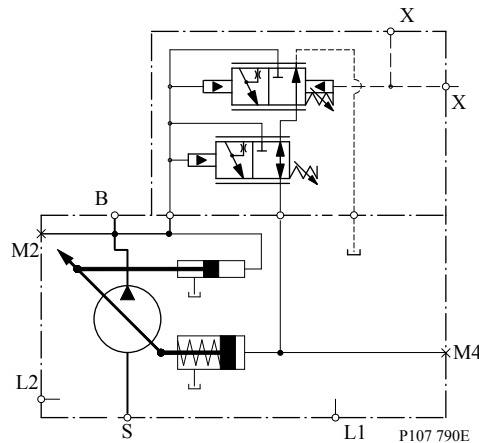
Model	bar	psi
F74B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
F90C	100-260 bar [1450-3770 psi]	N/A

LS setting range

Model	bar	psi
All	10-30	145-435

Frame F

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- M4 = Servo pressure gauge port
- X = LS signal port

Load Sensing Control with Bleed Orifice/Pressure Compensated

*Response/recovery times**

(msec)	Response	Recovery
E100B	45	200
E130B	50	200
E147C	60	200

PC setting range

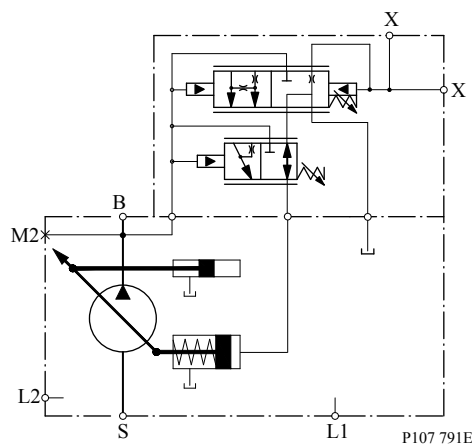
Model	LB	BB
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A

LS setting range

Model	bar	psi
All	10-34	145-435

Frame F

Schematic

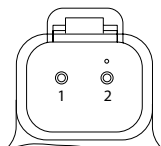


- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- M4 = Servo pressure gauge port
- X = LS signal port

Electric Controls

Connectors

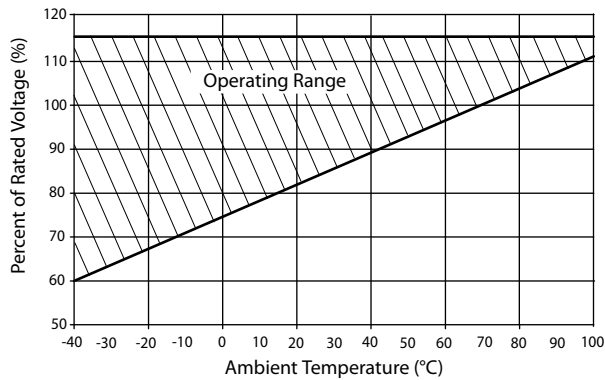
Description	Quantity	Ordering Number
Mating Connector	1	Deutsch® DT06-2S
Wedge Lock	1	Deutsch® W25
Socket Contact (16 and 18 AWG)	2	Deutsch® 0462-201-16141
Danfoss mating connector kit	1	K29657



P003 480

Frame F

Continuous Duty Operating Range



Solenoid Data - Normally Closed

Voltage	12V	24V
Threshold Control [mA] (310/260 bar PC setting, oil temp X)	200/400	100/200
End Current [mA] (20 bar LS setting, oil temp X)	1200	600

Solenoid Data - Normally Open

Voltage	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/310 bar PC setting, oil temp X)	1000/1100	500/550

Hysteresis

Frame	Hysteresis
F74B	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)
F90C	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)

Fan Drive Control Solenoid Data - Normally Closed

Voltage	12V	24V
Maximum Control Current [mA]	1800	920

Normally Closed Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

(msec)	Response	Recovery
F74B	35	120
F90C	35	135

* Without servo control orifice

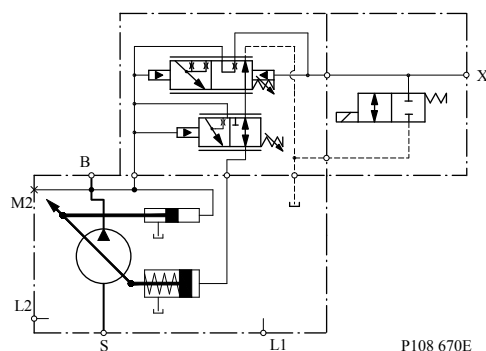
Frame F

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

PC setting range

Frame	AG, AR (12V)	BE, BR (12V)	AY, CR (24V)	BG, DR (24V)
F74B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
F90C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

Normally Open Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

(msec)	Response	Recovery
F74B	35	120
F90C	35	135

* Without servo control orifice

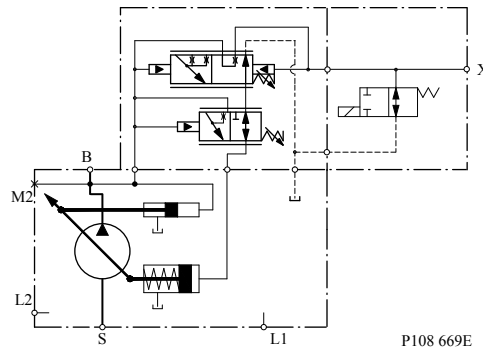
LS setting range

Model	bar	psi
All	12 - 40	[174 - 580]

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Frame F

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

PC setting range

Frame	AF, AN (12V)	BF, BN (12V)	AT, CN (24V)	DF, DN (24V)
F74B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
F90C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

Normally Closed Electric Proportional with Pressure Compensation Controls

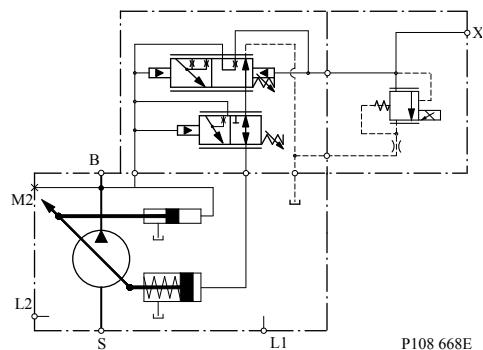
Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
F74B	35	365	35	280
F90C	35	410	35	315

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Schematic



Frame F

B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

X = Load Sense Port

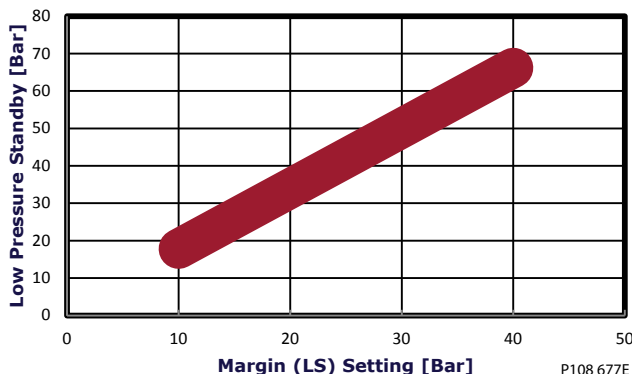
PC setting range

Frame	AH, AV (12V)	BH, BM (12V)	AK, AL (24V)	BK, BL (24V)
F74B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
F90C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

Frames E, F, J Electric Proportional Control Low Pressure Standby



Normally Open Electric Proportional with Pressure Compensation Controls

Response/Recovery times

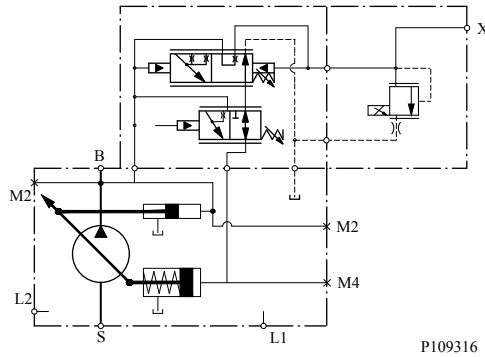
(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
F74B	35	365	35	280
F90C	35	410	35	315

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Frame F

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

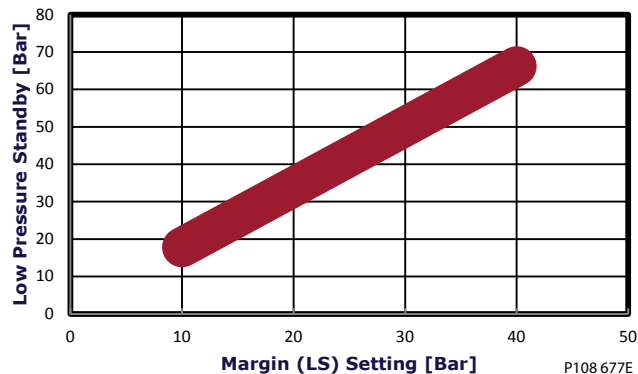
PC setting range

Frame	AW, AX (12V)	BW, BX (12V)	CK, CL (24V)	DK, DL (24V)
F74B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
F90C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

**Frames E, F, J Electric Proportional Control
 Low Pressure Standby**



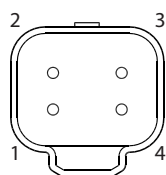
Frame F

Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls

Response/recovery times

(msec)	Response	Recovery
F74B	35	120
F90C	35	135

Pin location



P200151

Pinout

Pin	Description
1	Supply -
2	Output signal 2 - Secondary Signal
3	Output signal 1 - Primary Signal
4	Supply +

PC setting range

Frame	TA, TE (12V)	TC, TG (12V)	TB, TF (24V)	TD, TH (24V)
F74B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
F90C	100-260 bar [1450-3770] ps	Not Available	100-260 bar [1450-3770] ps	Not Available

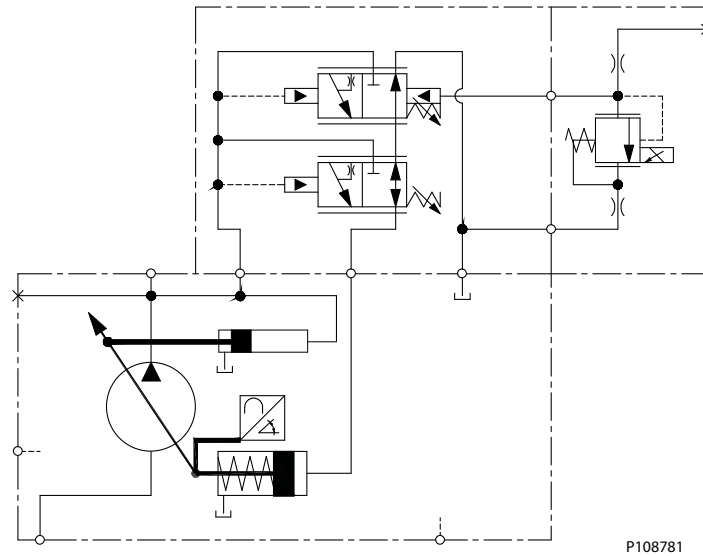
LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Frame F

F-frame pump with integrated ETL control



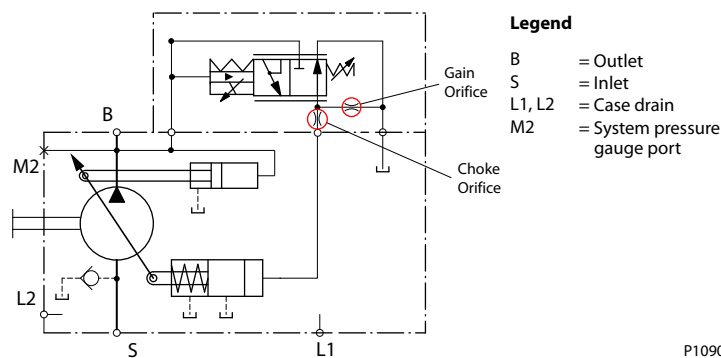
P108781

Normally Closed Fan Drive Control

PC setting range

Frame	SA, SE (12V)	SC, SG (12V)	SB, SF (24V)	SD, SH (24V)
F074B	100-210 bar [1450-3045] psi	220-310 bar [3190-4495] psi	100-210 bar [1450-3045] psi	220-310 bar [3190-4495] psi
F090C	100-210 bar [1450-3045] psi	220-260 bar [3190-3771] psii	100-210 bar [1450-3045] psi	220-260 bar [3190-3771] psii

Fan Drive Control Schematic



P109027

Frame F

Input shafts

Shaft data

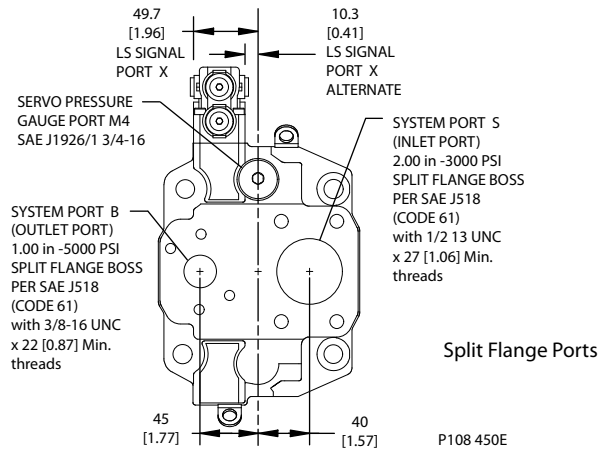
Code	Description	Maximum torque rating ¹ N•m [lbf•in]	Drawing
K4	Ø 31.75 mm [1.25 in] Straight keyed	734 [6495]	
S1	14 tooth spline 12/24 pitch (ANSI B92.1B 1996 - Class 6e)	800 [7080]	
S2	17 tooth spline 12/24 pitch (ANSI B92.1B 1996 - Class 6e)	1150 [10178]	

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

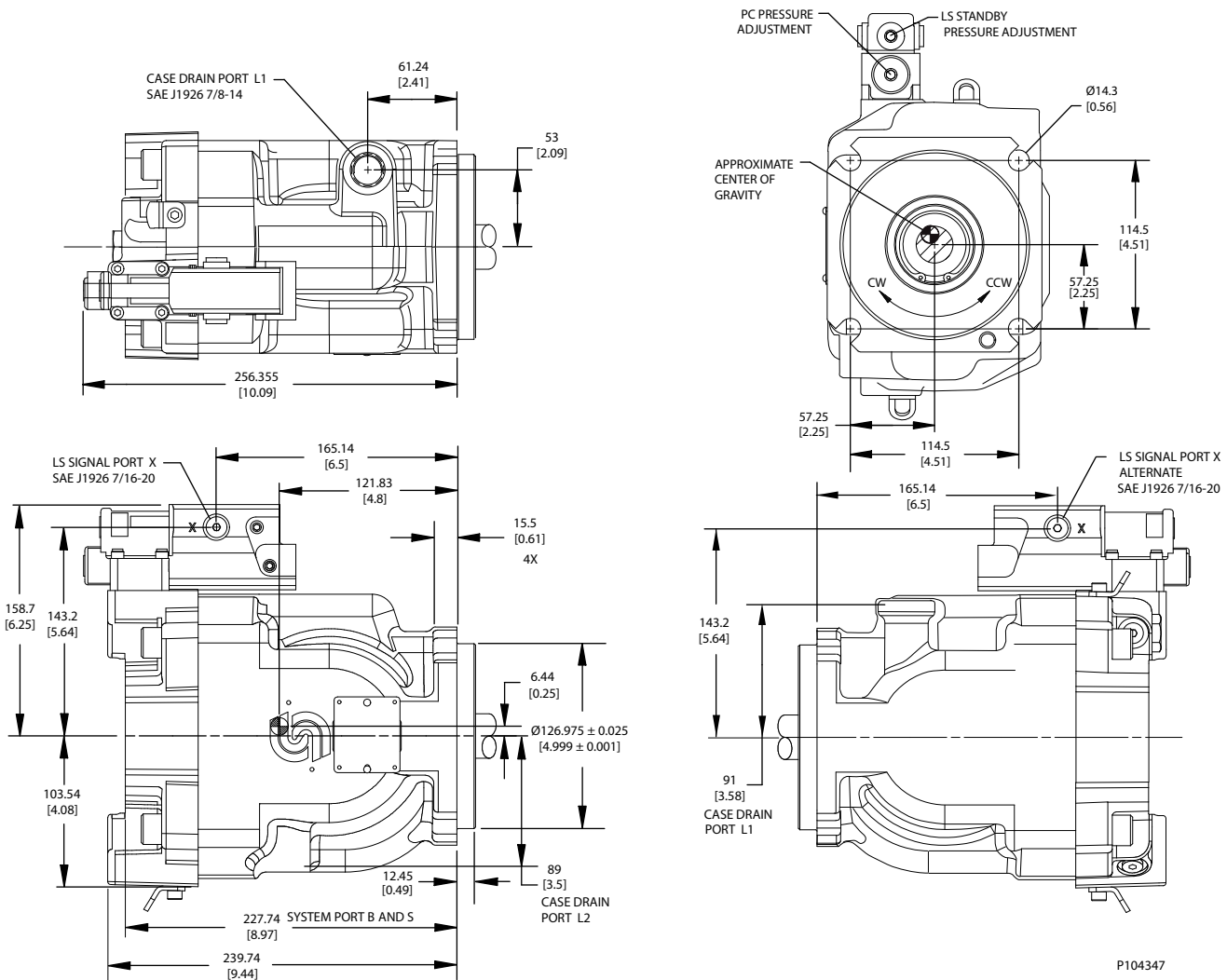
Frame F

Installation drawings

Axial Ported Endcap

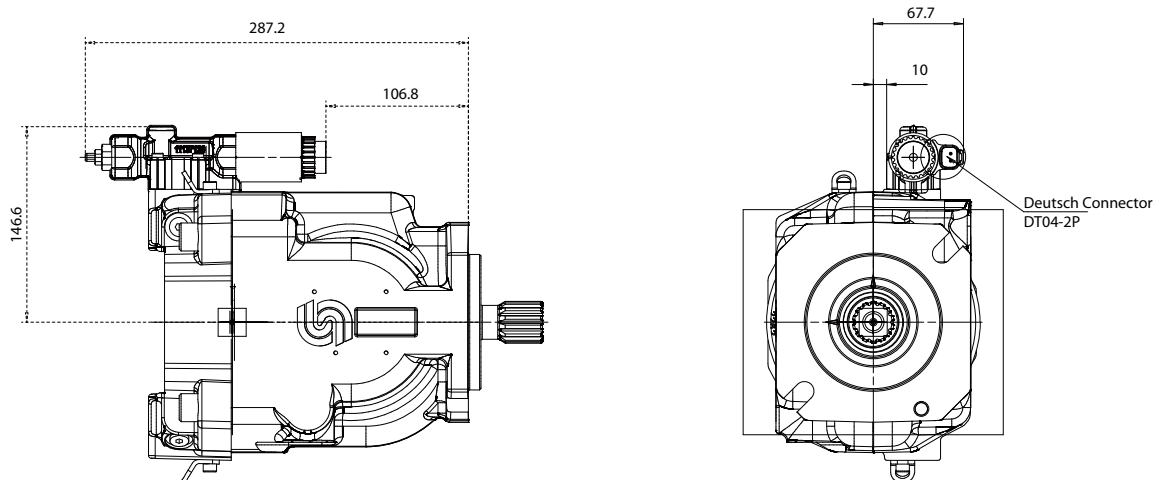


Axial Ported Endcap Installation Dimensions



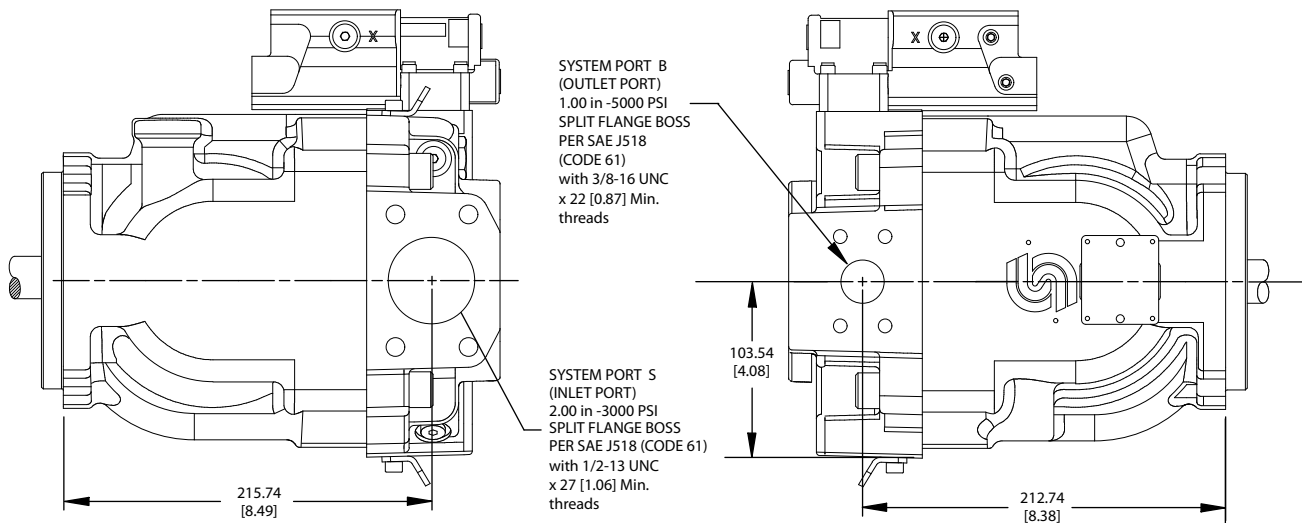
Frame F

Right Fan Drive Control



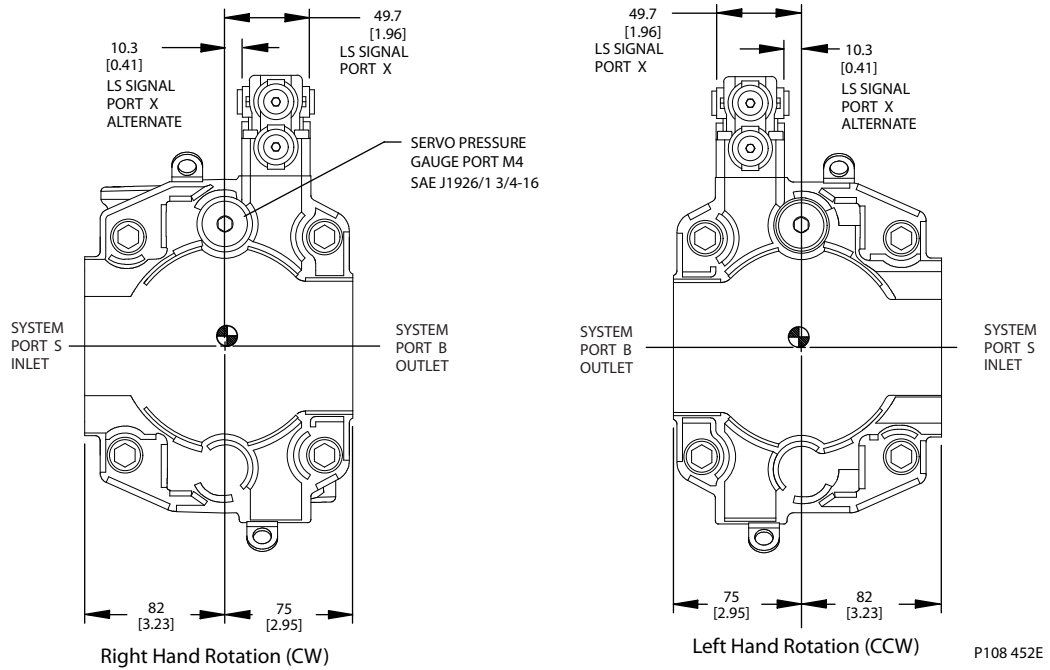
P109022

Radial Ported Endcap Split Flange Ports



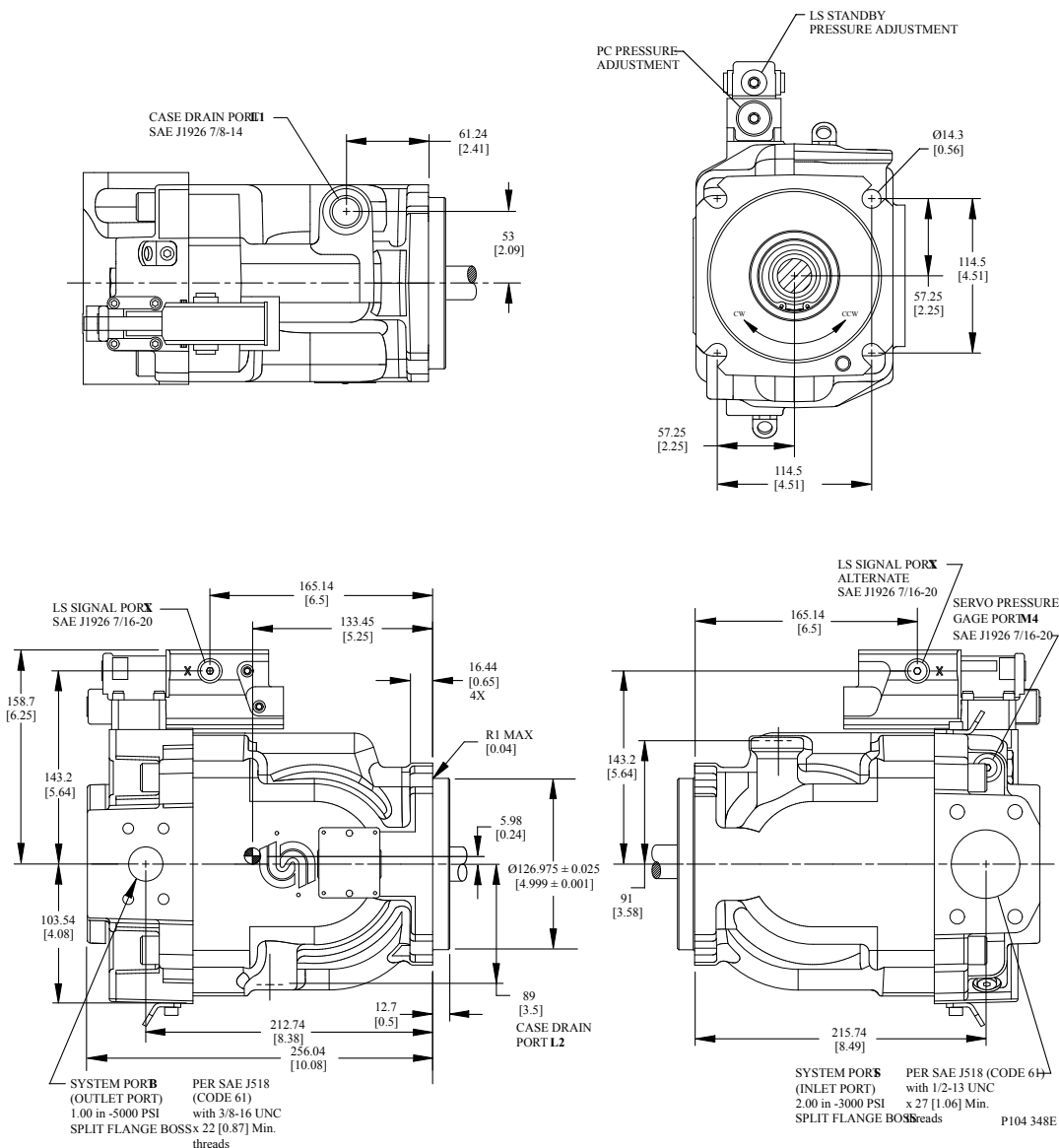
Frame F

Radial Ported Endcap Rear View



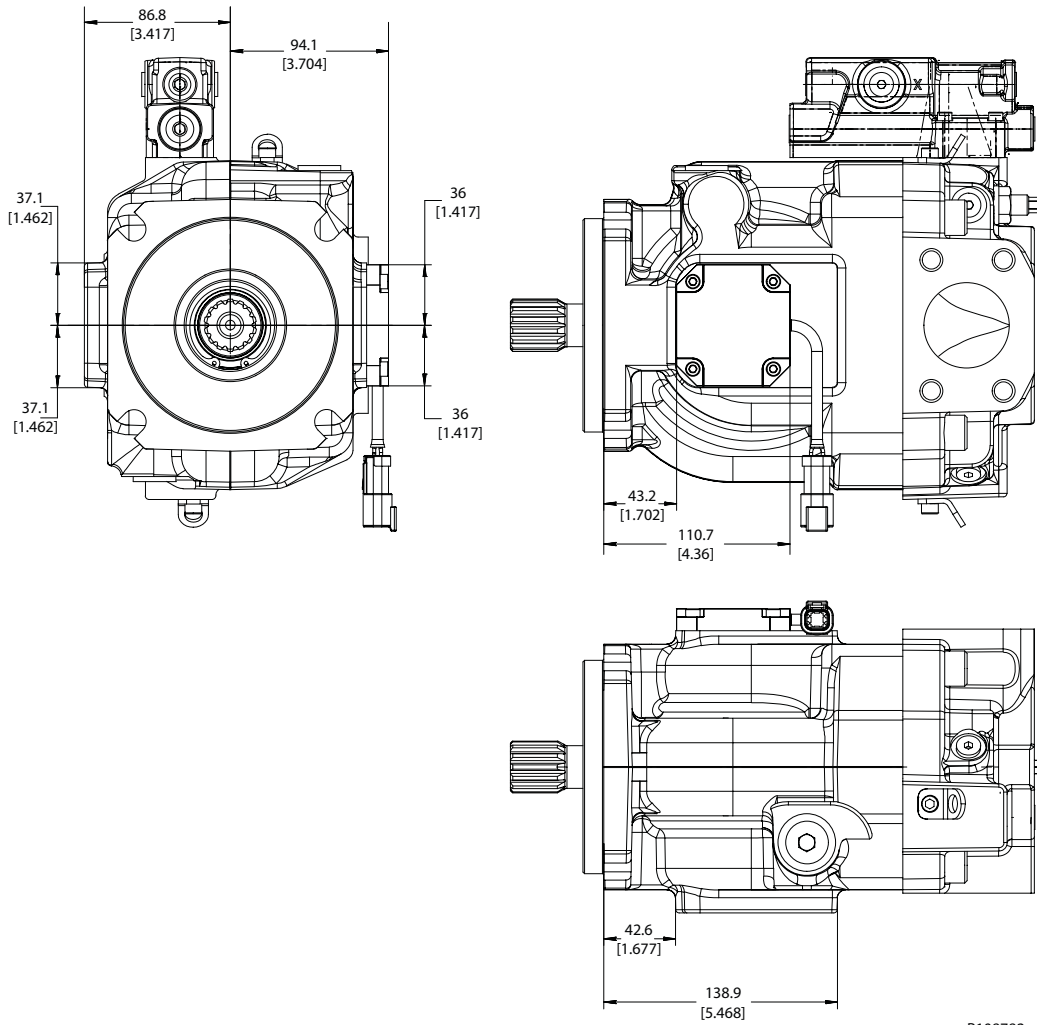
Frame F

Radial Ported Endcap Installation Dimensions



Frame F

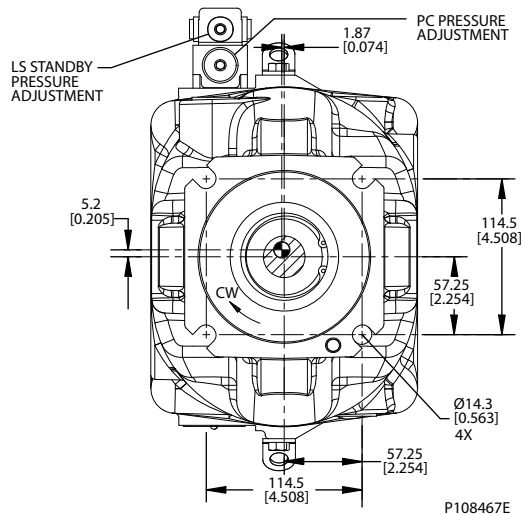
Right Angle Sensor Position Installation Dimensions



P108782

Frame F

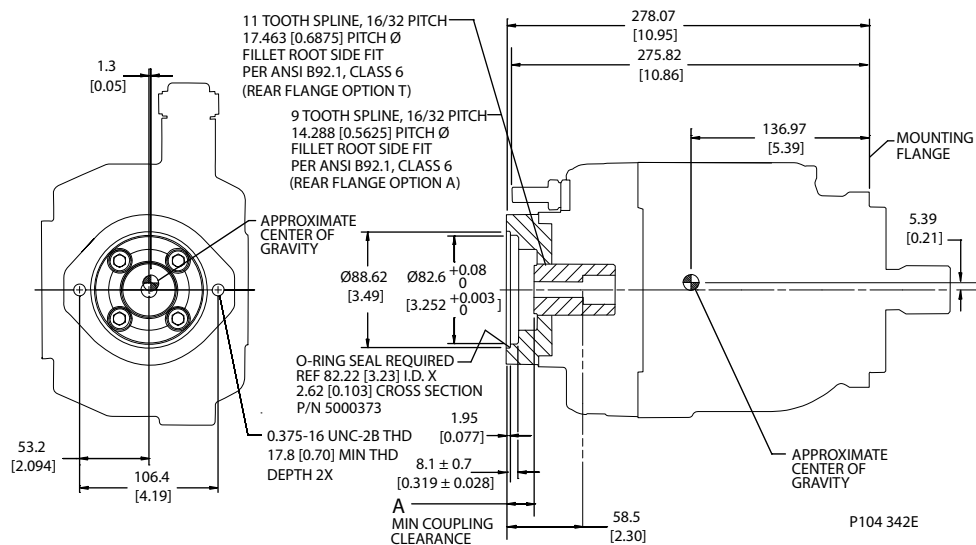
Front Mounting Flange



Auxiliary mounting pads

SAE-A auxiliary mounting pad

Dimensions



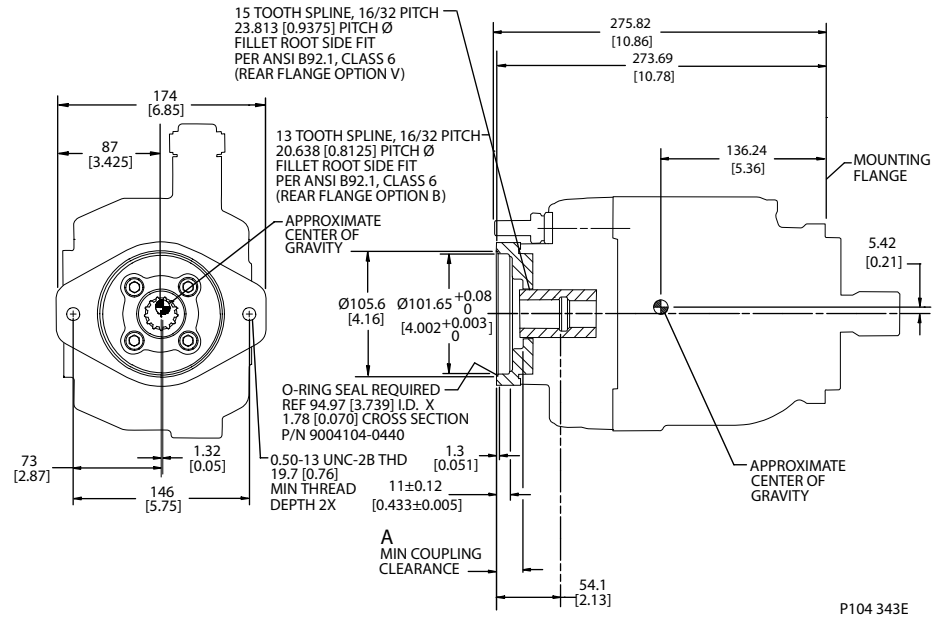
Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	13.5 mm [0.53 in]	15 mm [0.59 in]
Maximum torque	107 N·m [950 lbf·in]	147 N·m [1300 lbf·in]
Dimension A	14.9 mm [0.59 in]	16.1 mm [0.63 in]

Frame F

SAE-B auxiliary mounting pad

Dimensions

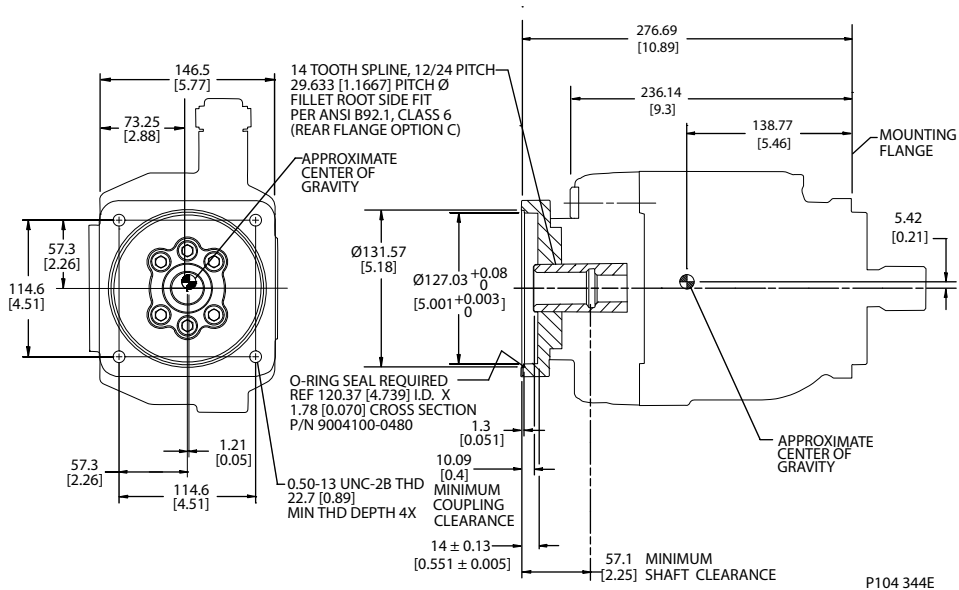


Specifications

Coupling	13-tooth	15-tooth
Spline minimum engagement	14.2 mm [0.56 in]	18.9 mm [0.74 in]
Maximum torque	249 N·m [2200 lbf·in]	339 N·m [3000 lbf·in]
Dimension A	20.7 mm [0.81 in]	12.7 mm [0.5 in]

SAE-C auxiliary mounting pad

Dimensions



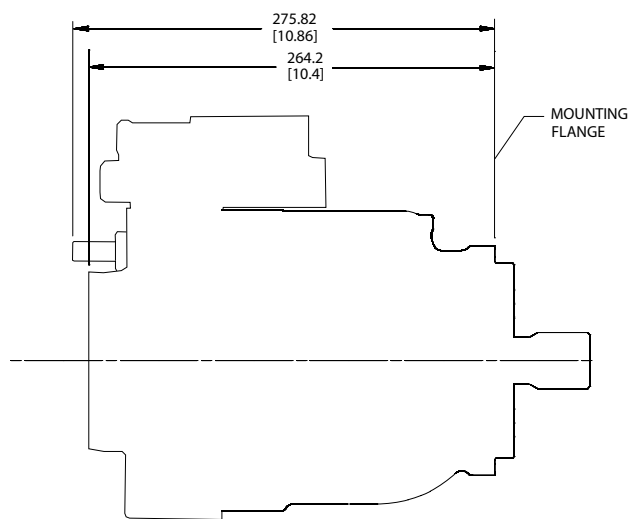
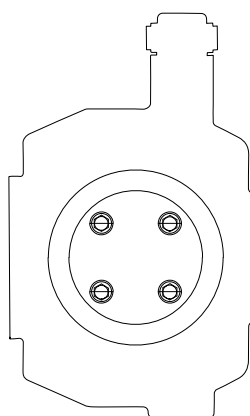
Frame F

Specifications

Coupling	14-tooth
Spline minimum engagement	18.3 mm [0.72 in]
Maximum torque	339 N·m [3000 lbf·in]

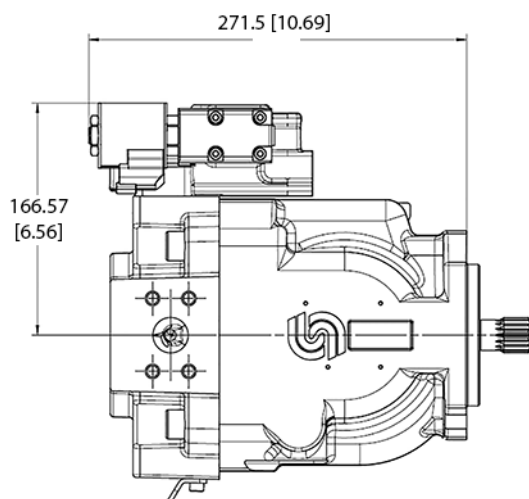
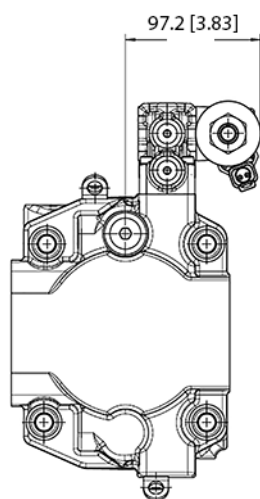
Running Cover

Dimensions



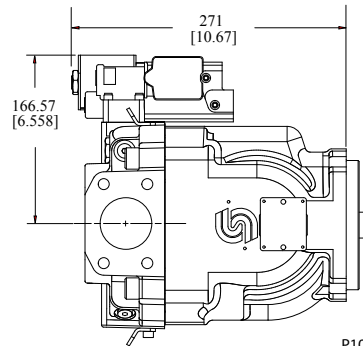
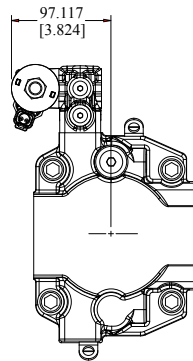
P104 346E

Radial Endcap Clockwise



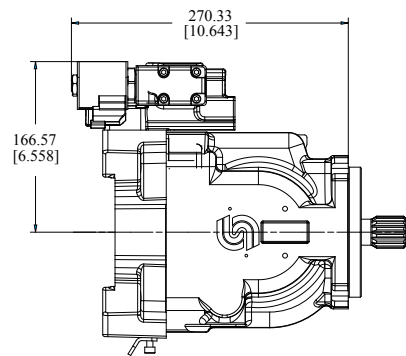
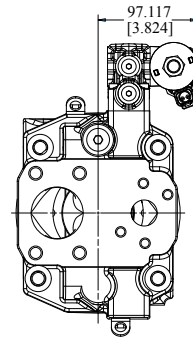
Frame F

Radial Endcap Counterclockwise



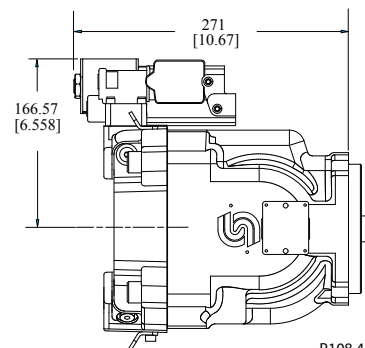
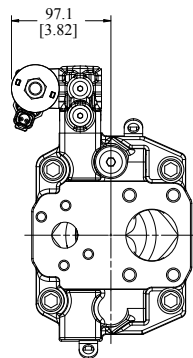
P108 455E

Axial Endcap Clockwise



P108 456E

Axial Endcap Counterclockwise



P108 457E

Displacement limiter

Series 45 F90C and F74B open circuit pumps are available with an optional adjustable displacement limiter. This adjustable stop limits the pump's maximum displacement.

Setting range

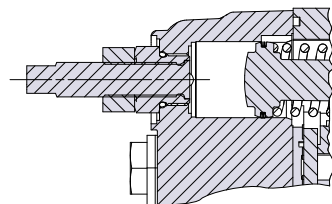
F90C	45.6 to 90 cm ³ [2.78 to 5.49 in ³]
F74B	34.1 to 74 cm ³ [1.92 to 4.52 in ³]

Frame F

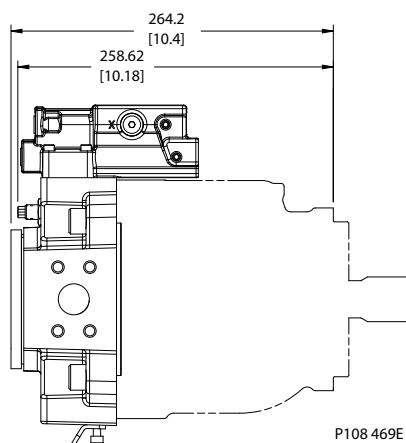
Displacement per turn

F90C	6.8 cm ³ /rev [0.41 in ³ /rev]
F74B	6.1 cm ³ /rev [0.37 in ³ /rev]

Displacement limiter cross-section



P104 345



P108 469E

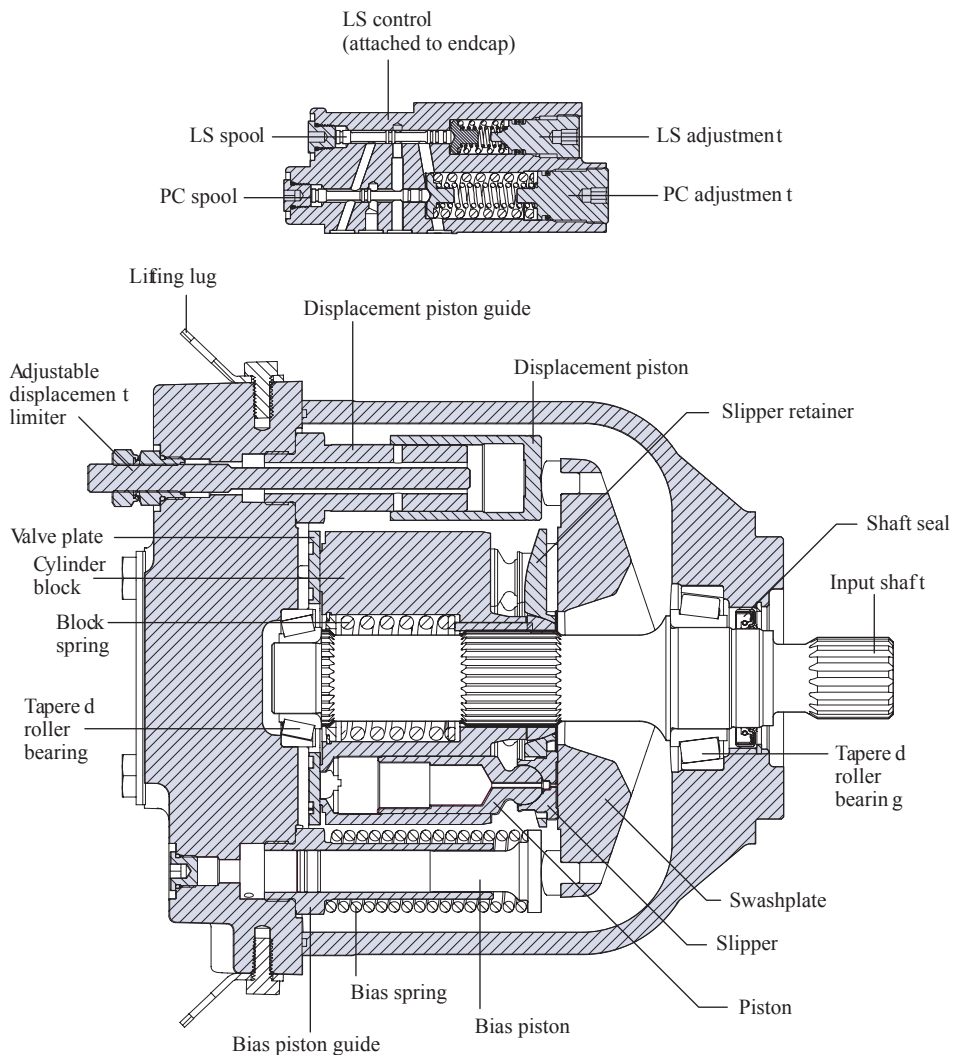
Frame E

Design

Series 45 Frame E pumps have a single servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. A bias spring and internal forces increase swashplate angle. The servo piston decreases swashplate angle. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swashplate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a viton lip-seal protects against shaft leaks.

