JORDAN VALLEY WATER CONSERVANCY DISTRICT (JVWCD)
11800 SOUTH ZONE C RESERVOIRS - VOLUME 3 OF 3
CHLORINE BUILDING
CONSTRUCTION PLANS

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

JVWCD PROJECT #4276

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

APPROVED

STEVE HANSEN, P.E., S.E.
PROJECT MANAGER

APPROVED

CLIFF LINFORD, P.E.
PROJECT ENGINEER

APPROVED

RANDY KNAPP, E.E.
PROJECT ENGINEER

REV NO.	COMMENT	DATE

SUNRISE ENGINEERING
6875 SOUTH 900 EAST
SALT LAKE CITY, UT 84047
TEL 801.523.0100
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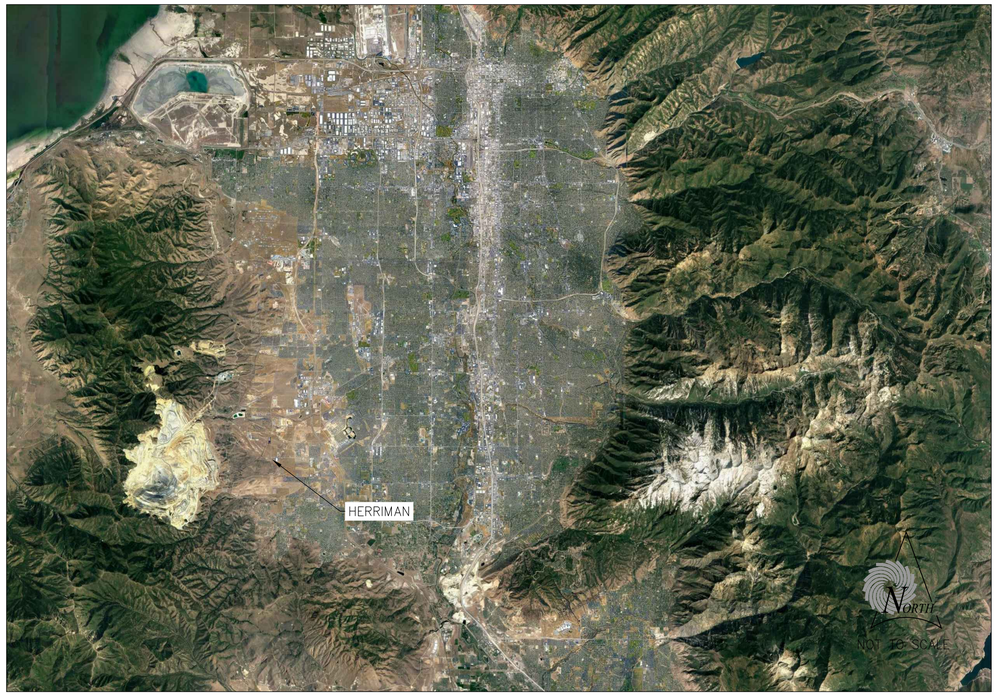
AREA MAP



LOCATION MAP

SHEET INDEX

CHLORINATION SYSTEM DESIGN CRITERIA

THE CHLORINATION SYSTEM WILL UTILIZE A 5% SOLUTION OF SODIUM HYPOCHLORITE TO DISINFECT THE WATER. THE SYSTEM IS DESIGNED TO INJECT THE SODIUM HYPOCHLORITE SOLUTION BASED OFF OF THE READINGS OF THE CHLORINE RESIDUAL ANALYZER. THE ANALYZERS READING POINTS ARE DOWNSTREAM OF THE CHLORINE INJECTION LOCATION.

THE CHLORINATION SYSTEM CONSISTS OF THE FOLLOWING:

1– 450 GALLON VERTICAL STORAGE TANK
2– 30 GALLON DAY TANK
3– 2" PVC OR CPVC INLET AND VENT PIPE
4– 1" PVC OR CPVC OUTLET PIPE
5– CHLORINE DOSING METER & PUMP
6– CHLORINE RESIDUAL ANALYZER
7–LEVEL SENSOR ON BULK TANK
8–LEVEL SENSOR AND SCALE FOR DAY TANK
9–MULTI–FUNCTION VALVE
10–NEW FLOW METER
11–BRASS INJECTOR WITH DUCK BILL

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL SURVEYING ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
AREA MAP, LOCATION MAP, SHEET INDEX