An adjustable one spool (PC only, not shown) or two spool (LS and PC) control senses system pressure and load pressure (LS controls). The control ports system pressure to the servo piston to control pump output flow.

Frame E cross section



P104001

Frame E

Technical Specifications

		E Frame			
		Unit	100B	130B	147C
Maximum Displacement		cm ³ [in ³]	100 [6.1]	130 [7.93]	147 [8.97]
Working Input Speed	Minimum	min -1 (rpm)	500	500	500
	Continuous		2450	2200	2100
	Maximum		2880	2600	2475
Working Pressure	Continuous	bar [psi]	310 [4500]	310 [4500]	260 [3770]
	Maximum		400 [5800]	400 [5800]	350 [5075]
Flow at rated speed (theoretical)		l/min [US gal/min]	245 [64.7]	286 [75.6]	309 [81.6]
Input torque at maximum displacement (theoretical) at 49° C [120°F]		N•m/bar [lbf•in/1000 psi]	1.592 [972]	2.07 [1263.6]	2.341 [1428.8]
Mass moment of inertia of internal rotating components		kg•m ² [slug•ft ²]	0.0128 [0.00944]	0.0128 [0.00944]	0.0128 [0.00944]
Weight	Axial ports	kg [lb]	51.3 [113]		
	Radial ports		54.9 [121]		
External Shaft Loads	External moment (Me)	N•m [lbf•in]	455 [4027]	360 [3186]	396 [3505]
	Thrust in (Tin), out (Tout)	N [lbf]	2846 [640]	1735 [390]	2113 [475]
Mounting flange load moments	Vibratory (continuous)	N•m [lbf•in]	1920 [17000]		
	Shock (maximum)		6779 [60000]		

Order code

Code description

Code	Description
R	Product Frame, Variable Open Circuit Pump
S	Rotation
P	Displacement
C	Control Type
D	Pressure Compensator Setting
E	Load Sense Setting
F	Not Used
G	Choke Orifice
H	Gain Orifice
J	Input Shaft/Auxiliary Mount/Endcap
K	Shaft Seal/Front Mounting Flange/Housing Ports
L	Displacement Limiter
M	Special Hardware
N	Special Features

Frame E

R Product

		E Frame		
		100B	130B	147C
ER	E Frame, variable displacement open circuit pump	•	•	•

S Rotation

L	Left Hand (counterclockwise)	•	•	•
R	Right Hand (clockwise)	•	•	•

P Displacement

100B	100 cm ³ /rev [6.10 in ³ /rev]	•		
130B	130 cm ³ /rev [7.93 in ³ /rev]		•	
147C	147 cm ³ /rev [8.97 in ³ /rev]			•

C Control type

		100B	130B	147C
PC	Pressure Compensator	•	•	•
BC*	Pressure Compensator [>280 bar]	•	•	
RP	Remote Pressure Compensator	•	•	•
BP*	Remote Pressure Compensator [>280 bar]	•	•	
FM*	Load Sensing/Pressure Comp. (NO, 24VDC) Left	•	•	•
LS	Load Sensing/Pressure Comp.	•	•	•
BS*	Load Sensing/Pressure Comp. [>280 bar]	•	•	
LB	Load Sensing/Pressure Comp. with internal bleed orifice	•	•	•
BB*	Load Sensing/Pressure Comp. with internal bleed orifice [>280 bar]	•	•	
AN	Electric On/Off w/Pressure Comp. (NO, 12VDC) Left	•	•	•
CN	Electric On/Off w/Pressure Comp. (NO, 24VDC) Left	•	•	•
AR	Electric On/Off w/Pressure Comp. (NC, 12VDC) Left	•	•	•
CR	Electric On/Off w/Pressure Comp. (NC, 24VDC) Left	•	•	•
AF	Electric On/Off w/Pressure Comp. (NO, 12VDC) Right	•	•	•
AT	Electric On/Off w/Pressure Comp. (NO, 24VDC) Right	•	•	•
AG	Electric On/Off w/Pressure Comp. (NC, 12VDC) Right	•	•	•
AY	Electric On/Off w/Pressure Comp. (NC, 24VDC) Right	•	•	•
BN*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Left	•	•	
DN*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Left	•	•	
BR*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Left	•	•	
DR*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Left	•	•	
BF*	Electric On/Off w/Pressure Comp. (NO, 12VDC) [>280 bar] Right	•	•	
DF*	Electric On/Off w/Pressure Comp. (NO, 24VDC) [>280 bar] Right	•	•	
BE*	Electric On/Off w/Pressure Comp. (NC, 12VDC) [>280 bar] Right	•	•	
BG*	Electric On/Off w/Pressure Comp. (NC, 24VDC) [>280 bar] Right	•	•	
AX	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Left	•	•	•
CL	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Left		•	•

Frame E

C Control type (continued)

		100B	130B	147C
AH	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Left	•	•	•
AL	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Left	•	•	•
AW	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) Right	•	•	•
CK	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) Right	•	•	•
AV	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) Right	•	•	•
AK	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) Right	•	•	•
BX*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Left	•	•	
DL*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Left	•	•	
BH*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Left	•	•	
BL*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Left	•	•	
BW*	Electric Proportional Pressure Control w/Pressure Comp. (NO,12VDC) [>280 bar] Right	•	•	
DK*	Electric Proportional Pressure Control w/Pressure Comp. (NO,24VDC) [>280 bar] Right	•	•	
BM*	Electric Proportional Pressure Control w/Pressure Comp. (NC,12VDC) [>280 bar] Right	•	•	
BK*	Electric Proportional Pressure Control w/Pressure Comp. (NC,24VDC) [>280 bar] Right	•	•	
FA*	Electric On/Off Dump valve w/Pressure Comp. + Load Sense (NC, 12VDC) Right	•	•	•
FB*	Electric On/Off Dump valve w/Pressure Comp. + Load Sense (NC, 12VDC) Left	•	•	•
FE*	Electric On/Off Dump valve w/Pressure Comp. + Load Sense (NC, 24VDC), Left	•	•	•
TA	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 12VDC), Left	•	•	•
TB	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 24VDC), Left	•	•	•
TC	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 12VDC), (>280bar) Left	•	•	•
TD	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 12VDC), (>280bar) Left	•	•	•
TE	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 12VDC), Right	•	•	•
TF	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 24VDC), Right	•	•	•
TG	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 12VDC), (>280bar) Right	•	•	•
TH	Electronic Torque Limiting Control w/Pressure Compensation/Load Sensing (NC, 24VDC), (>280bar) Right	•	•	•

Left - E-Frame: CW Only, F-Frame: CW Only, J-frame: CW Axial, CCW Radial

Right - E-Frame: CCW Only, F-Frame: CCW Only, J-frame: CCW Axial, CW Radial

* Not available on 147cc pumps

Frame E

D PC setting (2 digit code, 10 bar increments)

		E Frame		
		100B	130B	147C
Example	25 = 250 bar (3625 psi)			
10-26	100 to 260 bar [1450 to 3771 psi]	•	•	•
27-28	270 to 280 bar [3916 to 4061 psi]	•	•	
29-31	290-310 bar [4206 to 4496 psi]	•	•	

E Load sensing setting (2 digit code, 1 bar increments)

Example	20 = 20 bar (290 psi)			
10-34	10 to 34 bar [145 to 508 psi]	•	•	•
NN	Not applicable (pressure compensated only controls)	•	•	•

F Not used

NN	Not applicable	•	•	•
----	----------------	---	---	---

G Servo Control Orifice

N	None (standard)	•	•	•
E	0.8 mm diameter	•	•	•
F	1.0 mm diameter	•	•	•

H Gain Orifice

3	1.0 mm diameter	•	•	•
C	0.8 mm diameter Electronic Torque Limiting Control Orifice (with standard orifice)	•	•	•

Additional LS signal line orifice size options are available for necessary system tuning requirements. Contact your Danfoss representative for further information.

J Input Shaft

K5	1.5 inch straight keyed
S1	14 tooth 12/24 pitch
S2	17 tooth, 12/24 pitch
S4	13 tooth, 8/16 pitch

Auxiliary Mount/Endcap Style

Auxiliary Description	Endcap Style	Inlet Porting	Outlet Porting	Endcap Description	Code
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	NL
None	Axial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port M12 metric threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port M12 metric threads)	N1

Frame E

Auxiliary Mount/Endcap Style (continued)

None	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	NP
N1 Endcap Option					
Running Cover	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	RP
SAE-A, 11 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	TP
SAE-A, 9 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	AP
SAE-B, 13 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	BP
SAE-B, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	LP
SAE-BB, 13 teeth/with M12 thread	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port M12 metric threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port M12 metric threads)	U6
SAE-BB, 15 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	VP
SAE-C, 14 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	CP
SAE-CC, 17 teeth	Radial	Split Flange	Split Flange	Inlet - Code 61 Split Flange Port 4 Bolt (2.5 inch port 0.5 inch threads) Outlet - Code 62 Split Flange Port 4 Bolt (1.25 inch port 0.5 inch threads)	WP

J Input Shaft/Auxiliary Mount/Endcap

Available Combinations

	E Frame		
	100B	130B	147C
K5AP	•	•	•
K5BP	•	•	•
K5CP	•	•	•
K5D7	•	•	•

Frame E

	E Frame		
	100B	130B	147C
K5NL	•	•	•
K5NP	•	•	•
K5RP	•	•	•
K5VP	•	•	•
S1AP	•	•	•
S1BP	•	•	•
S1CP	•	•	•
S1LP	•	•	•
S1NL	•	•	•
S1N1	•	•	•
S1NP	•	•	•
S1RP	•	•	•
S1TP	•	•	•
S1VP	•	•	•
S2AP	•	•	•

	E Frame		
	100B	130B	147C
S2BP	•	•	•
S2CP	•	•	•
S2NL	•	•	•
S2NP	•	•	•
S2RP	•	•	•
S2TP	•	•	•
S2VP	•	•	•
S2WP	•	•	•
S4AP	•	•	•
S4BP	•	•	•
S4CP	•	•	•
S4NL	•	•	•
S4NP	•	•	•
S4RP	•	•	•
S4U6	•	•	•
S4TP	•	•	•
S4VP	•	•	•
S4WP	•	•	•

K Shaft seal

		E Frame		
		100B	130B	147C
A	Single (Viton)	•	•	•

Frame E

K Mounting flange and housing port style

1	SAE-C Flange 4-bolt/SAE O-ring boss ports	•	•	•
---	---	---	---	---

K Angle Sensor Housing

R	Angle Sensor Housing, Right Hand Side	•	•	•
---	---------------------------------------	---	---	---

L Displacement limiter

NNN	None (plugged)	•	•	•
AAA	Adjustable, factory set at max angle	•	•	•

M Special hardware

NNN	None	•	•	•
ANS	Angle Sensor Swashplate	•	•	•

N Special features

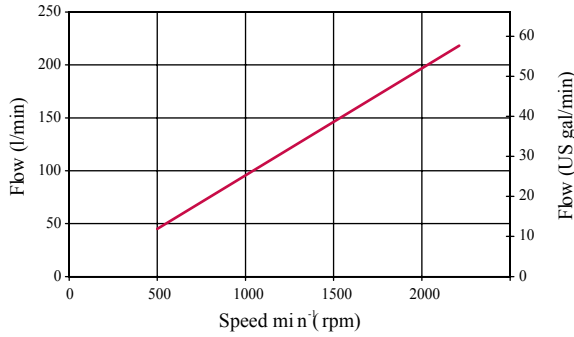
NNN	None	•	•	•
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Frame E

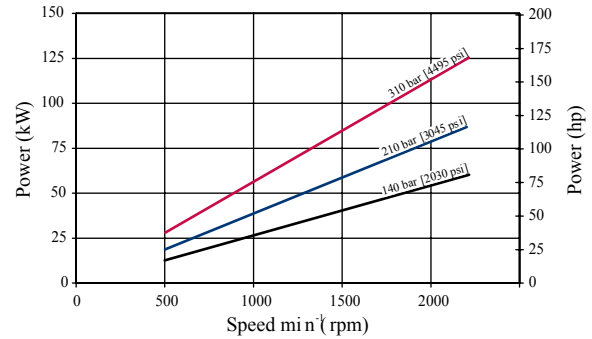
Performance E100B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

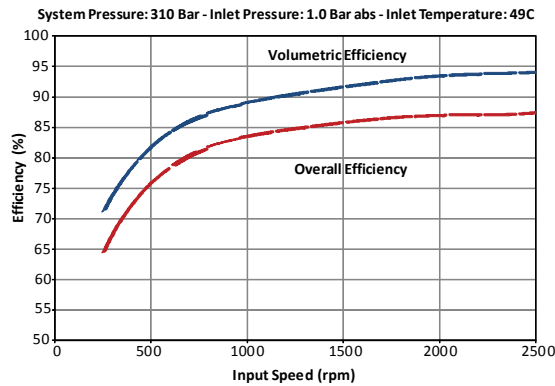
Flow vs. speed



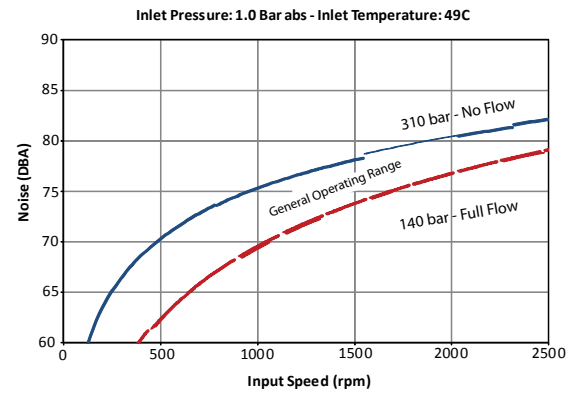
Input power vs. speed



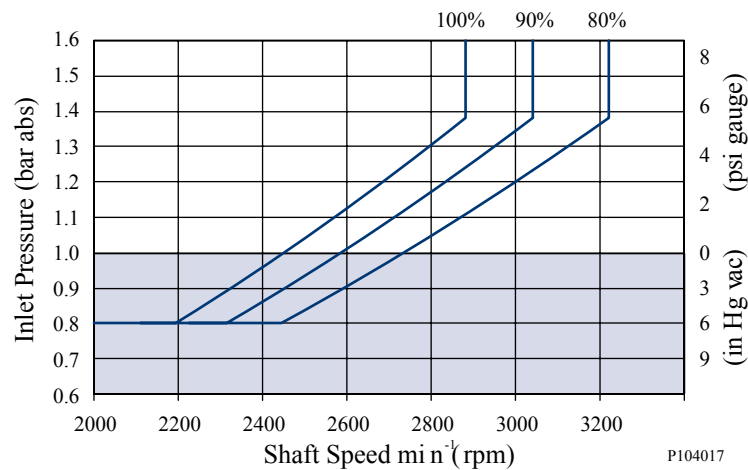
Efficiency



Noise



Inlet pressure vs. speed



P104017

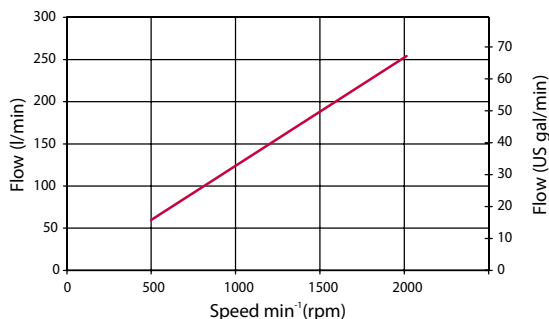
The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame E

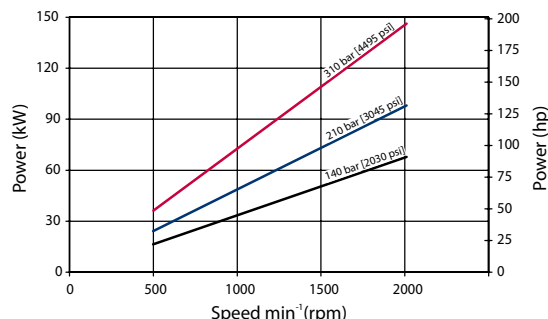
Performance E130B

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

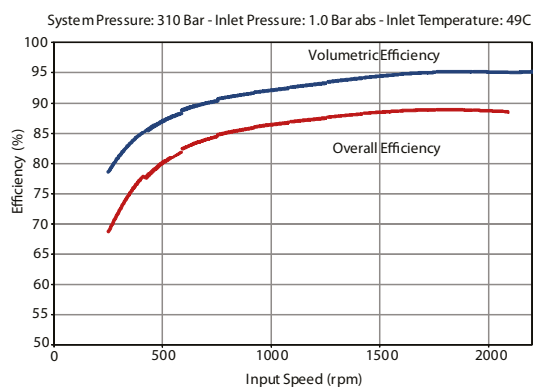
Flow vs. speed



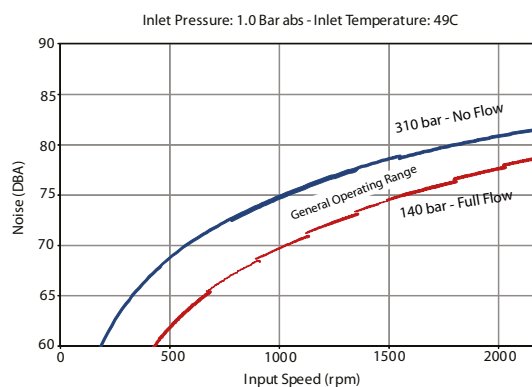
Input power vs. speed



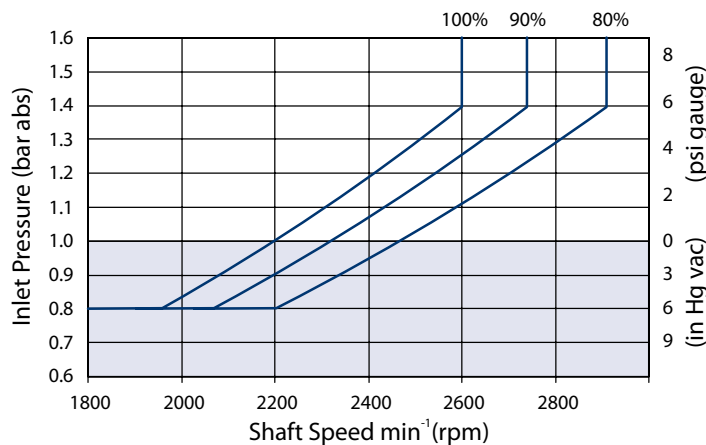
Efficiency



Noise



Inlet pressure vs. speed



P109281

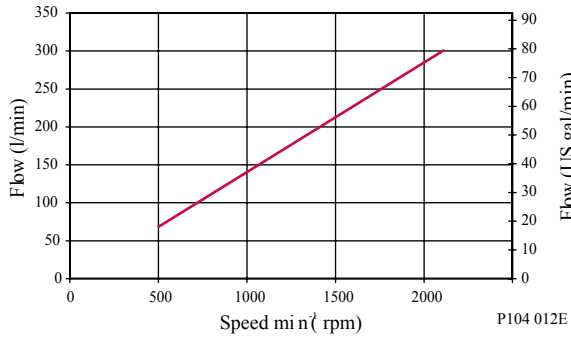
The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame E

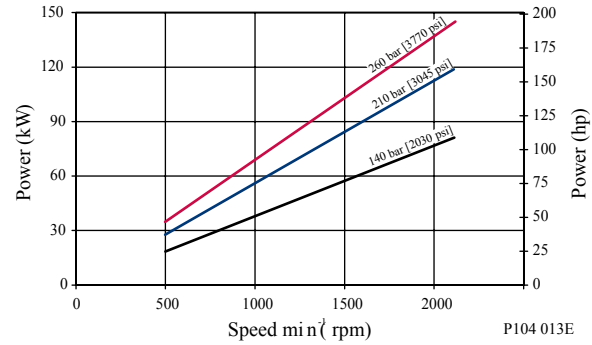
Performance E147C

Flow and power data valid at 49°C [120°F] and viscosity of 17.8 mm²/sec [88 SUS].

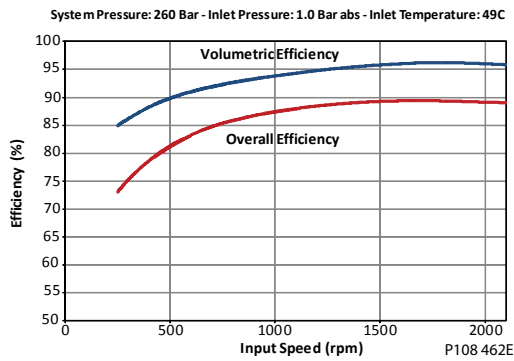
Flow vs. speed



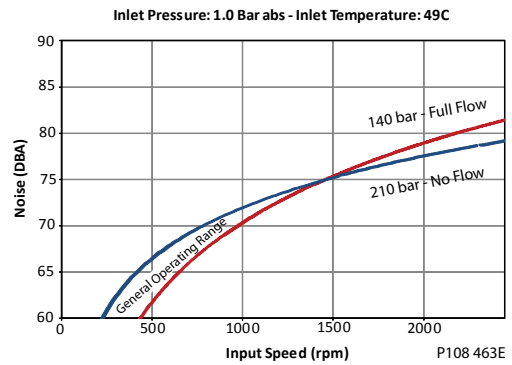
Input power vs. speed



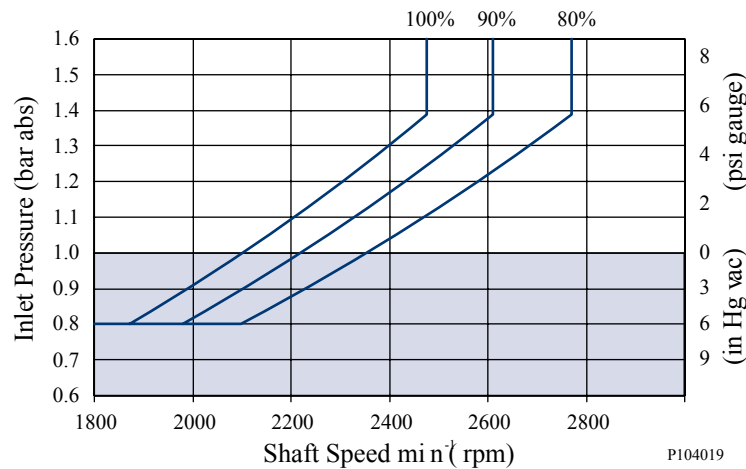
Efficiency



Noise



Inlet pressure vs. speed



The chart above shows allowable inlet pressure and speed at various displacements. Greater speeds and lower inlet pressures are possible at reduced displacement. Operating outside of acceptable limits reduces pump life.

Frame E

Hydraulic Controls

Pressure Compensated Controls

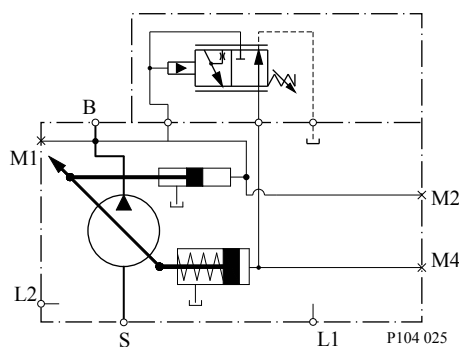
Response/recovery times

(ms)	Response	Recovery
E100B	45	175
E130B	55	175
E147C	60	190

PC Setting range

Model	PC	BC
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

M4 = Servo pressure gauge port

Remote Pressure Compensated Controls

Response/recovery times

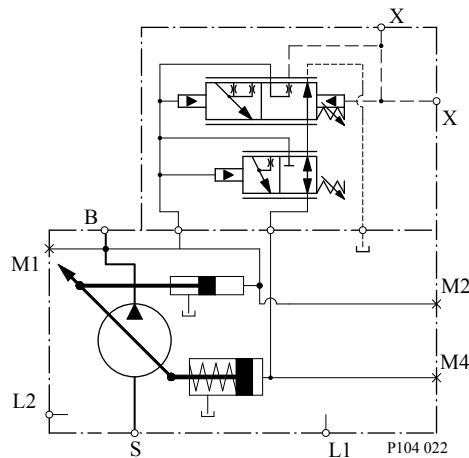
(ms)	Response	Recovery
E100B	45	175
E130B	55	175
E147C	60	190

Frame E

PC Setting range

Model	RP	BP
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- M4 = Servo pressure gauge port
- X = Remote PC port

Load Sensing/Pressure Compensated

Response/recovery times

(ms)	Response	Recovery
E100B	45	200
E130B	50	200
E147C	60	200

PC Setting range

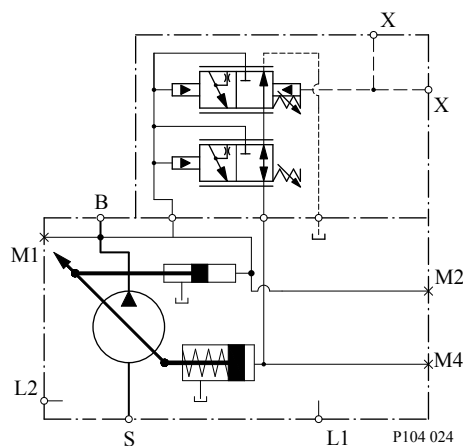
Model	LS	BS
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A

Frame E

LS setting range

Model	bar	psi
All	10–30	145–435

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

M4 = Servo pressure gauge port

X = LS signal port

Load Sensing Control with Bleed Orifice/Pressure Compensated

*Response/recovery times**

(msec)	Response	Recovery
E100B	45	200
E130B	50	200
E147C	60	200

PC setting range

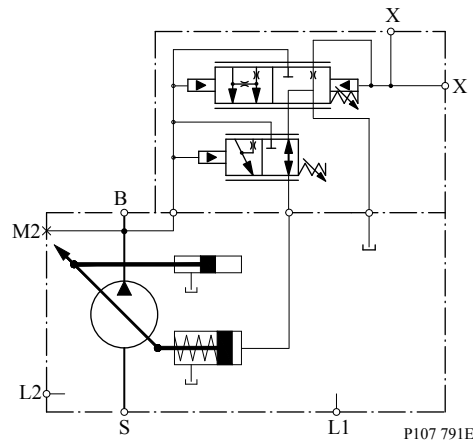
Model	LB	BB
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A

LS setting range

Model	bar	psi
All	10–34	145–435

Frame E

Schematic

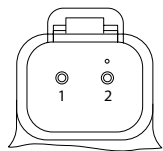


- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- M4 = Servo pressure gauge port
- X = LS signal port

Electric Controls

Connectors

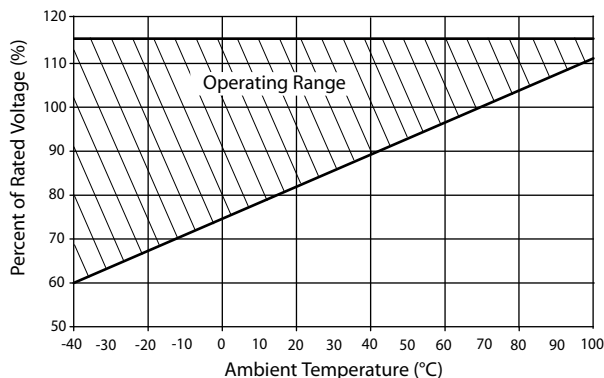
Description	Quantity	Ordering Number
Mating Connector	1	Deutsch® DT06-2S
Wedge Lock	1	Deutsch® W25
Socket Contact (16 and 18 AWG)	2	Deutsch® 0462-201-16141
Danfoss mating connector kit	1	K29657



P003 480

Frame E

Continuous Duty Operating Range



Solenoid Data - Normally Closed

Voltage	12V	24V
Threshold Control [mA] (310/260 bar PC setting, oil temp X)	200/400	100/200
End Current [mA] (20 bar LS setting, oil temp X)	1200	600

Solenoid Data - Normally Open

Voltage	12V	24V
Threshold Control [mA] (20 bar LS setting, oil temp X)	0	0
End Current [mA] (260/310 bar PC setting, oil temp X)	1000/1100	500/550

Hysteresis

Frame	Hysteresis
E100B, E130B	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)
E147C	Input hysteresis <4% (control current): Output hysteresis <4.5% (system pressure)

Normally Closed Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

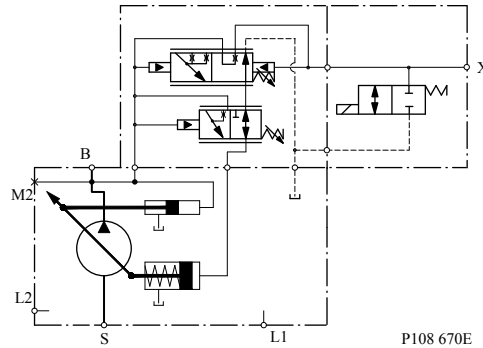
(msec)	Response	Recovery
E100B	45	175
E130B	55	175
E147C	60	190

* Without servo control orifice

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Frame E

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

X = Load Sense Port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

PC setting range

Frame	AG, AR (12V)	BE, BR (12V)	AY, CR (24V)	BG, DR (24V)
E100B	100-280 bar	290-310 bar	100-280 bar	290-310 bar
E130B	[1450-4060] psi	[4205-4495] psi	[1450-4060] psi	[4205-4495] psi
E147C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

Normally Open Electric On/Off with Pressure Compensation Controls

*Response/Recovery times**

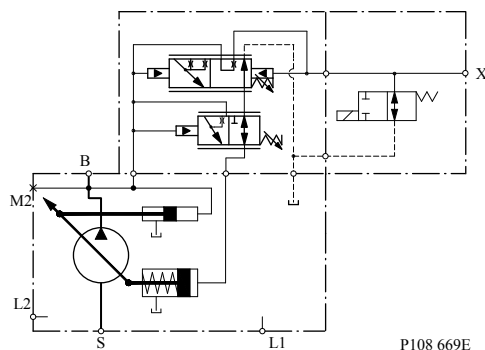
(msec)	Response	Recovery
E100B	45	175
E130B	55	175
E147C	60	190

* Without servo control orifice

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Frame E

Schematic



B = Outlet

S = Inlet

L1, L2 = Case drain

M2 = System pressure gauge port

X = Load Sense Port

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

PC setting range

Frame	AF, AN (12V)	BF, BN (12V)	AT, CN (24V)	DF, DN (24V)
E100B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
E130B				
E147C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

Normally Closed Electric Proportional with Pressure Compensation Controls

Response/Recovery times

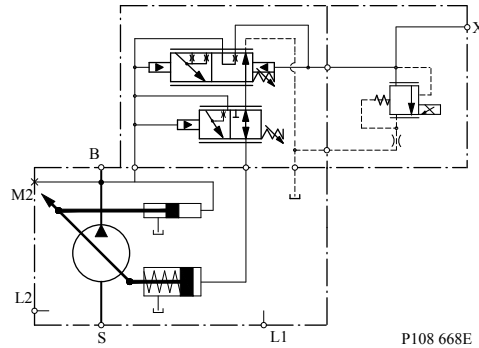
	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
(msec)				
E100B	45	530	45	405
E130B	55	530	55	405
E147C	60	580	60	440

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Frame E

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

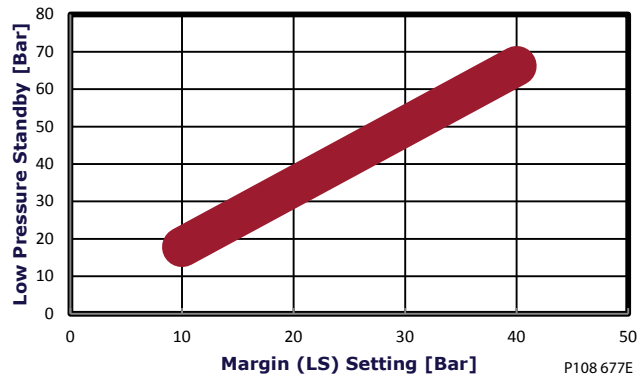
PC setting range

Frame	AH, AV (12V)	BH, BM (12V)	AK, AL (24V)	BK, BL (24V)
E100B	100-280 bar	290-310 bar	100-280 bar	290-310 bar
E130B	[1450-4060] psi	[4205-4495] psi	[1450-4060] psi	[4205-4495] psi
E147C	100-260 bar	Not Available	100-260 bar	Not Available
	[1450-3770] psi		[1450-3770] psi	

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

**Frames E, F, J Electric Proportional Control
 Low Pressure Standby**



Frame E

Normally Open Electric Proportional with Pressure Compensation Controls

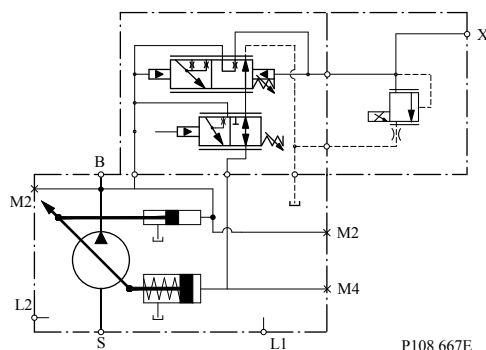
Response/Recovery times

(msec)	0.8mm Orifice		1.0mm Orifice	
	Response	Recovery	Response	Recovery
E100B	45	530	45	405
E130B	55	530	55	405
E147C	60	580	60	440

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

Schematic



- B = Outlet
- S = Inlet
- L1, L2 = Case drain
- M2 = System pressure gauge port
- X = Load Sense Port

PC setting range

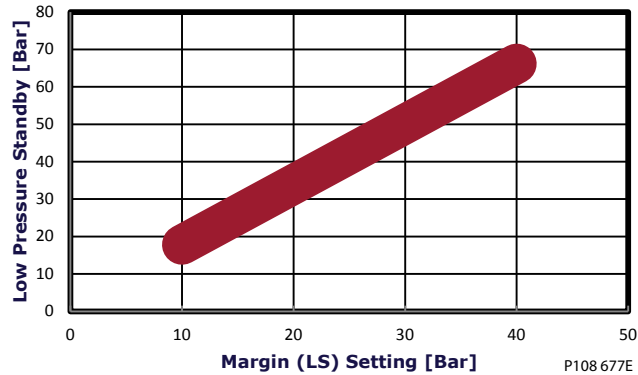
Frame	AW, AX (12V)	BW, BX (12V)	CK, CL (24V)	DK, DL (24V)
E100B	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi	100-280 bar [1450-4060] psi	290-310 bar [4205-4495] psi
E130B				
E147C	100-260 bar [1450-3770] psi	Not Available	100-260 bar [1450-3770] psi	Not Available

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

Electric proportional controls have a unique relationship between margin (LS) setting and low pressure standby. See the graph below for this relationship.

Frame E

**Frames E, F, J Electric Proportional Control
Low Pressure Standby**

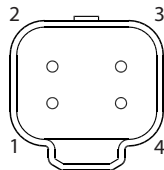


Normally Closed Electric Torque Limiting Control with Pressure Compensation Controls

Response/recovery times

(ms)	Response	Recovery
E100B	45	200
E130B	50	200
E147C	60	200

Pin location



P200 151

Pinout

Pin	Description
1	Supply -
2	Output signal 2 - Secondary Signal
3	Output signal 1 - Primary Signal
4	Supply +

PC Setting range

Frame	TA, TE (12Vdc)	TC, TG (12Vdc)	TB, TF (24Vdc)	TD, TH (24Vdc)
E100B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E130B	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]	100-280 bar [1450-4060 psi]	290-310 bar [4205-4495 psi]
E147C	100-260 bar [1450-3770 psi]	N/A	100-260 bar [1450-3770 psi]	N/A

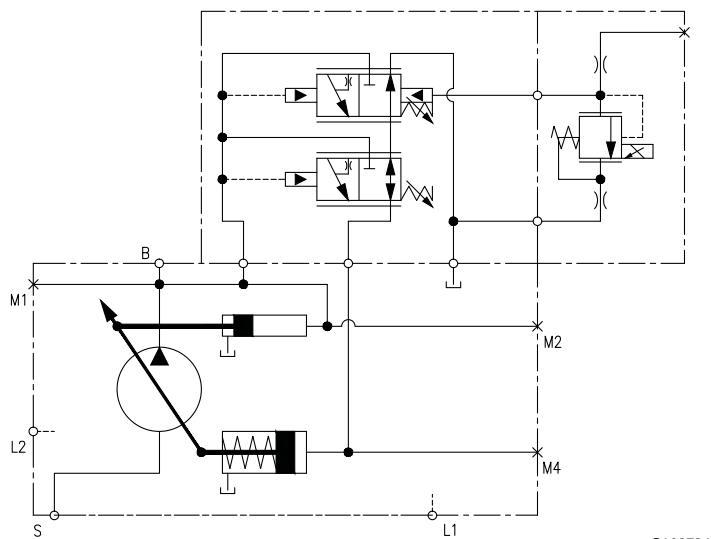
Frame E

LS setting range

Model	bar	psi
All	10 - 40	[145 - 580]

For fan-drive systems, and systems with motors, select an LS setting no less than 15 bar to enhance system stability. As the LS setting is reduced, the risk for system instability may be increased. A 20 bar LS setting is recommended as a starting point for all new applications.

E-frame pump with integrated ETL control



Frame E

Input shafts

Shaft data

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
K5	Ø 38.08 mm [1.5 in] Straight keyed	1161 [10 270]	
S1	14-tooth spline 12/24 pitch (ANSI B92.1B 1996 - Class 5)	800 [7080]	
S2	17-tooth spline 12/24 pitch (ANSI B92.1B 1996 - Class 5)	1150 [10178]	

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

Frame E

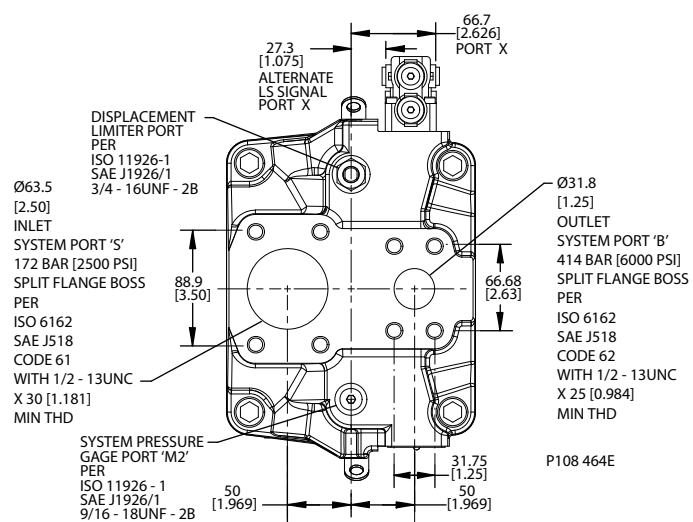
Shaft data

Code	Description	Maximum torque rating ¹ N·m [lbf·in]	Drawing
S4	13-tooth spline 8/16 pitch (ANSI B92.1B 1996 - Class 5)	1560 [13 807]	<p>13 TOOTH 8/16 PITCH 30° PRESSURE ANGLE 41.28 [1.625] PITCH DIA FILLET ROOT SIDE FIT COMPATIBLE WITH ANSI B92.1B-1996 CLASS 6e ALSO MATES WITH FLAT ROOT SIDE FIT</p> <p>Ø34.25 [1.348] MAX</p> <p>Ø43.94 ± 0.08 [1.73 ± 0.003]</p> <p>42 ± 0.15 [1.654 ± 0.006]</p> <p>67.0 ± 0.55 [2.64 ± 0.022]</p> <p>8 ± 0.8 [0.31 ± 0.03]</p> <p>P104035</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p>

1. See [Input shaft torque ratings](#) for an explanation of maximum torque.

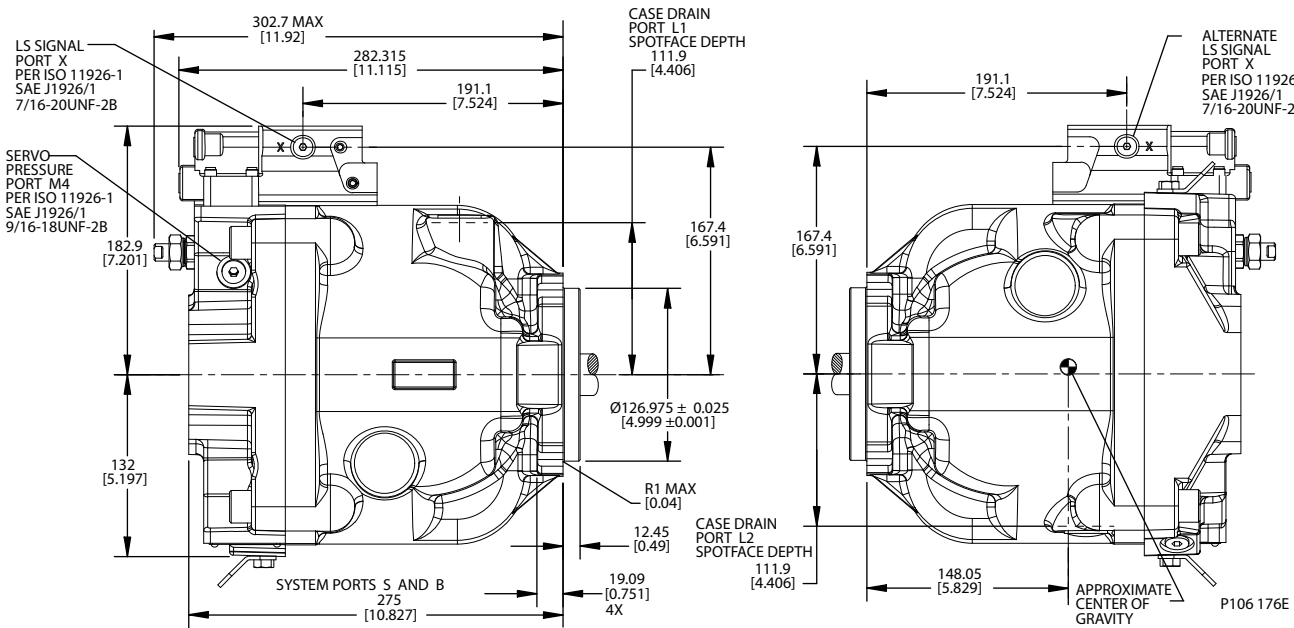
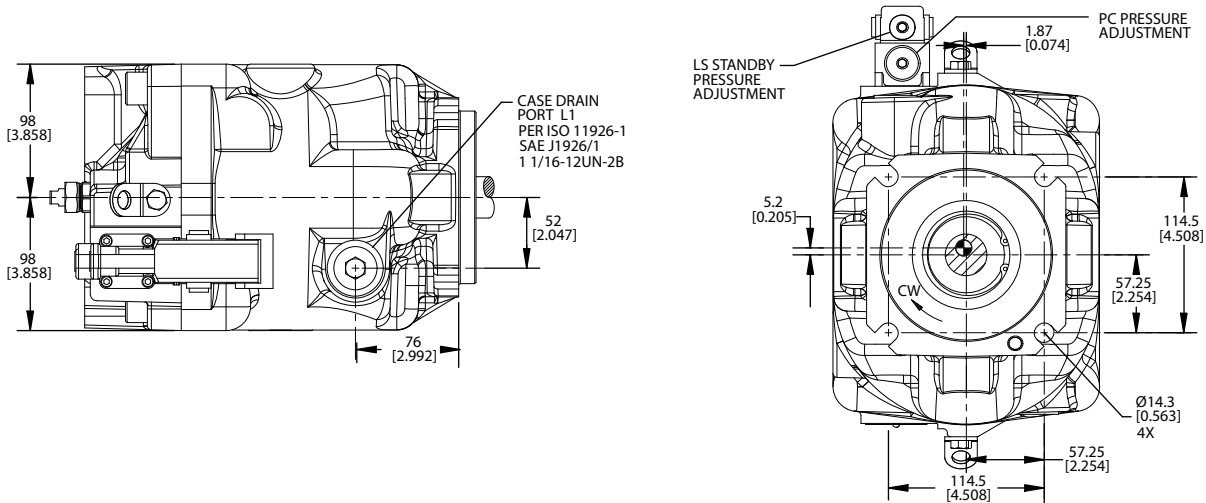
Installation drawings

Axial Ported Endcap



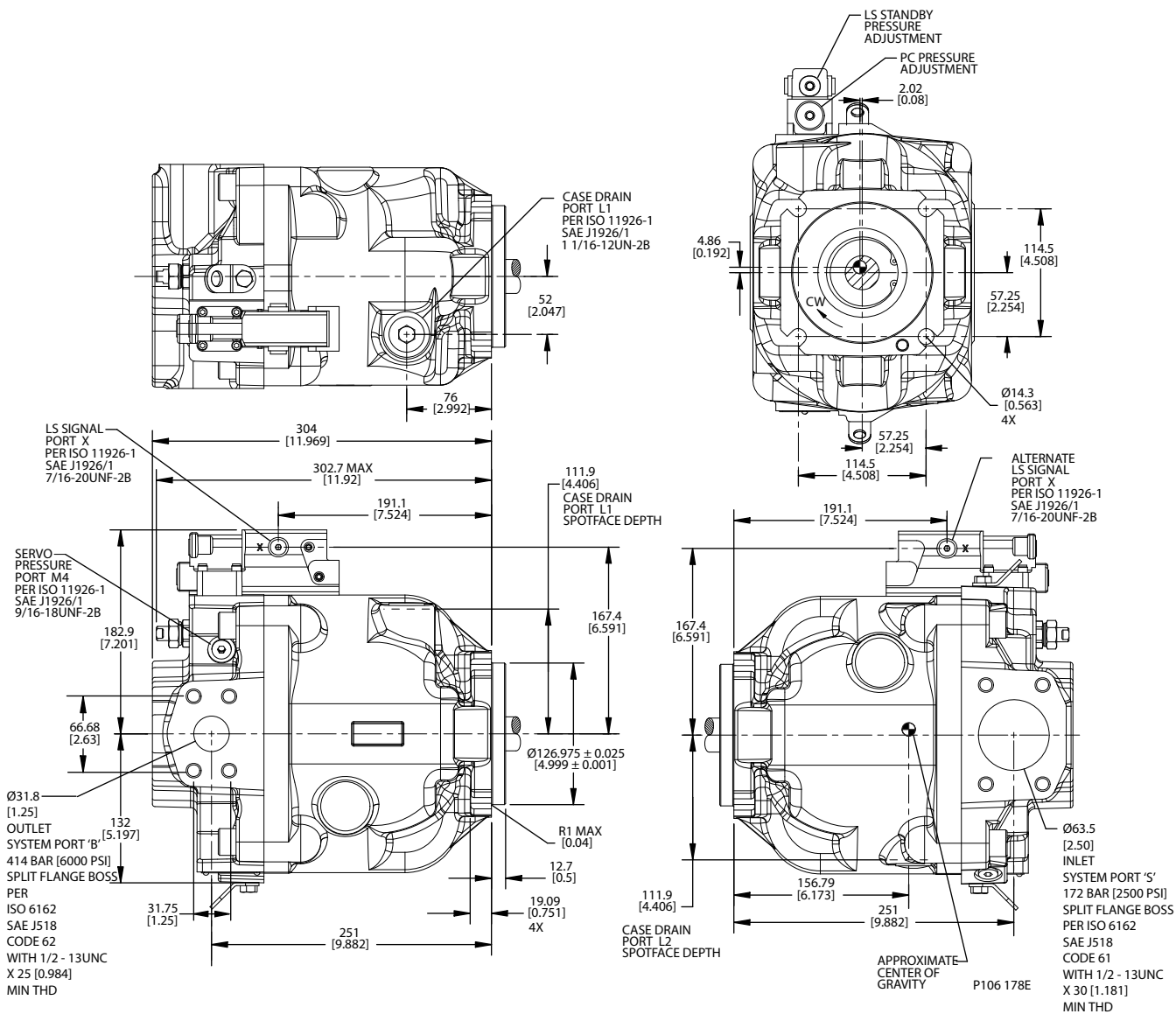
Frame E

Axial Ported Endcap Installation Dimensions



Frame E

Radial Ported Endcap Installation Dimensions

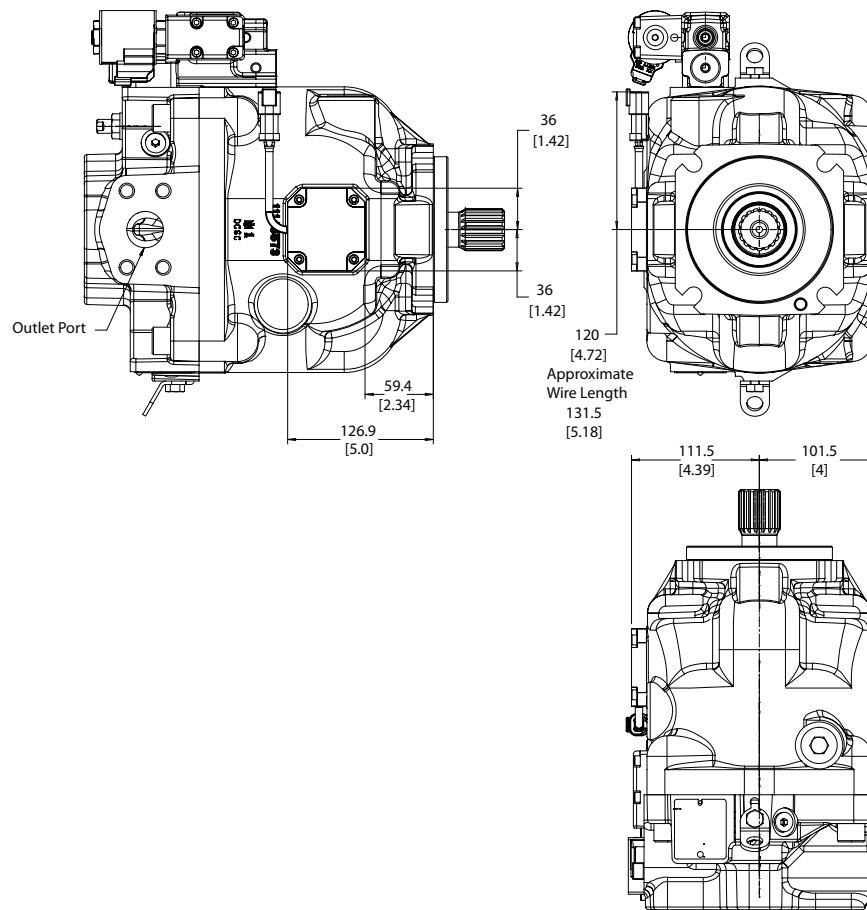


Frame E

Right Angle Sensor Position Installation Dimensions

The location convention for the E-Frame angle sensor is different from that of the J & F-Frame due to a difference in design of the endcap and servo systems. When looking at the input shaft, the angle sensor will be positioned on the same side as the outlet port of the endcap. The outlet port of the endcap is always the smaller of the inlet and outlet ports, indicated below. This is the 'right side' order code location, even though it appears on the left hand side from a frontal view.