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER G2
SHEET NUMBER 2 OF 43

14033649M

P:\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\CIVIL DESIGN DRAWINGS\SHEETS\JVWCD-CB-GEN.DWG

GENERAL CONSTRUCTION NOTES AND SPECIFICATIONS

NOTES	APWA REFERENCES
1. ALL CONSTRUCTION AND MATERIAL SHALL BE IN ACCORDANCE WITH THESE CONTRACT DOCUMENTS, INCLUDING ALL APPLICABLE SECTIONS OF THE MANUAL OF STANDARD SPECIFICATIONS 2017 EDITION (INCLUDING AMENDMENTS) AND MANUAL OF STANDARD PLANS 2017 EDITION PUBLISHED BY THE UTAH CHAPTER OF THE AMERICAN PUBLIC WORKS ASSOCIATION (APWA) AND THE UTAH CHAPTER OF THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA (AGC). THE SPECIFICATIONS AND THE STANDARD PLANS IN THE PROJECT MANUAL TAKE PRECEDENCE OVER THE MANUAL OF STANDARD SPECIFICATIONS AND STANDARD PLANS 2017 EDITIONS. REFERENCE SPECIFICATION SECTIONS ARE GIVEN FOR INFORMATION ONLY AND MAY NOT BE INCLUSIVE OF ALL APPLICABLE SECTIONS.	
2. COORDINATION: CONTRACTOR TO NOTIFY AFFECTED AGENCIES, RESIDENTS, BUSINESSES, SCHOOLS, AND PROPERTY OWNERS 14 DAYS PRIOR TO CONSTRUCTION.	01 31 13
3. SCHEDULE: CONTRACTOR WILL PROVIDE AND UPDATE A CONSTRUCTION SCHEDULE IN ACCORDANCE WITH THE SPECIFICATIONS AND THE REGULATIONS OF THE GOVERNING AGENCY FOR WORKING IN THE PUBLIC WAY PRIOR TO CONSTRUCTION.	01 32 16
4. SOIL TESTING: CONTRACTOR TO PROVIDE MARSHALL AND/OR PROCTOR TEST DATA 24 HOURS PRIOR TO USE, CERTIFIED IN WRITING FROM A LAB RECOGNIZED AND ACCEPTED BY JORDAN VALLEY WATER CONSERVANCY DISTRICT; AND THE RIGHT-OF-WAY GOVERNING AGENCY, AS APPLICABLE.	01 45 00 31 05 13 32 11 23 33 05 20 31 23 26
5. UTILITY LOCATIONS: • ALL UTILITY LOCATIONS ARE APPROXIMATE. • CONTRACTOR TO VERIFY DEPTHS OF UTILITIES IN THE FIELD BY POTHOLING A MINIMUM OF TWO WEEKS TIME AHEAD OF CONSTRUCTION TO AVOID CONFLICTS WITH ANY DESIGNED GRADE AND ALIGNMENT. IF A CONFLICT ARISES RESULTING FROM THE CONTRACTOR NEGLECTING TO POTHOLE UTILITIES, THE CONTRACTOR IS TO RESOLVE THE CONFLICT WITHOUT ADDITIONAL COST OR CLAIM TO THE OWNER. • CONTRACTOR SHALL POTHOLE CRITICAL LOCATIONS AND OBTAIN ALL EXISTING PIPE O.D. PRIOR TO ORDERING OR OBTAINING MATERIALS REQUIRED FOR CONNECTIONS TO EXISTING PIPING. UTILITY SHUT-DOWNS AND OTHER WORK WILL NOT BE SCHEDULED OR ALLOWED UNTIL THIS IS ACCOMPLISHED AND MATERIALS ARE ON SITE AND APPROVED FOR USE BY THE ENGINEER. • IRRIGATION PIPELINES MAY NOT BE LOCATED THROUGH THE NORMAL BLUE STAKE PROCESS. CONTACT IRRIGATION COMPANIES AS DETAILED IN SECTION 01 31 13 PRIOR TO CONSTRUCTION.	01 31 13 00 72 00 4.3
6. CHANGES: NO CHANGE IN DESIGN LOCATION OR GRADE WILL BE MADE BY THE CONTRACTOR WITHOUT THE WRITTEN APPROVAL OF THE PROJECT ENGINEER.	01 31 13 1.2C 00 72 00 10.1
7. SURVEY CONTROL: • ENGINEER TO PROVIDE INITIAL CONSTRUCTION STAKEOUT SURVEY. CONTRACTOR IS RESPONSIBLE FOR ADDITIONAL STAKEOUT AS NECESSARY AND ALL AS-BUILT SURVEY. • CONTRACTOR SHALL PRESERVE AND PROTECT ALL MONUMENTS AND MONUMENT REFERENCE MARKS WITHIN THE PROJECT SITE. IF A MONUMENT MUST BE DISTURBED DURING CONSTRUCTION, CONTRACTOR SHALL COMPLY WITH THE PROVISIONS OF SECTION 01 71 23. • THE LOCATION AND DEPTH OF ALL FITTINGS, BENDS, CONNECTIONS, OR COUPLINGS ARE TO BE ACCURATELY AND PRECISELY RECORDED BY THE CONTRACTOR PRIOR TO BACKFILLING. THESE ITEMS SHALL BE THOROUGHLY PHOTOGRAPHED BY THE CONTRACTOR AND PHOTOS PROVIDED TO THE ENGINEER AT THE END OF EACH WEEK.THE CONTRACTOR SHALL BE REQUIRED TO EXCAVATE AND EXPOSE ALL MATERIALS BURIED WITHOUT PRIOR AUTHORIZATION OF THE PROJECT ENGINEER OR SURVEYOR, AT HIS OWN COST. ALL COST OF RESTORATION OF EXCAVATED AREAS SHALL BE BORNE BY THE CONTRACTOR.	00 72 00 6.2A 01 71 23 00 72 00 4.4 01 71 34 00 72 00 13.5
8. CONTRACTOR RESPONSIBILITIES: • CONTRACTOR IS RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS. • ALL DEBRIS RESULTING FROM WORK ON THE PROJECT SHALL BE DISPOSED OF OFF-SITE BY THE CONTRACTOR AT SITES WHICH DEBRIS MAY BE LAWFULLY DISPOSED. • CONTRACTOR SHALL NOT ALLOW GROUNDWATER OR DEBRIS TO ENTER THE NEW PIPE DURING CONSTRUCTION. THE OPEN END OF ALL PIPES ARE TO BE COVERED AND SEALED AT THE END OF EACH DAY. • CONTRACTOR TO INSTALL INVERT COVERS IN ALL SANITARY SEWER AND STORM DRAIN MANHOLES AFFECTED BY THE PROJECT PRIOR TO STARTING CONSTRUCTION. • THE CONTRACTOR SHALL PROVIDE MEANS OF MANAGING ANY STORMWATER, GROUNDWATER, OR NUISANCE WATER FROM INTERFERING WITH THE CONSTRUCTION OPERATION. COST OF CONTROLLING ALL WATER SHALL BE INCLUDED IN THE CONTRACT PRICE FOR RELATED BID ITEMS. • CONTRACTOR WILL BE RESPONSIBLE FOR DUST CONTROL ACCORDING TO GOVERNING AGENCY STANDARDS: WET DOWN DRY MATERIALS AND RUBBISH TO CONTAIN ALL LOOSE MATERIALS. • ALTHOUGH SOME SURFACE FEATURES (FENCES, RETAINING WALLS, TREES, ETC.) HAVE BEEN CALLED OUT ON THE DRAWINGS FOR THE CONTRACTOR'S CONVENIENCE, NOT ALL ARE SHOWN OR IDENTIFIED. CONTRACTOR SHALL WALK THROUGH CONSTRUCTION AREA PRIOR TO BIDDING TO IDENTIFY SURFACE FEATURES THAT MUST BE PROTECTED OR REPLACED AS PART OF THE WORK. • CONTRACTOR SHALL TAKE PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING IMPROVEMENTS. ALL IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR RECONSTRUCTED AT THE EXPENSE OF THE CONTRACTOR TO ORIGINAL OR BETTER CONDITION TO THE SATISFACTION OF THE OWNER. • THE CONTRACTOR SHALL BE REQUIRED TO KEEP ALL CONSTRUCTION ACTIVITIES WITHIN ESTABLISHED JVWCD PROPERTY, AND TEMPORARY CONSTRUCTION EASEMENTS AS SHOWN, IF ANY. THIS SHALL INCLUDE BUT NOT LIMITED TO VEHICLES AND EQUIPMENT, LIMITS OF TRENCH EXCAVATION, EXCAVATED MATERIAL AND BACKFILL STORAGE. IF THE CONTRACTOR REQUIRES ADDITIONAL CONSTRUCTION EASEMENTS, IT SHALL BE SOLELY HIS RESPONSIBILITY TO OBTAIN THESE EASEMENTS.	01 57 00 3.2 01 74 13
9. STORM WATER MANAGEMENT PLAN: CONTRACTOR TO PROVIDE A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) OR EROSION SEDIMENT CONTROL PLAN TO ENGINEER FOR REVIEW BEFORE CONSTRUCTION BEGINS.	UTAH DEQ REGULATION R309-550-2
10. WATER AND SANITARY SEWER SEPARATION: FOLLOW REQUIREMENTS OF THE DIVISION OF DRINKING WATER OF THE UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY. THE HORIZONTAL DISTANCE BETWEEN PRESSURE WATER MAINS AND SANITARY SEWER LINES SHALL BE AT LEAST TEN FEET. WHERE WATER MAINS AND SEWER LINES CROSS, THE WATER MAIN SHALL BE AT LEAST 18-INCHES ABOVE THE SEWER LINE. WATER LINES AND SEWER LINES SHALL NOT BE INSTALLED IN THE SAME TRENCH. EXCEPTIONS TO THESE REQUIREMENTS MUST BE APPROVED BY THE PROJECT ENGINEER.	APWA STD. PLAN NO. 561 APWA STD. PLAN NO. 562
11. THRUST RESTRAINTS: • ALL MATERIALS USED FOR WATER PROJECTS SHALL BE RATED FOR A MINIMUM 200 PSI WORKING PRESSURE.	33 08 00 3.3 B.1