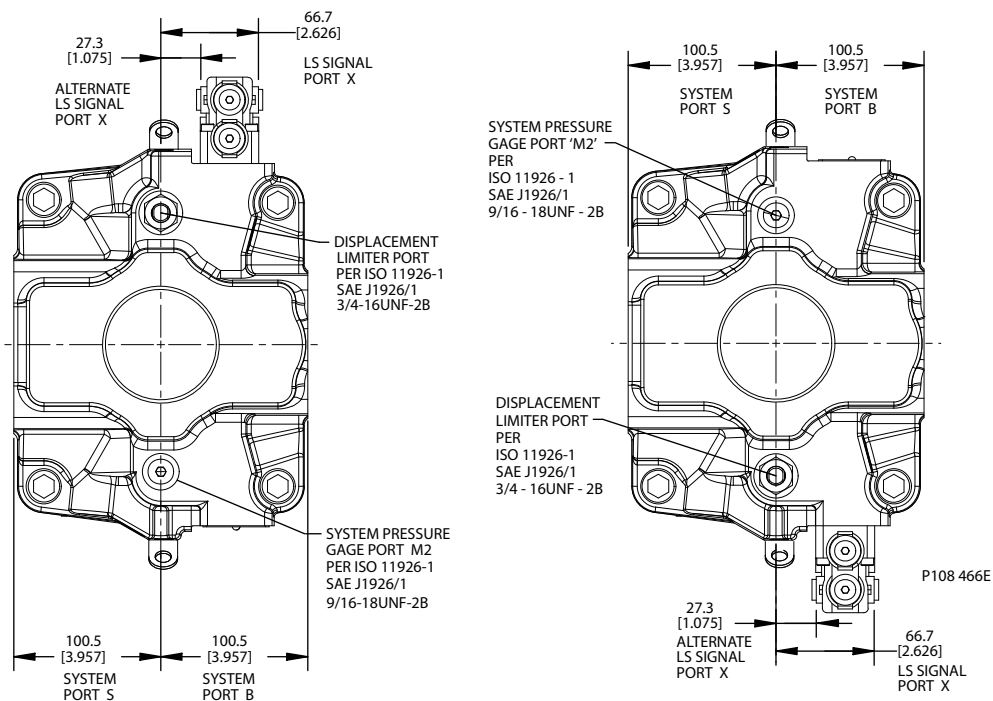
Clockwise rotation E-frames appear with the control on the top side in this view. Counter-clockwise rotation E-Frames appear with the control on the bottom side in this view.



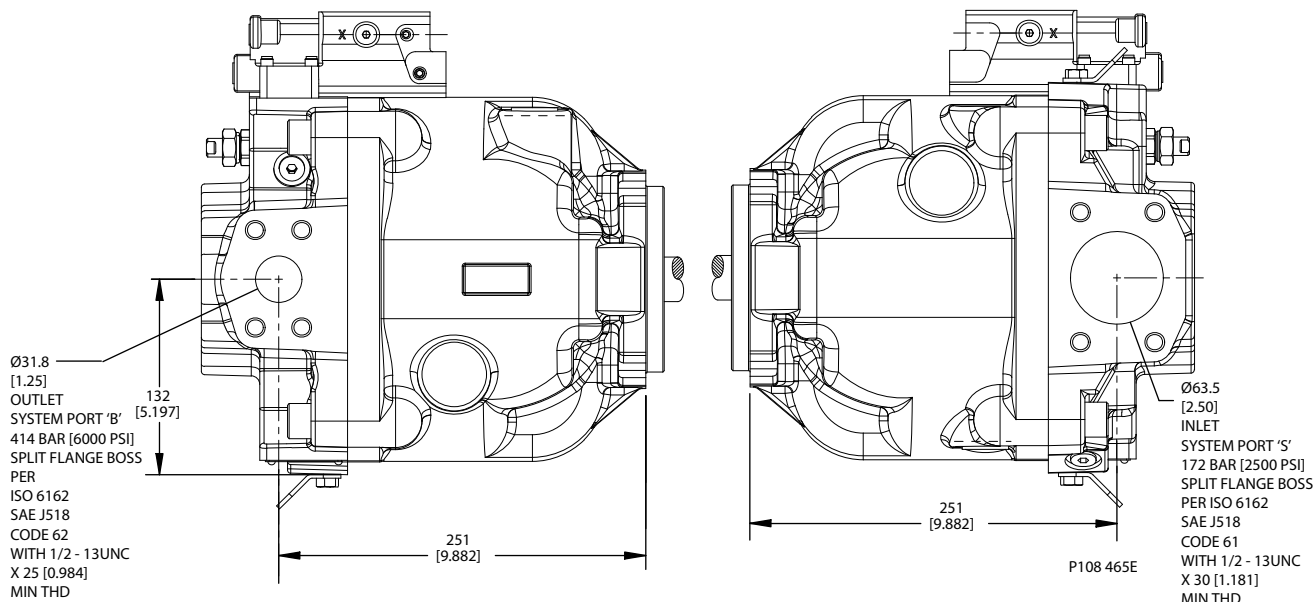
P108826

Frame E

Radial Ported Endcap Rear View

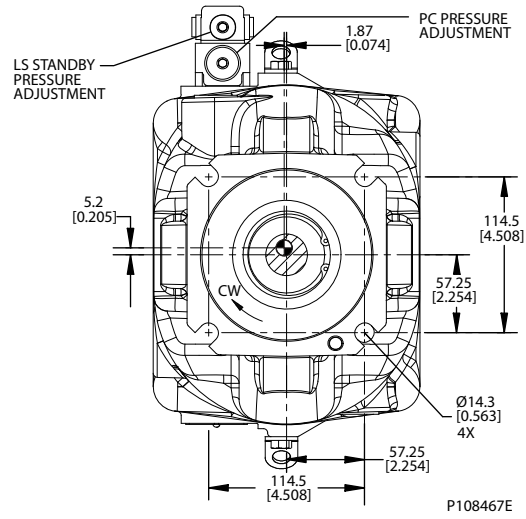


Radial Ported Endcap Split Flange Ports



Frame E

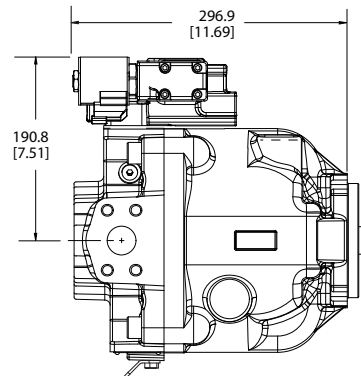
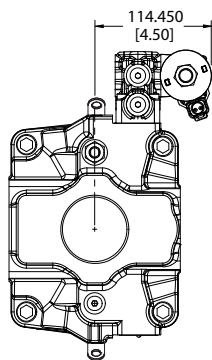
Front Mounting Flange



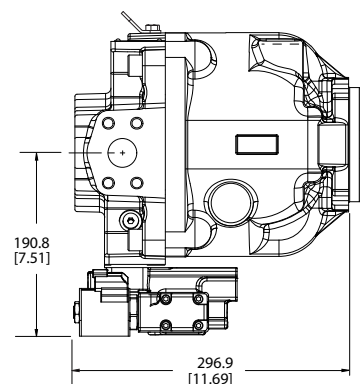
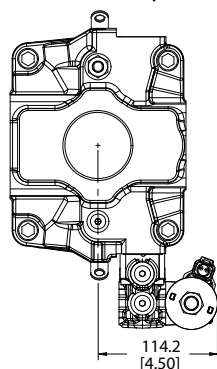
Frame E

Endcap Dimensions

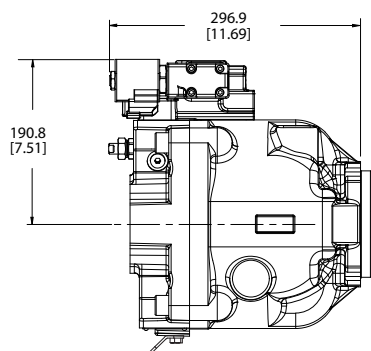
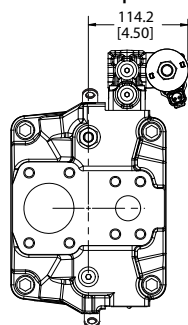
Radial Endcap Clockwise



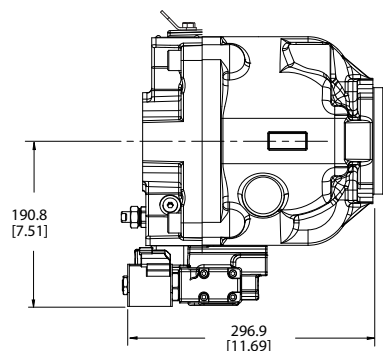
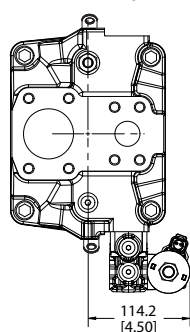
Radial Endcap Counterclockwise



Axial Endcap Clockwise



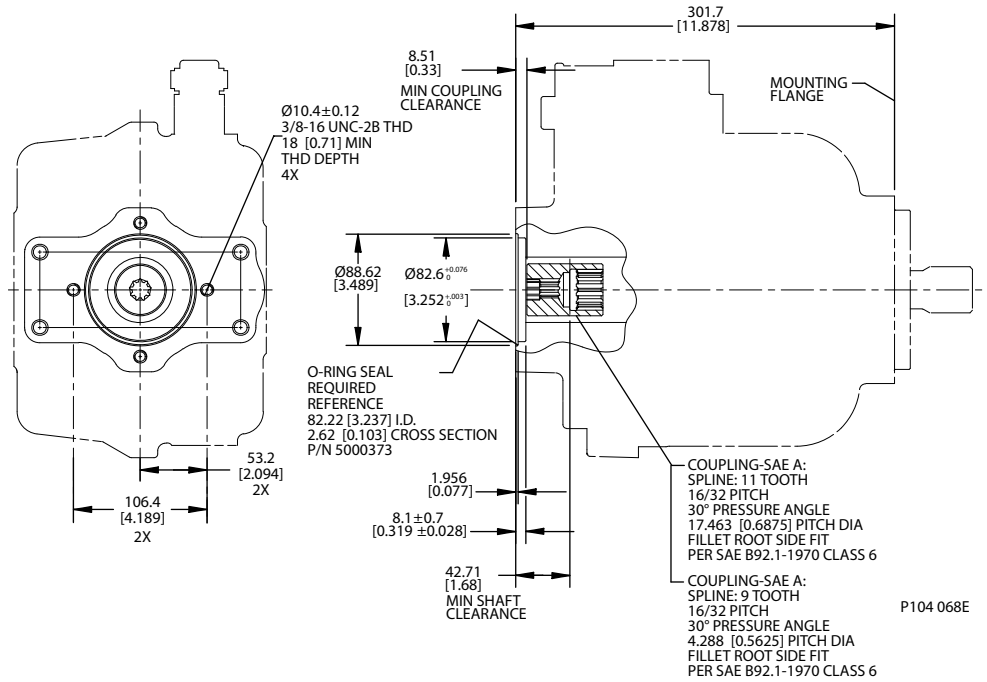
Axial Endcap Counterclockwise



Frame E

Auxiliary mounting pads

SAE-A Dimensions

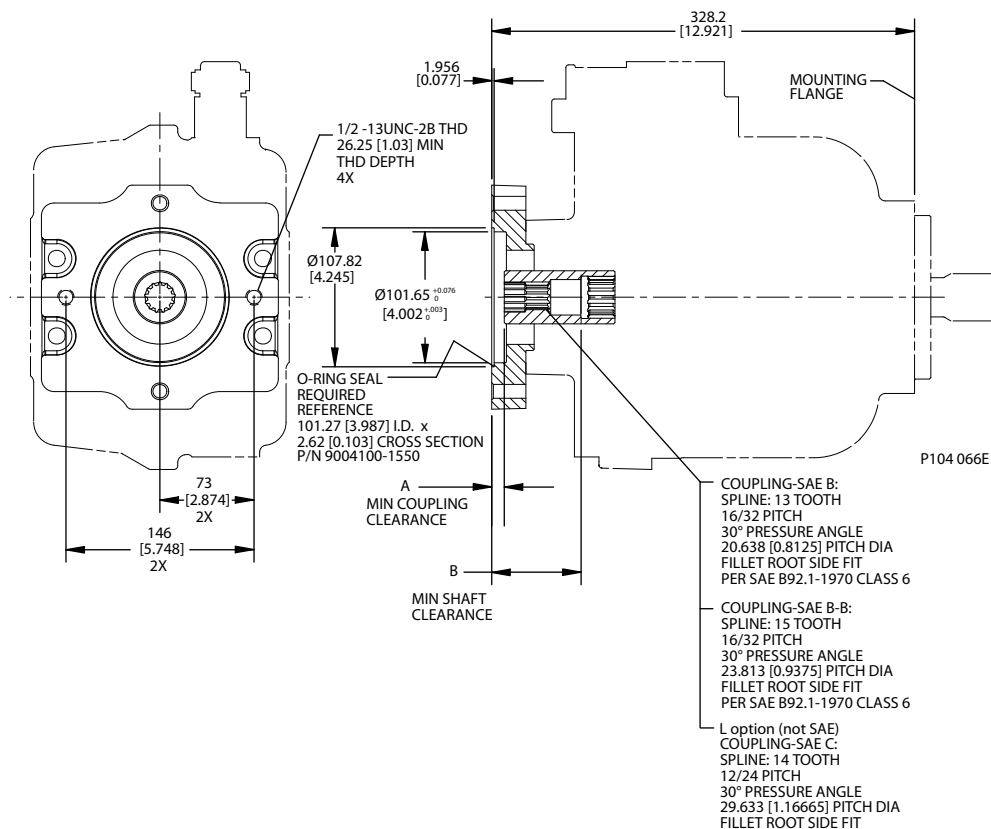


Specifications

Coupling	9-tooth	11-tooth
Spline minimum engagement	13.5 mm [0.53 in]	13.5 mm [0.53 in]
Maximum torque	107 N•m [950 lbf•in]	147 N•m [1300 lbf•in]

Frame E

SAE-B Dimensions

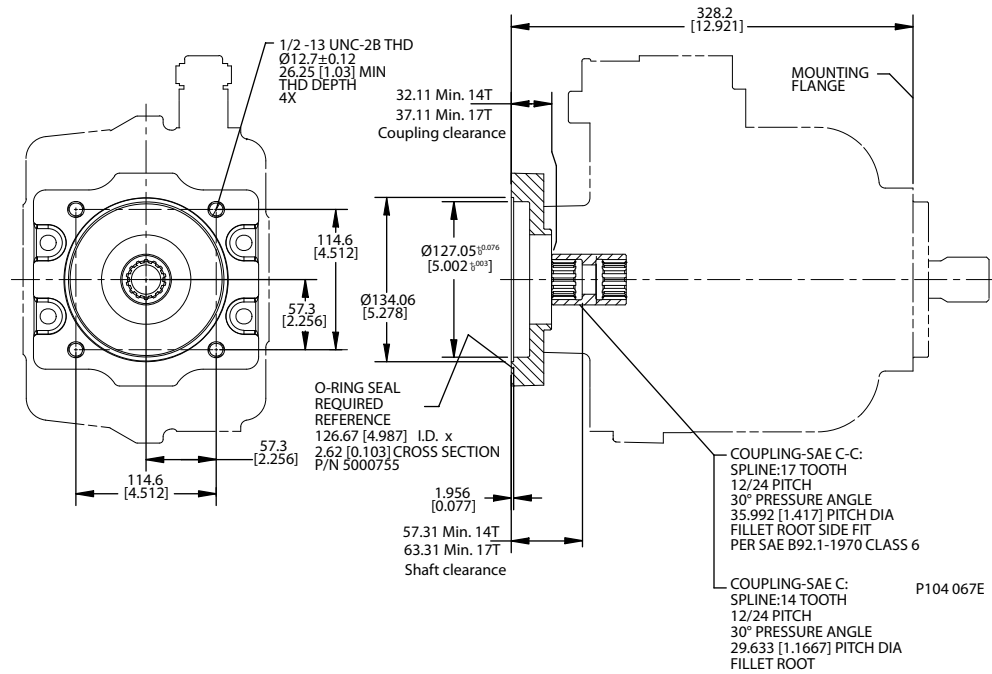


Specifications

Coupling	13 tooth	15 tooth	14 tooth
Spline Minimum Engagement	14.2 [0.559]	16.1 [0.634]	18.3 [0.720]
Maximum Torque	249 N·m [2200 lbf·in]	339 N·m [3000 lbf·in]	452 N·m [4000 lbf·in]
Dimension A	9.21 [0.36]	9.21 [0.36]	32.11 [1.26]
Dimension B	68.91 [2.71]	68.91 [2.71]	57.31 [2.256]

Frame E

SAE-C Dimensions



Specifications

Coupling	14-tooth	17-tooth
Spline minimum engagement	18.3 mm [0.72 in]	18.3 mm [0.72 in]
Maximum torque	452 N•m [4000 lbf•in]	452 N•m [4000 lbf•in]

Displacement Limiters

E Frame open circuit pumps are available with an optional adjustable displacement limiter. This adjustable stop limits the pump's maximum displacement.

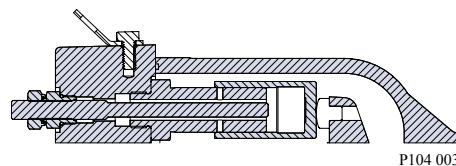
Setting range

E100B	40 to 100 cm ³ [2.44 to 6.1 in ³]
E130B	70 to 130 cm ³ [4.27 to 7.93 in ³]
E147C	87 to 147 cm ³ [5.31 to 8.97 in ³]

Displacement per turn

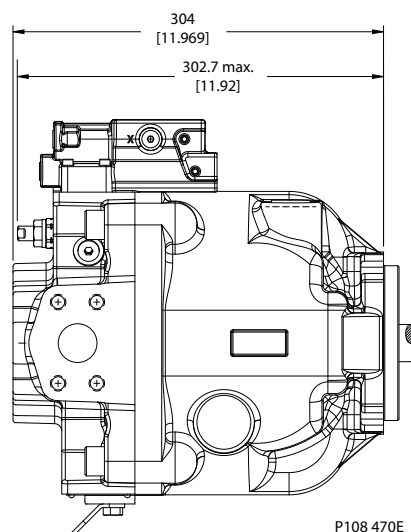
E100B	8.4 cm ³ /rev [0.51 in ³ /rev]
E130B	8.4 cm ³ /rev [0.51 in ³ /rev]
E147C	8.4 cm ³ /rev [0.51 in ³ /rev]

Displacement limiter cross-section



Frame E

Dimensions



Products we offer:

- Cartridge valves
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydraulic integrated circuits (HICs)
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
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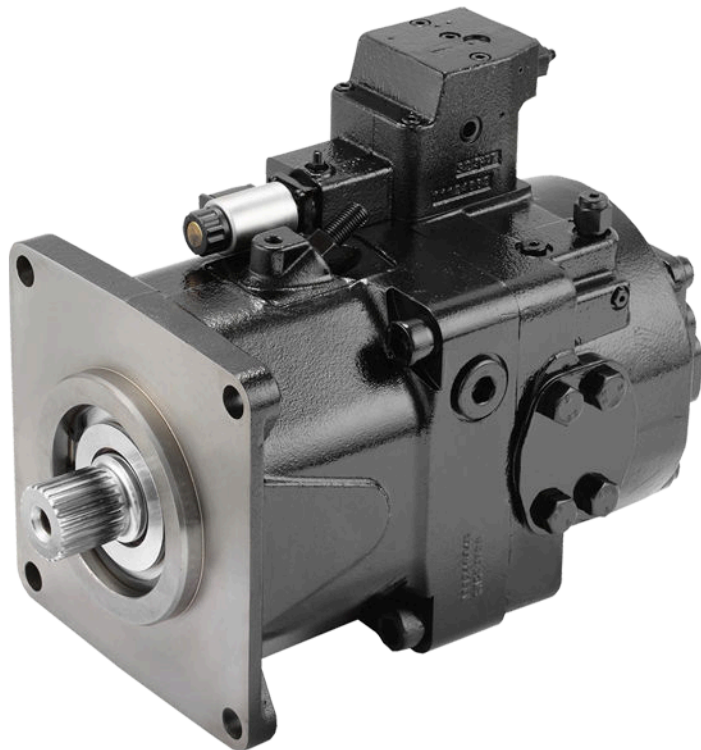
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Danfoss

Technical Information

D1 High Power Open Circuit Pumps

Size 130/145/193/260



Revision history

Table of revisions

Date	Changed	Rev
December 2021	Updated shaft specifications drawings	0501
October 2021	Added new auxiliary mounting options, updated inlet pressure gauge port section, corrected displacement setting sections	0401
February 2021	Added angle sensor section for D1P 260	0305
June 2020	Changed document number from 'BC00000243' and 'L1426007' to 'BC157786485289' and corrected shaft descriptions	0304
June 2019	Updated Model Code chapter	0202
December 2018	Updated shaft torque specifications	0201
November 2018	Added shaft option K	0113
October 2018	Minor Update	0112
August 2018	Minor Update (Model Code)	0111
July 2018	Minor Update	0110
July 2018	Added NPNR Control	0109
June 2018	Major Update	0108
May 2018	Added units and drawing	0107
January 2017	Added Size 130	0106
September 2016	some update of drawing and numbers	0105
May 2016	Added Size 260	0104
March 2016	minor update	0103
February 2016	minor update	0102
January 2016	Converted to Danfoss layout - DITA CMS	0101
July 2015	Updated drawings	AC
April 2015	Added 145 cc information	AB
May 2014	First edition	AA

Contents

General Information

Overview.....	6
Features and benefits.....	6
Typical applications.....	6
Design.....	7

Technical Specifications

Pump specifications.....	9
Fluid specifications.....	10
D1P 260 angle sensor.....	11
Angle sensor principle.....	11
Location.....	11
Angle sensor characteristics.....	12
Angle sensor electrical specifications.....	13
Angle sensor calibration.....	13
Angle sensor functionality.....	14

Model Code

Model code.....	15
Displacement, rotation and product version.....	16
Control types.....	16
Input shaft options.....	17
Mounting flange options.....	17
End cap and main port options.....	17
Auxiliary mounting flange options.....	18
Power control settings.....	18
Pressure compensated control settings.....	19
Load sensing control settings.....	19
Hydraulic displacement control setting.....	19
Maximum and minimum displacement settings.....	19
Minimum displacement settings.....	19
Special hardware and features.....	20
Tandem pump information.....	21

Parameters

Pressure.....	22
Speed.....	22
Performance.....	23
Input power.....	23
Output flow.....	25
Efficiency.....	26
Fluid.....	27
Viscosity.....	27
Temperature.....	27
Fluid velocity.....	27
Shaft torque ratings.....	28
Shaft load.....	28
Mounting flange loads.....	28
Auxiliary mounting pads.....	28
Estimating overhung load moments.....	29
Understanding and minimizing system noise.....	30
Installation.....	30
Filtration.....	30
Reservoir.....	31
Sizing Equations.....	31

Control Type

NPNN (Pressure Compensated Control).....	32
NPSN (Pressure Compensated Control + Load Sensing Control).....	34
NPNR (Pressure Compensated Control + Remote Pressure Compensated Control).....	36
TPSN (Power Control + Pressure Compensated Control + Load Sensing Control).....	38

Contents

NNES (Electric Displacement Control + Load Sensing Control).....	40
Solenoid Specification.....	42
Standard EDC Valve.....	43
NNES Priority.....	43
TPE2/TPE5 (Power Control + Pressure Compensated Control + Electric Displacement Control).....	44
TPE2/TPE5 Priority.....	44
NPE2/NPE0 (Pressure Compensated Control + Electric Displacement Control).....	45

Installation Drawings

Size 130/145.....	46
Dimensions (mm) and port descriptions.....	46
Size 130/145: TPSN w/o Charge Pump.....	46
Size 130/145: TPE5 w/o Charge Pump.....	48
Size 130/145: TPSN w/ Charge pump	50
Size 130/145: TPE5 w/ Charge Pump.....	52
Input shaft.....	54
Shaft specifications.....	54
Aux mounting flange.....	56
Size 130/145: Option NN (No Coupling).....	56
Size 130/145: Option A1 (SAE-A, 9 teeth).....	56
Size 130/145: Option A2 (SAE-A, 11 teeth).....	57
Size 130/145: Option B1 (SAE-B, 13 teeth).....	58
Size 130/145: Option B2 (SAE-B, 15 teeth).....	58
Size 130/145: Option BA (SAE-B, 13 teeth).....	59
Size 130/145: Option C5 (SAE-C, 14 teeth).....	59
Size 130/145: Option D5 (SAE-D, 24 teeth).....	60
Size 193.....	61
Dimensions (mm) and port descriptions.....	61
Size 193: TPE2 w/ Charge Pump.....	61
Size 193: TPSN w/ Charge Pump.....	63
Input shaft.....	65
Shaft specifications.....	65
Aux mounting flange.....	68
Size 193: Option NN (No Coupling).....	68
Size 193: Option A1 (SAE-A, 9 teeth).....	68
Size 193: Option A3 (SAE-A, 13 teeth).....	69
Size 193: Option B1 (SAE-B, 13 teeth).....	69
Size 193: Option B2 (SAE-B, 15 teeth).....	70
Size 193: Option BA (SAE-B, 13 teeth)	71
Size 193: Option BB (SAE-B, 13 teeth).....	72
Size 193: Option C5 (SAE-C, 14 teeth).....	73
Size 193: Option C9 (SAE-C, 13 teeth).....	73
Size 193: Option D2 (SAE-D, 13 teeth).....	74
Size 193: Option D5 (SAE-D, 24 teeth).....	74
Size 193: Option E2 (SAE-E, 24 teeth).....	75
Size 260.....	76
Dimensions (mm) and port descriptions.....	76
Size 260: TPE2 w/ Charge Pump.....	76
Size 260: TPSN w/ Charge Pump.....	78
Input shaft.....	80
Shaft specifications.....	80
Aux mounting flange.....	83
Size 260: Option A1 (SAE-A, 9 teeth).....	83
Size 260: Option A3 (SAE-A, 13 teeth).....	83
Size 260: Option B1 (SAE-B, 13 teeth).....	84
Size 260: Option B2 (SAE-B, 15 teeth).....	84
Size 260: Option BA (SAE-B, 13 teeth).....	85
Size 260: Option BB (SAE-B, 13 teeth).....	86
Size 260: Option C5 (SAE-C, 14 teeth).....	87
Size 260: Option C9 (SAE-C, 13 teeth).....	88

Contents

Size 260: Option D2 (SAE-D, 13 teeth).....	88
Size 260: Option D5 (SAE-D, 24 teeth).....	89
Size 260: Option E2 (SAE-E, 24 teeth).....	89
Size 260: Option E3 (SAE-E, 28 teeth).....	90
Inlet pressure gauge port.....	91

Additional Information

Tandem with Danfoss pumps.....	93
Tandem pump torque.....	93
Tightening torque.....	94

Installation Notes

Below reservoir (standard).....	95
Above reservoir.....	96
Reservoir installation.....	97

Displacement Limiter

Displacement limiter setting.....	98
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General Information

D1P overview

The D1 pump series are high performance variable axial piston pumps designed primarily for open circuit hydraulic systems used in heavy duty mobile applications.

Displacement options

- 130 cm³ [7.93 in³]
- 145 cm³ [8.85 in³]
- 193 cm³ [11.78 in³]
- 260 cm³ [15.87 in³]

Product highlights

- Maximum working pressure: 350 bar [5076 psi], peak pressure (intermittent): 400 bar [5802 psi].
- Input speed up to 2,500 rpm.

Control options

- Mechanical power control
- Electric power control
- Pressure compensated control
- Remote pressure compensated control
- Electric proportional displacement control
- Load sensing control

D1P features and benefits

- Robust design for harsh conditions.
- Swashplate, servo-controlled design, with proven reliability and performance.
- Angled piston bore design improves self-priming capability.
- The spherical valve plate and cylinder block interface provide stable cylinder block rotation, thus achieving high efficiency.
- Integral charge pump option allows the pump to run at higher speed and achieve good cold start performance.
- Full through-drive capability is suitable for adding axial piston pumps and gear pumps.
- Optimized cradle bearing improves pump service life.
- PLUS+1® compliant controls.
- Can be used together in combination with other Danfoss Power Solutions products in the overall hydraulic system, such as:
 - Pumps (S45, S90, H1P, gear pumps, etc.)
 - PVG valves
 - Motors (S90, H1B, etc.)

D1P typical applications

- Concrete Machinery
- Mining Machinery
- Drilling Machinery
- Material Handling
- Marine and Off-shore Machinery
- Oil Machinery

General Information

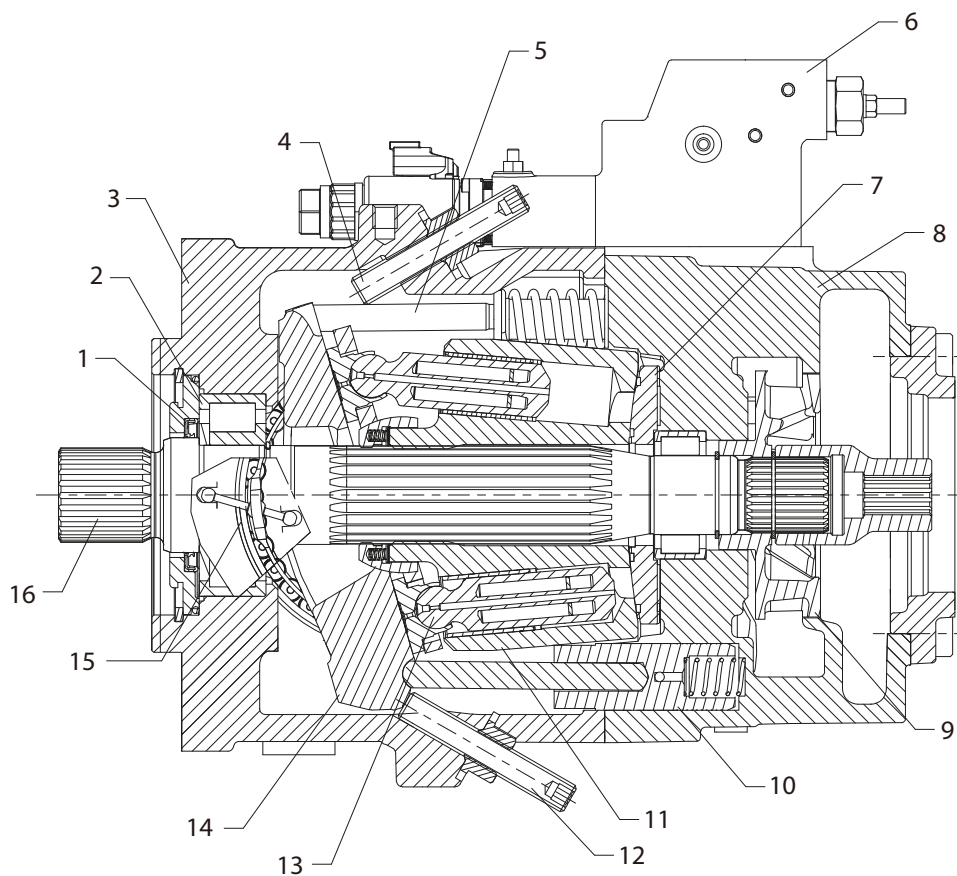
- Excavators
- Wheel Loaders
- Industrial Hydraulics

Design

D1P sectional view

The cross sectional view of the D1P can be used to identify individual parts of the product.

Series D1 pump (w/charge pump) cross-section view



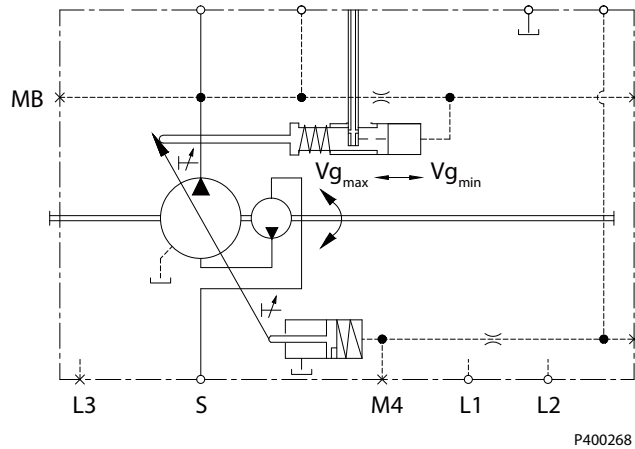
- | | | |
|--|---------------------------|---|
| 1. Shaft Seal | 2. Roller Bearing | 3. Housing |
| 4. Minimum Displacement Limiter | 5. Bias Piston | 6. Control (TPE5/TPE2) |
| 7. Valve Plate | 8. End cap | 9. Charge Pump |
| 10. Servo Piston | 11. Cylinder Block | 12. Maximum Displacement Limiter |
| 13. Piston | 14. Swashplate | 15. Swashplate Bearing |
| 16. Input Shaft | | |

Some internal parts may be different depending on frame size and options desired.

General Information

D1P schematic with charge pump

Basic schematic without control/with charge pump



The charge pump (see schematic) is a circulating pump with which the pump is charged and therefore can be operated at higher speeds. This also improves cold starting at low temperatures and high viscosity of the hydraulic fluid. The pressurized reservoir is therefore unnecessary in most cases. A reservoir pressure of a max. 2 bar is permissible with charge pump.

Technical Specifications
D1 130-260 pump specifications
(Theoretical values, without efficiency and tolerances; value rounded)

Features		Unit	130		145		193		260
			W/O Impeller	W/ Impeller	W/O Impeller	W/ Impeller	W/O Impeller	W/ Impeller	W/ Impeller
Displacement	Maximum	cm ³ [in ³]	130 [7.93]	130 [7.93]	145 [8.85]	145 [8.85]	193 [11.78]	193 [11.78]	260 [15.87]
	Minimum		0	0	0	0	0	0	0
Available rotation		CCW [L]	●	●	●	●		●	●
		CW [R]	●	●	●	●	●	●	●
Input speed	Min.	rpm	500	500	500	500	500	500	500
	Rated at max. displacement (Vg max.)		2200 ¹	2500 ²	2200 ¹	2500 ²	2200 ¹	2500 ¹	2300 ²
	Maximum at Vg < Vg max. ³		2500	2500	2200	2500	2500	2500	2300
Flow at max. speed & displacement (n max. & Vg max.)		l/min [US gal/min]	286 [76]	325 [86]	319 [84]	363 [96]	425 [112]	483 [128]	598 [158]
System (working) pressure ⁴	Max. working pressure	bar [psi]	350 [5076]						
	Max. pressure		400 [5802]						
Inlet pressure (absolute)	Minimum	bar [psi]	0.8 [11.6]	0.6 [8.7]	0.8 [11.6]	0.6 [8.7]	0.8 [11.6]	0.6 [8.7]	0.6 [8.7]
	Maximum		30 [435] ⁵	2 [29]	30 [435]	2 [29]	30 [435]	2 [29]	2 [29]
Case pressure (absolute)	Maximum above inlet	bar [psi]	1.2 [17.4]						
	Maximum		2 [29]						
Filling capacity		L [US gal]	2.9 [0.77]		2.9 [0.77]		3.8 [1]		4.6 [1.3]
Torque at Vg max. & Δp = 350 bar		N·m [lbf·in]	724 [6408]		808 [7151]		1075 [9515]		1448 [12816]
Power at Q max. (max. flow) & Δp = 350 bar		kW [hp]	159 [213]	190 [255]	186 [249]	211 [283]	248 [332]	281 [377]	349 [468]
Mass moment of inertia of internal rotating components		kg·m ² [slug·ft ²]	0.0299 [0.0221]	0.0306 [0.0226]	0.0299 [0.0221]	0.0306 [0.0226]	0.0547 [0.0403]	0.0576 [0.0426]	0.2080 [0.1537]
Mass		kg [lb]	68 [150]	74 [163]	68 [150]	74 [163]	101 [222]	106 [234]	141 [311]
External shaft loads	External moment M _e	N·m [lbf·in]	476 [4213]		476 [4213]		822 [7275]		1081 [9568]
Mounting flange load moments	Vibratory (continuous)	N·m [lbf·in]	4553 [40297]		4553 [40297]		6286 [55636]		8477 [75027]
	Shock (maximum)		8692 [76930]		8692 [76930]		13782 [121980]		16338 [144603]

¹ The values apply at absolute pressure (Pabs) of at least 0.8 bar [11.6psi] at the suction port S and mineral hydraulic fluid.

² The values apply at absolute pressure (Pabs) of at least 0.6 bar [8.7psi] at the suction port S and mineral hydraulic fluid.

³ The values apply at Vg ≤ Vg max or in case of an increase in the inlet pressure (Pabs) at the suction port S. Please refer to *Inlet Pressure vs Speed Graph* at [D1P speed overview](#) on page 22

⁴ Applied pressures above maximum working pressure requires Danfoss application approval. Maximum (peak) pressure is the highest intermittent (t<1s) outlet pressure allowed.

⁵ If the application requires the higher inlet pressure than 5 bar [72.5psi] (up to 30 bar [435psi]), please contact.Danfoss Power Solutions.

[Counterclockwise \(CCW\) & Clockwise \(CW\) directions as viewed from the shaft end of the pump.](#)

Exceeding the permissible values could cause a loss of function, reduced life or the destruction of the pump.

Do not exceed the values shown in the table above.

Technical Specifications
D1P fluid specifications

Features		Units	Value
Viscosity	Intermittent ¹⁾	mm ² /sec [SUS]	5 [42]
	Minimum		7 [49]
	Recommended range		16 - 36 [81 - 168]
	Maximum (cold start) ²⁾		1600 [xxxxx]
Temperature range	Minimum (cold start) ²⁾	°C [°F]	-40 [-40 °F]
	Maximum intermittent ¹⁾		115 [239 °F] ³⁾
Filtration (minimum) Cleanliness per ISO 4406	Temperature Range: -40 - 90 °C [-40 - 194°F]		20/18/15
	Temperature Range: 90 - 115 °C [194 - 239°F]		19/17/14

¹⁾ Intermittent = Short term $t < 3\text{min}$ per incident.

²⁾ Cold start = Short term $t < 3\text{min}$, $p \leq 30\text{ bar}$ [435 psi], $n \leq 1000\text{ min}^{-1}$ (rpm) , please contact Danfoss Power Solutions especially when the temperature is below -25 °C [-13 °F].

³⁾ Must not be exceeded locally either (e.g. in the bearing area) . The temperature in the bearing area is (depending on pressure and speed) up to 5 °C [41 °F] higher than the average case drain temperature.

Technical Specifications

D1P 260 angle sensor

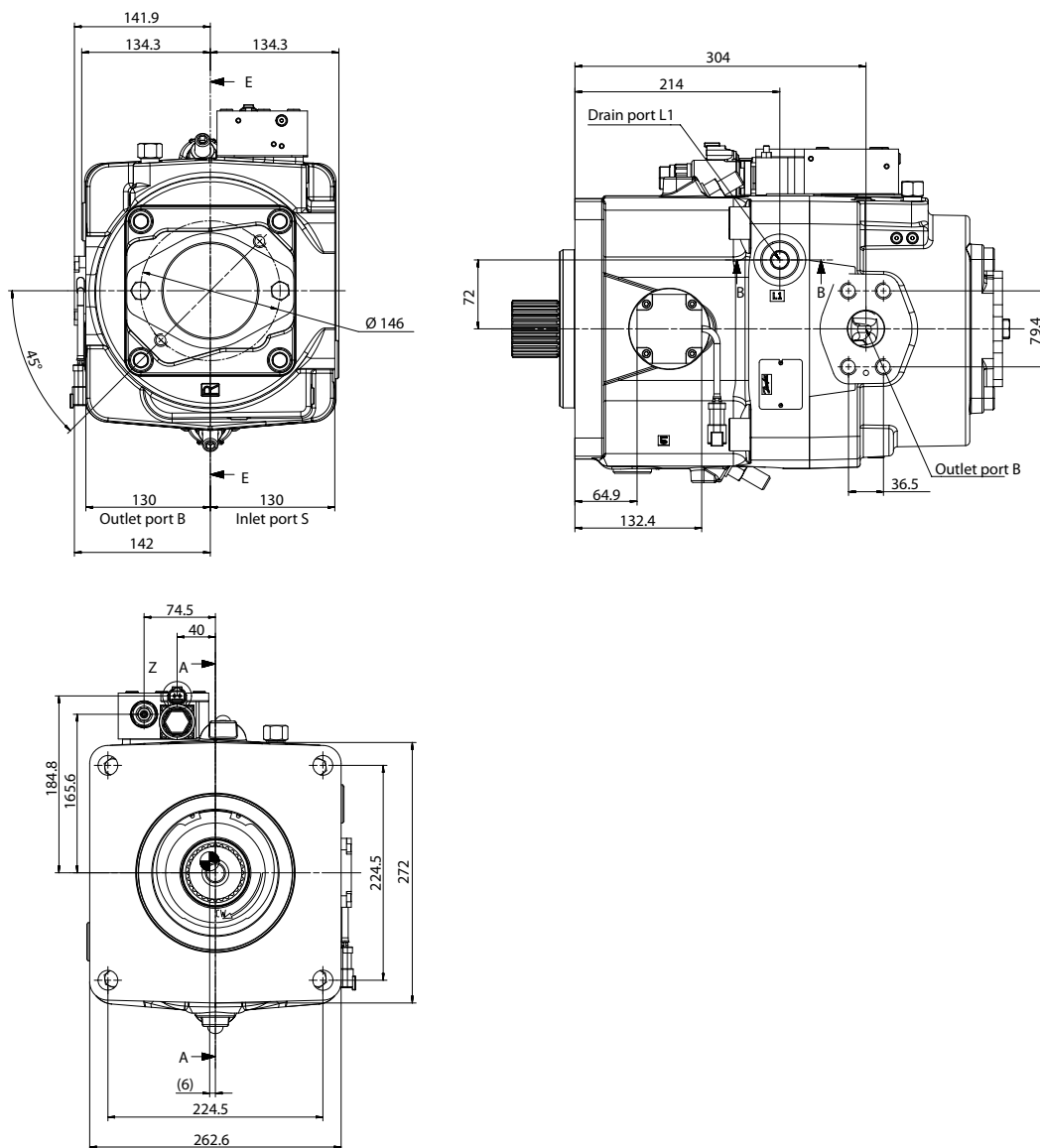
Angle sensor principle

The angle sensor option is exclusive to the D1P 260.