NOTES	APWA REFERENCES
12. CORROSION PROTECTION: • ALL EXPOSED NUTS AND BOLTS WILL BE COATED WITH CHEVRON FM #1 NON-OXIDE GREASE AND WRAPPED IN 8-MIL POLYETHYLENE WRAP. • ALL STEEL, CAST IRON, OR DUCTILE IRON VALVES, FITTINGS, ETC., SHALL BE EPOXY COATED AND TAPE WRAPPED IN ACCORDANCE WITH AWWA C214. • ALL TANK INTERIOR METAL COMPONENTS ARE TO BE STAINLESS STEEL WHERE NOT OTHERWISE SPECIFIED.	
13. WATER LINE COVER & MATERIAL: • ALL NEW PIPE SHALL BE DIP CL 350 UNLESS OTHERWISE SPECIFIED ON THE PLANS. • THE INSTALLATION OF VARIABLE SIZED OPENINGS IN TEES, ELBOWS, CROSSES, ETC. WHERE APPLICABLE IS AN ACCEPTABLE ALTERNATIVE TO THE USE OF A CROSS. • UNLESS OTHERWISE NOTED, CONTRACTOR TO PROVIDE A MINIMUM COVER OF 4.0 FEET FROM THE TOP OF THE WATER MAIN OR SERVICE TO FINISHED GRADE. PIPING THAT CAN NOT BE PROVIDED THIS MINIMUM COVER WILL REQUIRE A SPECIAL DESIGN BY THE CONTRACTOR FOR REVIEW AND APPROVAL BY ENGINEER.	33 11 00 1.3
14. WATER SHUT-DOWNS: • ALL EXISTING LINES AND SERVICES ARE TO REMAIN IN SERVICE UNTIL PROPOSED LINES ARE COMPLETED, FINISHED, TESTED, AND APPROVED BY THE ENGINEER. • OPERATION OF ALL EXISTING MAIN LINE VALVES TO BE COORDINATED THROUGH THE ENGINEER 48 HOURS IN ADVANCE OF SHUTDOWN. CONNECTIONS TO SOME WATERLINES SERVING COMMERCIAL AREAS MAY REQUIRE NIGHT OR WEEKEND SHUTDOWNS. CONTRACTOR TO PERFORM NIGHT OR WEEKEND WORK IN THESE AREAS AT NO ADDITIONAL COST TO OWNER. • OWNER AND ENGINEER DO NOT GUARANTEE WATER SHUT-DOWNS. CONTRACTOR TO DEVISE PLANS TO AVOID WORK STOPPAGES IN THE EVENT A COMPLETE SHUT-DOWN CANNOT BE ACHIEVED. • CONTRACTOR SHALL SUBMIT FOR REVIEW A SEQUENTIAL PLAN FOR CONNECTION, TESTING, AND FLUSHING OF ALL NEW WATER MAINS. • SHUT DOWN WILL BE REQUIRED FOR METER INSTALATION	
15. AERIAL PHOTOS IN DRAWINGS: THE AERIAL PHOTOS PROVIDED AS BACKGROUND IN THESE DRAWINGS ARE PROVIDED TO HELP CLARIFY THE WORK SITE. HOWEVER, THE PHOTOS DEPICT CONDITIONS AS THEY PREVIOUSLY EXISTED. PRESENT DAY CONDITIONS MAY VARY FROM THOSE SHOWN. CONTRACTOR SHALL VERIFY EXISTING CONDITIONS PRIOR TO BIDDING. BID SHALL INCLUDE ALL WORK REQUIRED TO COMPLETE THE PROJECT. CONTRACTOR IS EXPECTED TO WALK THE SITE PRIOR TO PROVIDING A BID.	
16. TEMPORARY STRUCTURES: THE CONTRACTOR SHALL AT HIS DISCRETION EMPLOY A REGISTERED PROFESSIONAL ENGINEER FOR THE DESIGN OF ANY TEMPORARY BRACING AND SHORING. THE CONTRACTOR IS RESPONSIBLE FOR THE STRENGTH AND STABILITY OF THE PRV/HYDRO STRUCTURE DURING CONSTRUCTION. THE CONTRACTOR SHALL PROVIDE TEMPORARY SHORING, BRACING, AND OTHER ELEMENTS REQUIRED TO MAINTAIN STABILITY UNTIL THE STRUCTURE AND NECESSARY PIPING ARE COMPLETE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BE FAMILIAR WITH THE WORK REQUIRED IN THE CONSTRUCTION DOCUMENTS AND THE REQUIREMENTS FOR EXECUTING IT PROPERLY.	
17. CONTRACTOR SHALL BE RESPONSIBLE FOR TEMPORARY AIR/VACS AND BLOW OFFS FOR FLUSHING, PRESSURE TESTING AND COMMISSIONING OF WATER MAINS.	
18. ALL MATERIALS THAT MAY COME IN CONTACT WITH DRINKING WATER, INCLUDING PIPES, GASKETS, LUBRICANTS AND O-RINGS, SHALL BE ANSI-CERTIFIED AS MEETING THE REQUIREMENTS OF ANSI/NSF STANDARD 61, DRINKING WATER SYSTEM COMPONENTS – HEALTH EFFECTS. TO PERMIT FIELD-VERIFICATION OF THIS CERTIFICATION, ALL COMPONENTS SHALL BE APPROPRIATELY STAMPED WITH THE NSF LOGO.	
19. ALL PIPE, JOINTS, FITTINGS, VALVES, AND FIRE HYDRANTS SHALL CONFORM TO ANSI/NSF STANDARD 61, AND APPLICABLE SECTIONS OF AWWA STANDARDS C104-A21.4-08 THROUGH C550-05 AND C900-07 THROUGH C950-07.	
20. ALL DUCTILE IRON PIPE SHALL MEET THE FOLLOWING STANDARDS, AWWA STANDARD C600-10, INSTALLATION OF DUCTILE IRON WATER MAINS AND THEIR APPURTENANCES.	
21. PRESSURE AND LEAKAGE TESTING – ALL TYPES OF INSTALLED PIPE SHALL BE PRESSURE TESTED AND LEAKAGE TESTED IN ACCORDANCE WITH AWWA STANDARD C600-10.	
22. THE OPEN ENDS OF ALL PIPELINES UNDER CONSTRUCTION SHALL BE COVERED AND EFFECTIVELY SEALED AT THE END OF THE DAY'S WORK.	
23. ALL NEW WATER MAINS OR APPURTENANCES SHALL BE DISINFECTED IN ACCORDANCE WITH AWWA STANDARD C651-05. ON ALL NEW AND EXTENSIVE DISTRIBUTION SYSTEM CONSTRUCTION, EVIDENCE OF SATISFACTORY DISINFECTION SHALL BE PROVIDED TO THE DIVISION. SAMPLES FOR COLIFORM ANALYSES SHALL BE COLLECTED AFTER DISINFECTION IS COMPLETE AND THE SYSTEM IS REFILLED WITH DRINKING WATER. A STANDARD HETEROTROPHIC PLATE COUNT IS ADVISABLE. THE USE OF WATER FOR PUBLIC DRINKING WATER PURPOSES SHALL NOT COMMENCE UNTIL THE BACTERIOLOGIC TESTS INDICATE THE WATER IS FREE FROM CONTAMINATION.	

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
GENERAL CONSTRUCTION NOTES

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER G3
SHEET NUMBER 3 OF 43

14033649M

P:\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\CIVIL DESIGN DRAWINGS\SHEETS\JVWCD-CB-GEN.DWG

ABBREVIATIONS

AB	ANCHOR BOLT
ALUM.	ALUMINUM
∠	ANGLE
APPROX.	APPROXIMATELY
ASSY.	ASSEMBLY
@	AT
AV	ALTITUDE VALVE
B.M.	BENCH MARK
BF	BUTTERFLY VALVE
BW	BACK OF WALL
B.W.	BOTH WAYS
BTM.	BOTTOM
BLDG.	BUILDING
BVCS	BEGINNING VERTICAL CURVE STATION
BVCE	BEGINNING VERTICAL CURVE ELEVATION
CB	CHORD BEARING
CI	CAST IRON
℄	CENTER LINE
CLR.	CLEAR
CONC.	CONCRETE
CFM	CUBIC FEET per MINUTE
CFS	CUBIC FEET per SECOND
CV	CONTROL VALVE
CW	CONCRETE WALL
CY	CUBIC YARD
DEG. OR °	DEGREE
DIA. OR ø	DIAMETER
DL	DRAIN LINE
DWG.	DRAWING
DI	DUCTILE IRON
EA.	EACH
EC	EDGE OF CONCRETE
EP	EDGE OF PAVEMENT
E.F.	EACH FACE
ELL.	ELBOW
ELEV.	ELEVATION
ETC.	ETCETERA
EVCE	END OF VERTICAL CURVE ELEVATION
EVCS	END OF VERTICAL CURVE STATION
EX.	EXISTING
EXIST.	EXISTING
EXP.	EXPANSION
E.G.	EXISTING GROUND
F	FOOTING OR FOUNDATION SLAB
F.F.	FINISH FLOOR
FT OR '	FEET
F.G.	FINISH GRADE
FTG.	FITTING
FLG	FLANGE
GAL.	GALLON
GALV.	GALVANIZED
GB	GRADE BREAK
GSP OR GS	GALVANIZED STEEL PIPE
GI	GALVANIZED IRON PIPE
GA.	GAUGE
GPM	GALLONS per MINUTE
GSN	GENERAL STRUCTURAL NOTES
GV	GATE VALVE
HORIZ.	HORIZONTAL
JVWCD	JORDAN VALLEY WATER CONSERVANCY DISTRICT
HB	HOSE BIB
IN. OR "	INCH
ID	INSIDE DIAMETER
INSUL.	INSULATION
INV.	INVERT
IPS	IRON PIPE SIZE
K	CURVE COEFFICIENT
L	LENGTH
LC	LENGTH OF CHORD ON HORIZONTAL CURVE
LF	LINEAR FEET
LVC	LENGTH OF VERTICAL CURVE
MH	MANHOLE
MFR.	MANUFACTURER
MAX.	MAXIMUM
MECH.	MECHANICAL
MGD.	MILLION GALLONS PER DAY
MIN.	MINIMUM
MID.	MIDDLE POINT OF HORIZONTAL CURVE
NO. OR #	NUMBER
O.C.	ON CENTER
OD	OUTSIDE DIAMETER
OF	OVERFLOW
PC	POINT OF CURVATURE
PT (ROAD)	POINT OF TANGENT
PL.	PLATE
PE	POLYETHYLENE
PT	POINT
PVI	POINT OF VERTICAL INTERSECTION
PRV	PRESSURE REDUCING VALVE
PVC	POLYVINYL-CHLORIDE
LB. OR #	POUND
PSF	POUNDS per SQUARE FOOT
PSI	POUNDS per SQUARE INCH
℞	PROPERTY LINE
R	RADIUS OF HORIZONTAL CURVE
RAD	RADIUS
RD	RING DRAIN
RCP	REINFORCED CONCRETE PIPE
REINF.	REINFORCEMENT
REQ'D.	REQUIRED
REV.	REVISION
SCH.	SCHEDULE
SPEC.	SPECIFICATION
SQ.	SQUARE
SF	SQUARE FEET
SI	SQUARE INCHES
ST. STL.	STAINLESS STEEL
STD.	STANDARD
STA	STATION
T	TANGENT OF HORIZONTAL CURVE
TW	TOP OF WALL
TYP.	TYPICAL
△	ANGLE BETWEEN TANGENTS HOR. CURVE
UBC	UNTREATED BASE COURSE
U.N.O.	UNLESS OTHERWISE NOTED
VERT.	VERTICAL
W/	WITH