The angle sensor option offered in D1P allows users to measure the angle of pump displacement. The angle sensor is an electronic sensor mounted to the housing of the pump, which reads the pump stroke angle based on the swashplate position. Interfacing with the angle sensor is achieved through a 4-pin DEUTSCH DTM04-4P receptacle attached to a flexible connection cable (for a mating connector, use DEUTSCH plug DTM06-4S). The sensor is mounted to the pump within an aluminum housing to prevent magnetic interference.

Location

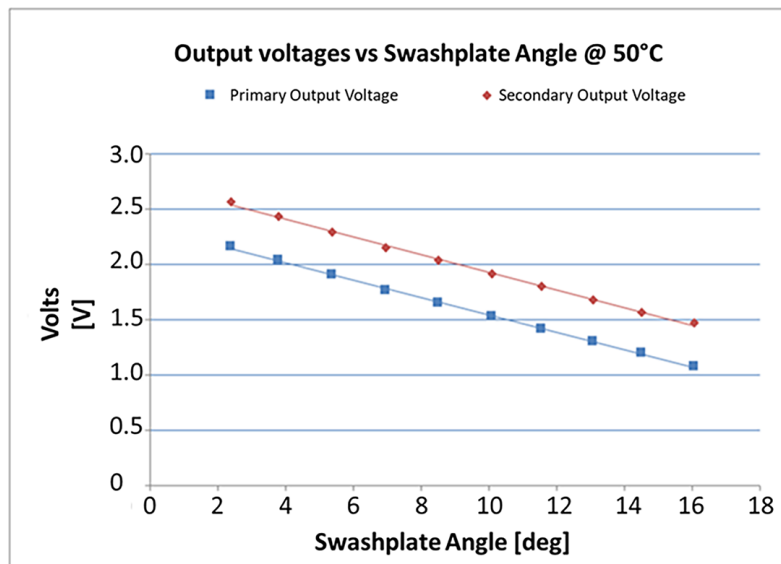
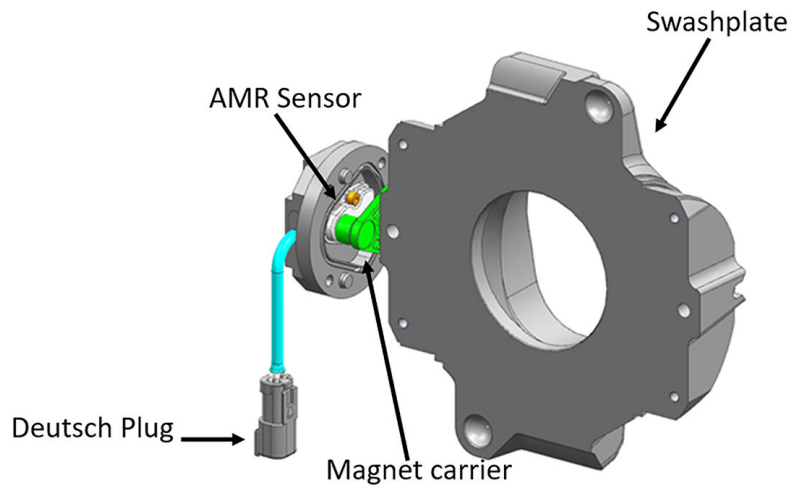
When the input shaft with the control is on the top side, the angle sensor will be viewed on the right-hand side. This convention is true for both clockwise and counterclockwise rotation.



Technical Specifications

Angle sensor characteristics

The angle sensor package incorporates two sensor signals (primary & secondary) within a single sensor housing. This package allows for improved accuracy and troubleshooting.



Technical Specifications
Angle sensor electrical specifications

Description	Minimum	Typical	Maximum	Unit	Note
Supply (V+)	4.75	5	5.25	Vdc	Sensor is ratiometric in the voltage range
Supply protection	-	-	28	Vdc	Sensor will switch off above 5.5 V
Supply current drawn	-	22	25	mA	Sensor supply at 5 V
Output short circuit current (VDD to SIG ½ and GND to SIG ½)	-	-	7.5	mA	Additional 7.5 mA for each sensor signal, total sensor 7.5x2+22=37 mA typical for FSO
Resolution	-	0.03	-	Degree	11 bit output channel
Hysteresis	-	-	-	-	Design of sensor eliminates any mechanical hysteresis
Environment temperature range	-40 [-40]	80 [176]	104 [220]	°C [°F]	If temperature limits are exceeded, the sensor will function at a reduced level of performance
Operating temperature range	20 [68]	50 [122]	104 [220]	°C [°F]	Temperature of oil
Storage temperature	-40 [-40]	-	125 [257]	°C [°F]	-
Refresh rate of the sensor	-	-	100	µs	Internal ADC refresh rate

Angle sensor calibration

A 2-point calibration of the sensor is recommended, with points measured at pump standby and maximum pump stroke. Maximum pump stroke can be achieved when the pump input shaft is not being turned, as D1P pumps are biased to maximum displacement. In some cases, the pump may need to be turned momentarily to ensure the pump is in the maximum displacement position; this can be achieved through a momentary switching of the engine starter on/off.

For minimum displacement calibration, the angle sensor can be calibrated by sending the pump to a standby condition, either high-pressure with a pressure compensator (PC control) or low-pressure with a flow compensator (LS control). Low-pressure standby is recommended if the control has load sensing or remote PC functionality. For best results, it is recommended to rotate the prime mover at the highest operating speed to achieve the lowest angle possible at standby conditions.

Technical Specifications**Angle sensor functionality**

The D1P angle sensor option is intended for advanced functionality such as electronic torque limiting, duty cycle measurement, troubleshooting, etc. The angle sensor is PLUS+1[®] compliant with an available hardware compliance block.

Angle Sensor Intended Functionality:

- Electronic Torque Limiting*
- Duty Cycle Recording
- Troubleshooting

Angle Sensor Unsupported Functionality:

- Displacement/Flow Control

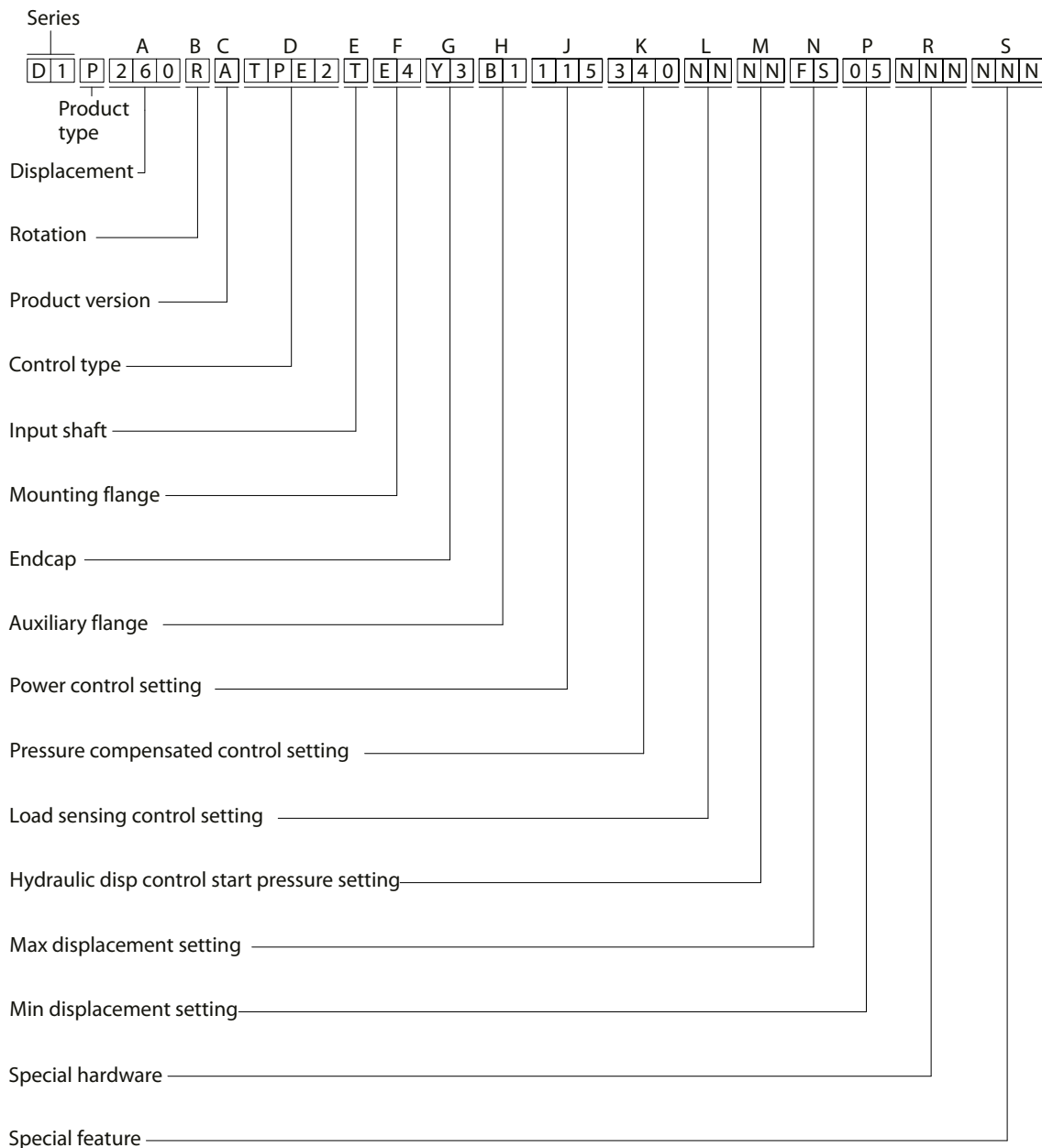
* Pre-programmed Electronic Torque Limiting control packages are currently not offered for D1P.

Model Code

D1P model code

The below illustration and the following sections describe how to identify parts of the model code and availability of certain part options based on frame size.

Example model code; D1P 260 shown



Model Code
D1P 130-260 displacement, rotation and product version
Displacement

Code	Description	130	145	193	260
130	130 cm ³ [7.93 in ³] max. displacement per revolution	●			
145	145 cm ³ [8.85 in ³] max. displacement per revolution		●		
193	193 cm ³ [11.78 in ³] max. displacement per revolution			●	
260	260 cm ³ [15.87 in ³] max. displacement per revolution				●

Rotation

Code	Description	130	145	193	260
R	Clockwise [CW]	●	●	●	●
L	Counter Clockwise [CCW]	●	●	●	●

Product Version

Code	Description	130	145	193	260
A		●	●	●	●

D1P 130-260 control types

Code	Description	130	145	193	260
NPNN	Pressure Compensated Control	●	●	●	●
NPSN	Pressure Compensated Control + Load Sensing Control	●	●	●	●
NPNR	Pressure Compensated Control + Remote Pressure Compensated Control	●	●	●	●
TPSN	Power Control + Pressure Compensated Control + Load Sensing Control	●	●	●	●
NNES	Positive Electric Displacement Control (24V DEUTSCH, 2-pin) w/Manual Override + Load Sensing Control	●	●	●	●
TPE2	Power Control + Pressure Compensated Control + Positive Electric Displacement Control (24V DEUTSCH, 2-pin) w/Manual Override			●	●
TPE5	Power Control + Pressure Compensated Control + Positive Electric Displacement Control (24V DEUTSCH, 2-pin) w/Manual Override (The control outline and size is the same as the 193/260 TPE2 control)	●	●		
NPE2	Pressure Compensated Control + Positive Electric Displacement Control (24V DEUTSCH, 2-pin) w/Manual Override	●	●	●	●
NPE0	Pressure Compensated Control + Positive Electric Displacement Control (24V DEUTSCH, 2-pin) w/Manual Override w/o Shuttle valve	●	●	●	●

Control Code Explanation:

- First digit: Power control (Torque control) , "N" means no power control.
- Second digit: Pressure compensated control, "N" means no pressure compensated control.
- Third & Fourth digits: Proportional displacement control or Load sensing control , "NN" means no control in either category.

 Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install the relief valve can lead to system damage and/or injury.

Model Code
D1P 130-260 input shaft options

Code	Description	130	145	193	260
T	130/145/193: Spline, DIN 5480 W50 x 2 x 30 x 24 x 9g; 260: Spline, DIN 5480 W60 x 2 x 30 x 28 x 9g; Shaft Seal Material: FKM	●	●	●	●
S	Spline, SAE J744 1 3/4in, 13T 8/16 DP; Shaft Seal Material: FKM	●	●	●	●
A	193: Spline, SAE J744 2in, 15T 8/16 DP; 260: Spline, SAE J744 2 1/4in, 17T 8/16 DP; Shaft Seal Material: FKM			●	●
P	Straight Keyed DIN 6885, 130/145: AS14 x 9 x 80 193: AS16 x 10 x 100 260: AS18 x 11 x 100 Shaft Seal Material: FKM	●	●	●	●
K*	SAE J744 (D/E) 3in straight keyed shaft 0.4375x3.000in			●	●

* There is no impeller option for sizes 130 and 145 with this shaft.

D1P 130-260 mounting flange options

Code	Description	130	145	193	260
D4	SAE J744 152-4 (D)	●	●		
E4	SAE J744 165-4 (E)			●	●

D1P 130-260 end cap and main port options
End cap and main ports

Code	Description	Rotation	130	145	193	260
N1	Radial, side, flange ports Inlet: 3in port, M16 x 2; Outlet: 1in port, M12 x 1.75 SAE J518 without impeller	CW [R] CCW [L]	●	●		
N2	Radial, side, flange ports Inlet: 3 1/2in, M16 x 12; Outlet: 1 1/2in, M16 x 2 SAE J518 Without impeller	CW [R]			●	
Y1	Radial, side, flange ports Inlet: 3in port, M16 x 2; Outlet: 1 1/4in port, M14 x 2 SAE J518 With impeller	CW [R] CCW [L]	●	●		
Y2	Radial, side, flange ports Inlet: 3 1/2in port, M16 x 2; Outlet: 1 1/2in port, M16 x 2 SAE J518 With impeller	CW [R] CCW [L]			●	
Y3	Radial, side, flange ports Inlet: 4in port, M16 x 2; Outlet: 1 1/2in port, M16 x 2 SAE J518 With impeller	CW [R] CCW [L]				●

Model Code
D1P 130-260 auxiliary mounting flange options
Auxiliary mounting flange (through-drive flange)

Code	Description	130	145	193	260
NN	No auxiliary flange	●	●	●	●
A1	SAE J744 82-2 (A); Spline coupling: 5/8in 9T 16/32DP	●	●	●	●
A2	SAE J744 82-2 (A); Spline coupling: 3/4in 11T 16/32DP	●	●		
A3	SAE J744 82-2 (A); Spline coupling: 7/8in 13T 16/32DP			●	●
B1	SAE J744 101-2 (B) ; Spline coupling: 7/8in 13T 16/32DP	●	●	●	●
B2	SAE J744 101-2 (B); Spline coupling: 1in 15T 16/32DP	●	●	●	●
BA	SAE J744 101-2 (B); Spline coupling: 7/8in 13T 16/32DP; Adapter 90°	●	●	●	●
BB	SAE J744 101-2 (B); Spline coupling: 7/8in 13T 16/32DP; Cover 45°			●	●
C5	SAE J744 127-2&4 (C) ; Spline coupling:1 1/4in 14T 12/24DP	●	●	●	●
C9	SAE J744 127-2&4 (C); Spline coupling: 1 3/4in 13T 8/16DP			●	●
D2	SAE J744 152-4 (D); Spline coupling: 1 3/4in 13T 8/16DP	●	●	●	●
D5	SAE J744 152-4 (D) ; Spline coupling: N50x2x30x24x9H	●	●	●	●
E2	SAE J744 165-4 (E) ; Spline coupling: N50 x 2 x 30 x 24 x 9H			●	●
E3	SAE J744 165-4 (E) ; Spline coupling: N60 x 2 x 30 x 28 x 9H				●

D1P 130-260 power control settings
Power control setting at 1500rpm (kW), "3 digit code"

Code ¹	Description	130	145	193	260
NNN	No Power Control	●	●	●	●
XXX	xxx kW between ranges specified below (For example: Code "090" means 90kW) at 1500 rpm				
030-115	30-115 kW [40-154 hp] at 1500 rpm ²	●	●		
035-155	35-155 kW [47-208 hp] at 1500 rpm ²			●	
040-210	40-210 kW [54-282 hp] at 1500 rpm ²				●

¹ For settings out of these ranges, please contact Danfoss Power Solutions.

² Only increments of 5kW [6.7 hp] are allowed. E.g. 035, 040, 045, etc.)

If the speed is not 1500rpm, please make a conversion using the following formula, assuming constant torque:

$$P_{\text{setting@1500 rpm}} = P_{\text{actual}} * \frac{1500}{n_{\text{actual}}}$$

For example:

If actual power is 110 kW at 2100 rpm, the conversion to obtain the power control setting at 1500 rpm should be $110 * 1500 / 2100 = 79$, choose 080 option (round to closest 5 kW increment option).

Model Code

D1P 130-260 pressure compensated control setting

Pressure compensated control setting (bar), "3 digit code"

Code*	Description	130	145	193	260
NNN	No Pressure compensated control	●	●	●	●
XXX	xxx bar between the range specified below (For example: Code "320" means 320 bar [4641 psi])				
150~350	150~350 bar [2176~5076 psi] (Please select pressure compensated control setting in increments of 10 bar [145 psi]. E.g. 150 or 160 or 170, etc.)	●	●	●	●

* For settings out of these ranges, please contact Danfoss Power Solutions.

D1P 130-260 load sensing control settings

L - Load Sensing Control Setting (bar), "2 digit code"

Code	Description	130	145	193	260
NN	No load sensing control	●	●	●	●
XX	xx bar between the range specified below (For example: Code "25" means 25 bar [363 psi])				
10~35*	10~35 bar [145~508 psi] (Please select load sensing control setting in increments of 1 bar [14.5 psi]. E.g. 10 or 11 or 12, etc.)	●	●	●	●

* For settings out of these ranges, please contact Danfoss Power Solutions. Range allowed for NPNR (Pressure compensated + Remote Pressure compensated control) is 15-35 bar

D1P 130-260 hydraulic displacement control setting

Hydraulic displacement control start pressure setting, "2 digit code"

Code	Description	130	145	193	260
NN	No hydraulic displacement control	●	●	●	●
04-10	4-10 bar			●	●

D1P 130-260 maximum displacement settings

Maximum displacement setting, "2 digit code"

Code	Description	130	145	193	260
FS	Factory setting : 100%	●	●	●	●
XX ¹	XX% of maximum displacement (For example: Code "90" means 90% of maximum displacement) ²	●	●	●	●

¹ Please consider frame sizing and increments when selecting a maximum displacement setting (see [displacement limiter](#) for more information).

² Only increments of 5% are allowed. (E.g. 70, 75, 80 etc.)

D1P 130-260 minimum displacement settings

Minimum displacement setting, "2 digit code"

Code	Description	130	145	193	260
FS	0% of maximum displacement limit setting	●	●	●	●
XX	XX% of maximum displacement limit setting ¹	●	●	●	●

¹ Only increments of 5% are allowed. (E.g. 05, 10, etc.)

Model Code

[If a different minimum displacement setting is required, please contact Danfoss Power Solutions.](#)

D1P 130-260 special hardware and special features

Special hardware

Code	Description	130	145	193	260
NNN	None	●	●	●	●
NNA	No special hardware; with angle sensor				●

Special features

Code	Description	130	145	193	260
NNN	Factory Setting (Paint-black, tag, Danfoss, format A)	●	●	●	●
NXN	Factory Setting (No paint, tag, Danfoss, format A, w/o filter)	●	●	●	●
NNF	Factory Setting (Paint-black, tag, Danfoss, format A) with control oil filter				●

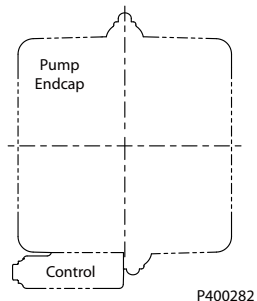
Model Code

D1P tandem pump information

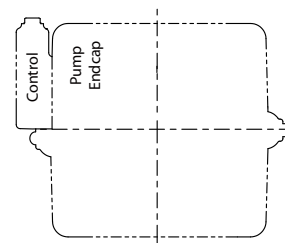
Information about tandem pump direction and ordering instructions are found below.

Pump direction

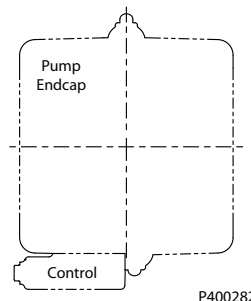
Auxiliary pump
INDEX = 0°



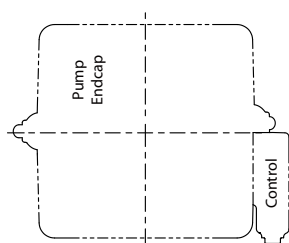
Auxiliary pump
INDEX = 90°



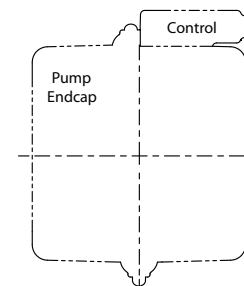
When assembling a system the first pump is always to be considered at 0° INDEX as shown below.



Auxiliary pump
INDEX = 270°



Auxiliary pump
INDEX = 180°



For gear pump tandem angle information, please contact Danfoss Power Solutions.

Ordering tandem pumps

When ordering tandem pumps, the type designations of the 1st and 2nd pumps must be connected by a "+", and tandem pump angle should be given as indicated below.

Ordering example:

D1P193RATPE2TE4Y2E2090320NNNNF5FSNNNNNN +

D1P193RATPE2TE4Y2NN090320NNNNF5FSNNNNNN

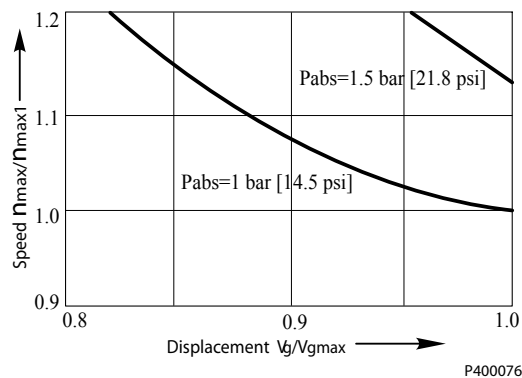
Tandem angle 0° + 180°

Parameters
D1P pressure overview

Maximum working pressure	The highest recommended outlet (application). Operating at or below this pressure should yield satisfactory product life. For all applications, the load should move below this pressure. This corresponds to the maximum allowable pressure compensated control setting.
Maximum (peak) pressure	The highest intermittent ($t < 1s$) outlet pressure allowed. Maximum machine load should never exceed this pressure, and pressure overshoots should not exceed this pressure.
Inlet pressure	The absolute pressure in the pump suction port, it is related to pump speed. Make sure it is in the allowable range, see D1 pump specifications .
Case pressure	The case pressure at the ports L1 and L2 may be a maximum of 1.2 bar [17.4 psi] higher than the inlet pressure at the port S but not higher than 2 bar. Size drain plumbing accordingly and connect it to tank directly. The housing must always be filled with hydraulic fluid.

D1P speed overview

Rated speed	The fastest recommended operating speed at full displacement and at least 0.6 bar [8.7 psi] abs with charge pump (0.8 bar [11.6 psi] abs without charge pump) inlet pressure. Operating at or below this speed should yield satisfactory product life.
Maximum speed	The highest recommended operating speed at full power conditions. Operating at or beyond maximum speed requires positive inlet pressure and/or a reduction of pump outlet flow. Refer to the <i>Inlet pressure vs. speed</i> chart below.

Inlet pressure vs. speed


Minimum speed	The lowest operating speed allowed. Operating below this speed will not yield satisfactory performance.
----------------------	---

Caution! Threat to pump life!

Working outside of the pump's operating parameters may result in shortened life expectancy of the pump.

Always work within the operating conditions of the pump application.

With accurate duty cycle information, your Danfoss Power Solutions representative can assist you in calculating expected pump life.

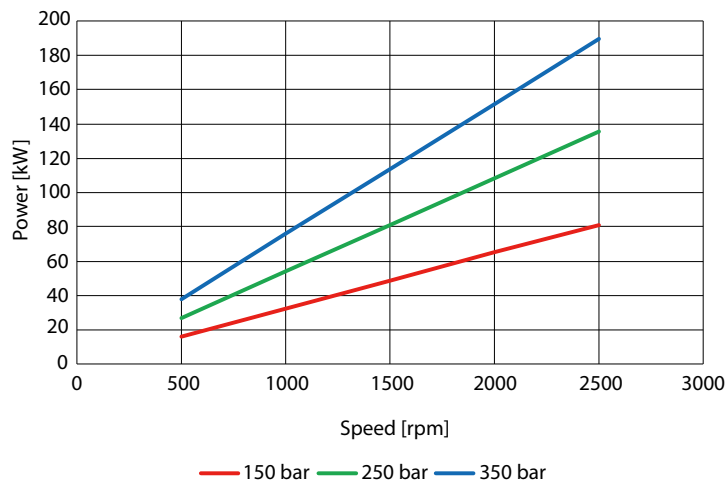
Parameters

Performance

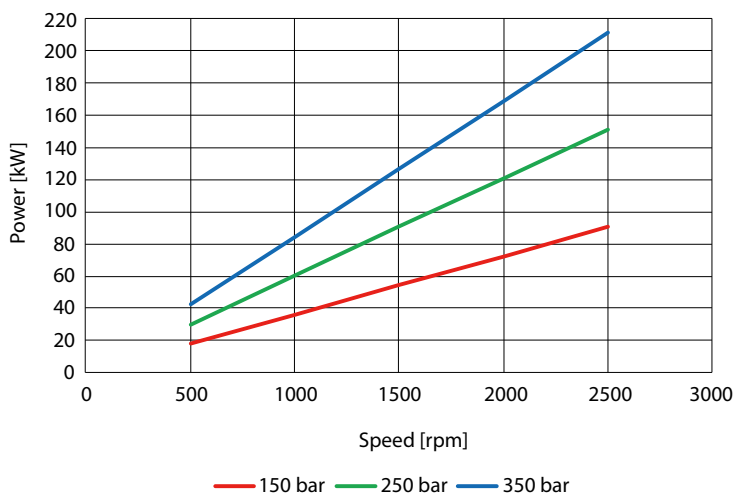
D1P input power

Input power requirements depend on displacement per revolution, speed, efficiency, and operating pressure.

130cc power vs input speed

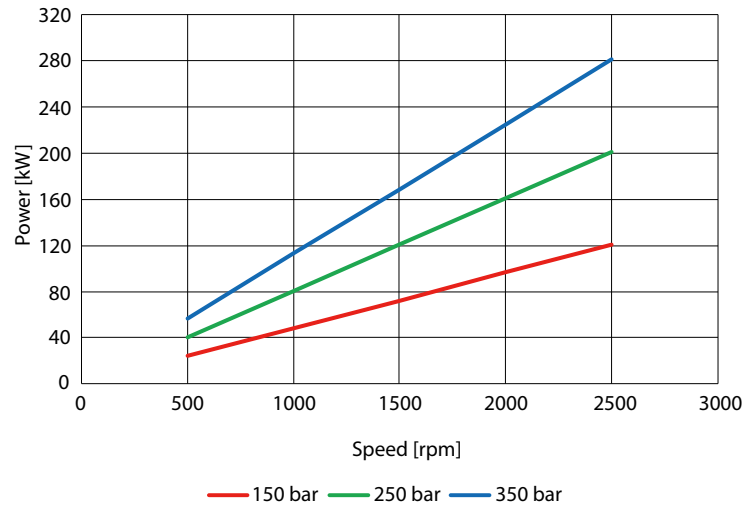


145cc power vs input speed

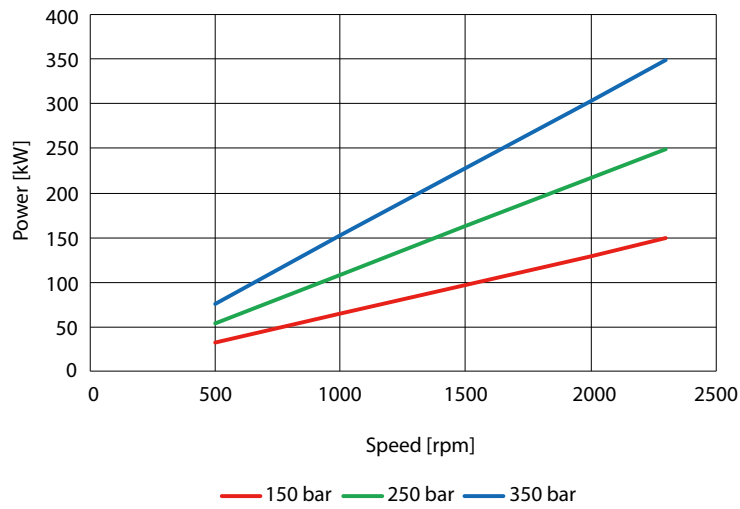


Parameters

193cc power vs input speed



260cc power vs input speed

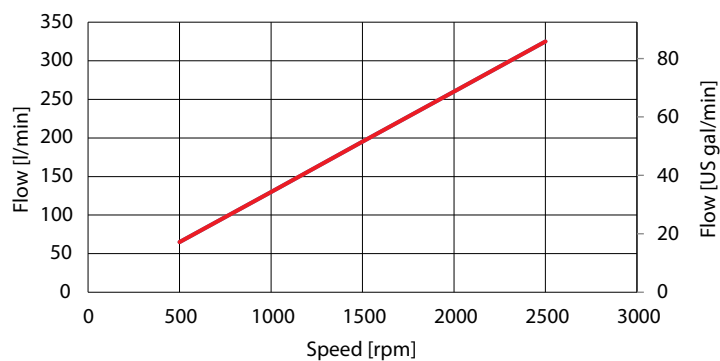


Parameters

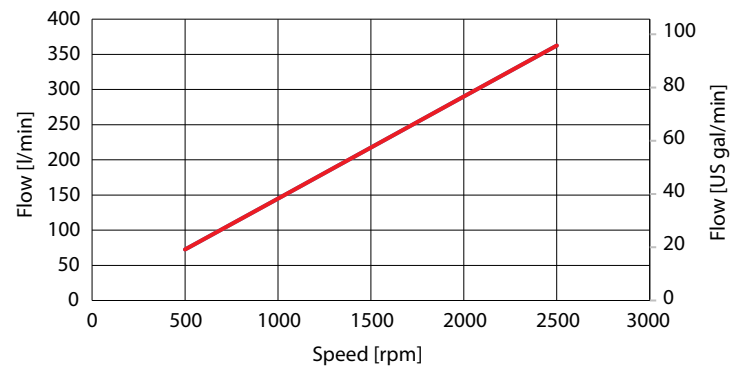
D1P output flow

Output flow depends on displacement per revolution, speed, and efficiency.

130cc flow vs speed

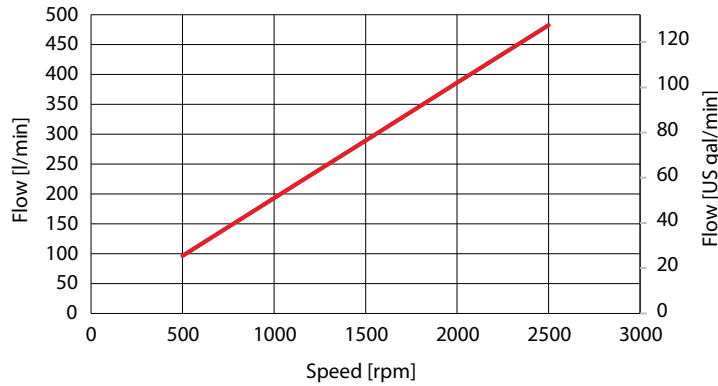


145cc flow vs speed

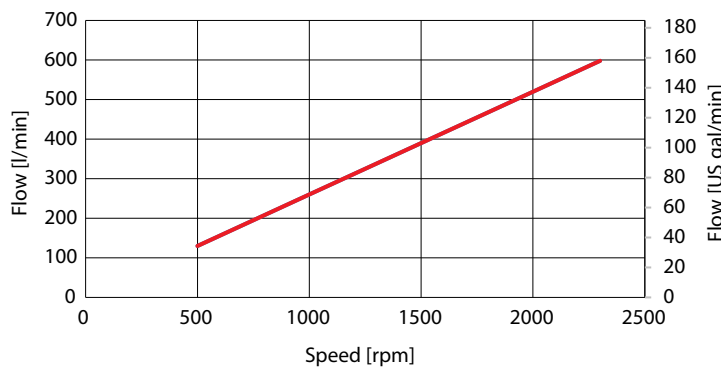


Parameters

193cc flow vs speed



260cc flow vs speed



D1P efficiency overview

Efficiency data depends on various operating parameters such as: working and inlet pressure, operating temperature, displacement, and fluid viscosity. For an accurate efficiency calculation, please contact your Danfoss Power Solutions representative.

All performance data are theoretical values, without efficiency or tolerances. Data valid at full displacement and operation parameters within the recommended ranges.

Parameters

D1P fluid overview

Ratings and performance data for D1 pumps are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These include premium turbine oils, API CD engine oils per SAE J183, M2C33F or G automatic transmission fluids (ATF), Dexron II (ATF) meeting Allison C-3 or Caterpillar T0-2 requirements, and certain specialty agricultural tractor fluids. For more information on hydraulic fluid selection, see Danfoss Power Solutions publications **BC152886484524** *Hydraulic Fluids and Lubricants*, Technical Information, and **520L0465** *Experience with Biodegradable Hydraulic Fluids*, Technical Information.

D1P viscosity

Minimum Viscosity This should only occur during brief occasions of maximum ambient temperature and severe duty cycle operation.

Maximum Viscosity This should only occur at cold start. Pump performance will be reduced. Limit speeds until the system warms up.

Maintain fluid viscosity within the recommended range for maximum efficiency and pump life.

D1P temperature overview

Minimum Temperature Relates to the physical properties of the component materials. Cold oil will not affect the durability of the pump components. However, it may affect the ability of the pump to provide flow and transmit power

Maximum Temperature Relates to material properties. Don't exceed it. Measure maximum temperature at the hottest point in the system. This is usually the case drain.

D1P fluid velocity

Choose piping sizes and configurations sufficient to maintain optimum fluid velocity, and minimize pressure drops. This reduces noise, pressure drops, overheating and maximizes system life and performance.

Recommended fluid velocities

System lines	6 to 9 m/sec
Suction line	1 to 2 m/sec
Case drain	3 to 5 m/sec

Typical guidelines; obey all pressure ratings.

Velocity equations

SI units

Q = flow (l/min)

A = area (mm²)

Velocity = (16.67·Q)/A (m/sec)

Parameters

D1P shaft torque ratings

Shaft drawings and maximum torque ratings are found in these sections:

- [Size 130/145 shaft specifications](#)
- [Size 193 shaft specifications](#)
- [Size 260 shaft specifications](#)

Maximum torque ratings are based on shaft strength with no radial force; do not exceed the torque limits.

D1P shaft load

Series D1 pump bearing is capable of accepting external radial and thrust (axial) loads. The external radial shaft load limits are a function of the load position, orientation, and the operating conditions of the pump.

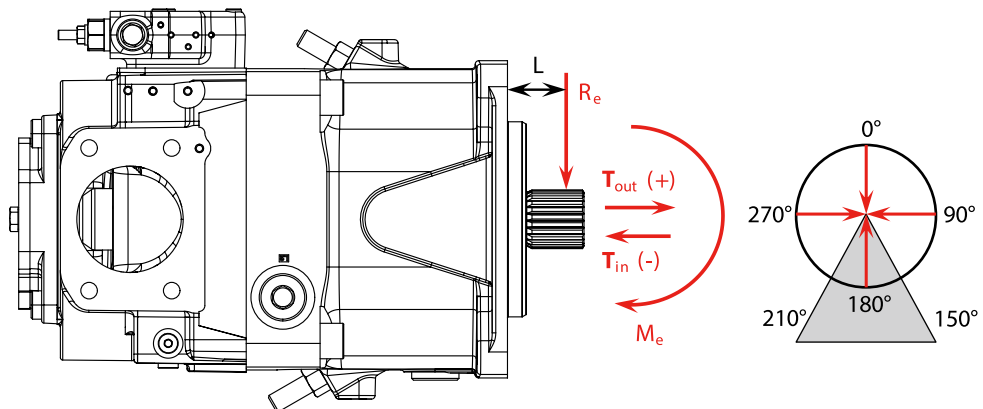
The maximum allowable radial load (R_e) is based on the maximum external moment (M_e) and the distance (L) from the mounting flange to the load. Compute radial loads using the formula below. [D1 pump specifications](#) gives maximum external radial load (R_e) and thrust (axial) load (T_{in} , T_{out}) limits.

$$M_e = R_e \cdot L$$

L = Distance from mounting flange to point of load

M_e = Maximum external moment

R_e = Maximum radial side load



P400077

All shaft loads affect bearing life. In applications where external shaft loads cannot be avoided, maximize bearing life by orienting the load between the 150° and 210° positions, as shown.

D1P mounting flange loads

Adding auxiliary pumps and/or subjecting pumps to high shock loads may overload the pump mounting flange. [D1 pump specifications](#) gives allowable continuous and shock load moments. Applications with loads outside allowable limits require additional pump support.

- **Shock load moment (M_S)** is the result of an instantaneous jolt to the system.
- **Continuous load moments (M_C)** are generated by the typical vibratory movement of the application.

D1P auxiliary mounting pads

Auxiliary mounting pads are available. Since the auxiliary pad operates under case pressure, use an O-ring to seal the auxiliary pump mounting flange to the pad. Oil from the main pump case lubricates the drive coupling.

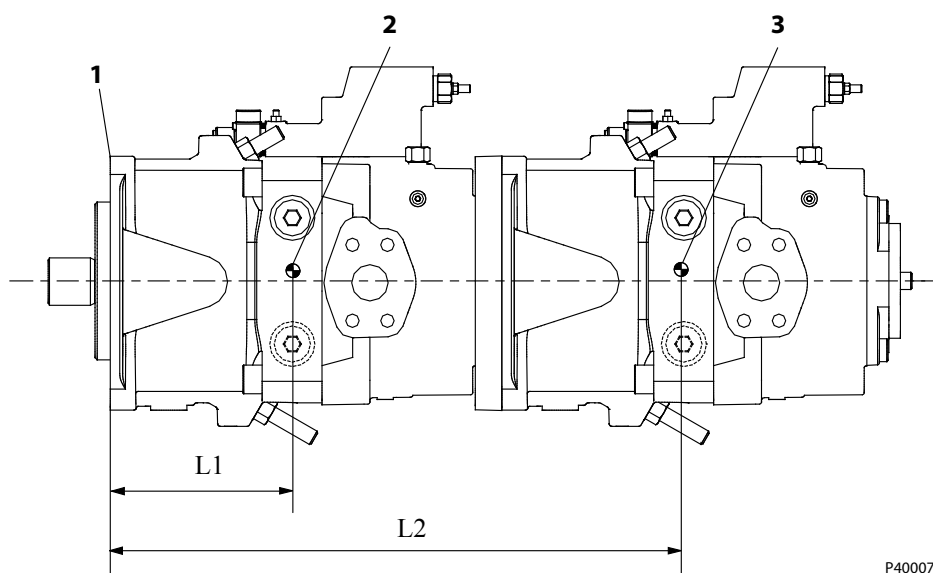
Parameters

- The combination of auxiliary shaft torque and main pump torque must not exceed the maximum pump input shaft rating. Shaft drawing section in Installation drawings chapter gives input shaft torque ratings.
- Applications subject to severe vibratory or shock loading may require additional support to prevent mounting flange damage. The table gives allowable continuous and shock load moments.

D1P estimating overhung load moments

Use the equations below to estimate the overhung load moments for multiple pump mounting. See Installation drawings chapter to find the distance from the mounting flange to the center of gravity. Refer to the to find pump weight.

Overhung load example



P400078

1. Mounting Flange 2. Center of Gravity (CG), Pump 1 3. Center of Gravity (CG), Pump 2
- **Shock load formula** $M_S = G_S \cdot K \cdot (W_1 \cdot L_1 + W_2 \cdot L_2 + \dots + W_n \cdot L_n)$
 - **Continuous load formula** $M_C = G_C \cdot K \cdot (W_1 \cdot L_1 + W_2 \cdot L_2 + \dots + W_n \cdot L_n)$

SI units

M_S = Shock load moment (N·m)

M_C = Continuous (vibratory) load moment (N·m)

G_S = Acceleration due to external shock (G's)

G_C = Acceleration due to continuous vibration (G's)

K = Conversion factor = 0.00981

W_n = Mass of nth pump (kg)

L_n = Distance from mounting flange to nth pump CG (mm)

Parameters

Understanding and minimizing system noise

Noise is transmitted in fluid power systems in two ways: as fluid borne noise, and structure borne noise.

Fluid-borne noise (pressure ripple or pulsation) is created as pumping elements discharge oil into the pump outlet. It is affected by the compressibility of the oil, and the pump's ability to transition pumping elements from high to low pressure. Pulsations travel through the hydraulic lines at the speed of sound until there is a change (such as an elbow) in the line. Amplitude varies with overall line length and position.

Structure borne noise is transmitted wherever the pump casing connects to the rest of the system. The way system components respond to excitation depends on their size, form, material, and mounting.

[System lines and pump mounting can amplify pump noise.](#)

Follow these suggestions to help minimize noise in your application:

- Use flexible hoses.
- Limit system line length.
- If possible, optimize system line position to minimize noise.
- If you must use steel plumbing, clamp the lines.
- If you add additional support, use rubber mounts.
- Test for resonance in the operating range; if possible avoid them.

D1P installation

Series D1 pumps may be installed in any position. To optimize inlet conditions, install the pump at an elevation below the minimum reservoir fluid level. Design inlet plumbing to maintain inlet pressure within prescribed limits (see Inlet pressure limits on [D1 pump specifications](#))

Fill the pump housing and inlet line with clean fluid during installation. Connect the case drain line to the uppermost drain port (L1, L2 or L3) to keep the housing full during operation.

To allow unrestricted flow to the reservoir, use a dedicated drain line. Connect it below the minimum reservoir fluid level and as far away from the reservoir outlet as possible. Use plumbing adequate to maintain case pressure within prescribed limits (see case pressure limits on [D1 pump specifications](#)).

D1P filtration

To prevent damage to the pump, including premature wear, fluid entering the pump inlet must be free of contaminants. Series D1 pumps require system filtration capable of maintaining fluid cleanliness at class 20/18/15 according to ISO 4406-1999 or better.

Danfoss Power Solutions does not recommend suction line filtration. Suction line filtration can cause high inlet vacuum, which limits pump operating speed. Instead we recommend a 125 µm (150 mesh) screen in the reservoir covering the pump inlet. This protects the pump from coarse particle ingestion.

Return line filtration is the preferred method for open circuit systems. Consider these factors when selecting a system filter:

- Cleanliness specifications
- Contaminant ingress rates
- Flow capacity
- Desired maintenance interval

Typically, a filter with a beta ratio of $\beta_{10} = 10$ is adequate. However, because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system.

*For more information, see Danfoss Power Solutions publication **BC152886482150** [Design Guidelines for Hydraulic Fluid Cleanliness](#).*

Parameters

Reservoir

The reservoir provides clean fluid, dissipates heat, and removes entrained air from the hydraulic fluid. It allows for fluid volume changes associated with fluid expansion and cylinder differential volumes. Minimum reservoir capacity depends on the volume needed to perform these functions. Typically, a capacity of one to three times the pump flow (per minute) is satisfactory.

Locate the reservoir outlet (suction line) near the bottom, allowing clearance for settling foreign particles. Place the reservoir inlet (return lines) below the lowest expected fluid level, as far away from the outlet as possible.

Sizing Equations

Use these equations to help choose the right pump size and displacement for your application.

Based on SI units

Flow Output flow $Q = \frac{V_g \cdot n \cdot \eta_v}{1000}$ (l/min)

Torque Input torque $M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$ (N·m)

Power Input power $P = \frac{M \cdot n \cdot \pi}{30\,000} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$ (kW)

Based on US units

Output flow $Q = \frac{V_g \cdot n \cdot \eta_v}{231}$ (US gal/min)

Input torque $M = \frac{V_g \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$ (lbf·in)

Input power $P = \frac{M \cdot n \cdot \pi}{198\,000} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$ (hp)

Variables

SI units [US units]

V_g = Displacement per revolution cm^3/rev [in^3/rev]

P_o = Outlet pressure bar [psi]

P_i = Inlet pressure bar [psi]

Δp = $p_o - p_i$ (system pressure) bar [psi]

n = Speed min^{-1} (rpm)

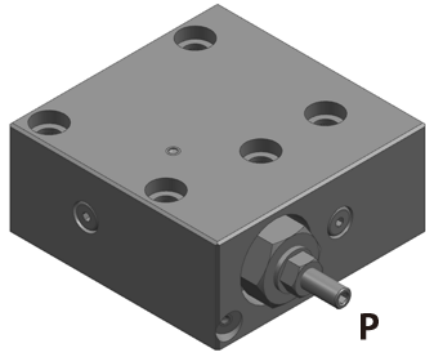
η_v = Volumetric efficiency

η_m = Mechanical efficiency

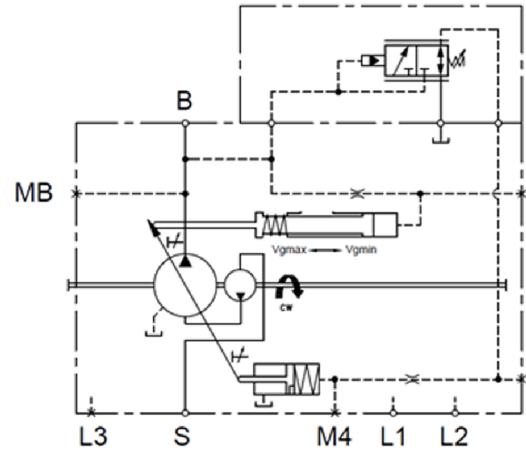
η_t = Overall efficiency ($\eta_v \cdot \eta_m$)

Control Type

NPNN (Pressure Compensated Control)



D1P 130/145/193/260+NPNN



P400575

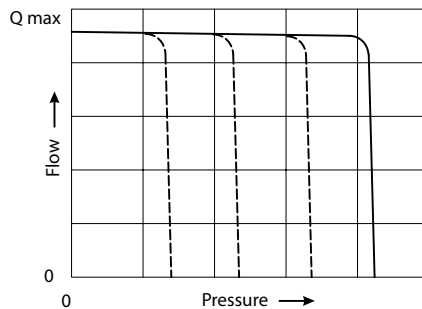
Pressure Compensated Control (P) Principle

The P control design maintains a constant pressure in the hydraulic circuit as flow varies. The P control modulates pump flow accordingly to maintain system pressure at the P setting as the P adjusting screw and spring defines.

Pressure Compensated Control (P) Operation

When system pressure, acting on the non-spring end of the P spool, overcomes the force of the P spring, the spool shifts porting system pressure to the servo piston and the swashplate angle decreases. When system pressure drops below the P setting, the P spring shifts the spool in the opposite direction connecting the servo piston to pump case and the swashplate angle increases. The swashplate is maintained at whatever angle is required to keep system pressure at the P setting.

P characteristic



⚠ Warning

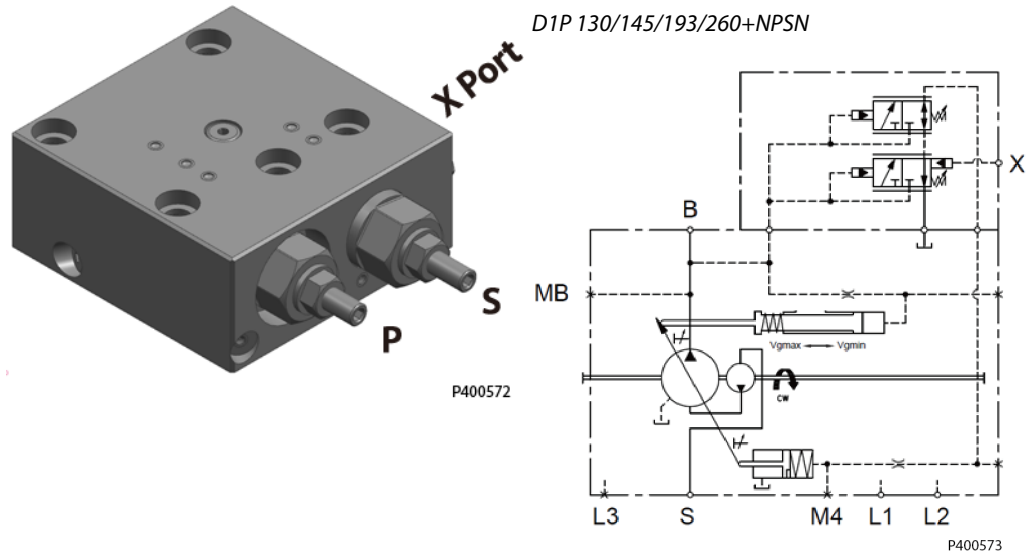
A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install the relief valve can lead to system damage and/or injury.

Control Type**Response/Recovery**

Pressure Compensated (PC) Control Response/Recovery Times* @80°C, 350 bar, 1500rpm		
Frame Size	Response (msec)	Recovery (msec)
130cc	150	270
145cc	150	270
193cc ¹	280	500
260cc	154	327

¹ Tested at 1800rpm

Values may vary depending on application conditions. For more information, please contact Danfoss Power Solutions.

Control Type
NPSN (Pressure Compensated Control + Load Sensing Control)

Pressure Compensated Control (P) Principle and Operation

Please refer to [NPNN \(Pressure Compensated Control\)](#) on page 32

Load Sensing Control (S) Principle

The S control design matches pump flow with system demand. The S control senses the flow demand of the system as a pressure drop across the external control valve (1).

As (1) opens and closes, the pressure difference (Δ) across the valve changes. When opening, the Δ decreases. When closing, the Δ increases. The S control then increases or decreases pump flow to the system until the pressure Δ becomes equal to the S setting as defined by the S adjusting screw and spring.

Load Sensing Control (S) Operation

Through internal porting, system pressure [upstream of (1)] is applied to the non-spring end of the S spool, and through hydraulic line connected at port X, load pressure [downstream of (1)] is applied to the spring end. This arrangement allows the S spool to act on the Δ between system pressure and load pressure. The S spring sets the threshold of operation (S setting).

Because the swashplate is biased to maximum angle, the pump attempts to deliver full flow to the hydraulic system. When the flow being delivered exceeds demand, the pressure Δ across the (1) is great enough to overcome spring force and shift the S spool porting system pressure to the servo piston. The pump de-strokes reducing flow until the Δ across the (1) becomes equal to the S setting.

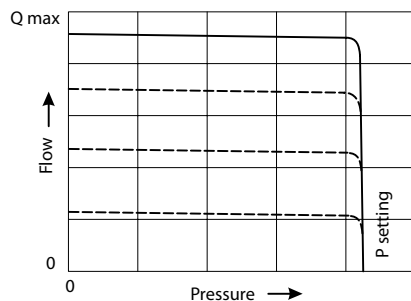
When flow being delivered is less than demand, the Δ across the (1) drops below the S setting and the S spring shifts the spool connecting the servo piston to pump case. The pump strokes increasing flow until the Δ across the (1) becomes equal to the S setting.

When the external control valve (1) is placed in neutral, it connects the LS signal line to drain. With no LS pressure acting on the non-spring end of the LS spool, the pump adjusts stroke to whatever position necessary to maintain system pressure at the LS setting. The pump is now in low pressure standby mode.

(1) is not in the scope of supply.

Control Type

S characteristic



Warning

A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install the relief valve can lead to system damage and/or injury.

NPSN Priority

The Pressure Compensated Control (P) has priority over the Load Sensing Control (S).

Response/Recovery

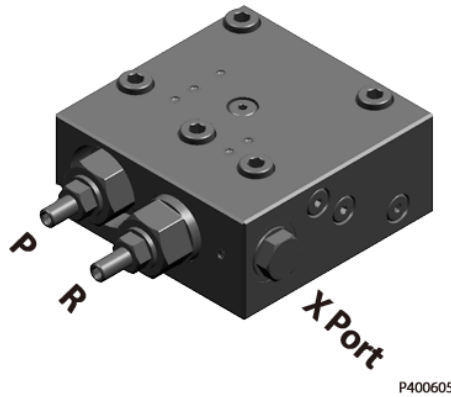
Load Sensing (LS) Response/Recovery Times @80°C, 1500rpm, LS Setting at 25 bar		
Frame Size	Response (msec)	Recovery (msec)
130cc	260	360
145cc	260	360
193cc ¹	233	264
260cc	309	327

¹ Tested with a LS setting of 20bar

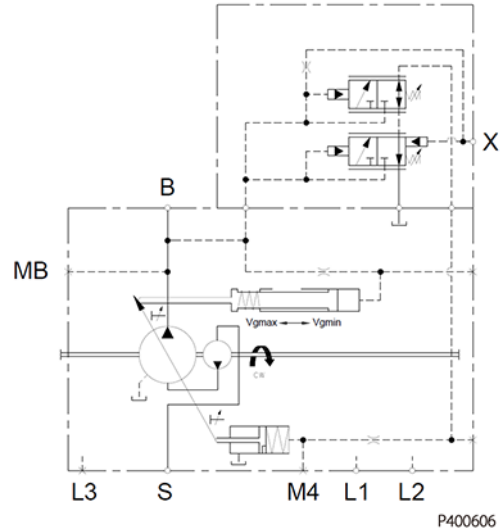
Values may vary depending on application conditions. For more information, please contact Danfoss Power Solutions

Control Type

NPNR (Pressure Compensated Control + Remote Pressure Compensated Control)



D1P 130/145/193/260+NPNR



Pressure Compensated Control (P) Principle and Operation

Please refer to [NPNR \(Pressure Compensated Control\)](#) on page 32.

Remote Pressure Compensated Control (R) Principle

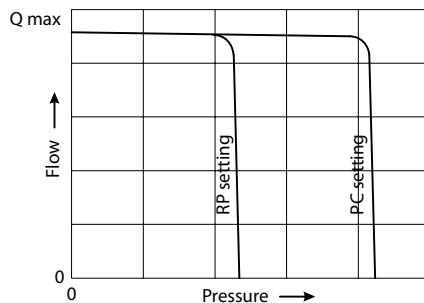
The remote PC control is a two-stage control that allows multiple PC settings. Remote PC controls are commonly used in applications requiring low and high pressure PC operation.

For this control, Danfoss recommends a load sense setting of 25 bar.

Remote Pressure Compensated Control (R) Operation

The remote PC control uses a pilot line connected to an external hydraulic valve. The external valve changes pressure in the pilot line, causing the PC control to operate at a lower pressure. When the pilot line is vented to reservoir, the pump maintains pressure at the load sense setting. When pilot flow is blocked, the pump maintains pressure at the PC setting. An on-off solenoid valve can be used in the pilot line to create a low-pressure standby mode. A proportional solenoid valve, coupled with a microprocessor control, can produce an infinite range of operating pressures between the low pressure standby setting and the PC setting.

R characteristic



Control Type

 **Warning**

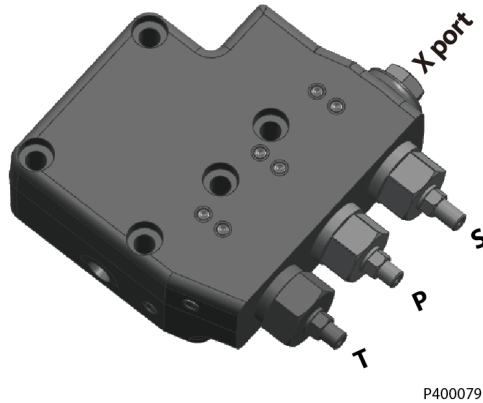
A relief valve is required to be installed in the pump outlet for additional system protection. Failure to install the relief valve can lead to system damage and/or injury.

NPNR Priority

When the pump's X-port is vented to tank, or limited to some pressure setting via a remote valve, the remote pressure compensator function will control the maximum outlet pressure of the pump. If the pump's outlet pressure reaches the pressure setting of the pressure compensator (PC) function, the PC function will take priority and limit the pump's maximum pressure.

Control Type

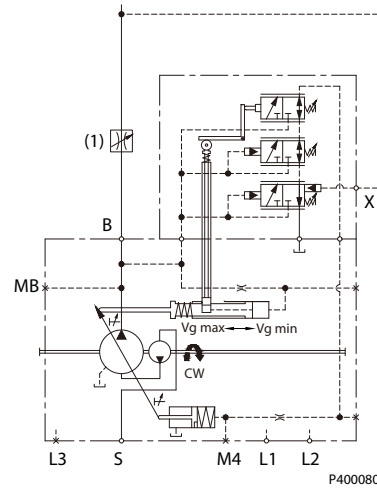
TPSN (Power Control + Pressure Compensated Control + Load Sensing Control)



D1P 130/145/193/260+TPSN

*Control oil filter is optional

P400079



Power Control (T) Principle

The power control regulates the displacement of the pump depending on the working pressure so that a given drive power is not exceeded at constant drive speed, this function can prevent engine stall or protect electric generator.

$$P_B \cdot V_g = C$$

P_B = working pressure
 V_g = displacement
 C = constant

The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.

Power Control (T) Operation

The working pressure acts on a rack-pivot via a roller jack which produces a rotating torque, an externally adjustable spring force counteracts this which determines the power setting.

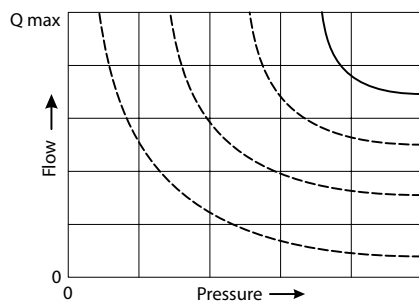
If the moment generated by working pressure exceeds the moment generated by spring force, the control valve is actuated by the rack-pivot, and pump reduces displacement. The lever length at the rack-pivot is shortened and the working pressure can increase at the same rate as the displacement decreases without the drive powers being exceeded.

$$(P_B \cdot V_g = C).$$

The hydraulic output power (characteristic T) is influenced by the efficiency of the pump.

Control Type

T characteristic



Pressure Compensated Control (P) Principle and Operation

Please refer to [NPNN \(Pressure Compensated Control\)](#) on page 32

Load Sensing Control (S) Principle and Operation

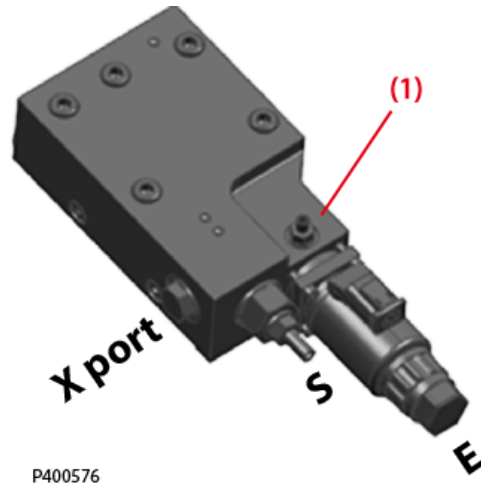
Please refer to [NPSN \(Pressure Compensated Control + Load Sensing Control\)](#) on page 34

TPSN Priority

The Pressure Compensated Control (P) has priority over the Power Control (T), Power Control has priority over Load Sensing Control (S).

Control Type

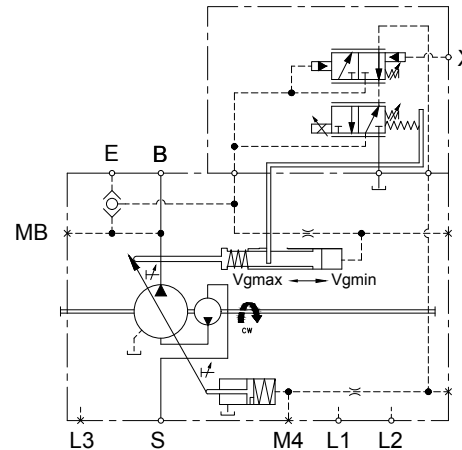
NNES (Electric Displacement Control + Load Sensing Control)



Warning

(1) Adjustment is not permissible

D1P 130/145/193/260 NNES



Electric Displacement Control (E) Principle

The electric displacement control uses an electric proportional solenoid valve to vary the pump's displacement from minimum displacement to maximum displacement or from maximum displacement to minimum displacement. The swashplate angle (pump displacement) is proportional to the electrical input signal (control current).

Electric Displacement Control (E) Operation

This control is current driven, requiring a Pulse Width Modulated (PWM) signal. Pulse width modulation allows more precise control of current to the solenoid. The PWM signal causes the solenoid pin to push against the E spool, which depressurizes the end of servo piston, the swashplate angle increases under the force of the bias piston

A swashplate feedback link provides swashplate position force to the solenoid through the E spool's linear spring. The control reaches equilibrium when the position of the swashplate spring feedback force exactly balances the input command solenoid force from the operator. As working pressure changes with load, the control and servo/swashplate system work constantly to maintain the commanded position of the swashplate.

Electric Displacement Control (E) Operating Instruction

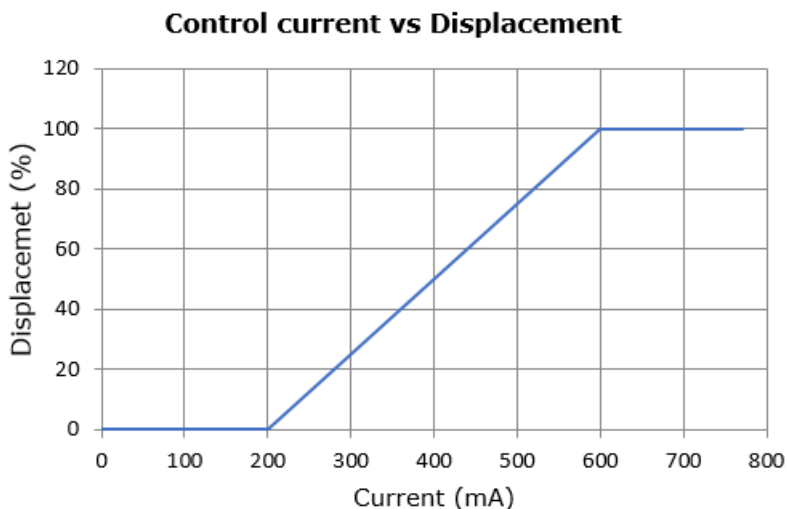
To make sure the electric displacement control works properly, a minimum control pressure of 30 bar [435 psi] is required. The required control pressure is taken either from the working pressure, or from the externally applied control pressure at the E port.

If you can't make sure that the working pressure is above 30 bar all the time, then a minimum of 30bar [435 psi] pressure supply at the E port is mandatory in order to control the displacement of the pump at all times. This pressure supply can be provided from different sources, such as an additional small gear or piston pump and a relief valve, or an accumulator.

[If E port is not connected, remove the shuttle valve](#)

Control Type

Typical operating curve



Hysteresis

EDC Hysteresis¹	
Input hysteresis	<4.5%
Output hysteresis @50% displacement	<4.0%

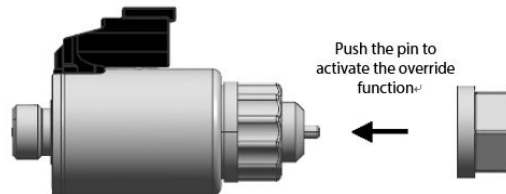
¹ Values may vary depending on application conditions. For more information, please contact Danfoss Power Solutions

Response/Recovery

Response/Recovery Times @ 1500rpm (50°C)¹		
Recovery 0%-100%	130cc (263 bar)	260 msec
	145cc (263 bar)	260 msec
	193cc (160 bar)	272 msec
	260cc (200 bar)	370 msec
Response 100%-0%	130cc (263 bar)	390 msec
	145cc (263 bar)	390 msec
	193cc (160 bar)	186 msec
	260cc (200 bar)	390 msec

MOR

Each Electric Displacement Control (EDC) is equipped with a Manual Over Ride (MOR) function for temporary actuation of the control to aid in diagnostics, even if insufficient or no current is supplied to the solenoid actuator. Initial activation of the MOR function will require a higher force to overcome the sticking effect between the pin and O-ring seal. Repeated activation of this functionality should provide better controllability.

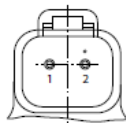
Control Type

⚠ Warning

Do not actuate the MOR unless the machine is in a "SAFE" mode. Unintended MOR operation will cause the pump to go into stroke, use only for diagnosis purposes.

Solenoid Specification
Technical data - Solenoid

Voltage	24V (±20%)
Start current at Vg min.	200 mA
End Current at Vg max.	600 mA
Maximum current	770 mA
Coil Resistance @ 20 °C [70 °F]	22.7 Ω
PWM Range	70~200 Hz
PWM Frequency (preferred)*	100 Hz
IP Rating (IEC 60 529) + DIN 40 050, part 9	IP 67
IP Rating (IEC 60 529) + DIN 40 050, part 9 with mating connector	IP 69K

* PWM signal required for optimum control performance

Mating connector for Solenoid


Description	Ordering Number	Quantity
Mating Connector	DEUTSCH DT06-2S	1
Wedge Lock	DEUTSCH W2S	1
Socket contact (16 and 18 AWG)	DEUTSCH 0462-201-16141	2
Danfoss mating connector kit	K29657	1
The mating connector is not included in the delivery contents, this can be delivered by Danfoss on request.		

Plug polarity is not necessary (Ex. either pin 1 or pin 2 can be used as positive).

Compatible PLUS+1® controllers(see below):

MC012	AI152986480902
MC024	AI152986480953
MC038	AI152886480992

Control Type

MC050	AI152986480864
MC088	AI152886480776

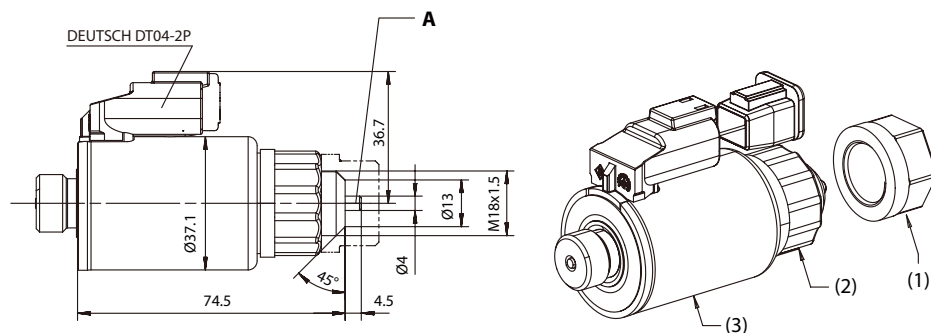
For further information: please visit: <http://www.danfoss.com/Products/MobileElectronics/index.htm>

Standard EDC Valve

The position of the connector can be changed by turning the solenoid body. Proceed as follows:

1. Loosen protection cap (1).
2. Loosen lock nut (2).
3. Turn the solenoid body (3) to the desired position.
4. Tighten the lock nut (2).
5. Tighten the protection cap (1).

Tightening Torque of lock nut: $5 \pm 1 \text{ N}\cdot\text{m}$ [$44.25 \pm 8.85 \text{ lbf}\cdot\text{in}$]

Standard EDC Valve


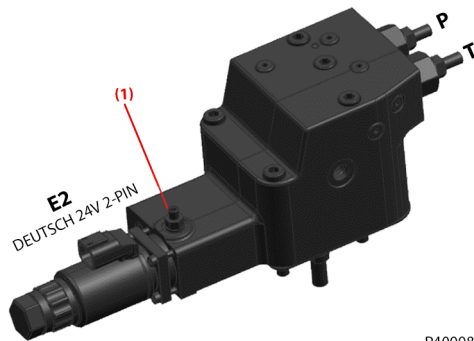
A - Actuation Forces	
Breakaway Force (First actuation)	45 N [10.12 lbf] max.
Repeat of Actuation	25 N [5.62 lbf] max.

NNES Priority

Both the Electric Displacement Control (EDC) and the Load Sensing Control (LS) are used to control the pump's displacement. The pump will output the smallest displacement when both control functions are given control instruct.

Control Type

TPE2/TPE5 (Power Control + Pressure Compensated Control + Electric Displacement Control)



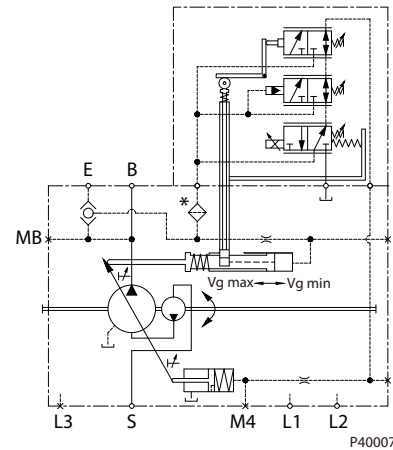
D1P 130/145+TPE5

D1P 193/260+TPE2

*Control oil filter is optional

Warning

(1) Adjustment is not permissible



Power Control (T) Principle and Operation

Please refer to [TPSN \(Power Control + Pressure Compensated Control + Load Sensing Control\)](#) on page 38

Pressure Compensated Control (P) Principle and Operation

Please refer to [NPNN \(Pressure Compensated Control\)](#) on page 32

Electric Displacement Control (E2/E5) Principle and Operation

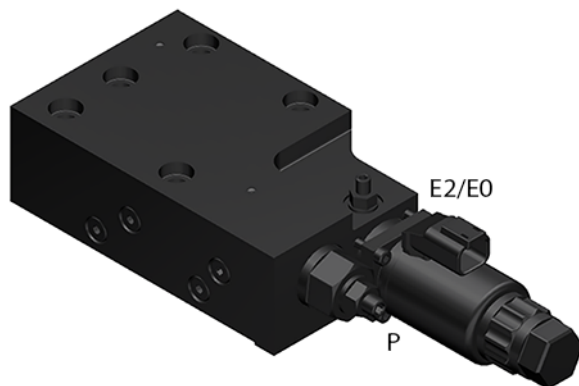
Please refer to [NNES \(Electric Displacement Control + Load Sensing Control\)](#) on page 40

TPE2/TPE5 Priority

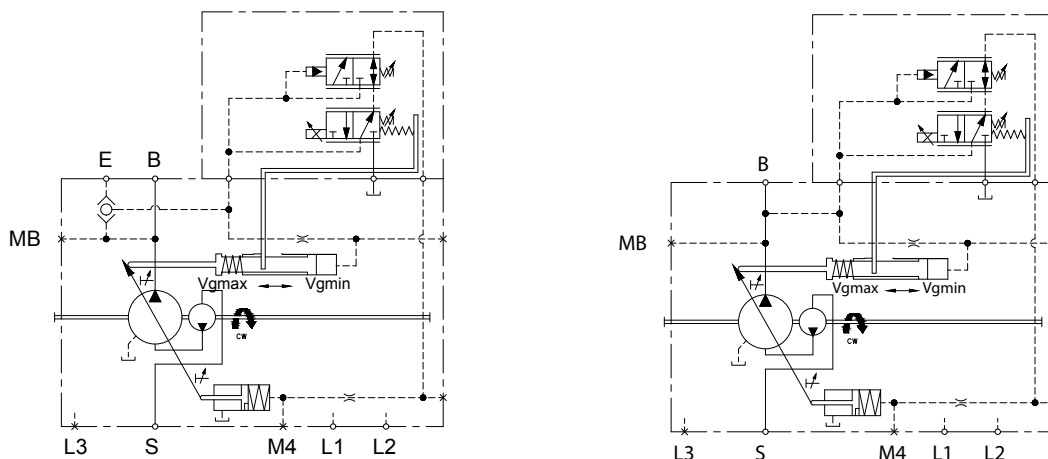
The Pressure Compensated Control (P) has priority over the Power Control (T), and the Power Control (T) has priority over Electric Displacement Control (EDC).

Control Type

NPE2/NPE0 (Pressure Compensated Control + Electric Displacement Control)



D1P with NPE2 (left); D1P with NPE0 (right)



Pressure Compensated Control (P) Principle and Operation

Please refer to [NPNN \(Pressure Compensated Control\)](#) on page 32.

Electric Displacement Control (E2/E0) Principle and Operation

Please refer to [NNES \(Electric Displacement Control + Load Sensing Control\)](#) on page 40.

Shuttle Valve/Pilot Supply

Please refer to Electric Displacement Control (E) Operating Instruction section at [NNES \(Electric Displacement Control + Load Sensing Control\)](#) on page 40.

To determine if an external control pilot supply is needed, please consult your Danfoss Power Solutions representative.

D1P pumps configured with an NPE2 control will come with a shuttle valve installed at the E port. D1P pumps with an NPE0 control will not include the shuttle valve.

Installation Drawings

Size 130/145

Dimensions (mm) and port descriptions

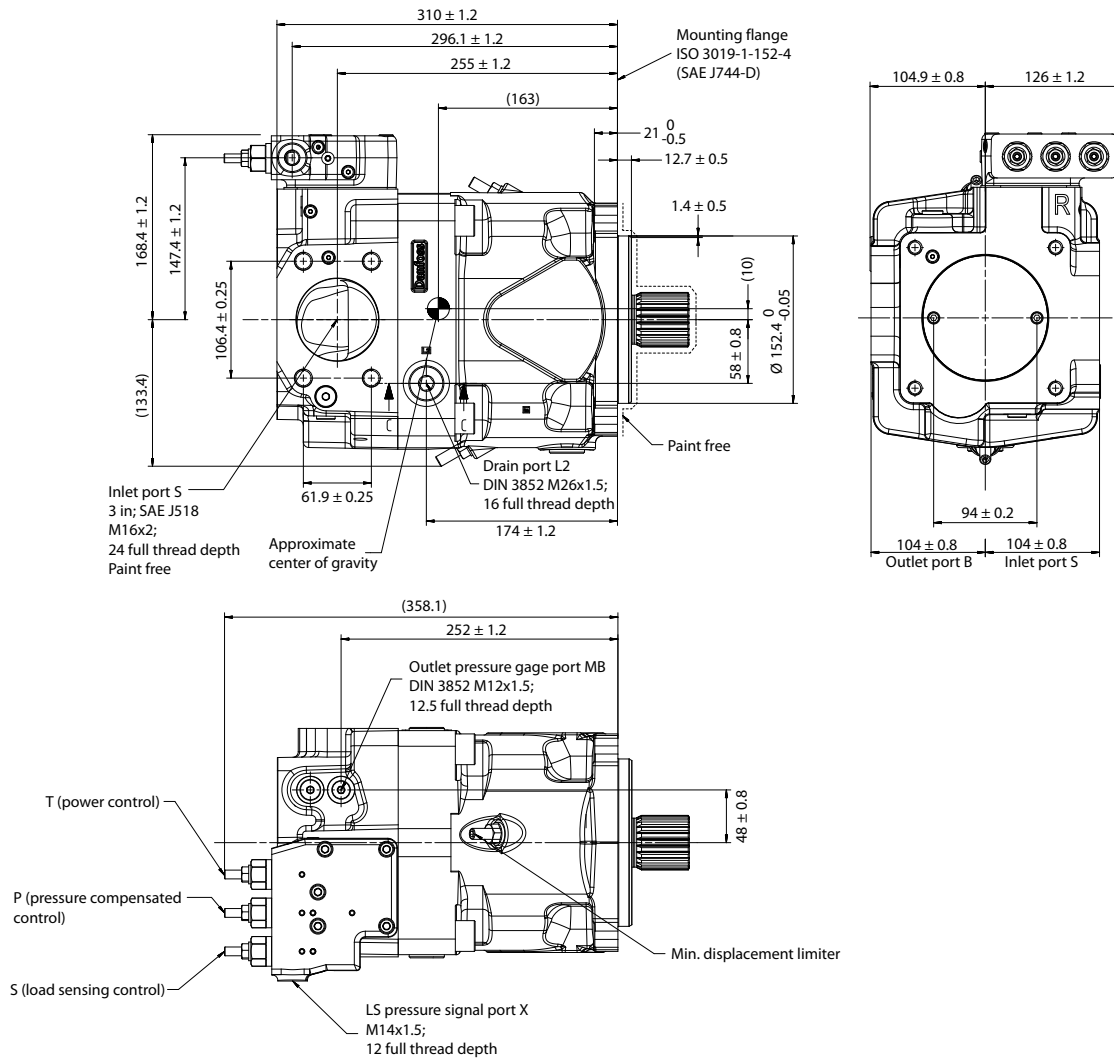
Size 130/145: TPSN w/o Charge Pump

Control : TPSN

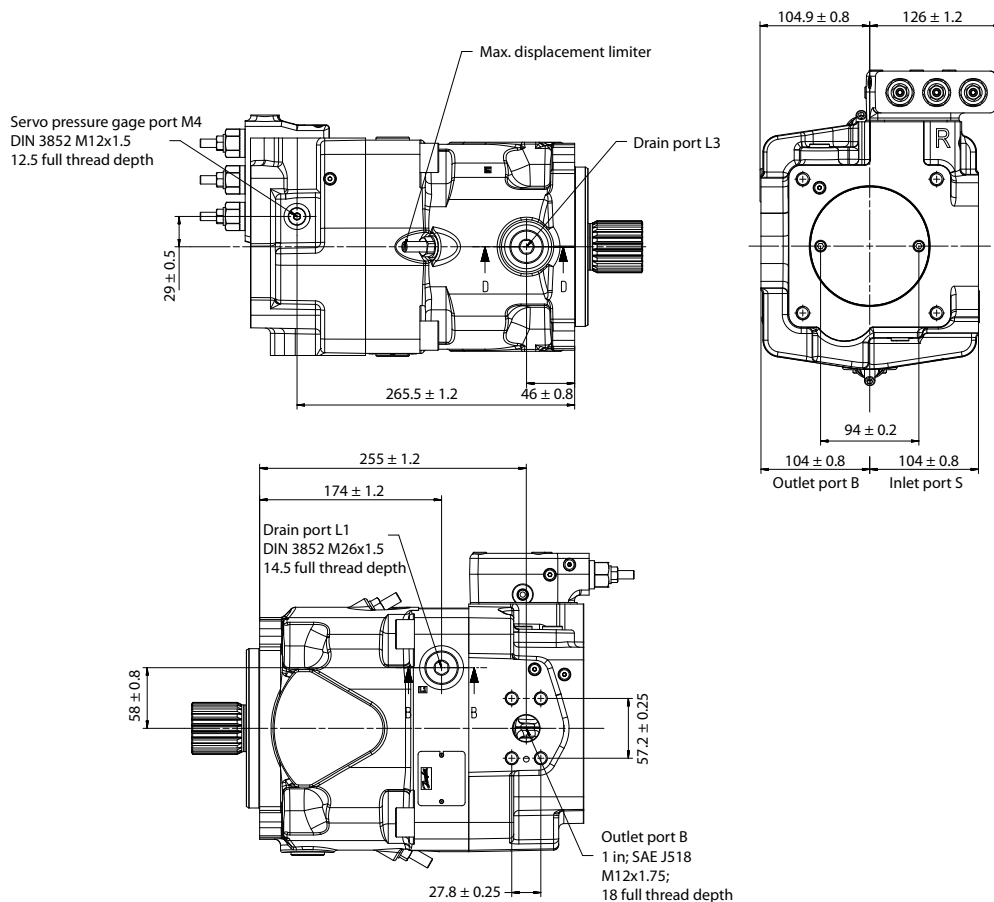
Power Control (T) + Pressure Compensated Control (P) + Load Sensing Control (S)

Auxiliary flange : NN (No Auxiliary flange)

Charge pump : Without



Before finalizing your design, please request a certified drawing.

Installation Drawings


Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 in, M12 x 1.75; 18 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 in, M16 x 2; 24 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M26 x 1.5; 14.5, 16, 14 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
X	LS port	DIN 3852	M14 x 1.5; 12.5 deep	400 [5802]	O

¹⁾ For required torque, please refer to [D1P tightening torque](#) on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

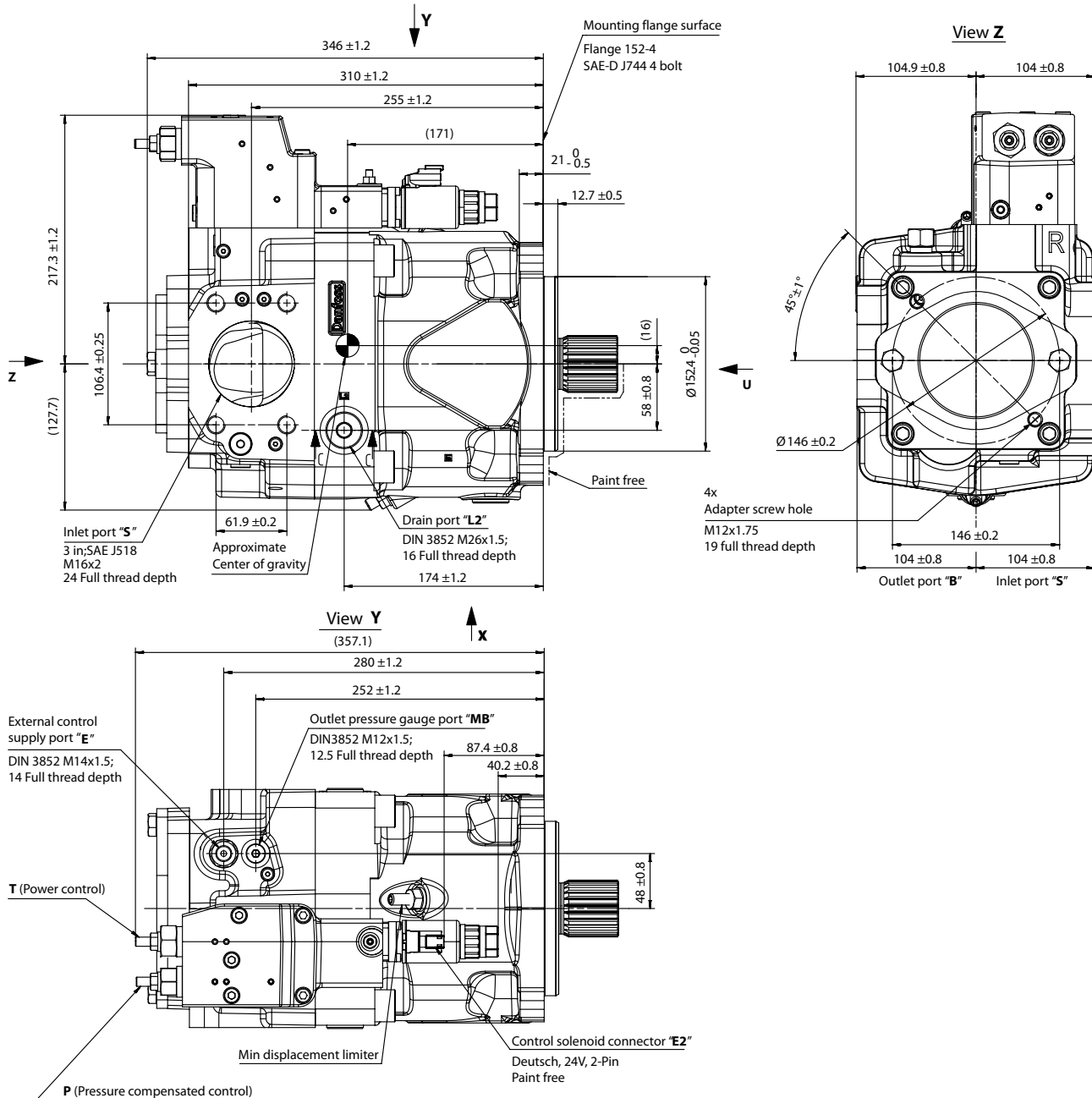
Size 130/145: TPE5 w/o Charge Pump

Control : TPE5

Power Control (T) + Pressure Compensated Control (P) + Electric Displacement Control (E5)

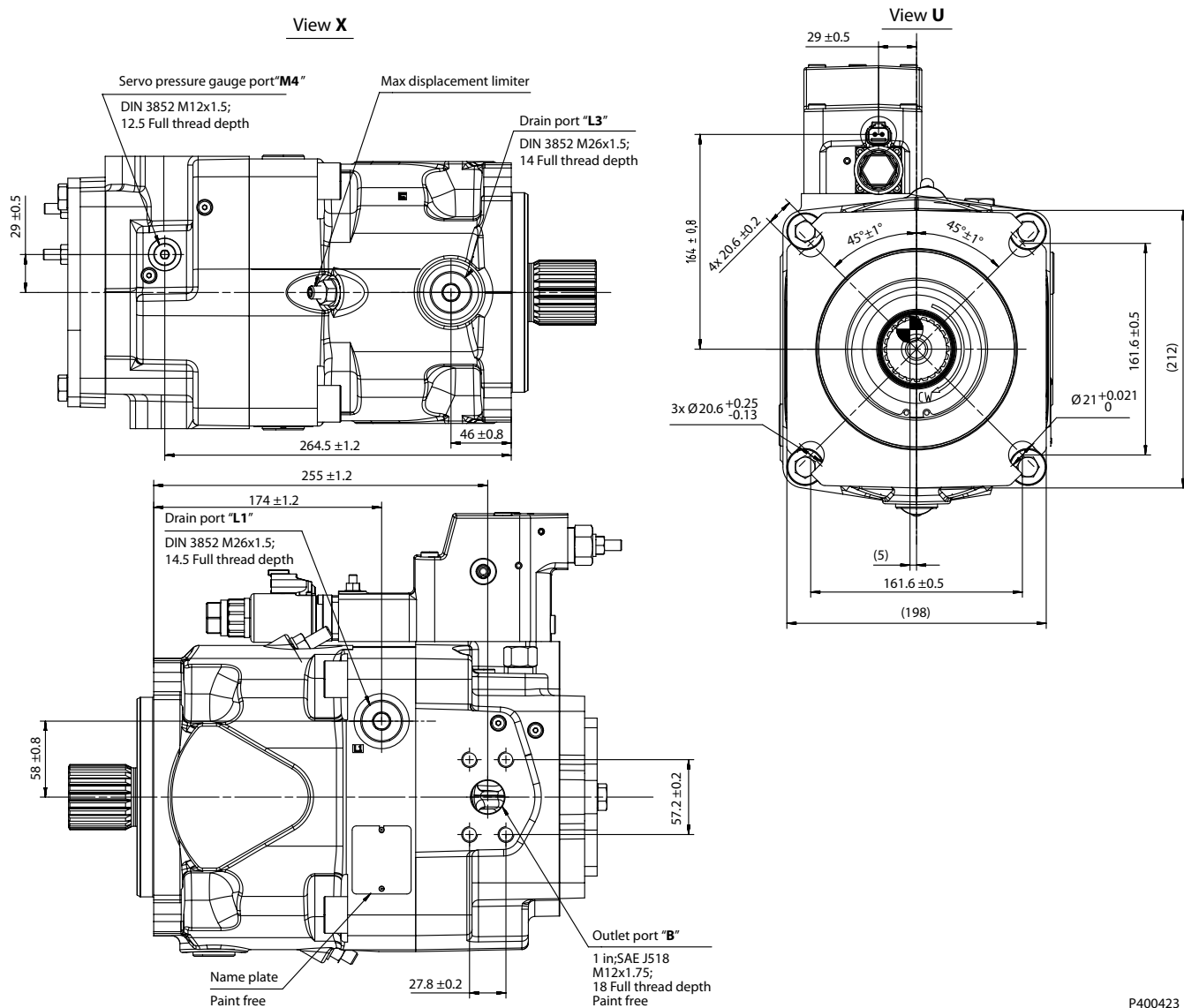
Auxiliary flange : B1

Charge pump : Without



P400422

Before finalizing your design, please request a certified drawing.

Installation Drawings


P400423

Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 in, M12 x 1.75; 18 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 in, M16 x 2; 24 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M26 x 1.5; 14.5, 16, 14 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
E	External control port	DIN 3852	M14 x 1.5; 12 deep	200 [2901]	X

¹⁾ For required torque, please refer to [DIP tightening torque](#) on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

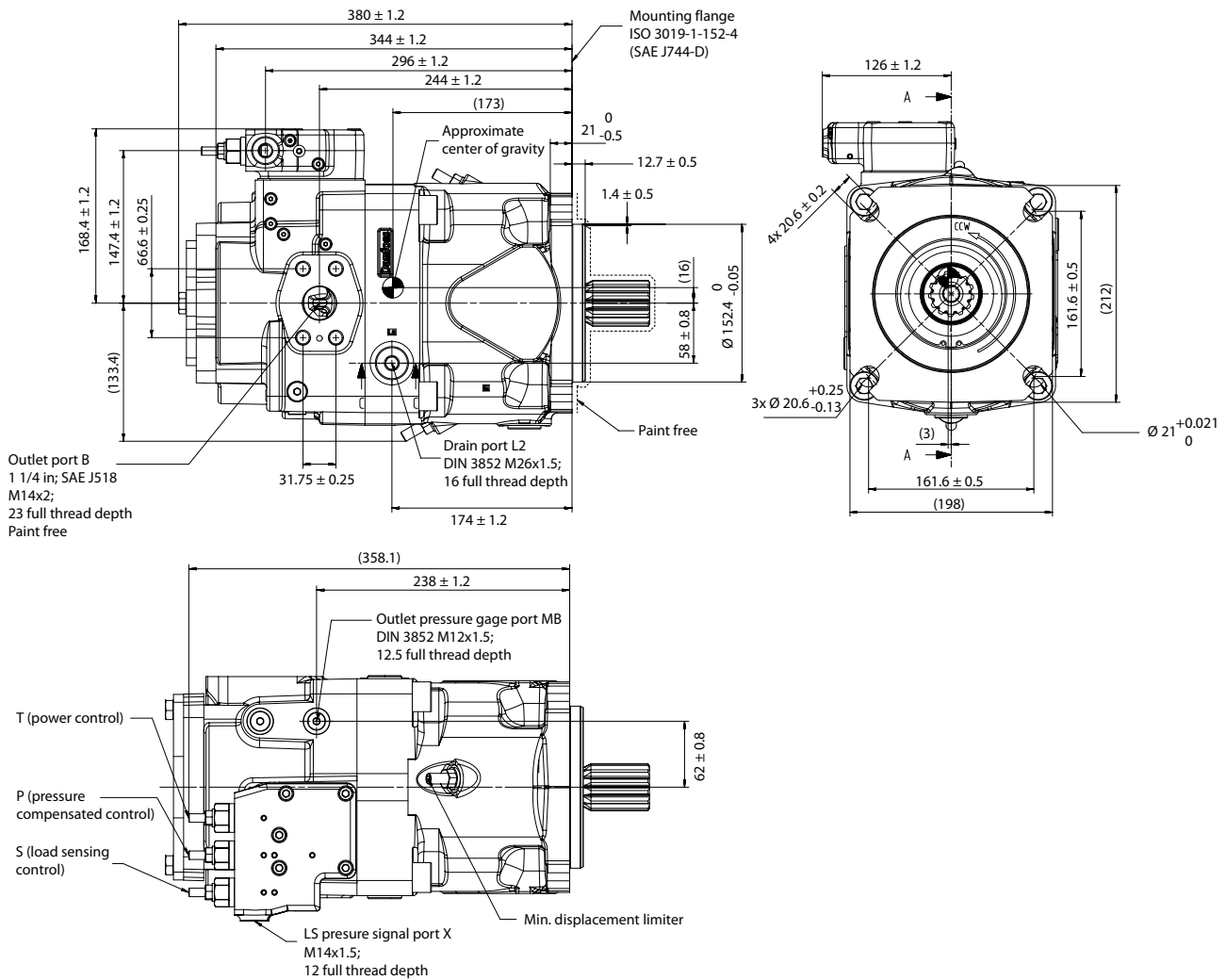
Size 130/145: TPSN w/ Charge pump

Control : TPSN

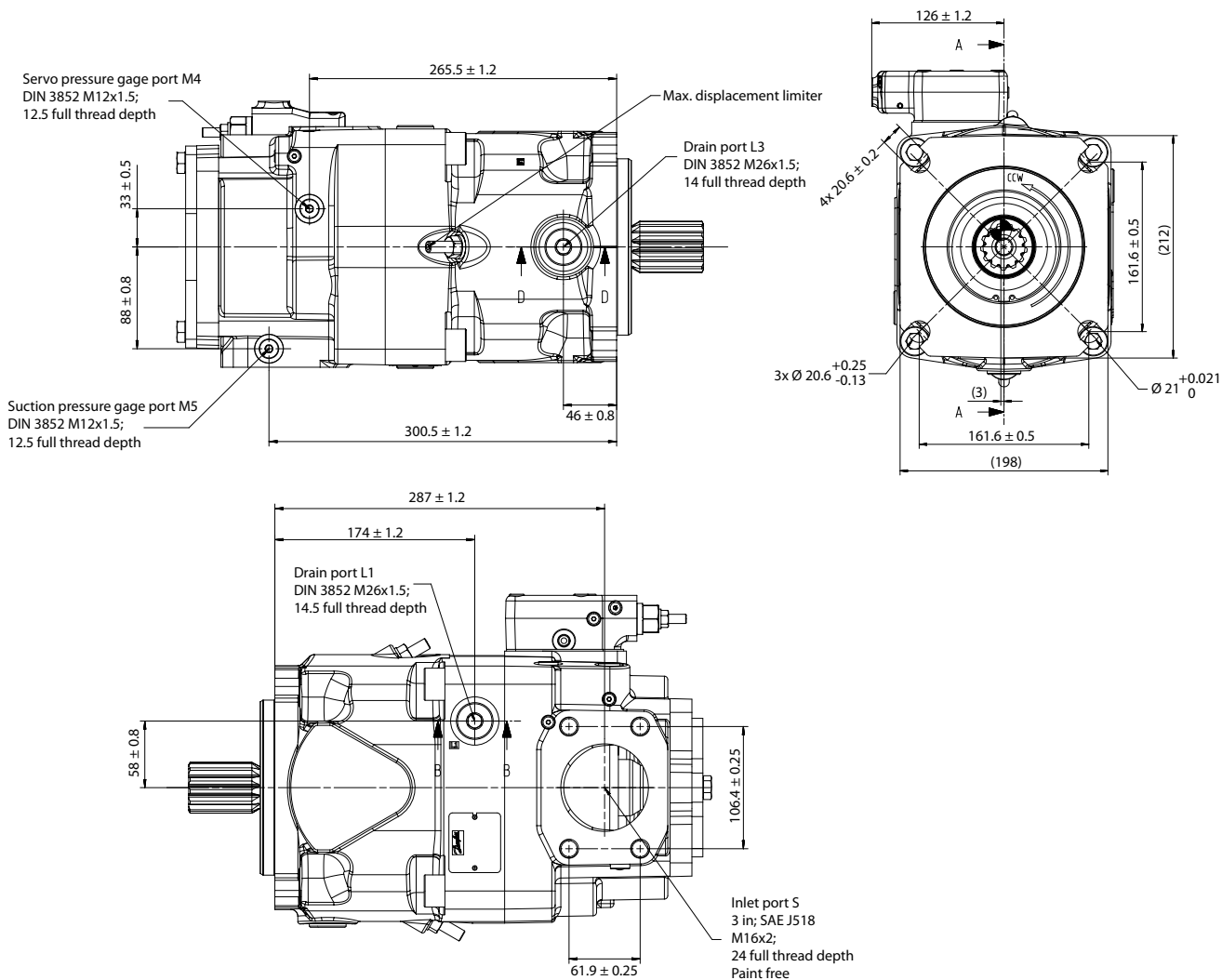
Power Control (T) + Pressure Compensated Control (P) + Load Sensing Control (S)

Auxiliary flange : B1

Charge pump : With



Before finalizing your design, please request a certified drawing.