LEGEND

EXISTING

- WATERLINE
- GAS
- FIBER OPTIC
- TELEVISION
- TELEPHONE
- POWER LINE
- SEWER LINE
- STORM DRAIN
- FENCE
- CENTERLINE
- EDGE OF PAVEMENT
- PROPERTY LINE
- CURB & GUTTER
- LANDSCAPED AREA
- DIRTROAD
- EXISTING GATE VALVE
- STORM DRAIN MANHOLE
- WATER MANHOLE
- FIRE HYDRANT
- IRRIGATION BOX
- CATCH BASIN
- WATER METER
- SEWER MANHOLE
- POWERPOLE
- STREET LIGHT
- ELECTRIC BOX

PROPOSED

- 18" STORM LINE
- 18" OVERFLOW LINE
- 16" WATER LINE
- 10" DRAIN LINE
- 10" STORM LINE
- 6" RING DRAIN LINE
- CURB & GUTTER
- CURB & GUTTER, REVERSE PITCH
- LANDSCAPED AREA
- BUTTERFLY VALVE
- GATE VALVE
- 11.25° ELBOW
- 22.5° ELBOW
- 45° ELBOW
- 90° ELBOW
- TEE (SIZED BY WATER LINE)
- CROSS (SIZE AS REQ'D ON PLAN)
- FIRE HYDRANT
- AIR VAC
- BLOW OFF
- REDUCER (SIZE AS REQ'D ON PLAN)
- CHAIN LINK FENCE
- METAL GUARDRAIL

FUTURE/OTHERS

- 12" WATER LINE
- 16" WATER LINE
- 24" WATER LINE
- CENTERLINE
- CROSS REFERENCING
  - DETAIL DESIGNATION
  - DRAWING NUMBER
- CONSTRUCTION NOTES
  - TYPICAL OR ADDITIONAL NOTE
  - CONSTRUCTION NOTE #
- R.O.W. MARKER
- PROPERTY CORNER
- ALUM CAP U.E.L.S

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
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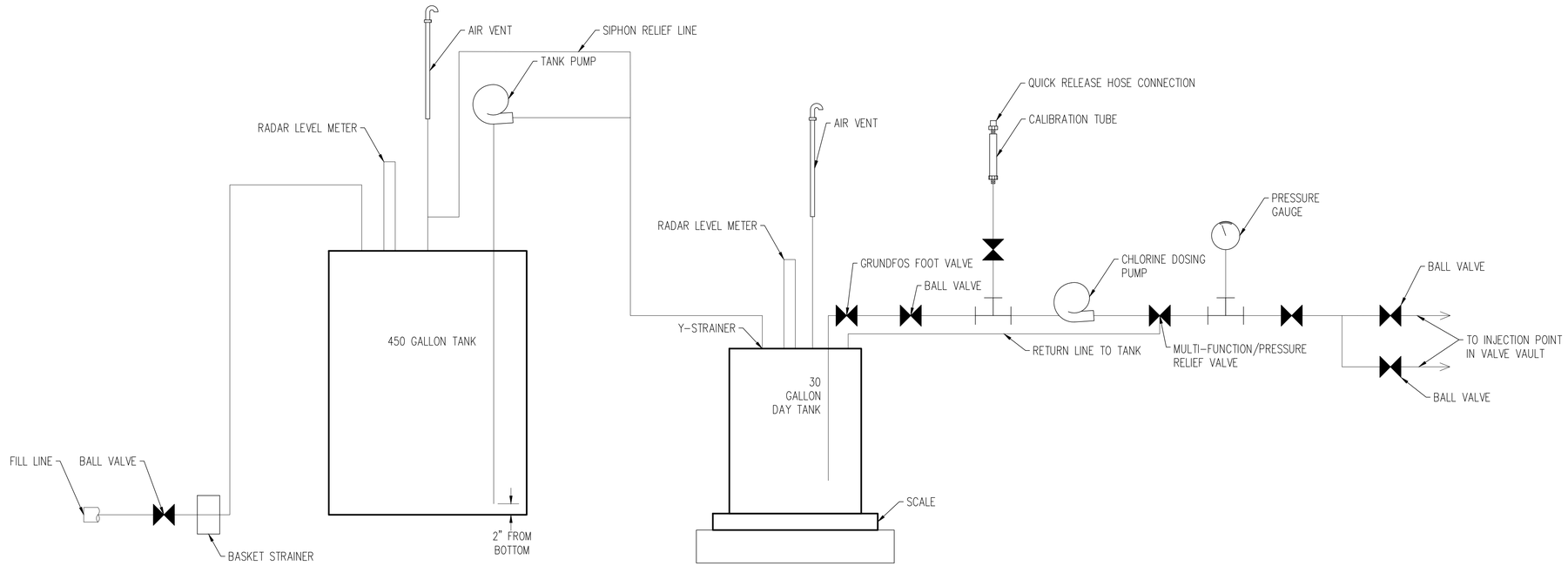
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
ABBREVIATIONS AND LEGEND

SCALE:
DATE 11/16/2023
PROJECT NUMBER S100.30
DRAWING NUMBER G4
SHEET NUMBER 4 OF 43

14033649M

P:\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\CIVIL DESIGN DRAWINGS\SHEETS\JVWCD-CB-GEN.DWG



A ~ PROCESS FLOW DIAGRAM

NTS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

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CHLORINE BUILDING
PROCESS FLOW DIAGRAM