Installation Drawings


Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 ¼ in, M14 x 2; 23 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 in, M16 x 2; 24 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M26 x 1.5; 14.5, 16, 14 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
X	LS port	DIN 3852	M14 x 1.5; 12.5 deep	400 [5802]	X

¹⁾ For required torque, please refer to *D1P tightening torque* on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

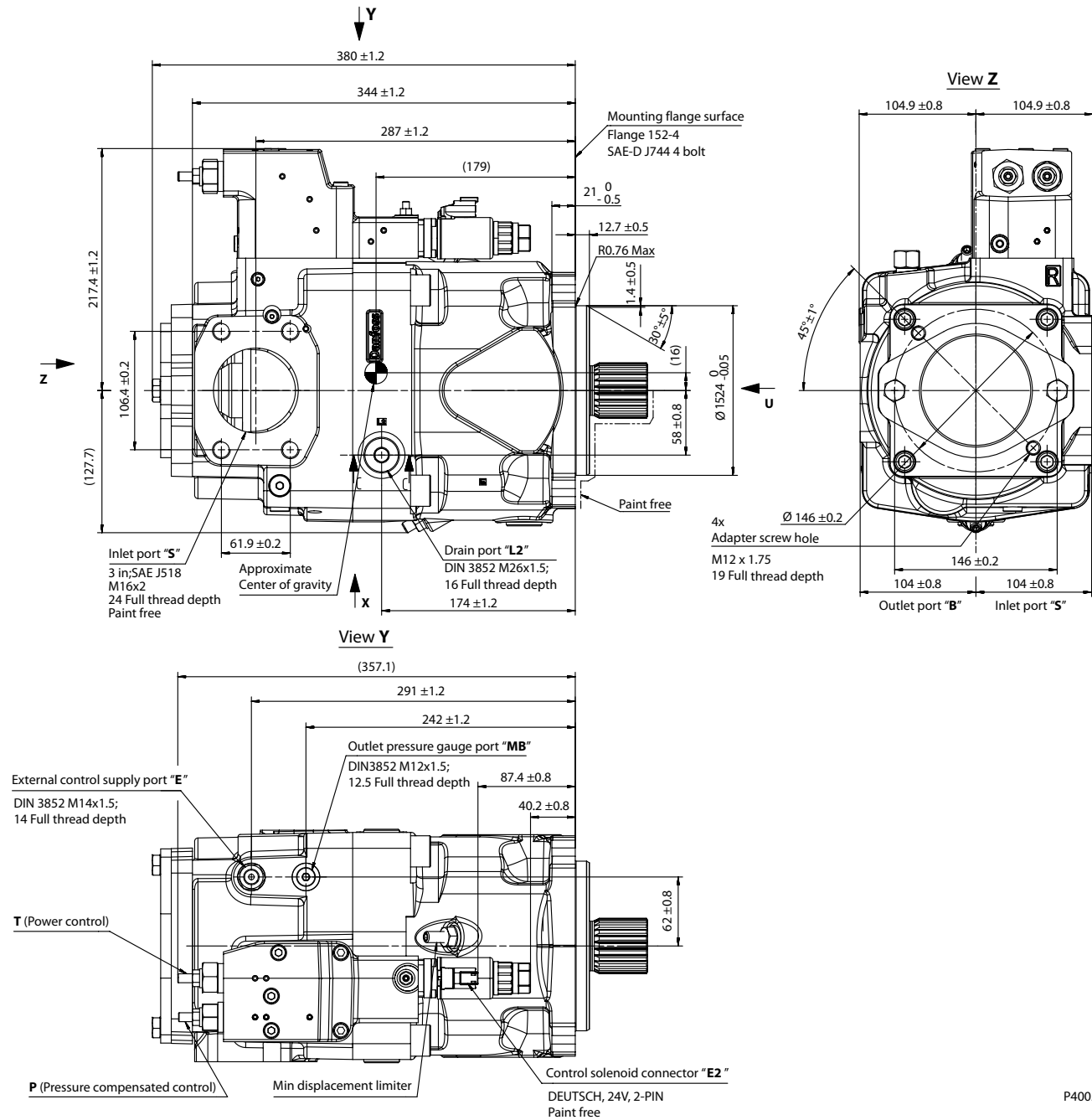
Size 130/145: TPE5 w/ Charge Pump

Control : TPE5

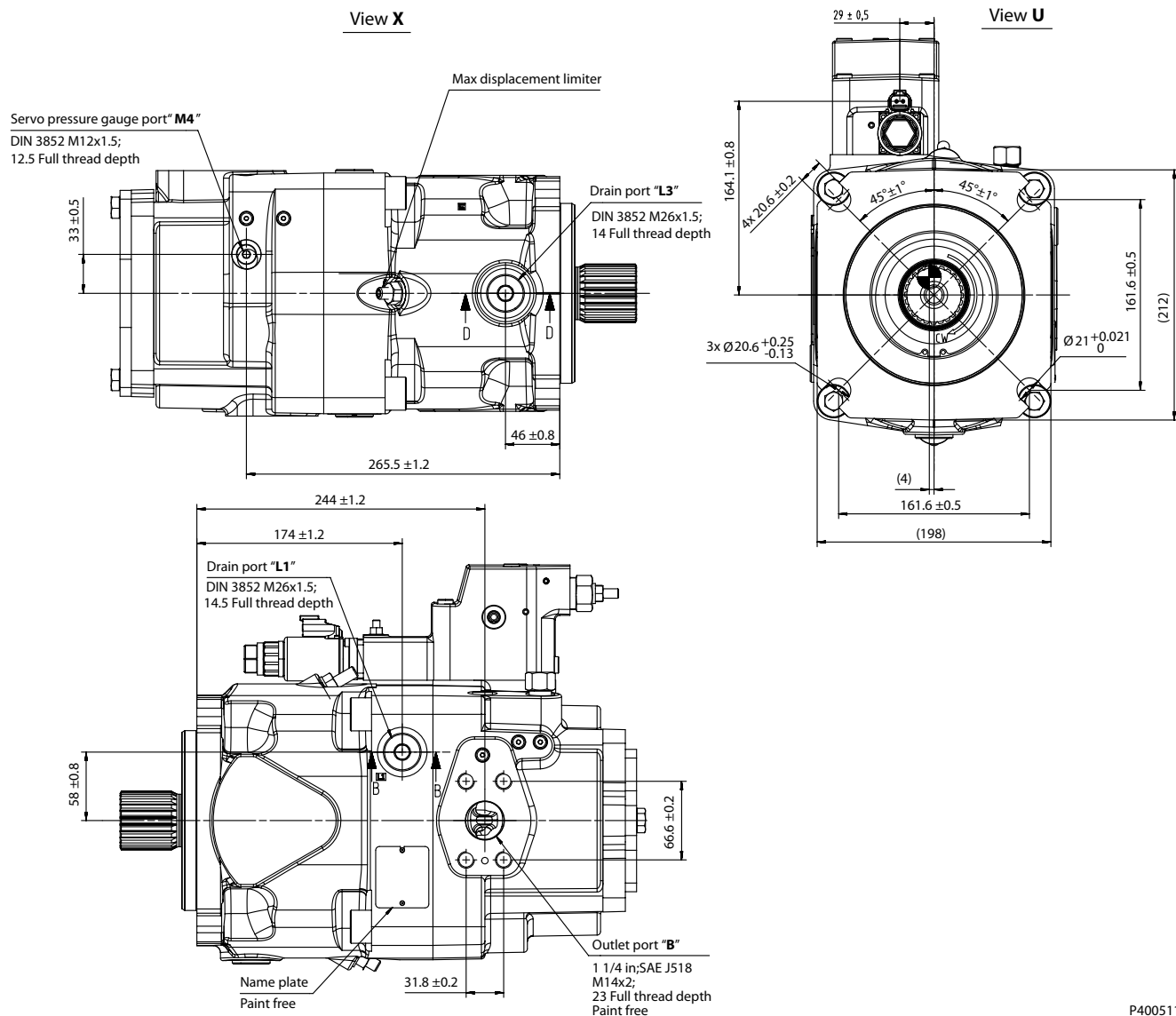
Power Control (T) + Pressure Compensated Control (P) + Electric Displacement Control (E5)

Auxiliary flange : B1

Charge pump : With



Before finalizing your design, please request a certified drawing.

Installation Drawings


Before finalizing your design, please request a certified drawing.

P400511

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 ¼ in, M14 x 2; 23 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 in, M16 x 2; 24 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M26 x 1.5; 14.5, 16, 14 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
E	External control port	DIN 3852	M14 x 1.5; 12 deep	200 [2901]	X

¹⁾ For required torque, please refer to [DIP tightening torque](#) on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

Input shaft

D1P 130/145 shaft specifications

Shaft torque and dimensions

Code	Description	Maximum Torque Rating	Drawing
T	Splined shaft DIN 5480, W50 x 2 x 30 x 24 x 9g	3100 N•m [27437 lbf•in]	<p>Mating coupling must not protrude beyond this point</p> <p>Paint free</p> <p>Spline data Number of teeth : 24 Modules : 2 Pressure angle : 30° Pitch Ø : Ø48 Type of fit : Flat root side Per : DIN 5480 Class 9g</p> <p>10 ± 0.8</p> <p>12 ± 2 5.2 ± 0.5</p> <p>Ø44.5^{+0.12}₀</p> <p>36 ± 2 Full thd</p> <p>43.5⁰_{-0.5}</p> <p>45 ± 1 (65)</p> <p>Ø17^{+0.2}₀</p> <p>Ø23^{+0.2}₀</p> <p>Ø49.6^{-0.16}₀</p> <p>Ø105.5 ± 0.25</p> <p>M16 x 2-6H THD⁽¹⁾</p> <p>Mounting flange Flange 152-4 Per SAE J744</p> <p>P400085</p> <p>Min. active spline length⁽²⁾: 43.5 mm [1.71 in]</p>
S	Splined shaft SAE J744, 1 3/4 in. 13T, 8/16 DP	1528 N•m [13524 lbf•in]	<p>Mating coupling must not protrude beyond this point</p> <p>Paint free</p> <p>Spline data Number of teeth : 13 Pitch fraction : 8/16 Pressure angle : 30° Pitch Ø : Ø41.275 Type of fit : Fillet root side Per : ANSI B92.1-1996. Class 5</p> <p>10 ± 0.8</p> <p>12 ± 2 5.2 ± 0.5</p> <p>Ø34.5 ± 0.1</p> <p>36 ± 2 Full thd</p> <p>44 ± 1</p> <p>55⁰_{-0.5}</p> <p>(77)</p> <p>Ø17^{+0.2}₀</p> <p>Ø23^{+0.2}₀</p> <p>Ø44.45^{-0.127}₀</p> <p>Ø105.5 ± 0.25</p> <p>5/8-11 UNC-2B THD⁽¹⁾</p> <p>Mounting flange Flange 152-4, Per SAE J744</p> <p>P400424</p> <p>Min. active spline length⁽²⁾: 55 mm [2.71 in]</p>

Installation Drawings

Shaft torque and dimensions (continued)

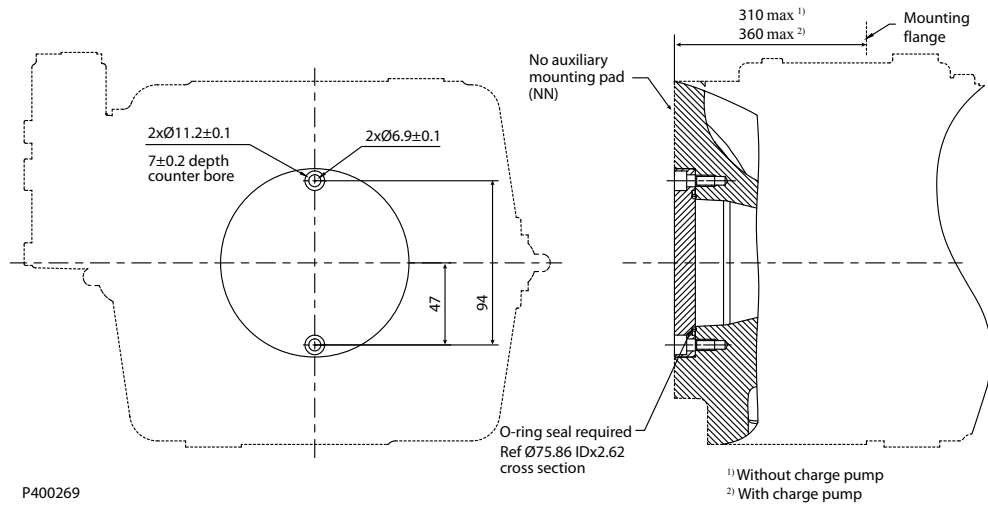
Code	Description	Maximum Torque Rating	Drawing
P	Straight keyed shaft, DIN 6885, AS14 x 9 x 80	1411 N·m [12488 lbf·in]	<p>Mating coupling must not protrude beyond this point</p>
K	SAE J744 (D/E) 3in straight keyed shaft, 0.4375 x 3.000 in	1787 N·m [15816 lbf·in]	<p>Mating coupling must not protrude beyond this point</p>

- 1) Center bore according to DIN 332 (thread according to DIN 13)
- 2) Minimum active spline length for the specified torque ratings

Installation Drawings

Aux mounting flange

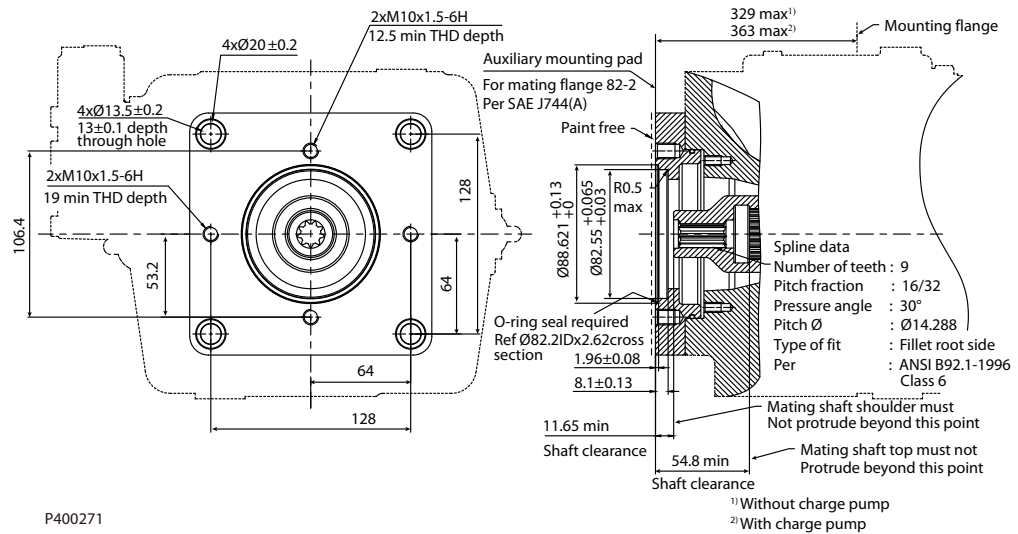
Size 130/145: Option NN (No Coupling)



Specifications

Option	Coupling
NN	No coupling

Size 130/145: Option A1 (SAE-A, 9 teeth)

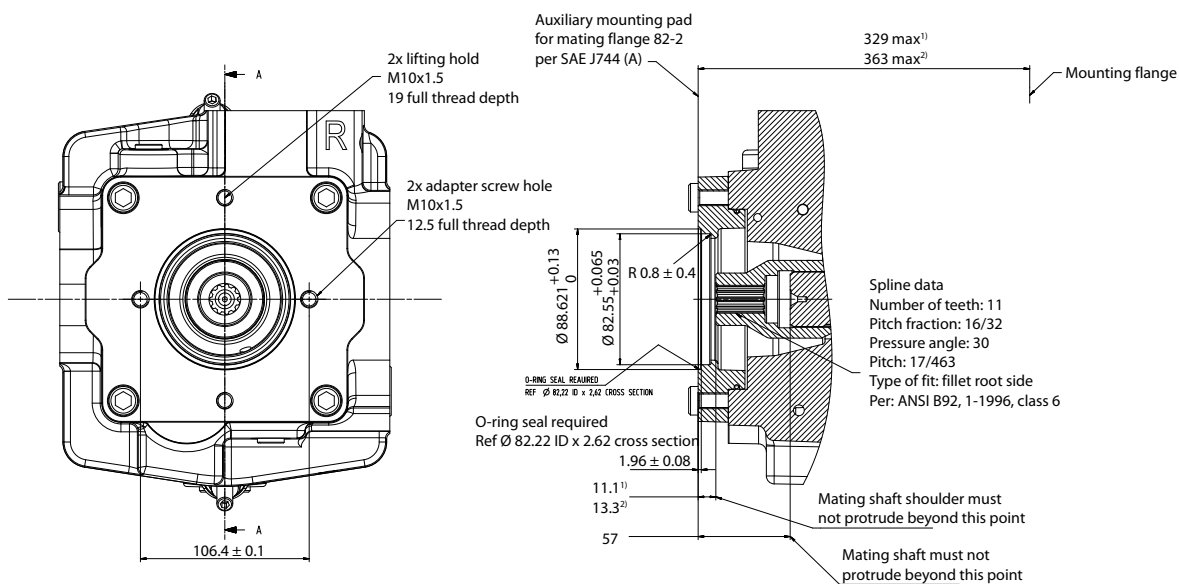


Specifications

Option	Coupling	Max torque
A1	5/8 in, 9T, 16/32 DP	205 N·m [1814.40 lbf·in]

Installation Drawings

Size 130/145: Option A2 (SAE-A, 11 teeth)



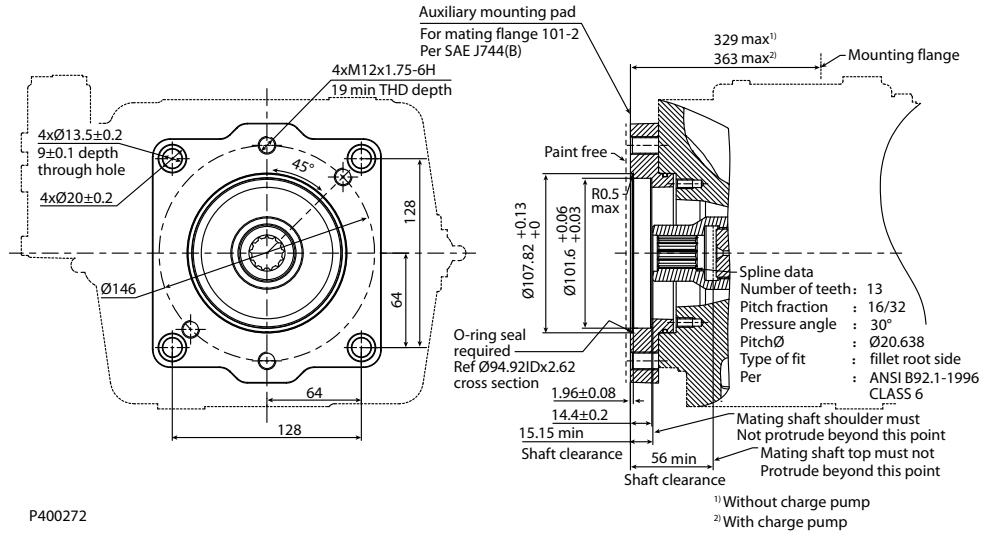
¹⁾Without charge pump
²⁾With charge pump

Specifications

Option	Coupling	Max torque
A2	3/4in, 11T, 16/32DP	Pending

Installation Drawings

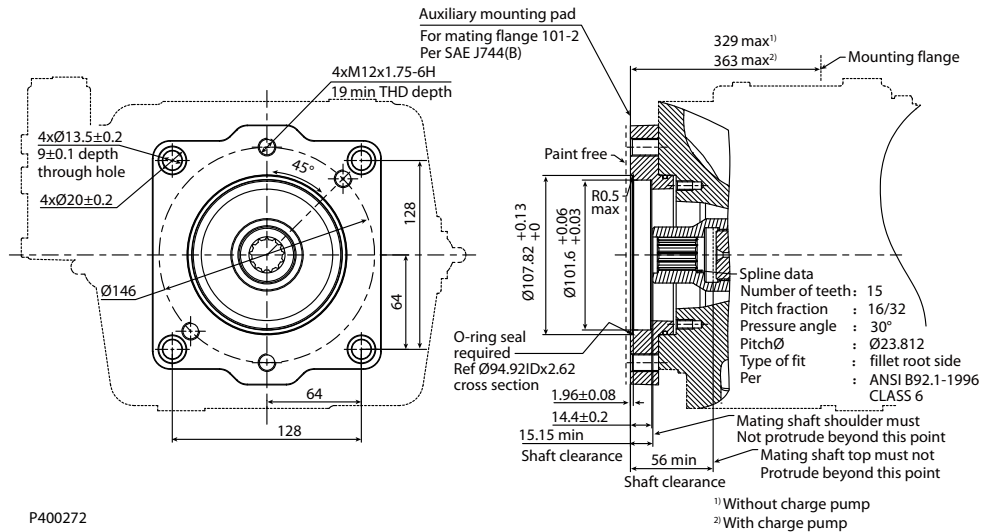
Size 130/145: Option B1 (SAE-B, 13 teeth)



Specifications

Option	Coupling	Max torque
B1	7/8 in, 13T, 16/32 DP	411 N·m [3637.66 lbf·in]

Size 130/145: Option B2 (SAE-B, 15 teeth)

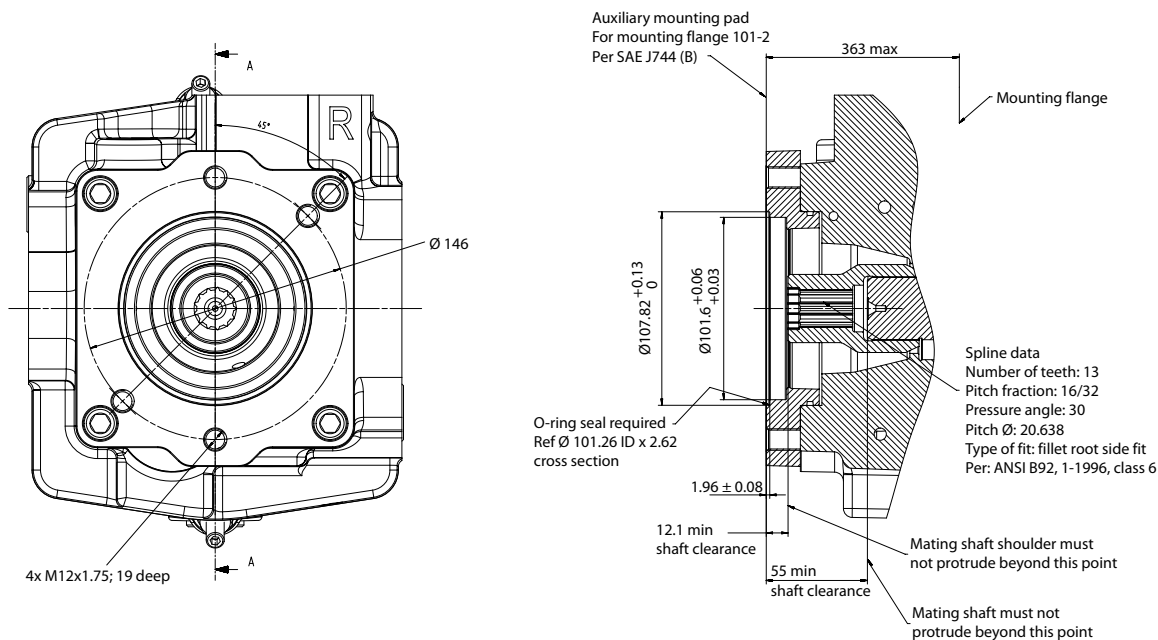


Specifications

Option	Coupling	Max torque
B2	1in, 15T, 16/32DP	Pending

Installation Drawings

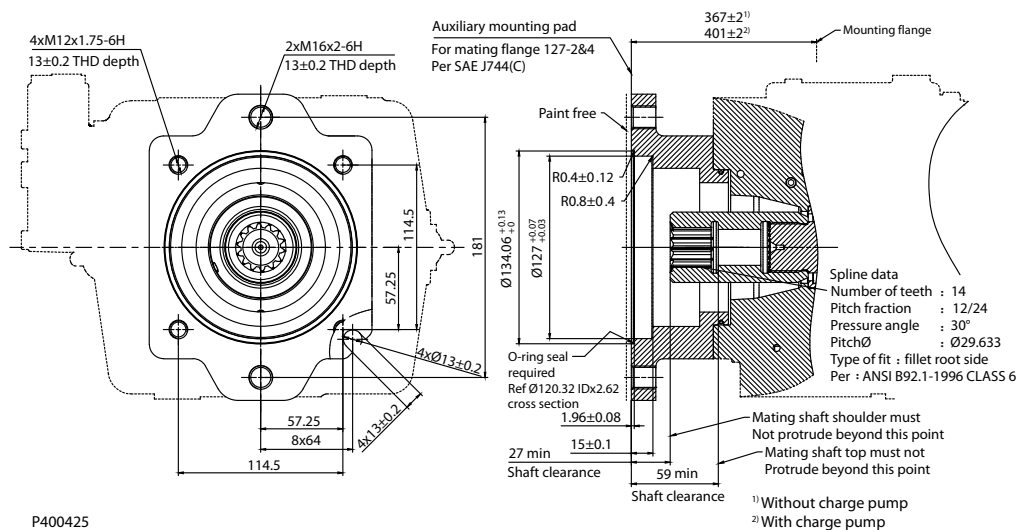
Size 130/145: Option BA (SAE-B, 13 teeth)



Specifications

Option	Coupling	Max torque
BA	7/8in, 13T, 16/32DP	411 N·m [3637.66 lbf·in]

Size 130/145: Option C5 (SAE-C, 14 teeth)

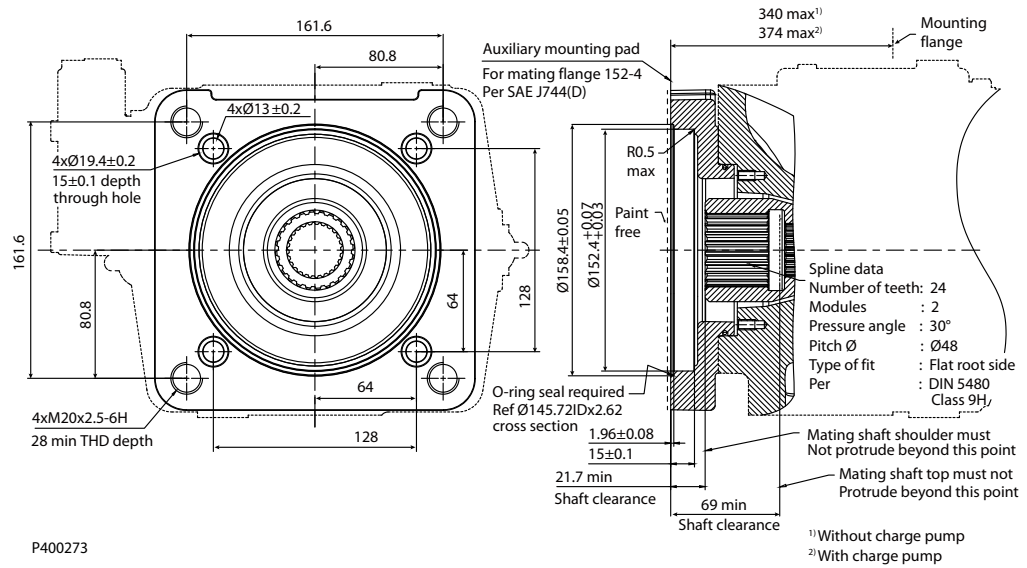


Specifications

Option	Coupling	Max torque
C5	1 ¼ in, 14T 12/24 DP	1164 N·m [10302.27 lbf·in]

Installation Drawings

Size 130/145: Option D5 (SAE-D, 24 teeth)



Specifications

Option	Coupling	Max torque
D5	N50 x 2 x 30 x 24 x 9H	1164 N•m [10302.27 lbf•in]

Before finalizing your design, please request a certified drawing.

Installation Drawings

Size 193

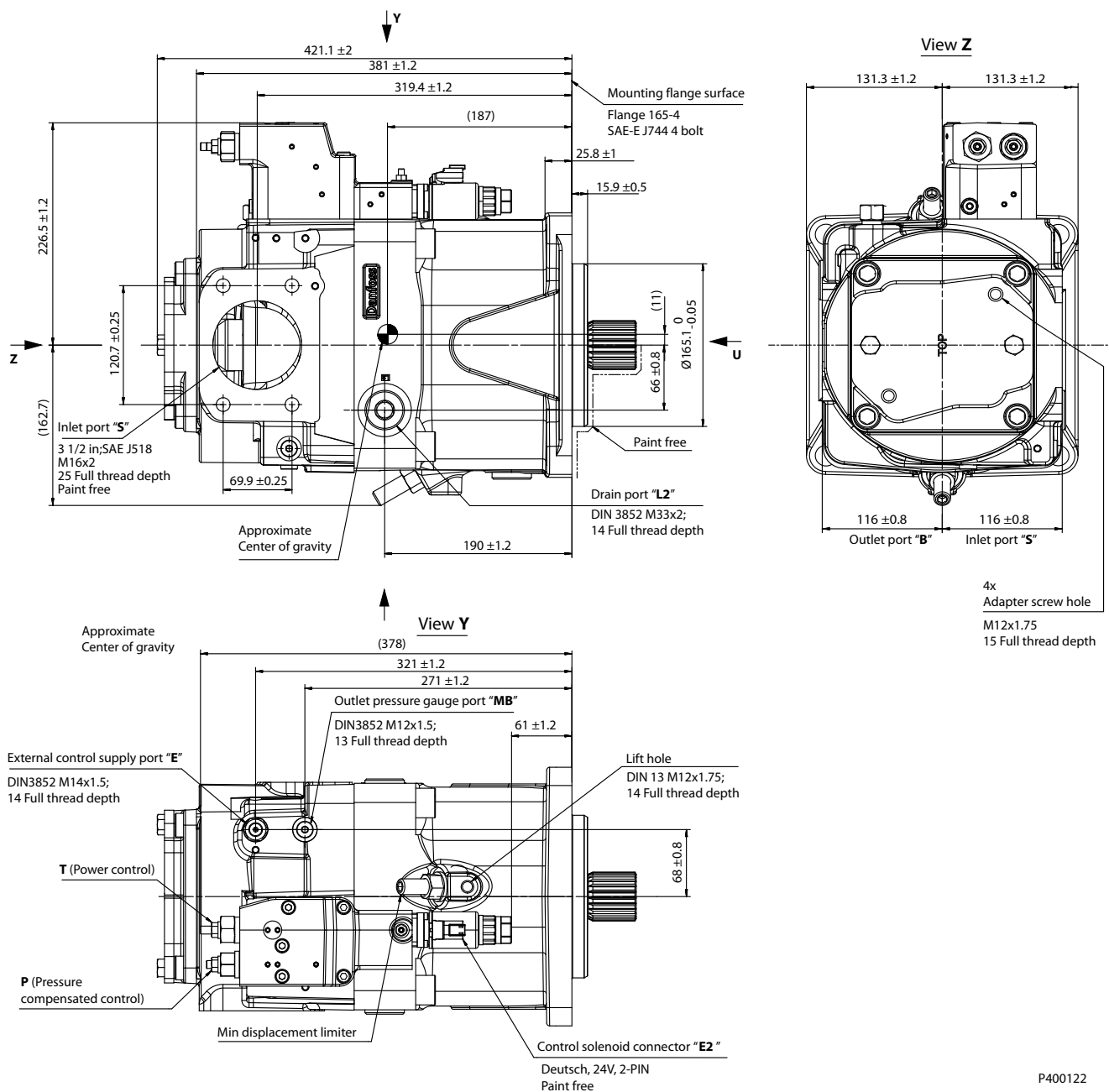
Dimensions (mm) and port descriptions

Size 193: TPE2 w/ Charge Pump

Control : TPE2

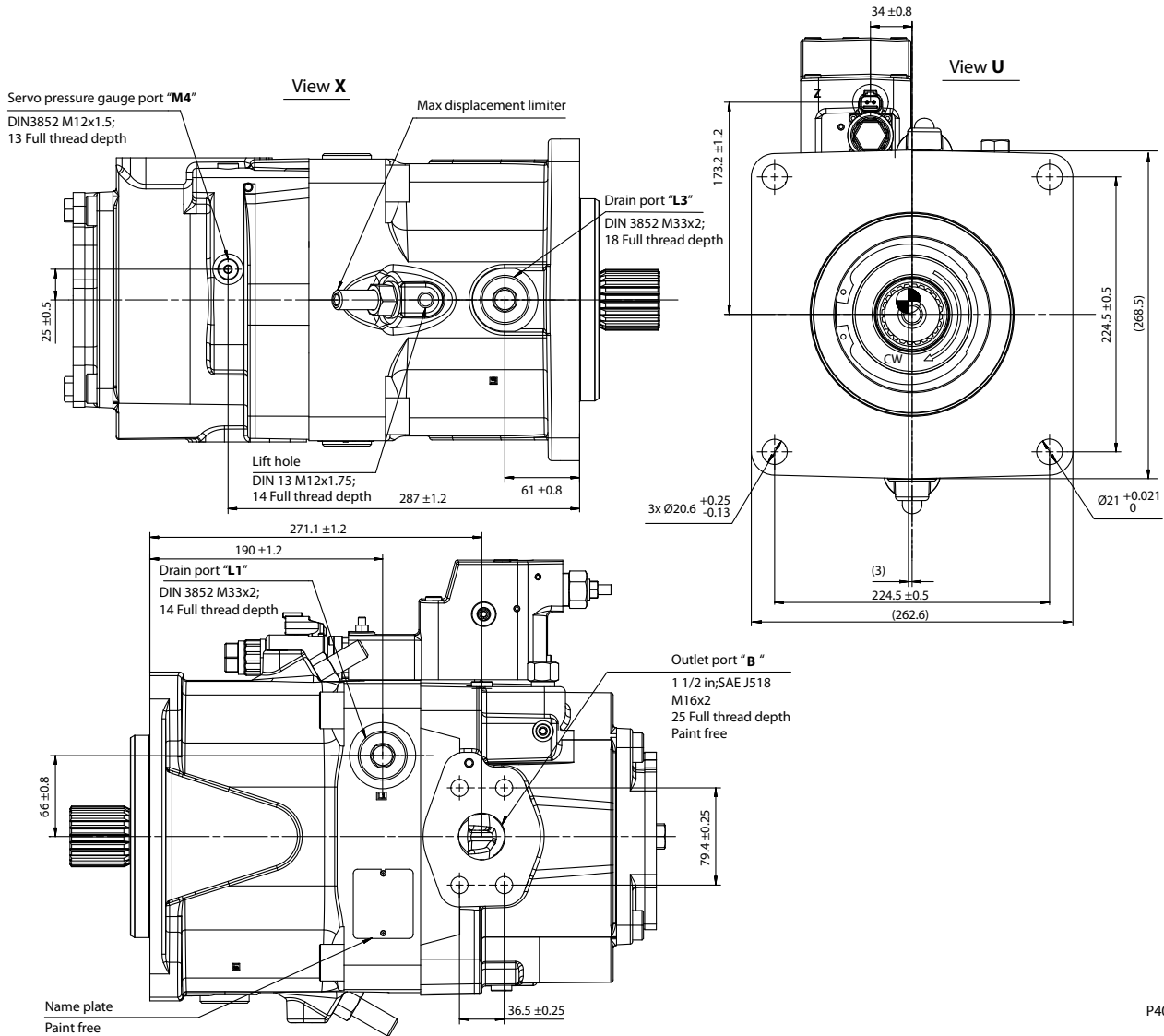
Power Control (T) + Pressure Compensated Control (P) + Electric Displacement Control (E2)

Auxiliary flange : B1



P400122

Before finalizing your design, please request a certified drawing.

Installation Drawings


P400123

Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 1/2 in, M16 x 2; 25 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 1/2 in, M16 x 2; 25 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M33 x 2; 14,14, 18 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 13 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 13 deep	400 [5802]	X
E	External control port	DIN 3852	M14 x 1.5; 14 deep	200 [2901]	X ⁴⁾

¹⁾ For required torque, please refer to [DIP tightening torque](#) on page 94

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery)

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

⁴⁾ If E port is not used, remove the shuttle valve and lock port by seal plug.

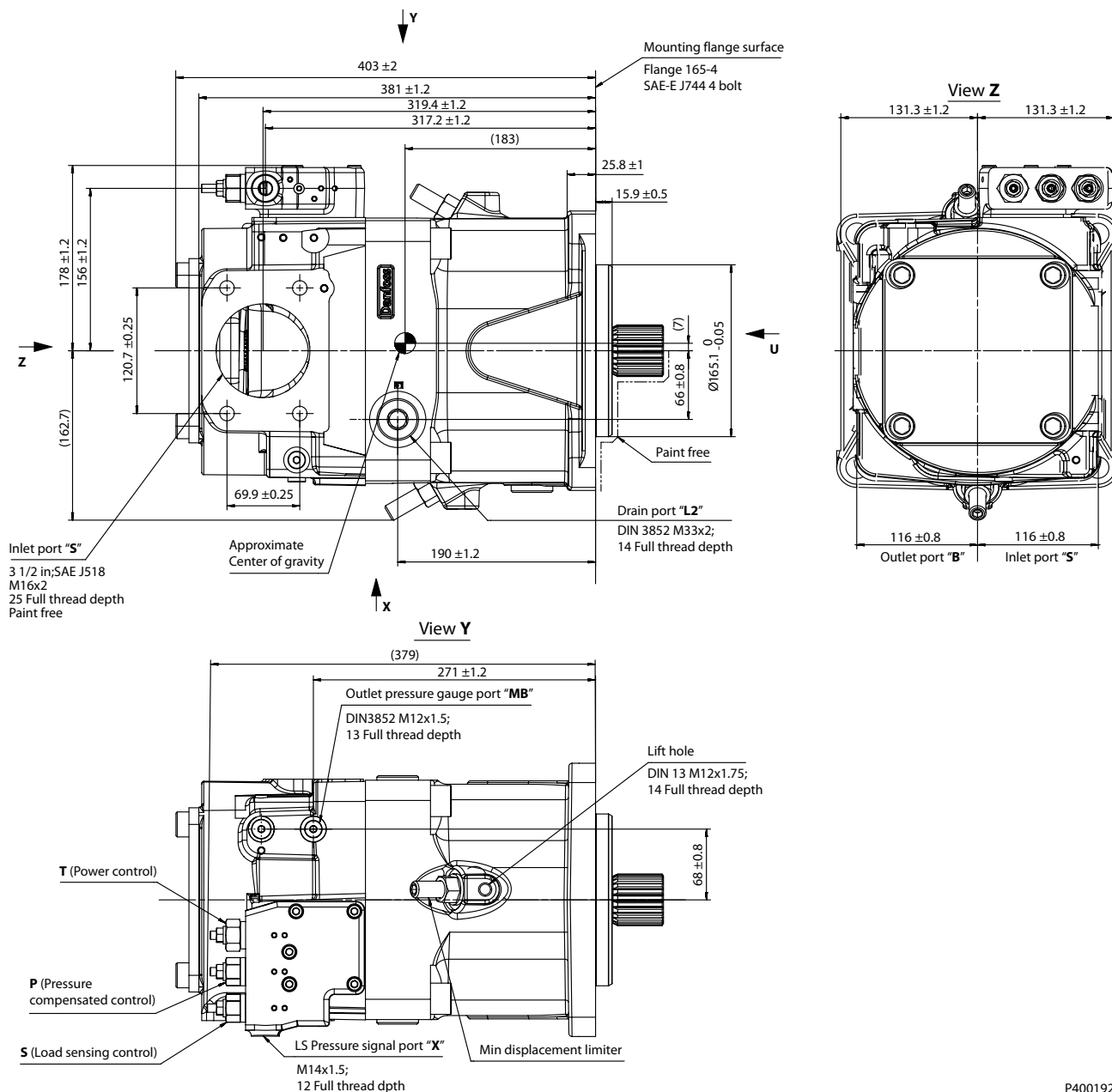
Installation Drawings

Size 193: TPSN w/ Charge Pump

Control : TPSN

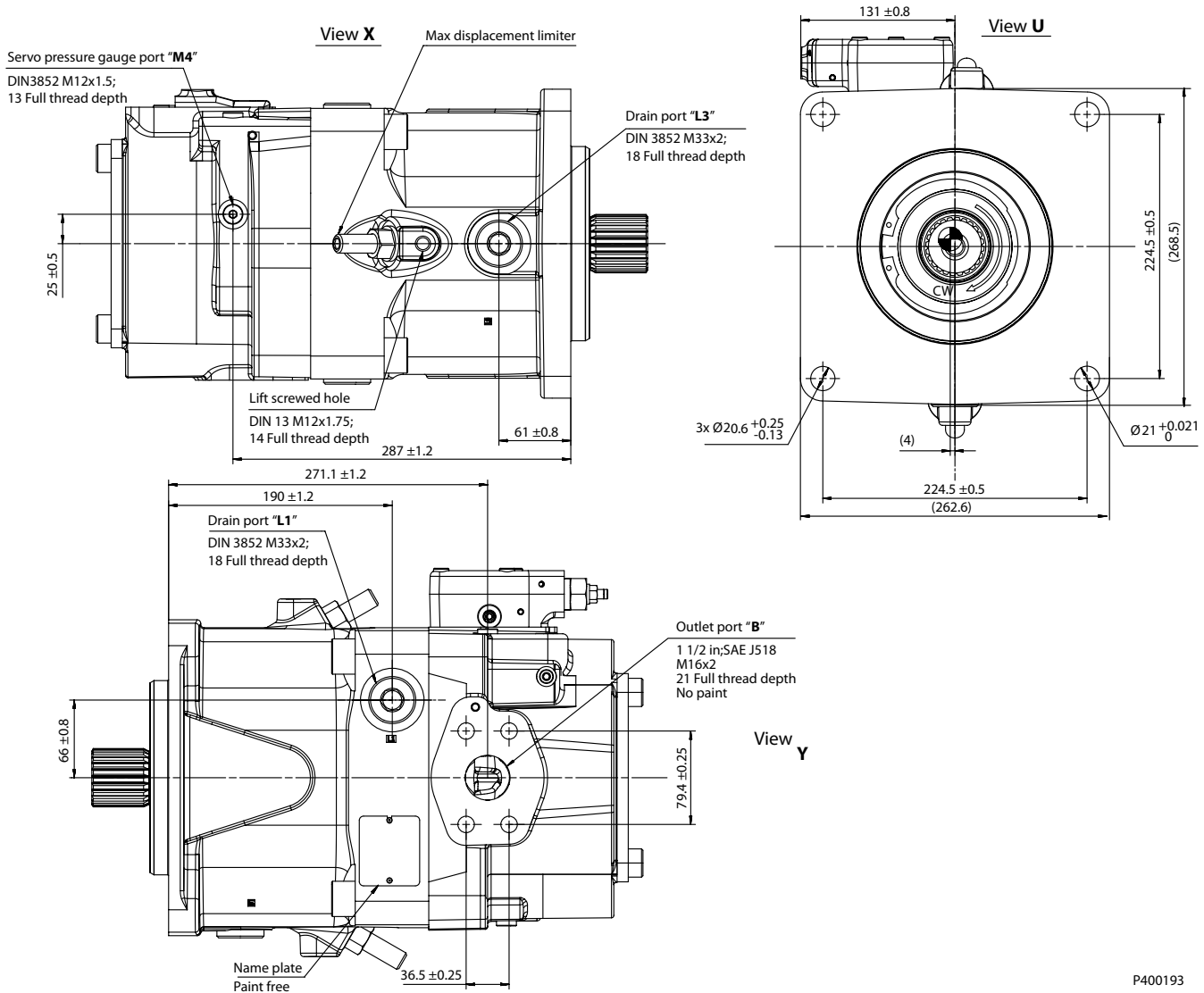
Power Control (T) + Pressure Compensated Control (P) + Load Sensing Control (S)

Auxiliary flange : NN



P400192

Before finalizing your design, please request a certified drawing.