SCALE:
DATE 11/16/2023
PROJECT NUMBER S.1.0.0.30
DRAWING NUMBER MP1
SHEET NUMBER 5 OF 43

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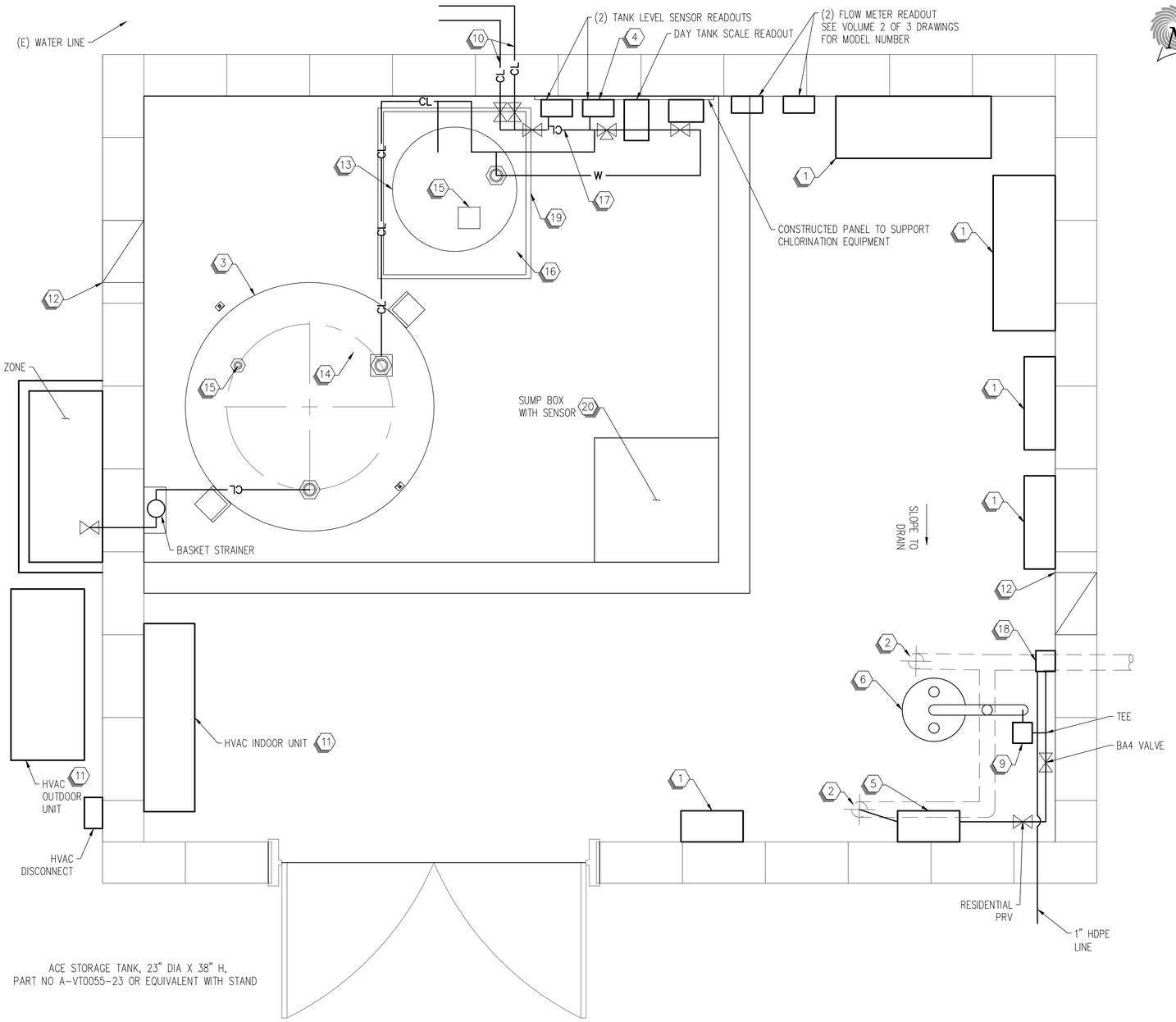
PIPING LAYOUT SCHEDULE

NO.	DESCRIPTION	SIZE	REMARKS
1	ELECTRICAL PANEL	PER ELECTRICAL SHEETS	
2	FLOOR DRAIN	4"	A / MP3
3	VERTICAL STORAGE TANK	450 GALLON	CUSTOM ROTO VERTICAL TANK, 48" DIA X 62" H, PART NO. CRMI-450VT OR EQUIVALENT J / MP4
4	CHLORINE PUMP & PIPING ASSEMBLY		C / MP3
5	CHLORINE RESIDUAL ANALYZER SYSTEM		ATI Q46H/62-63 RESIDUAL CHLORINE MONITOR K / MP4
6	EYE WASH ASSEMBLY		E / MP3
7	WATER SERVICE LINE HDPE	1"	
8	EYEWASH VALVE ASSEMBLY	PER DETAIL	M / MP4
9	PROSERIES WATER HEATER PR008240 ASSEMBLY	PR008240	WATER HEATER SHALL BE INSTALLED LOWER THAN THE EYEWASH
10	BURIED PVC CASING FOR CHLORINE TUBING	3"	B / MP3
11	HVAC	PER ELECTRICAL	
12	WALL FAN PER ELECTRICAL PLANS	PER ELECTRICAL	
13	DAY USE TANK	30 GALLON	POLYPROCESSING 30 GAL TANK STOCK NO. 1000030
14	TANK PUMP	475 GALLON UPRIGHT	INCLUDE LUTZ DRUM PUMP
15	RADAR LEVEL METER		SIEMENS LEVEL SENSOR (IP65/NEMA 4X)
16	DAY TANK SCALE	55 GAL CAP.	FORCE FLOW DRUMM-SCALE WITH SOLO G2 DISPLAY OR EQUIVALENT
17	MULTI-FUNCTION VALVE		C / MP3
18	SCALA2 3-45 A BOOSTER PUMP	PRODUCT NO. 98562818	M / MP4
19	CONCRETE PEDESTAL	30" X 32" X 18"	115 / S3.3
20	SUMP BOX SENSOR		L / MP4



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CHLORINE BUILDING PIPING

1" = 1' AT 22X34 1/2" = 1' AT 11X17

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

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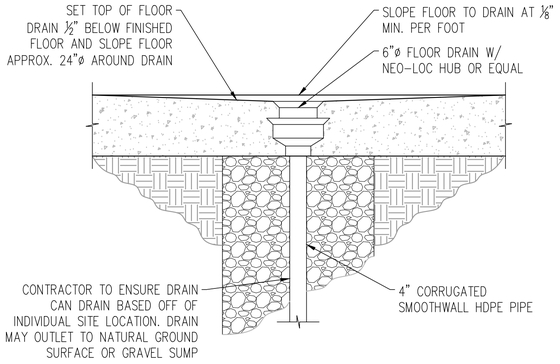
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
CHLORINE BUILDING LAYOUT

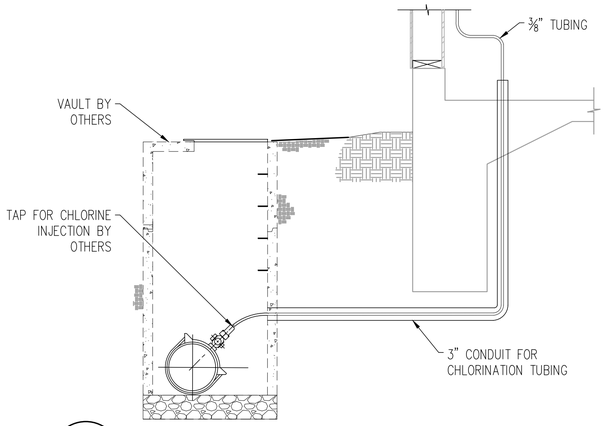
SCALE:
DATE 11/16/2023
PROJECT NUMBER S100.30
DRAWING NUMBER MP2
SHEET NUMBER 6 OF 43