Installation Drawings


P400193

Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 1/2 in, M16 x 2; 25 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	3 1/2 in, M16 x 2; 25 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M33 x 2; 14, 14, 18 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 13 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 13 deep	400 [5802]	X
X	LS port	DIN 3852	M14 x 1.5; 12 deep	400 [5802]	O

¹⁾ For required torque, please refer to [DIP tightening torque](#) on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

Input shaft

D1P 193 shaft specifications

Code	Description	Maximum Torque Rating	Drawing
T	Splined shaft DIN 5480, W50 x 2 x 30 x 24 x 9g	3100 N·m [27437 lbf·in]	<p> Mating coupling must not protrude beyond this point Paint free Spline data Number of teeth: 24 Module: 2 Pressure angle: 30° pitch: Ø 48 Type of fit: flat root side fit Per: DIN 5480 CLASS 9g </p> <p> 10.4 ± 0.8 5.2 ± 0.5 Ø17 ± 0.2 Ø23 ± 0.2 Ø49.6 ± 0.1 Ø126 ± 0.1 12 ± 2 38 ± 2 FULL THD 44.0 ± 0.5 60 ± 1 (66) M16 x 2-6H THD⁽¹⁾ Mounting flange Flange 165-4 Per SAE J744 </p> <p>Min. active spline length⁽²⁾: 44 mm [1.73 in]</p>
S	Splined shaft SAE J744, 1 3/4 in, 13T, 8/16 DP	1536 N·m [13595 lbf·in]	<p> Mating coupling must not protrude beyond this point Paint free Spline data Number of teeth: 13 Pitch friction: 8/16 Pressure angle: 30° pitch: Ø 41.275 Type of fit: Fillet root side Per: ANSI B92.1-1996, Class 5 </p> <p> 7.8 ± 0.8 12 ± 2 5.2 ± 0.5 Ø34.5 ± 0.1 Ø44.45 ± 0.1 Ø126 ± 0.1 36 ± 2 FULL THD 44 ± 1 55.0 ± 0.5 (74.7) 5/8-11 UNC-2B THD⁽¹⁾ Mounting flange Flange 165-4 Per SAE J744 </p> <p>Min. active spline length⁽²⁾: 55 mm [2.17 in]</p>

Installation Drawings

Code	Description	Maximum Torque Rating	Drawing
A	Splined shaft SAE J744, 2 in, 15T, 8/16 DP	2422 N•m [21437 lbf•in]	<p>7.8 ± 0.8</p> <p>Mating coupling must not protrude beyond this point</p> <p>Paint free</p> <p>Spline data Number of teeth: 15 Pitch friction : 8/16 Pressure angle : 30° pitch : Ø 47.625 Type of fit : Fillet root side Per : ANSI B92.1-1996, Class 5</p> <p>12 ± 2 5.2 ± 0.5</p> <p>Ø40.7±0.1</p> <p>Ø50.8 - 0.127 Ø126±0.1</p> <p>36 ± 2 FULL THD 44 ± 1</p> <p>66.0 0.5</p> <p>(87.7)</p> <p>Mounting flange Flange 165-4 Per SAE J744</p> <p>5/8-11 UNC-2B THD Ø17±0.2 Ø23±0.2</p> <p>P400427</p> <p>Min. active spline length⁽²⁾: 66 mm [2.60 in]</p>

Installation Drawings

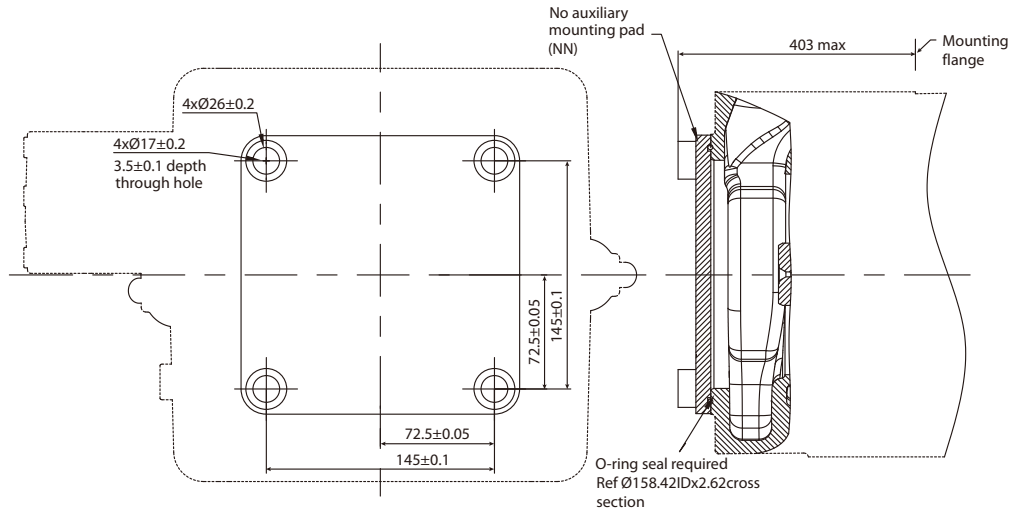
Code	Description	Maximum Torque Rating	Drawing
P	Straight keyed shaft, DIN 6885, AS16x10x100	2195 N·m [19427 lbf·in]	
K	SAE J744 (D/E) 3in straight keyed shaft, 0.4375x3.000 in	1787 N·m [15816 lbf·in]	

- 1) Center bore according to DIN 332 (thread according to DIN 13)
- 2) Minimum active spline length for the specified torque ratings

Installation Drawings

Aux mounting flange

Size 193: Option NN (No Coupling)

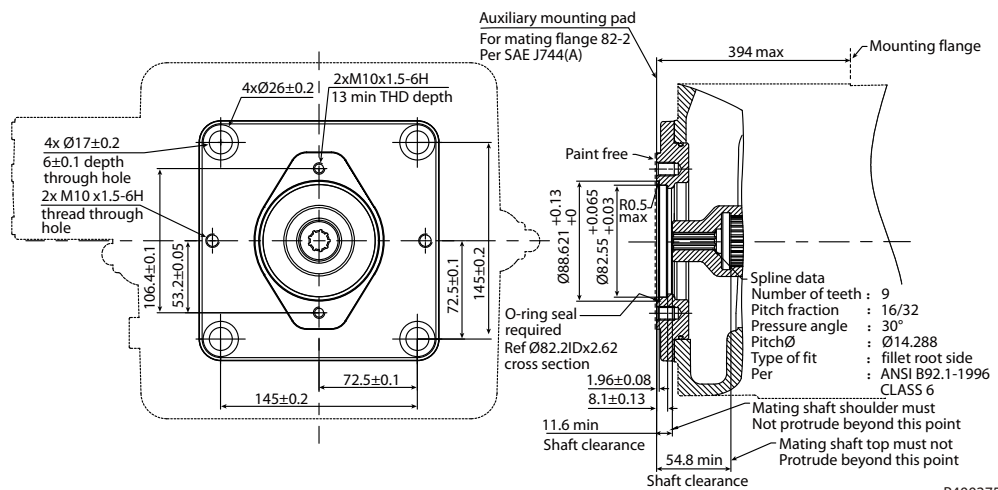


P400274

Specifications

Option	Coupling
NN	No coupling

Size 193: Option A1 (SAE-A, 9 teeth)



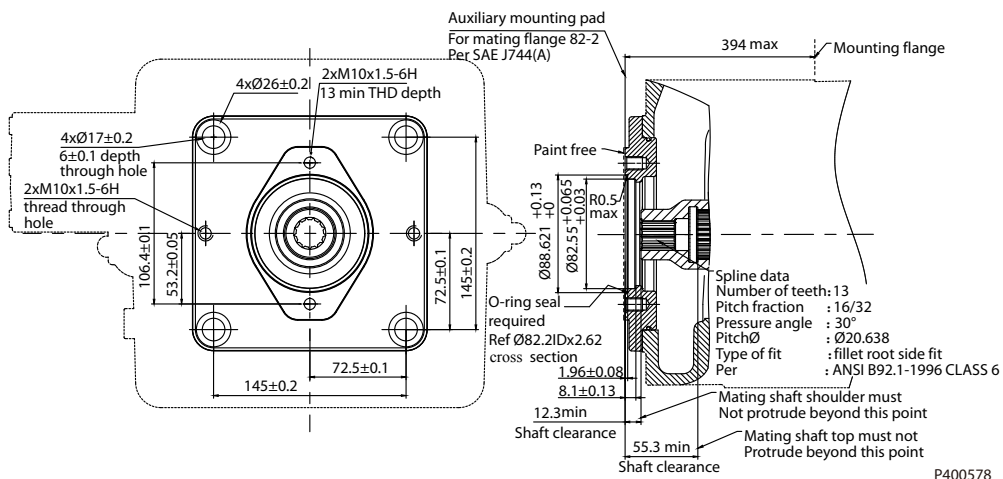
P400275

Specifications

Option	Coupling	Max torque
A1	5/8 in, 9T, 16/32 DP	205 N·m [1814.40 lbf·in]

Installation Drawings

Size 193: Option A3 (SAE-A, 13 teeth)

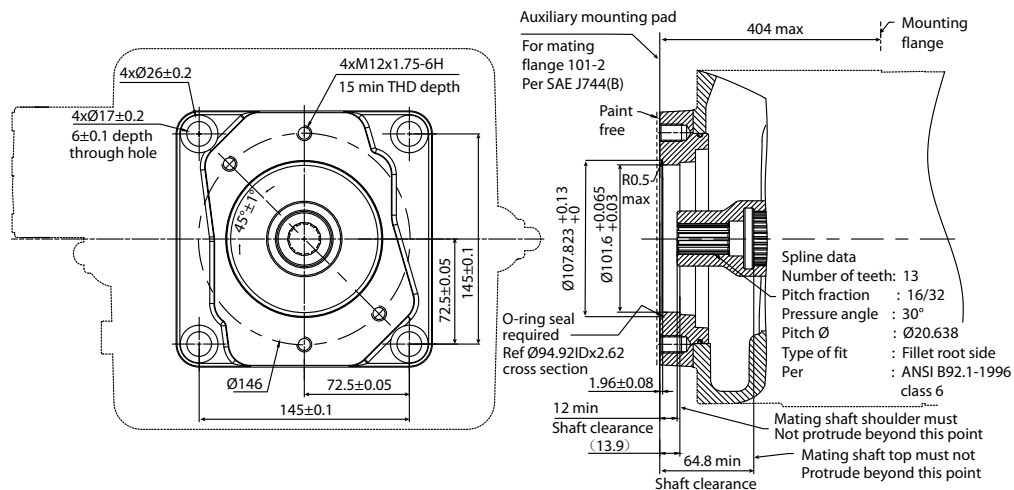


P400578

Specifications

Option	Coupling	Max torque
A3	7/8 in, 13T, 16/32 DP	619 N·m [5478.61 lbf·in]

Size 193: Option B1 (SAE-B, 13 teeth)



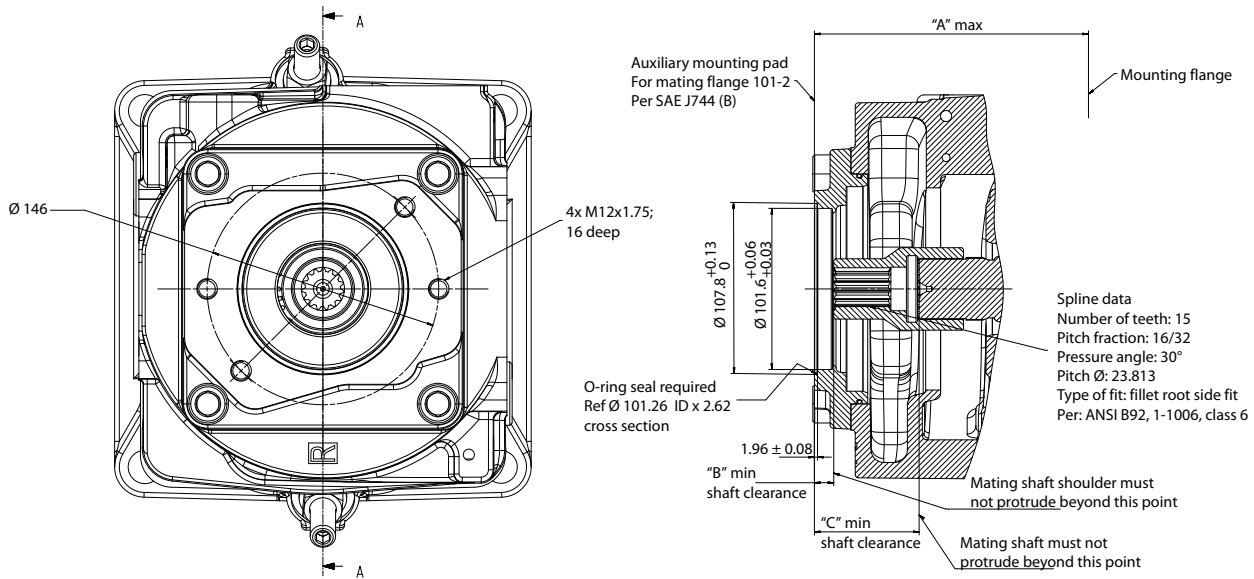
P400276

Specifications

Option	Coupling	Max torque
B1	7/8 in, 13T, 16/32 DP	411 N·m [3637.66 lbf·in]

Installation Drawings

Size 193: Option B2 (SAE-B, 15 teeth)

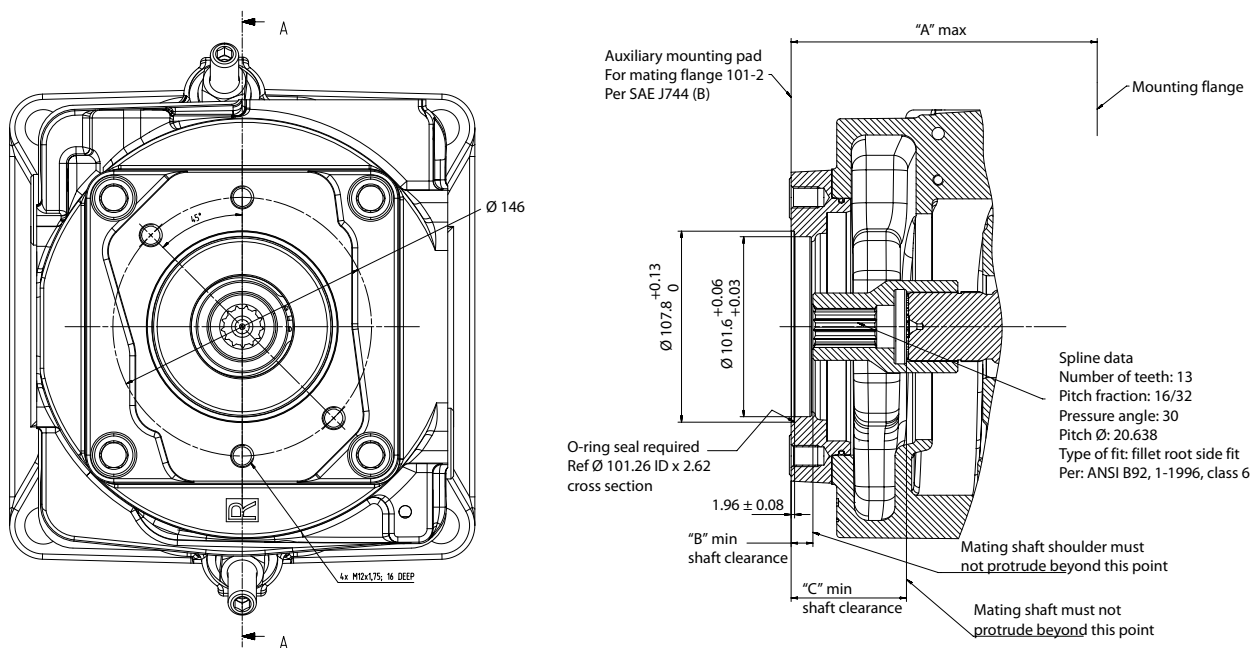


Legend

Dimension	Y2	N3
A	404	369.8
B	12.2	12.3
C	65	63.2

Specifications

Option	Coupling	Max torque
B2	1in, 15T, 16/32DP	Pending

Installation Drawings
Size 193: Option BA (SAE-B, 13 teeth)

Legend

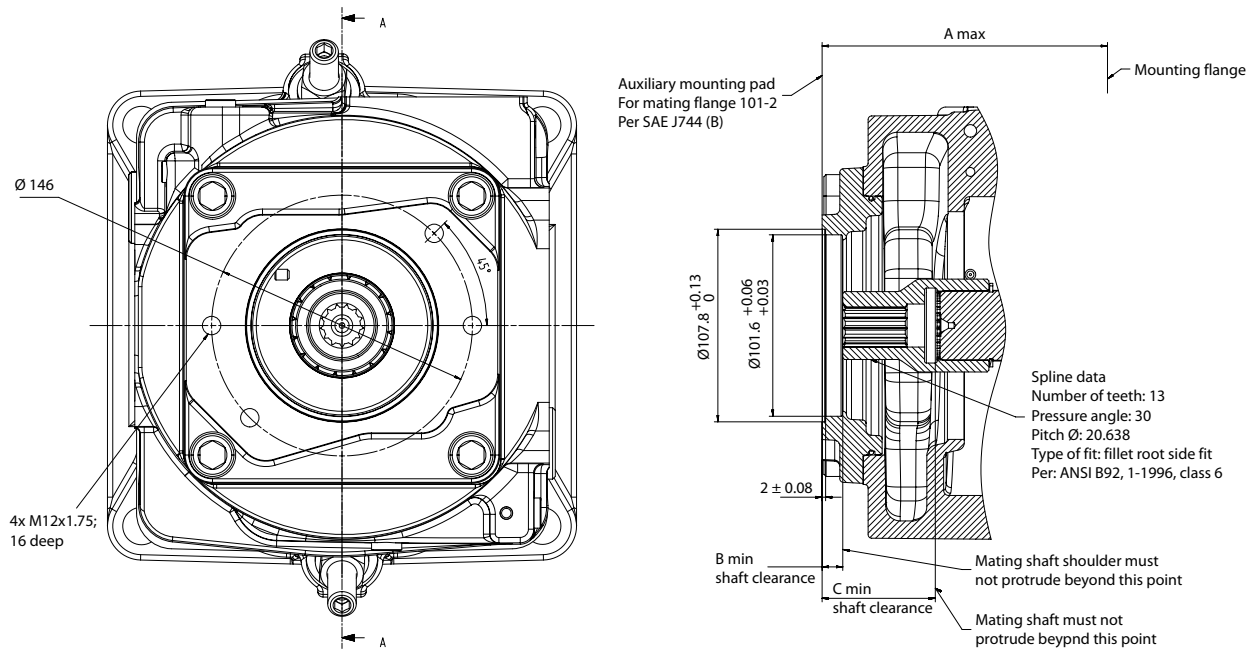
Dimension	Value
A	404
B	12
C	64

Specifications

Option	Coupling	Max torque
BA	7/8in, 13T, 16/32DP	411 N·m [3637.66 lbf·in]

Installation Drawings

Size 193: Option BB (SAE-B, 13 teeth)



Legend

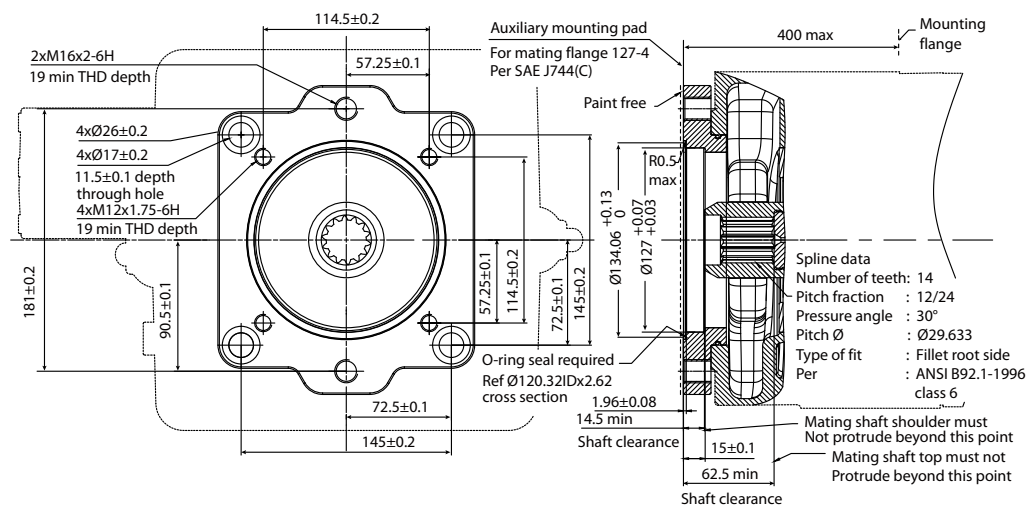
Dimension	Value
A	404
B	11.6
C	63.4

Specifications

Option	Coupling	Max torque
BB	7/8in, 13T, 16/32DP	411 N·m [3637.66 lbf·in]

Installation Drawings

Size 193: Option C5 (SAE-C, 14 teeth)

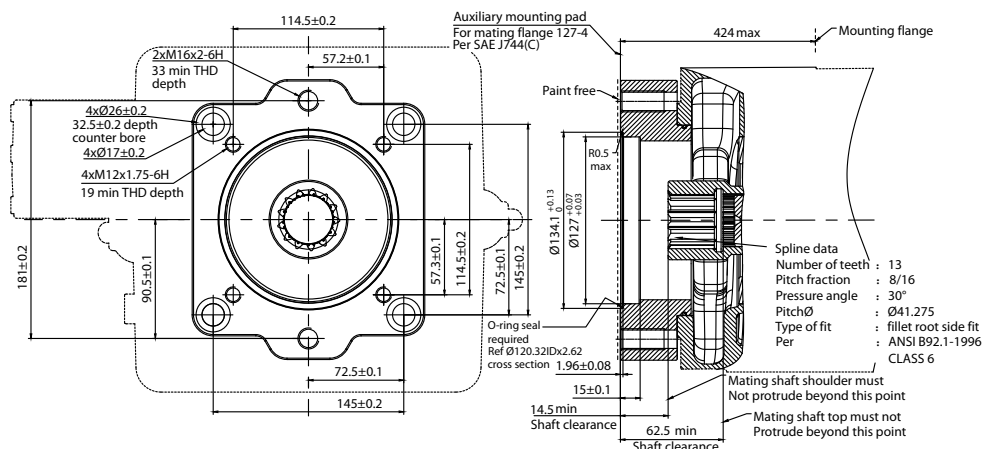


P400277

Specifications

Option	Coupling	Max torque
C5	1 1/4 in, 14T, 12/24 DP	1289 N·m [11408.61 lbf·in]

Size 193: Option C9 (SAE-C, 13 teeth)



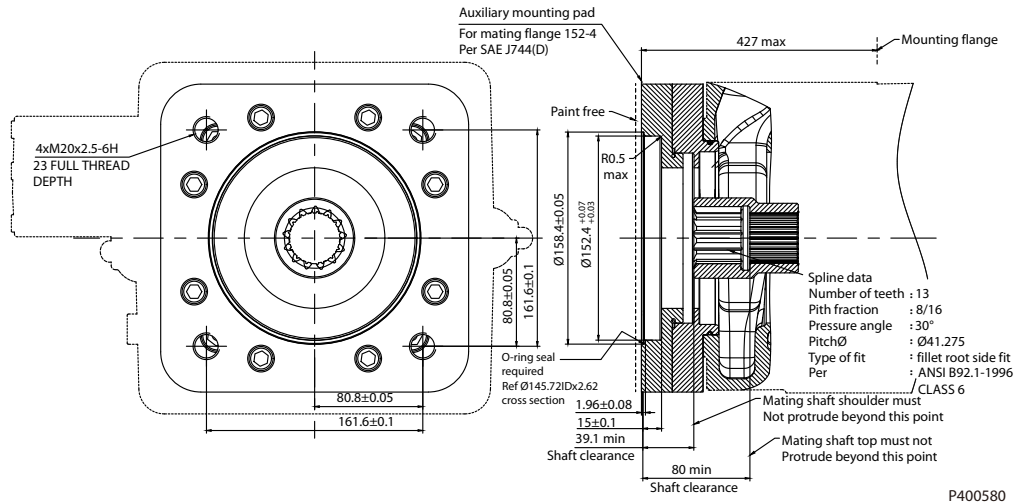
P400579

Specifications

Option	Coupling	Max torque
C9	1 3/4 in, 13T, 8/16 DP	1790 N·m [15842.83 lbf·in]

Installation Drawings

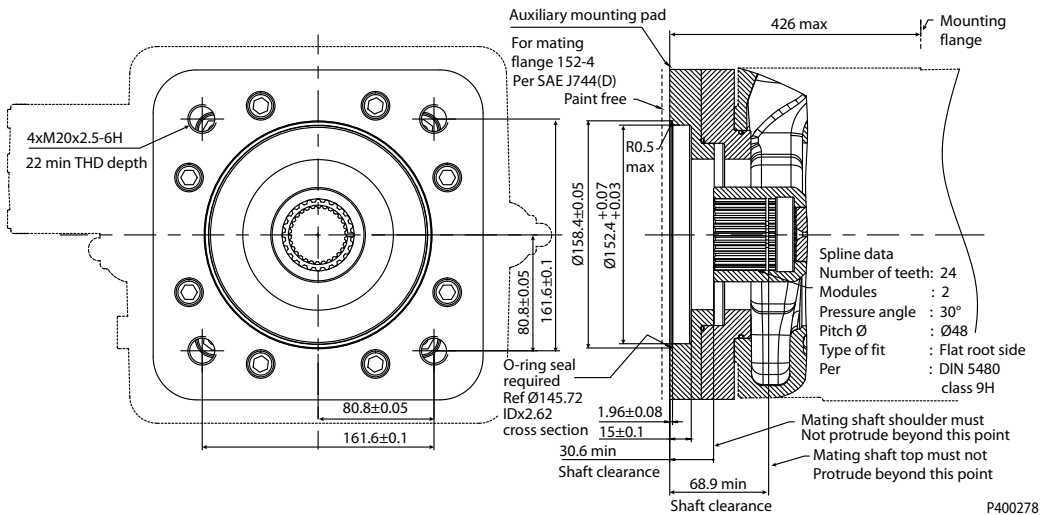
Size 193: Option D2 (SAE-D, 13 teeth)



Specifications

Option	Coupling	Max torque
D2	1 3/4 in, 13T, 8/16 DP	1630 N·m [14426.72 lbf·in]

Size 193: Option D5 (SAE-D, 24 teeth)

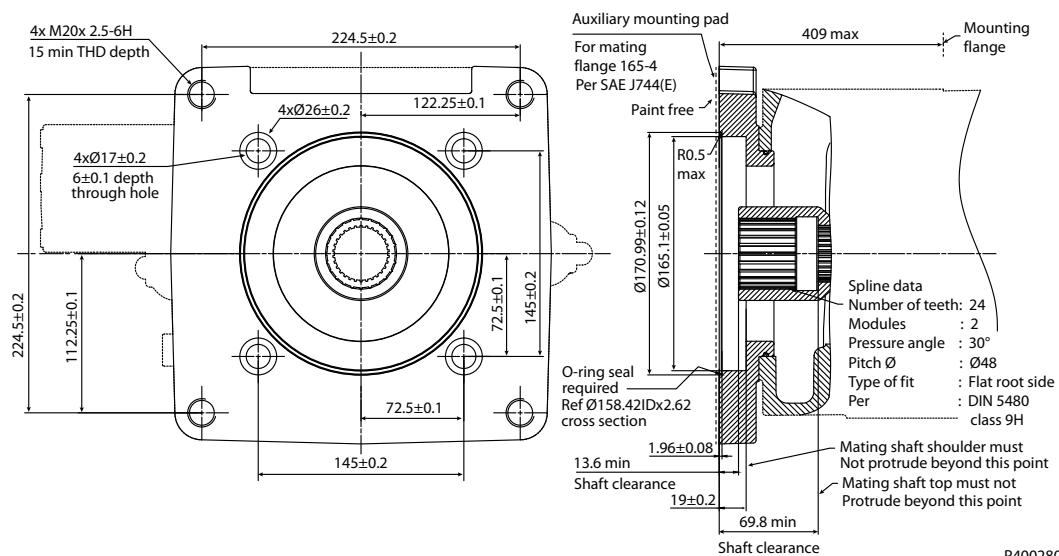


Specifications

Option	Coupling	Max torque
D5	N50 x 2 x 30 x 24 x 9H	1790 N·m [15842.83 lbf·in]

Installation Drawings

Size 193: Option E2 (SAE-E, 24 teeth)



Specifications

Option	Coupling	Max torque
E2	N50 x 2 x 30 x 24 x 9H	1790 N·m [15842.83 lbf·in]

Before finalizing your design, please request a certified drawing.

Installation Drawings

Size 260

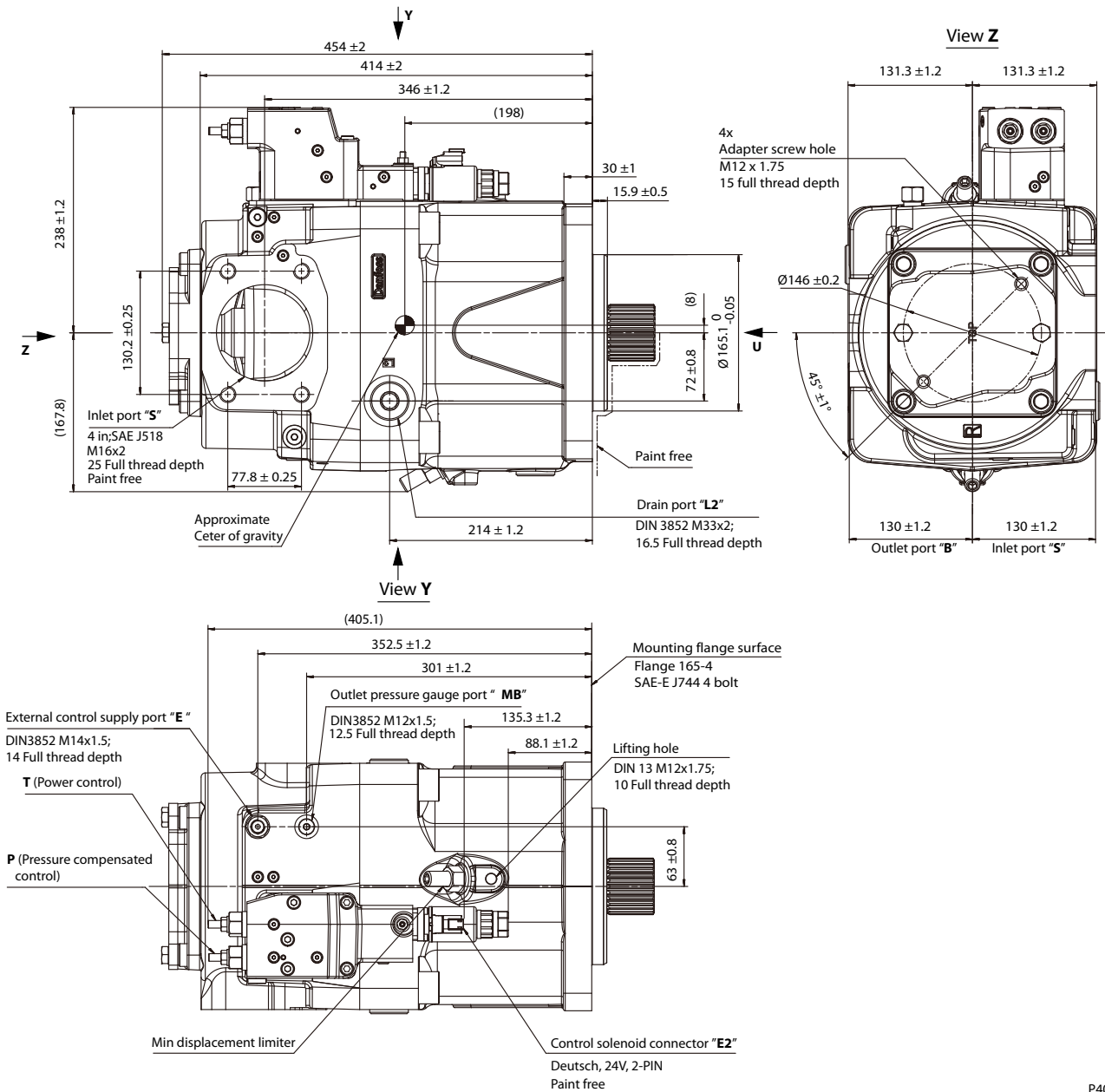
Dimensions (mm) and port descriptions

Size 260: TPE2 w/ Charge Pump

Control : TPE2

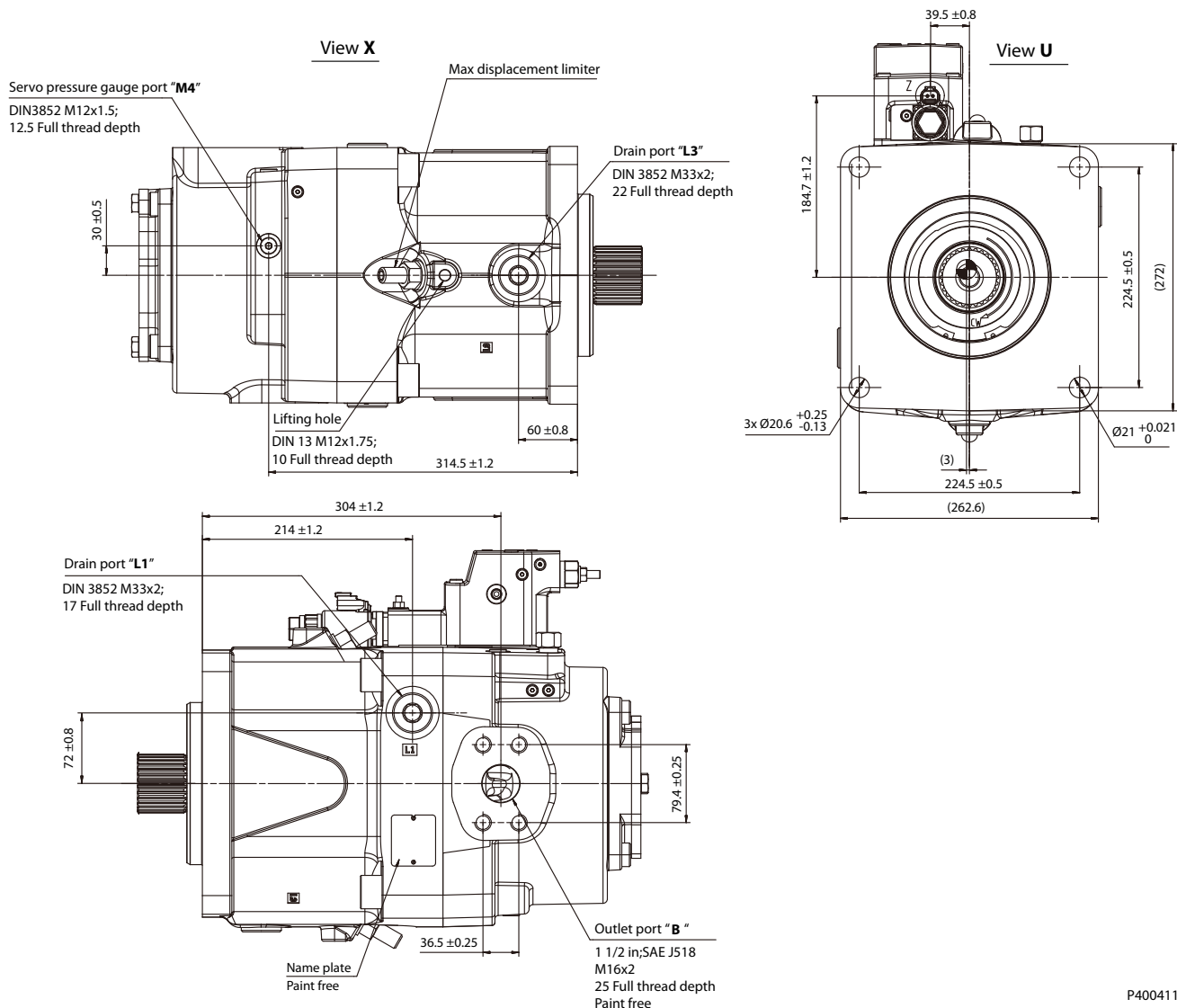
Power Control (T) + Pressure Compensated Control (P) + Electric Displacement Control (E2)

Auxiliary flange : B1



P400410

Before finalizing your design, please request a certified drawing.

Installation Drawings


P400411

Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 1/2 in, M16 x 2; 25 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	4 in, M16 x 2; 25 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M33 x 2; 17, 16.5, 22 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
E	External control port	DIN 3852	M14 x 1.5; 14 deep	200 [2901]	X ⁴⁾

¹⁾ For required torque, please refer to [DIP tightening torque](#) on page 94

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery)

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

⁴⁾ If E port is not used, remove the shuttle valve and lock port by seal plug.

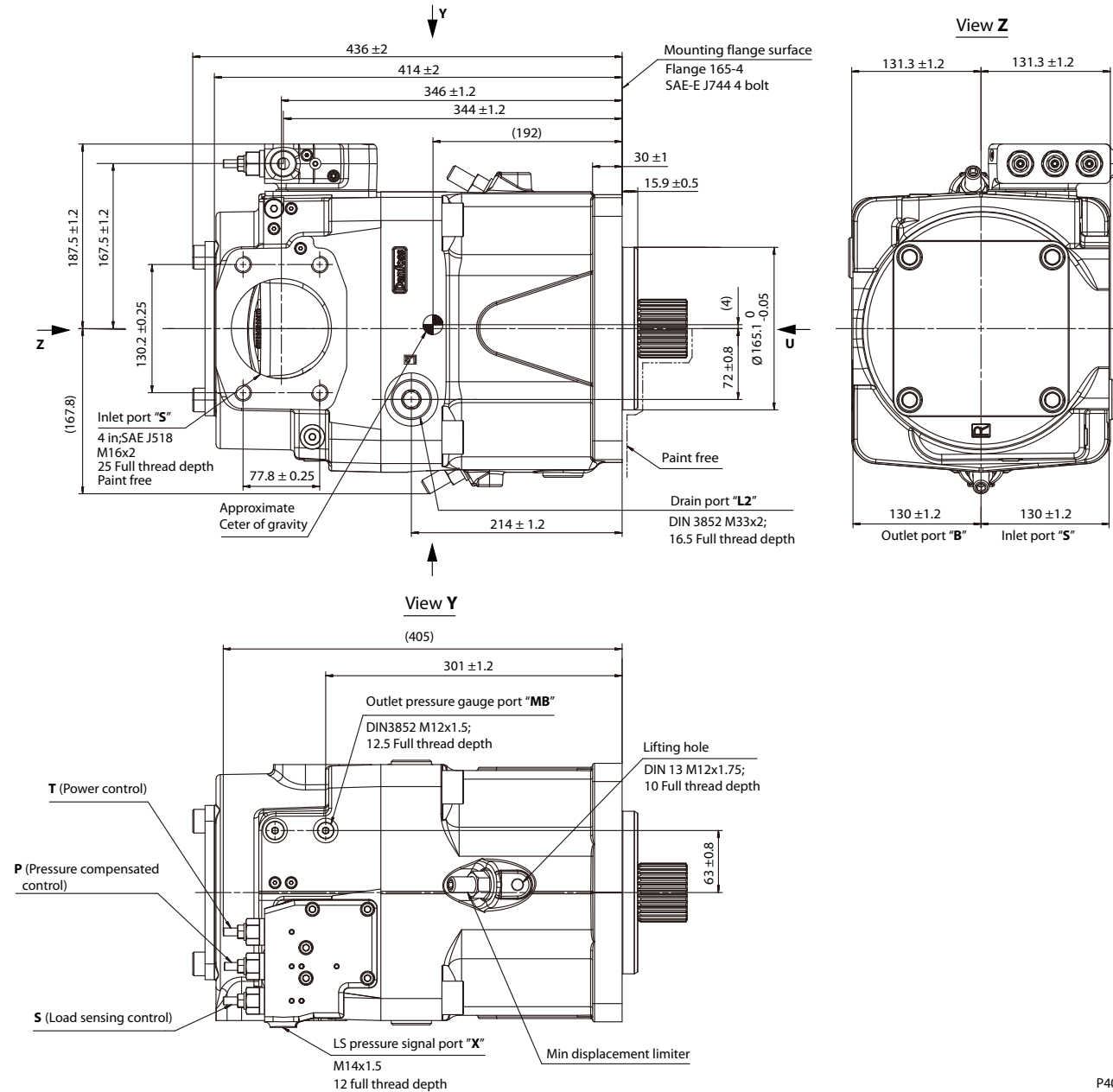
Installation Drawings

Size 260: TPSN w/ Charge Pump

Control : TPSN

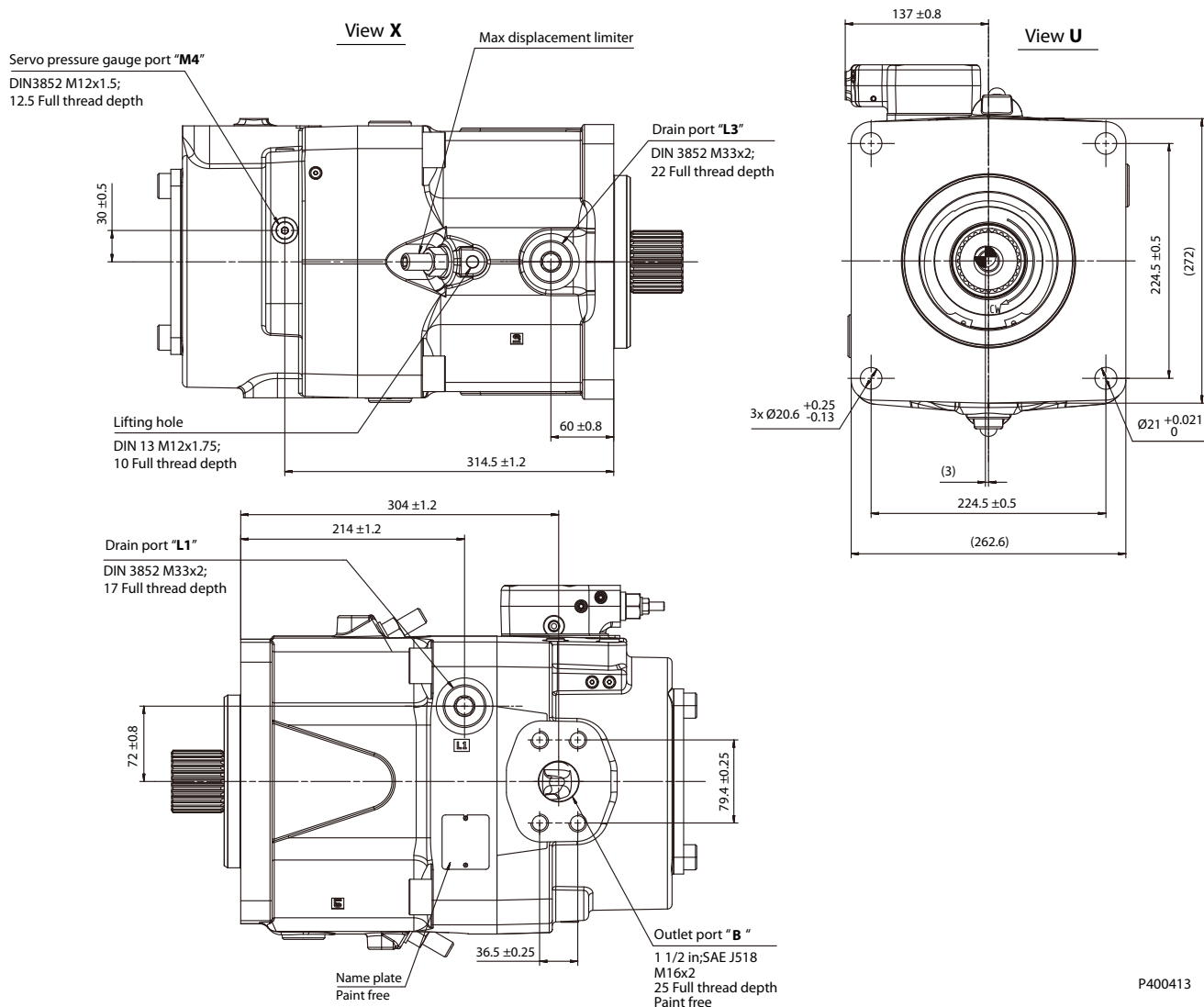
Power Control (T) + Pressure Compensated Control (P) + Load Sensing Control (S)

Auxiliary flange : NN



P400412

Before finalizing your design, please request a certified drawing.

Installation Drawings


P400413

Before finalizing your design, please request a certified drawing.

Port Descriptions

Ports	Description	Standard	Size ¹⁾	Max. pressure (bar [psi])	State ²⁾
B	Outlet port, Fixing thread	SAE J518, DIN13	1 1/2 in, M16 x 2; 25 deep	400 [5802]	O
S	Suction port, Fixing thread	SAE J518, DIN13	4 in, M16 x 2; 25 deep	2 [29]	O
L₁, L₂, L₃	Drain port	DIN 3852	M33 x 2; 17, 16.5, 22 deep	2 [29]	X ³⁾
M₄	Measurement point, servo-piston chamber	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
M_B	Measurement point, outlet port	DIN 3852	M12 x 1.5; 12.5 deep	400 [5802]	X
X	LS port	DIN 3852	M14 x 1.5; 12 deep	400 [5802]	O

¹⁾ For required torque, please refer to *D1P tightening torque* on page 94.

²⁾ O = Open, must be connected (closed by plastic plug on delivery) / X = Closed (closed by metal plug on delivery).

³⁾ Depending on installation position, one of L₁, L₂ and L₃ must be connected (please refer to Installation Notes).

Installation Drawings

Input shaft

D1P 260 shaft specifications

Code	Description	Maximum Torque Rating	Drawing
T	Splined shaft DIN 5480, W60 x 2 x 30 x 28 x 9g	5432 N·m [48077 lbf·in]	<p>Min. active spline length⁽²⁾: 47 mm [1.85 in]</p>
S	Splined shaft SAE J744, 1 3/4 in. 13T, 8/16 DP	1535 N·m [13586 lbf·in]	<p>Min. active spline length⁽²⁾: 55 mm [2.17 in]</p>

Installation Drawings

Code	Description	Maximum Torque Rating	Drawing
A	Splined shaft SAE J744, 2 1/4 in. 17T, 8/16 DP	3621 N·m [32049 lbf·in]	<p>Min. active spline length⁽²⁾: 66 mm [2.60 in]</p>

Installation Drawings

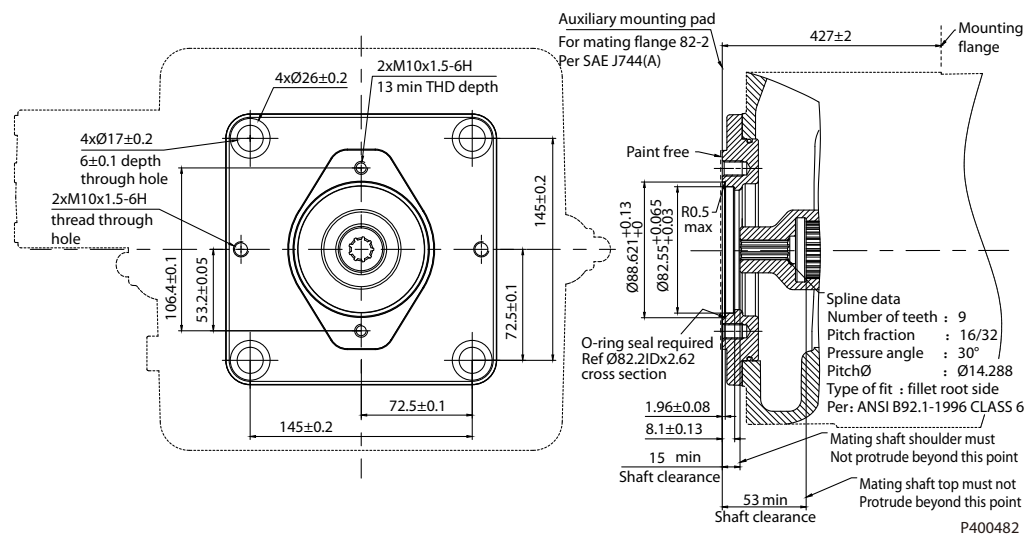
Code	Description	Maximum Torque Rating	Drawing
P	Straight keyed shaft, DIN 6885, AS18x11x100	2571 N•m [22755 lbf•in]	
K	SAE J744 (D/E) Ø1.75in straight keyed shaft, 0.4375 x 3.000in key	1787 N•m [15816 lbf•in]	

- 1) Center bore according to DIN 332 (thread according to DIN 13)
- 2) Minimum active spline length for the specified torque ratings

Installation Drawings

Aux mounting flange

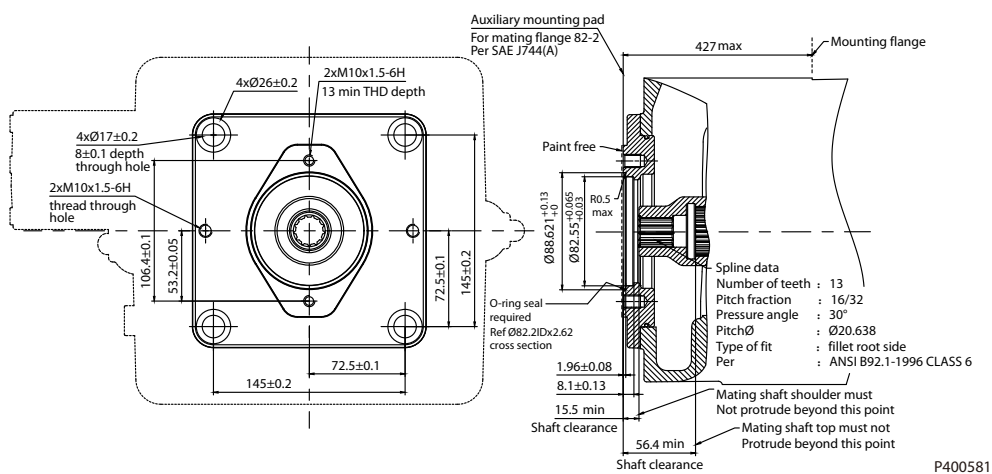
Size 260: Option A1 (SAE-A, 9 teeth)



Specifications

Option	Coupling	Max torque
A1	5/8 in, 9T, 16/32 DP	205 N·m [1814.40 lbf·in]

Size 260: Option A3 (SAE-A, 13 teeth)

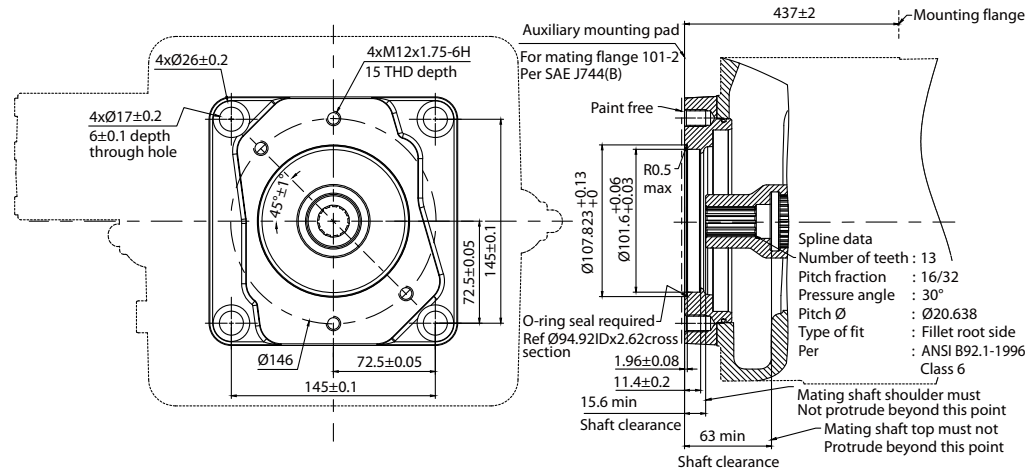


Specifications

Option	Coupling	Max torque
A3	7/8 in, 13T, 16/32 DP	619 N·m [5478.61 lbf·in]

Installation Drawings

Size 260: Option B1 (SAE-B, 13 teeth)

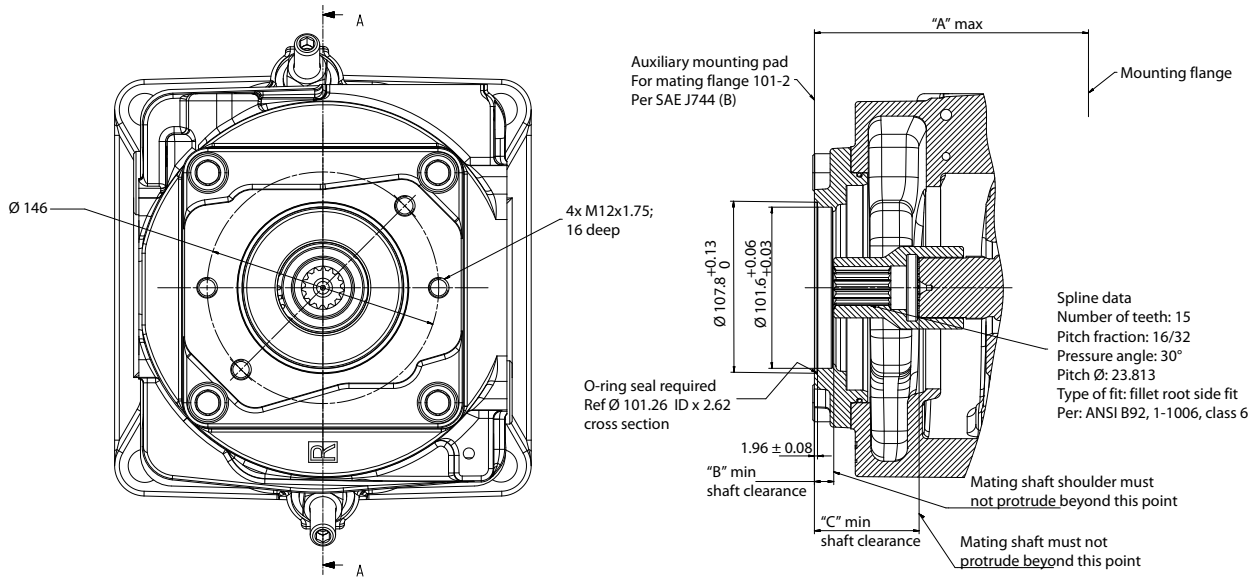


P400415

Specifications

Option	Coupling	Max torque
B1	7/8 in, 13T, 16/32 DP	411 N·m [3637.66 lbf·in]

Size 260: Option B2 (SAE-B, 15 teeth)

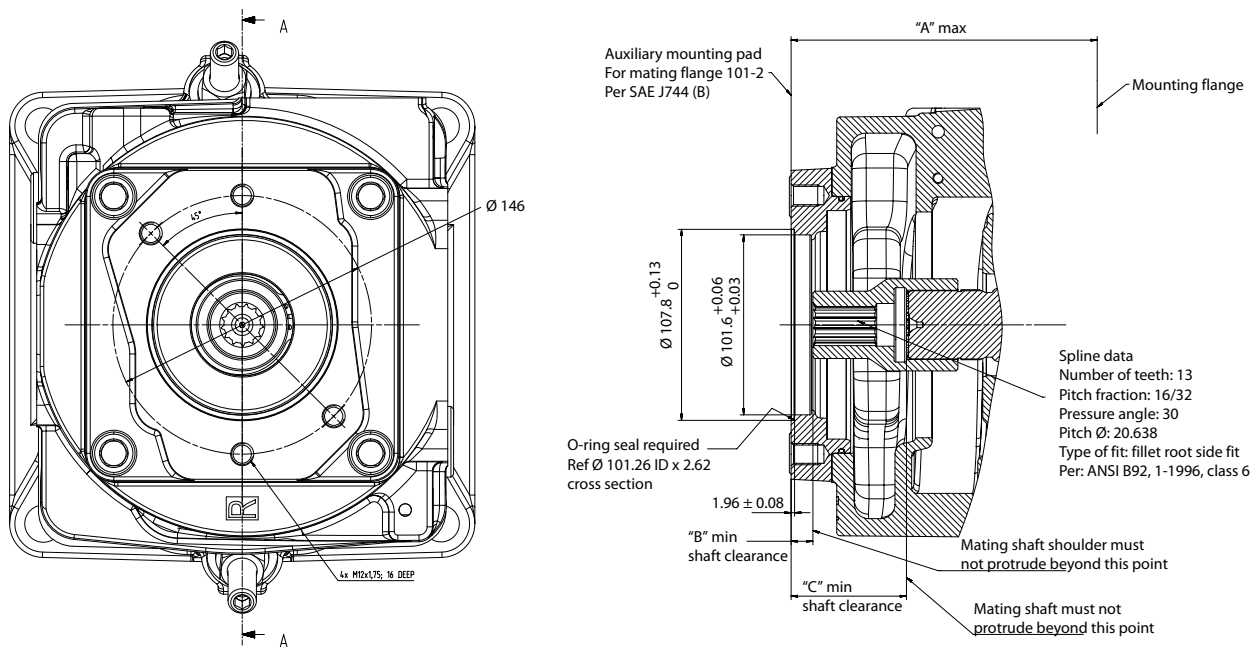


Legend

Dimension	Y3
A	437
B	15.4
C	63

Installation Drawings
Specifications

Option	Coupling	Max torque
B2	1in, 15T, 16/32DP	Pending

Size 260: Option BA (SAE-B, 13 teeth)

Legend

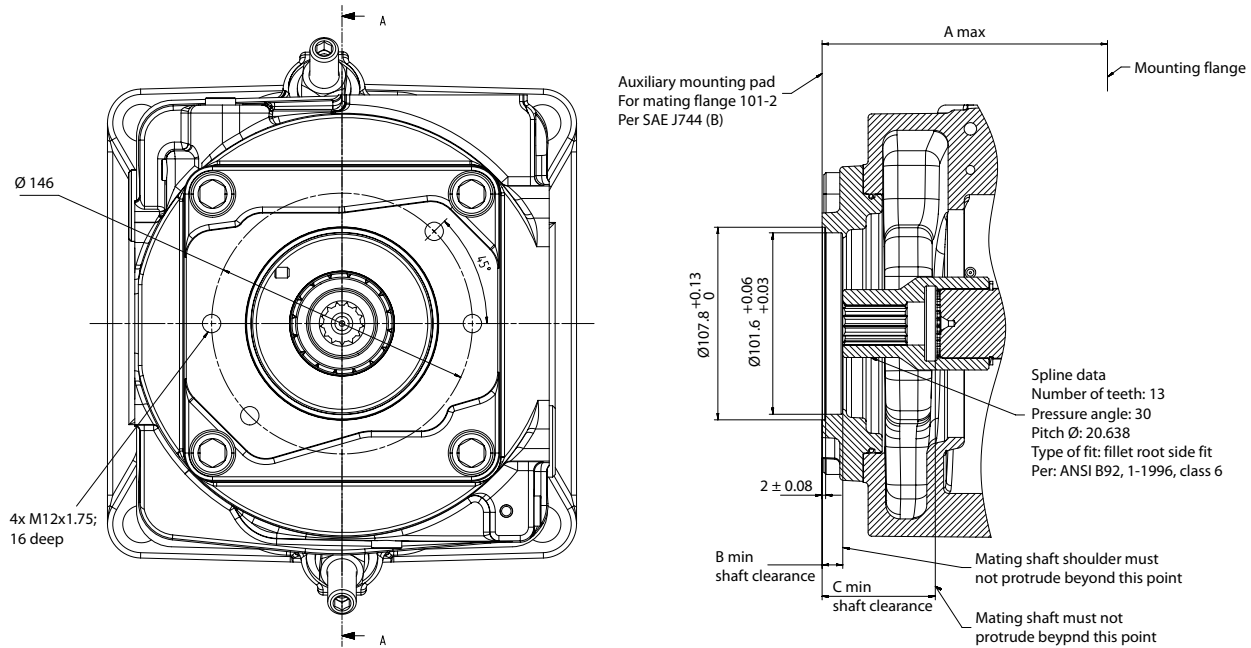
Dimension	Value
A	437
B	15.4
C	63

Specifications

Option	Coupling	Max torque
BA	7/8in, 13T, 16/32DP	411 N·m [3637.66 lbf·in]

Installation Drawings

Size 260: Option BB (SAE-B, 13 teeth)



Legend

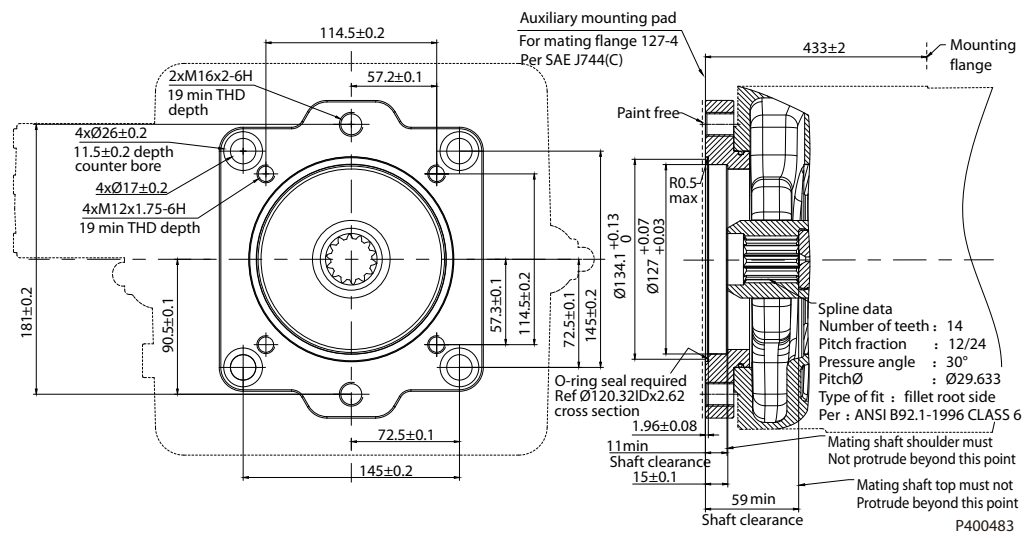
Dimension	Value
A	437
B	15.4
C	62.25

Specifications

Option	Coupling	Max torque
BB	7/8in, 13T, 16/32DP	411 N·m [3637.66 lbf·in]

Installation Drawings

Size 260: Option C5 (SAE-C, 14 teeth)

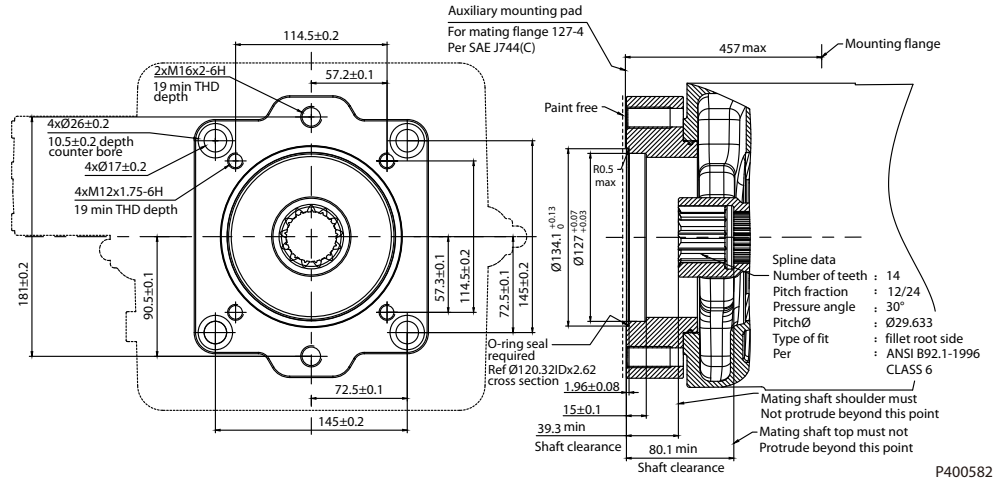


Specifications

Option	Coupling	Max torque
C5	1 1/4 in, 14T, 12/24 DP	1638 N·m [14497.52 lbf·in]

Installation Drawings

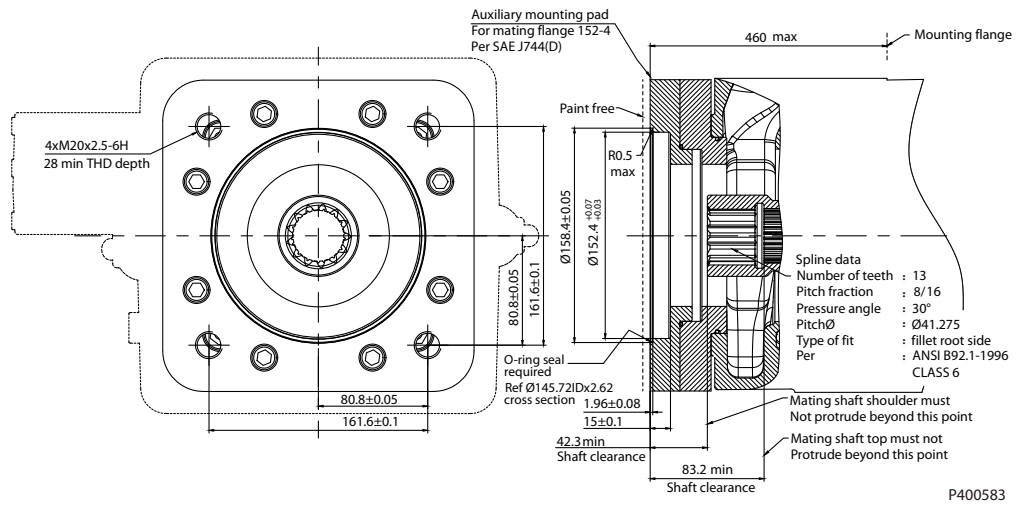
Size 260: Option C9 (SAE-C, 13 teeth)



Specifications

Option	Coupling	Max torque
C9	1 3/4 in, 13T, 8/16 DP	1891 N·m [16736.76 lbf·in]

Size 260: Option D2 (SAE-D, 13 teeth)

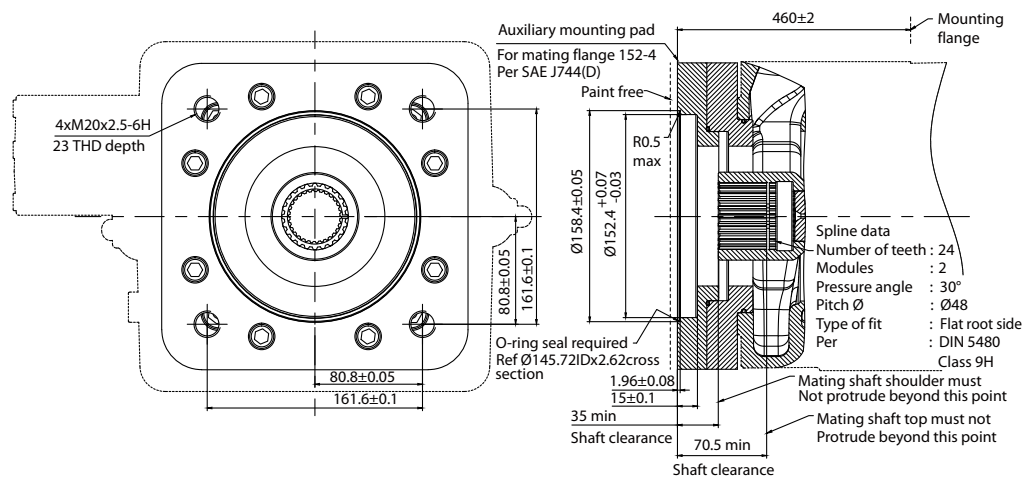


Specifications

Option	Coupling	Max torque
D2	1 3/4 in, 13T, 8/16 DP	1819 N·m [16099.50 lbf·in]

Installation Drawings

Size 260: Option D5 (SAE-D, 24 teeth)

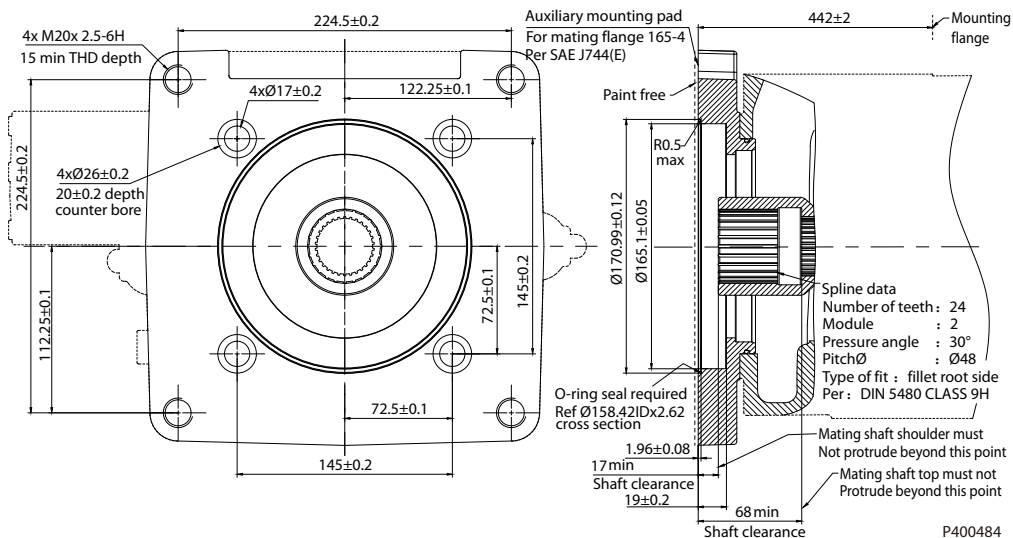


P400416

Specifications

Option	Coupling	Max torque
D5	N50 x 2 x 30 x 24 x 9H	1936 N·m [17135.04 lbf·in]

Size 260: Option E2 (SAE-E, 24 teeth)



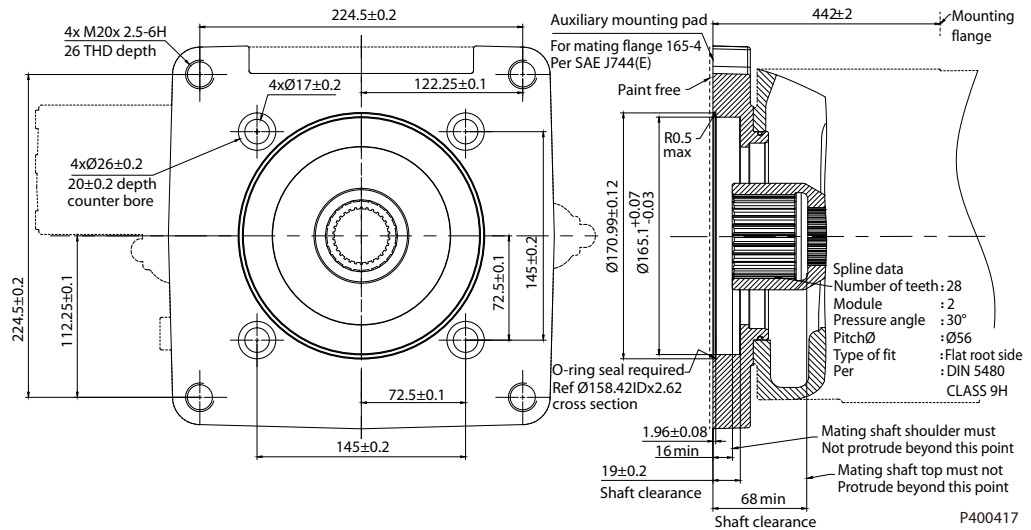
P400484

Specifications

Option	Coupling	Max torque
E2	N50 x 2 x 30 x 24 x 9H	1936 N·m [17135.04 lbf·in]

Installation Drawings

Size 260: Option E3 (SAE-E, 28 teeth)



Specifications

Option	Coupling	Max torque
E3	N60 x 2 x 30 x 28 x 9H	1936 N·m [17135.04 lbf·in]

Before finalizing your design, please request a certified drawing.

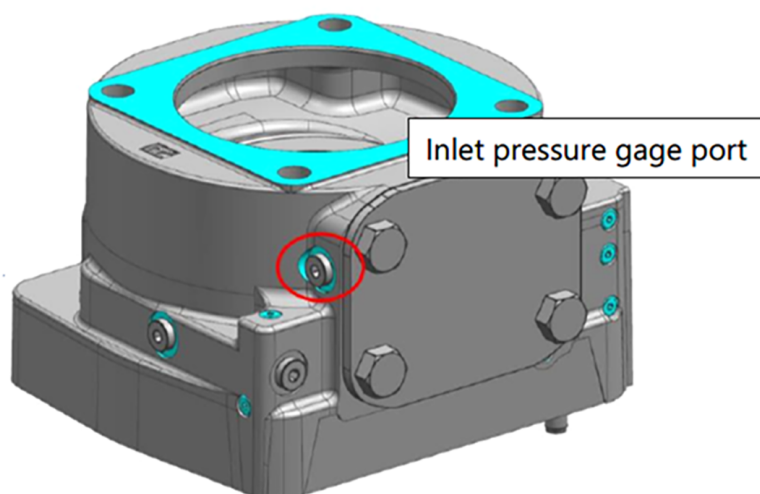
Installation Drawings

Inlet pressure gauge port

An inlet pressure gauge port is offered in certain porting configurations. Pump configurations with this additional port are indicated in the table below.

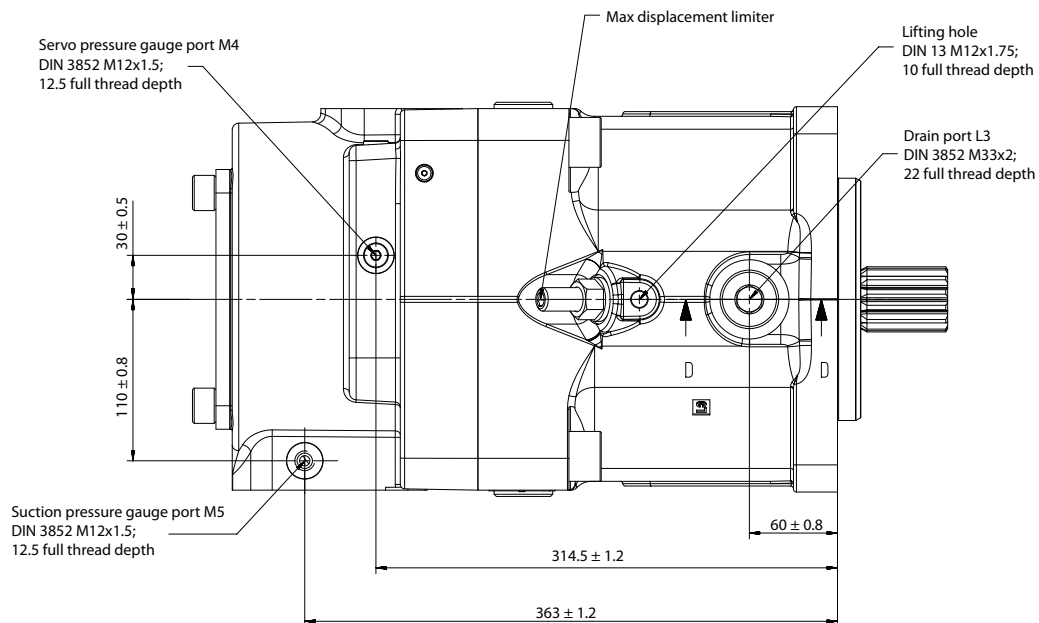
Displacement	Porting Option		Inlet pressure gauge port
D1P145	CW	w/o impeller	No
		w/ impeller	Yes
	CCW	w/o impeller	Yes
		w/ impeller	Yes
D1P193	CW	w/o impeller	Yes
		w/ impeller	Yes
	CCW	w/ impeller	No
D1P260	CW	w/ impeller	No
	CCW	w/ impeller	Yes

Inlet pressure gauge port general location



Installation Drawings

D1P 260 CCW + Inlet pressure gauge port



Port	Description	Standard	Size	Max. Pressure (bar [psi])	State
M5	Measurement point, suction pressure	DIN 3852	M12 x 1.5	100 [1450]	X

Additional Information
D1P tandem with Danfoss pumps

1st Pump			2nd Pump						
D1P (OC)			D1P (OC)	S45 (OC)	S90 (CC)	H1P (CC)	S42 (CC)	S40 (CC)	Gear Pump
Through Drive									
Flange	Coupling	Code	Size (shaft)	Size (shaft)	Size (shaft)	Size (shaft)	Size (shaft)	Size (shaft)	Size (shaft)
82-2 A	5/8 in 9T	A1							4 ~ 45 (SA, SM, SE)
		A3							7 ~ 45 (SH)
101-2 B	7/8 in 13T	B1		25, 30, 38, 45 (C2)		45, 53 (G4)	28, 32, 41, 51 (C)	25, 35, 44, 46 (A)	7 ~ 90 (SA, SL, SH)
127-2&4 C	1 1/4 in 14T	C5		45, 51, 60, 65, 74, 75, 90, 100, 130, 147 (S1)	55, 75, 100 (S1)	60, 68, 69, 78, 89, 100 (G1)			22 ~ 200 (RA, RD, S0)
	1 3/4 in 13T	C9		100, 130, 147 (S4)					
152-4 D	W50	D5	130/145 (T)						
	1 3/4 in 13T	D2			130 (F1)	115, 130, 147, 165 (G3)			
165-4 E	W50	E2	193 (T)						
165-4 E	W60	E3	260 (T)						

D1P tandem pump torque

Maximum torque rating and tandem pump torque

D1 Pump Displacement		130/145	193	260
Torque at Vg max and $\Delta p = 350$ bar		724/808 N·m [6407.94/7151.40 lbf·in]	1075 N·m [9514.55 lbf·in]	1448 N·m [12815.88 lbf·in]
Max torque rating of input shaft	T	3100 N·m [27437 lbf·in]	3100 N·m [27437 lbf·in]	5432 N·m [48077 lbf·in]
	S	1528 N·m [13524 lbf·in]	1536 N·m [13595 lbf·in]	1535 N·m [13586 lbf·in]
	A	-	2422 N·m [21437 lbf·in]	3621 N·m [32049 lbf·in]
	P	1411 N·m [12488 lbf·in]	2195 N·m [19427 lbf·in]	2571 N·m [22755 lbf·in]
	K	1787 N·m [15816 lbf·in]	1787 N·m [15816 lbf·in]	1787 N·m [15816 lbf·in]

Additional Information
Maximum torque rating and tandem pump torque (continued)

D1 Pump Displacement		130/145	193	260
Max torque rating of different aux mounting flange options	A1	205 N·m [1814.40 lbf·in]	205 N·m [1814.40 lbf·in]	205 N·m [1814.40 lbf·in]
	A2	Pending	-	-
	A3	-	619 N·m [5478.61 lbf·in]	619 N·m [5478.61 lbf·in]
	B1	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]
	B2	Pending	Pending	Pending
	BA	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]
	BB	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]	411 N·m [3637.66 lbf·in]
	C5	1164 N·m [10302.27 lbf·in]	1289 N·m [11408.61 lbf·in]	1638 N·m [14497.52 lbf·in]
	C9	-	1790 N·m [15842.83 lbf·in]	1891 N·m [16736.76 lbf·in]
	D2	1130 N·m [10001.35 lbf·in]	1630 N·m [14426.72 lbf·in]	819 N·m [16099.51 lbf·in]
	D5	1164 N·m [10302.27 lbf·in]	1790 N·m [15842.83 lbf·in]	1936 N·m [17135.04 lbf·in]
	E2	-	1790 N·m [15842.83 lbf·in]	1936 N·m [17135.04 lbf·in]
	E3	-	-	1936 N·m [17135.04 lbf·in]

D1P tightening torque

The following tightening torques apply:

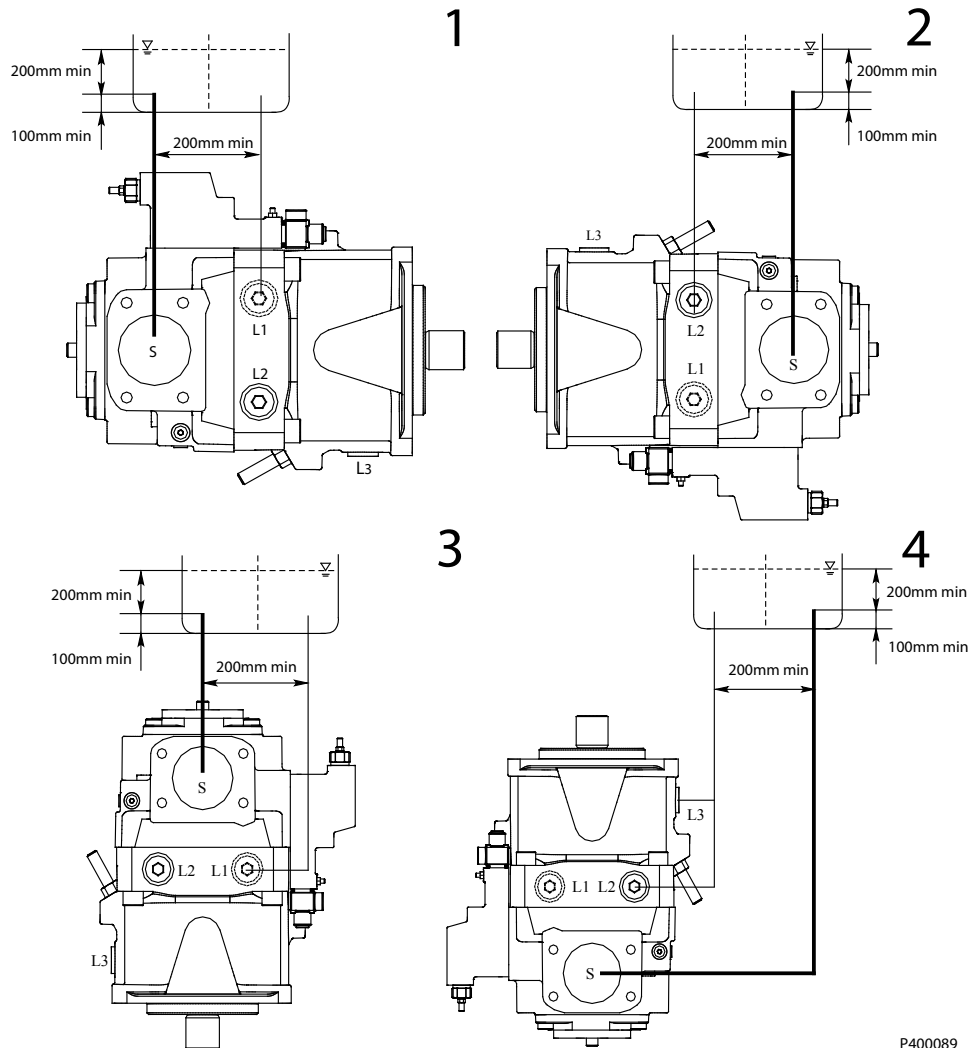
- Fittings** Observe the manufacturer's instruction regarding the tightening torques of the fittings used.
- Fixing screws** For fixing screws according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.
- Locking screws** For the metal locking screws supplied with the D1 pump, the required torques are as indicated in the table below:

Thread size	Standard	Required torque	Wrench size
M12 x 1.5	DIN 3852	25 N·m [221.27 lbf·in]	6 mm
M14 x 1.5		34 N·m [300.93 lbf·in]	6 mm
M26 x 1.5		60 N·m [531.05 lbf·in]	12 mm
M33 x 2		225 N·m [1991.42 lbf·in]	17 mm

Installation Notes

D1P below-reservoir (standard)

Recommended arrangements : 1 and 2.



P400089

Fill pump case with clean oil before start

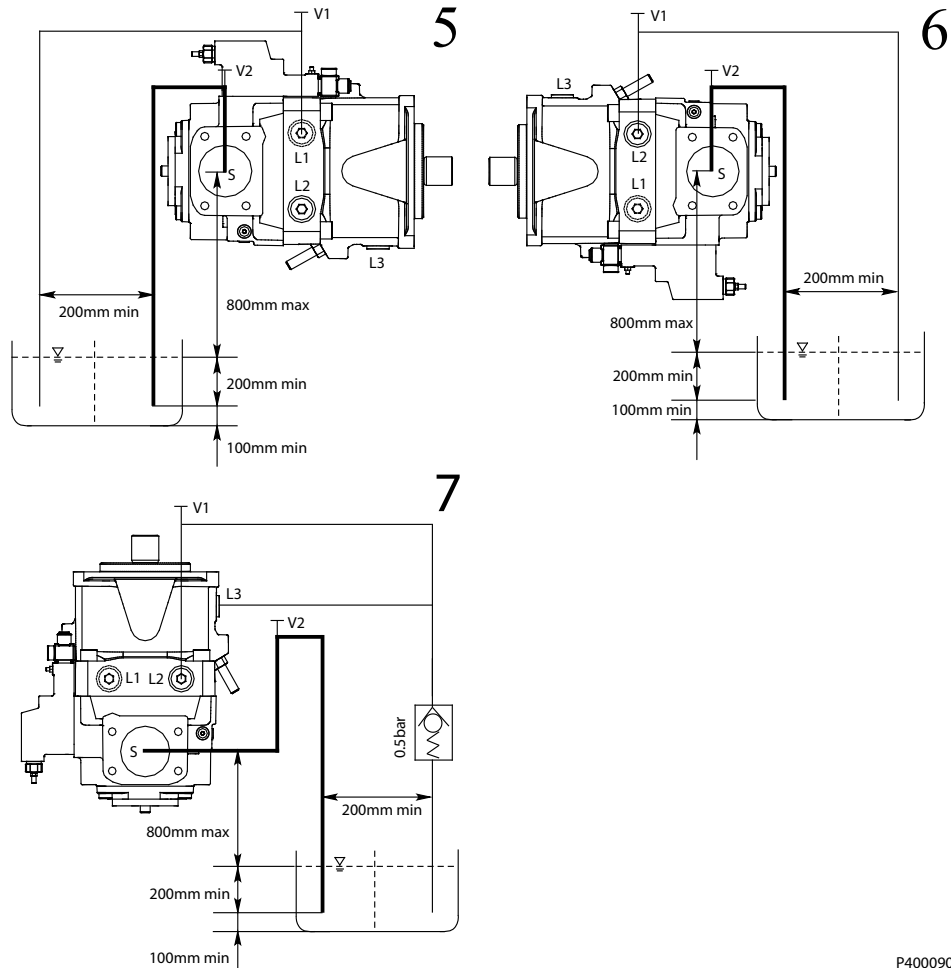
Suction (absolute) : P min = 0.6 bar with charge pump (0.8 bar without charge pump), P max = 2 bar. Do not restrict suction line

Drain (absolute) : P max = 2 bar. Do not restrict drain line, do not combine drain line

Arrangements	Air Bleeding	Filling
1	L1	S + L1
2	L3	S + L2
3	L1 / L2	S + L1 / L2
4	L3	S + L1 / L2

Installation Notes

D1P above-reservoir



P400090

Fill pump case with clean oil before start

Suction (absolute) : P min = 0.6 bar with charge pump (0.8 bar without charge pump), P max = 2 bar. Do not restrict suction line

Drain (absolute) : P max = 2 bar. Do not restrict drain line, do not combine drain line

Arrangements	Air Bleeding	Filling
5	V1 + V2	V2 (S) + V1 (L1)
6	L3 + V2	V2 (S) + V1 (L2)
7	V1 + V2	V2 (S) + V1 (L1 / L2)

Caution! Installation hazards!

Failure to adhere to the installation notes may result in shortened product life.

The maximum allowable suction height is 0.8m. The allowable suction height is derived from the total pressure loss.

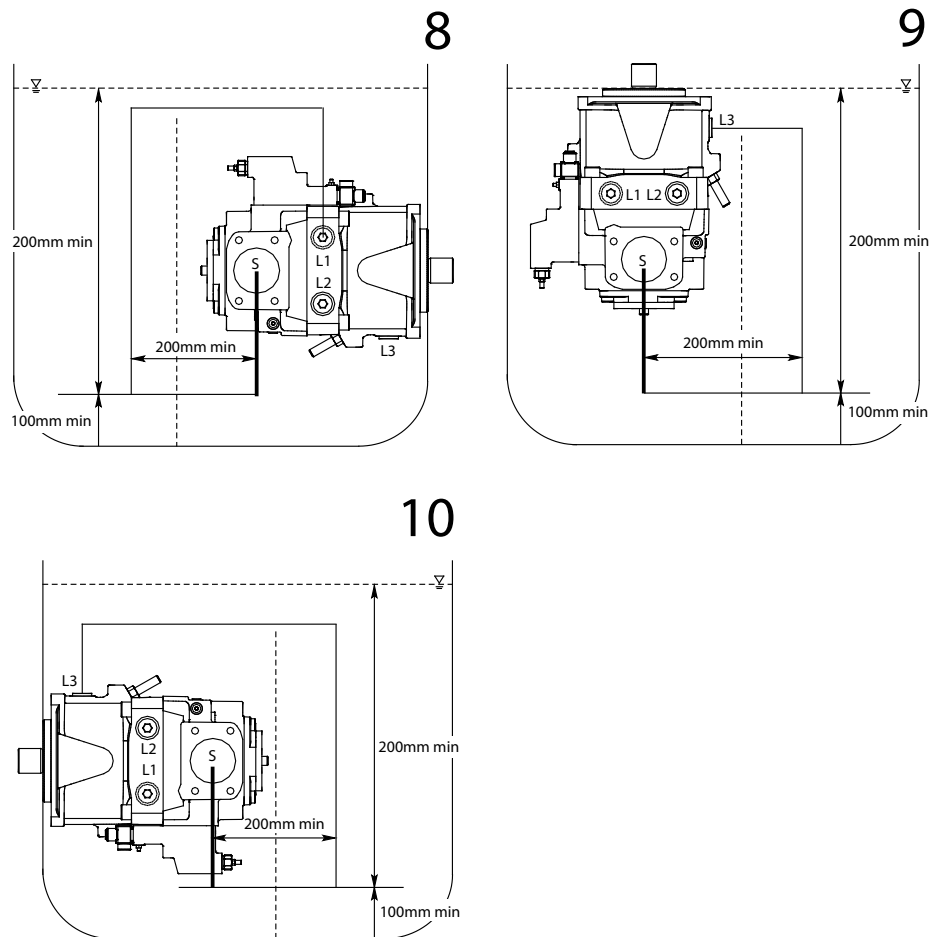
The D1 pump with charge pump is not designed for above-Reservoir installation.

For control options with pressure controllers, proportional displacement control, the minimum displacement setting must be $V_g \geq 5\% V_{g \max}$.

Recommendation for arrangement 7 (shaft upwards): A check valve in the case drain line (cracking pressure 0.5 bar) can prevent draining of the case interior.

Installation Notes

D1P reservoir installation



P400091

Fill pump case with clean oil before start

Suction (absolute) : P min = 0.6 bar with charge pump (0.8 bar without charge pump), P max = 2 bar. Do not restrict suction line

Drain (absolute) : P max = 2 bar. Do not restrict drain line, do not combine drain line

Arrangements	Air Bleeding	Filling
8	L1	Automatically via all open L1, L2, L3 and S ports through position below the hydraulic fluid level.
9	L3	
10	L3	

- It is recommended to fit a pipe to the suction port S and fitting a pipe to case drain port L1, L2 or L3 (See arrangements), the other case drain ports must be plugged in this situation. The pump should be filled before fitting the pipe and filling the tank with hydraulic fluid.
- It is only permissible to install a pump with solenoids (E.g. a pump with electric displacement control) at tank-level, if used hydraulic fluids are based on mineral oil and the oil temperature in the tank does not exceed 80° C.

Displacement Limiter

D1P displacement limiter

Series D1 pumps feature maximum and minimum displacement limiters, which limit displacement mechanically.

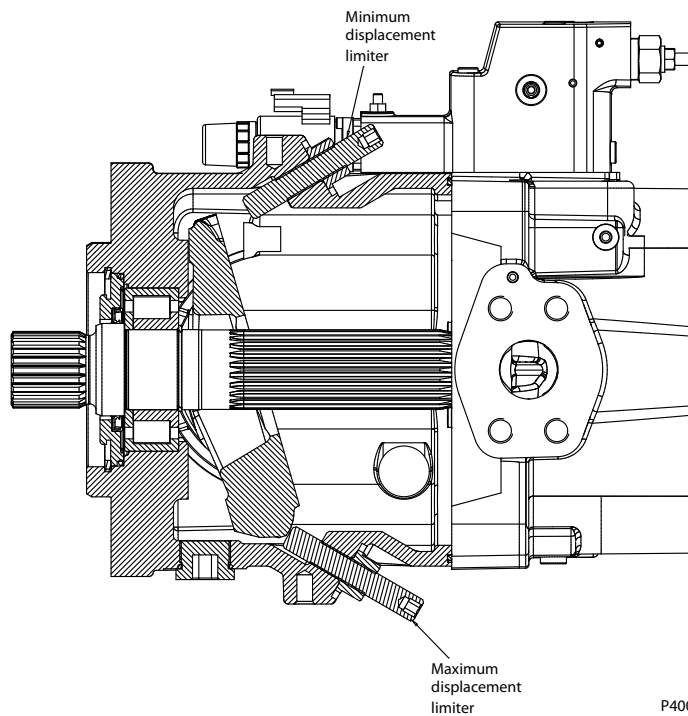
Maximum Displacement Limiter

Frame	Setting range	Displacement change per turn
130	72 cm ³ – 130 cm ³	11 cm ³ /rev
145	72 cm ³ – 145 cm ³	11 cm ³ /rev
193	0 cm ³ – 193 cm ³	16 cm ³ /rev
260	56 cm ³ – 260 cm ³	19 cm ³ /rev

Minimum Displacement Limiter

Frame	Setting range	Displacement change per turn
130	0 cm ³ – 124 cm ³	9 cm ³ /rev
145	0 cm ³ – 124 cm ³	9 cm ³ /rev
193	0 cm ³ – 193 cm ³	15 cm ³ /rev
260	0 cm ³ – 260 cm ³	18 cm ³ /rev

Displacement Limiter Cross-Section View



P400281

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