7381648M

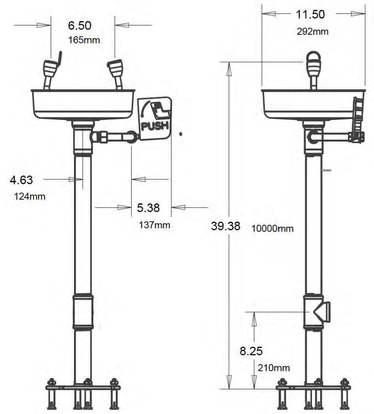
P:\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\CIVIL DESIGN DRAWINGS\SHEETS\JVWCD-CB-MP.DWG



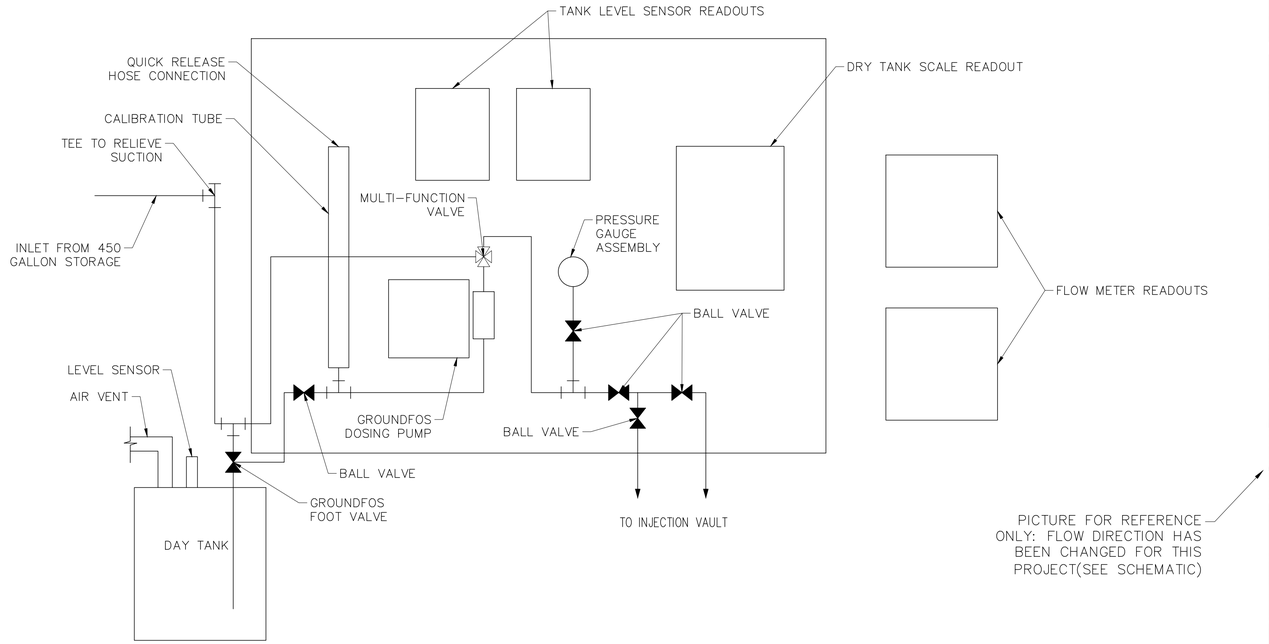
A ~ FLOOR DRAIN
NTS



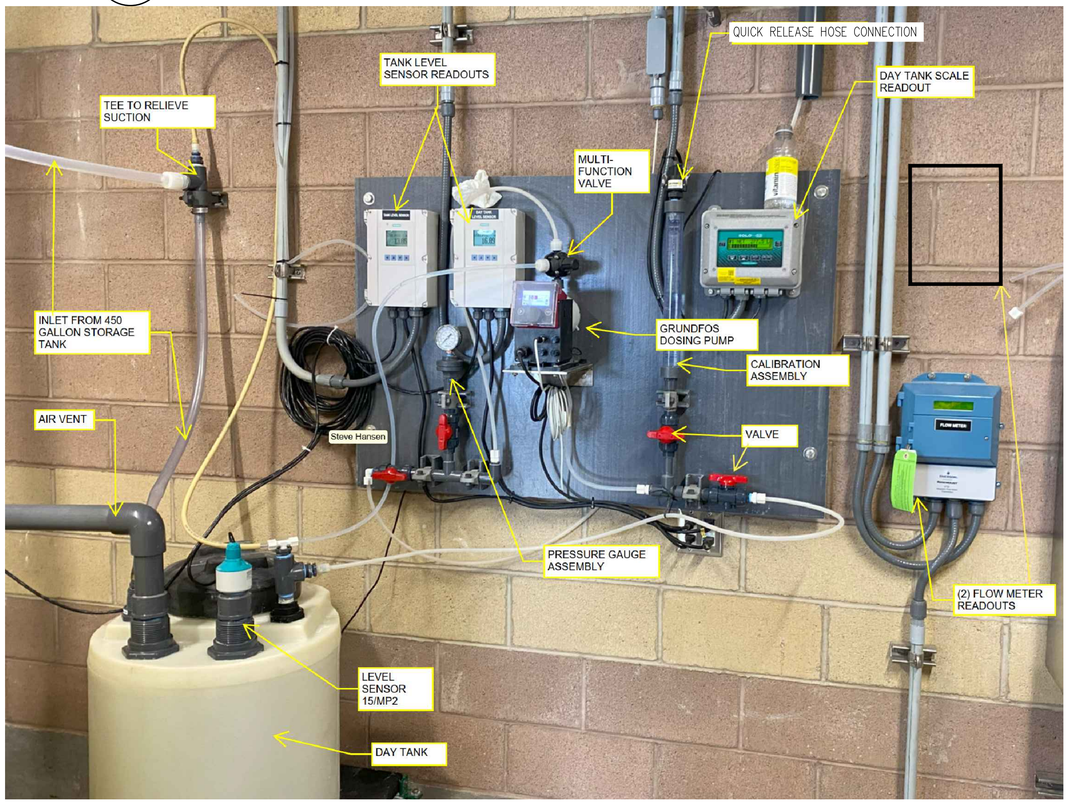
B ~ CHLORINATION TUBING CASING
NTS



E ~ EMERGENCY EYEWASH STATION
NTS



PICTURE FOR REFERENCE ONLY: FLOW DIRECTION HAS BEEN CHANGED FOR THIS PROJECT(SEE SCHEMATIC)



C ~ CHLORINE PUMP AND PIPING ASSEMBLY
NTS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
MECHANICAL PIPING DETAILS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S100030
DRAWING NUMBER MP3
SHEET NUMBER 7 OF 43

7381648M

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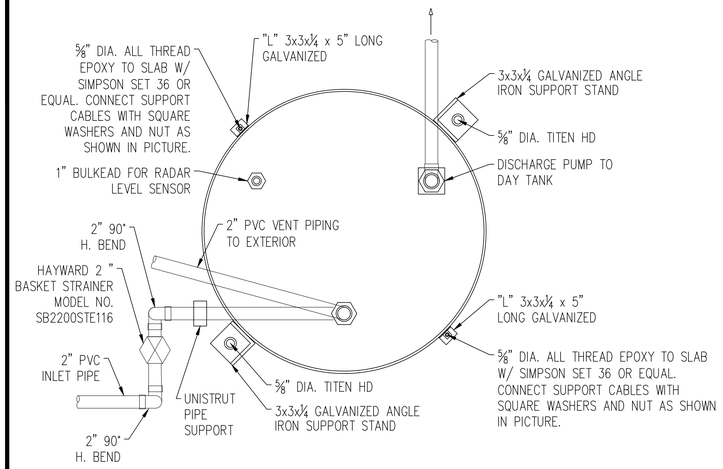
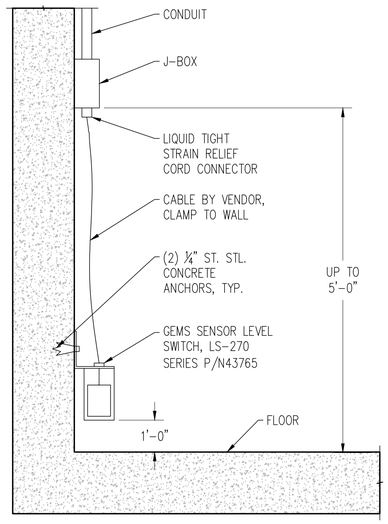
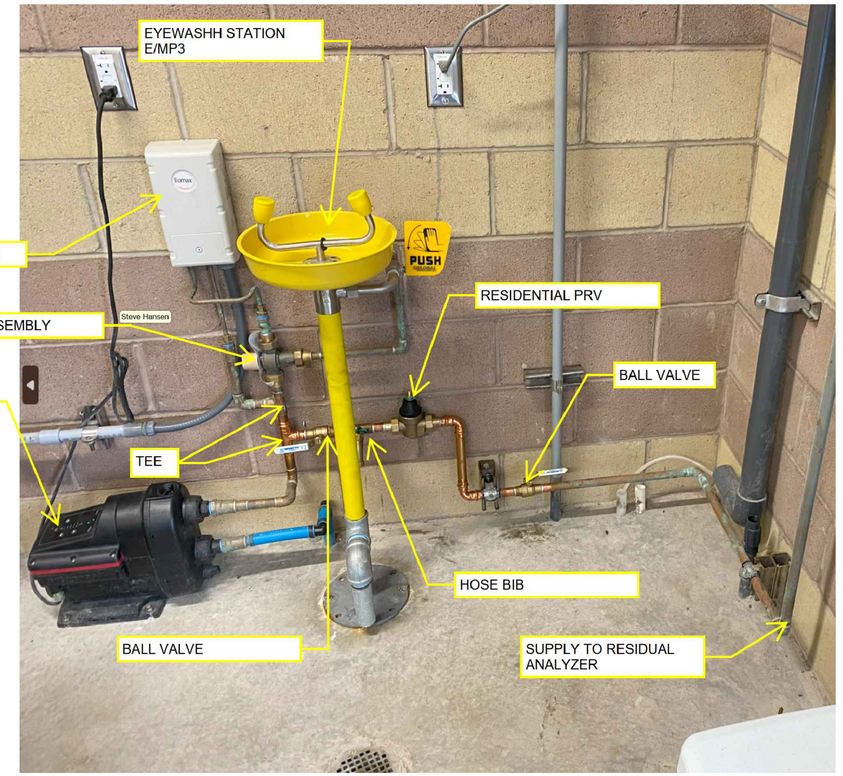


H ~ CHLORINATION TANK - PLAN VIEW
NTS



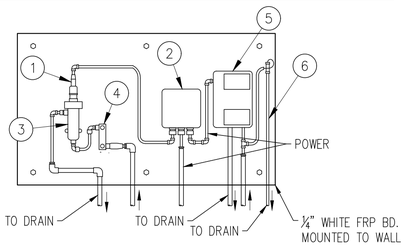
L ~ SUMP BOX SENSOR
NTS



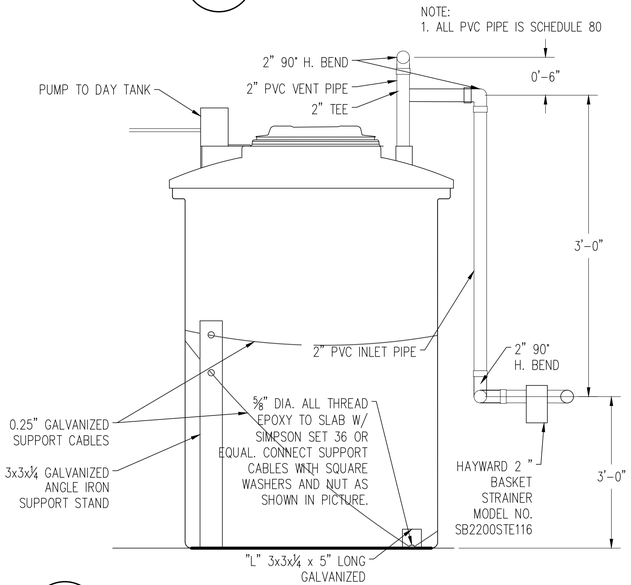
M ~ WATER SUPPLY EMERGENCY EYEWASH AND RESIDUAL ANALYZER
NTS

EQUIPMENT SCHEDULE

MK. NO.	DESCRIPTION	REMARKS
1	PH/TEMP SENSOR	HACH DPD1P1
2	CONTROLLER	ATI Q46H/62-63 RESIDUAL CHLORINE MONITOR
3	FLOW CELL	
4	ROTOMETER	
5	CHLORINE ANALYZER	
6	1/2" STAND PIPE	



K ~ NEW RESIDUAL ANALZER
NTS



J ~ CHLORINATION TANK - PROFILE VIEW
NTS

N ~ BASKET STRAINER
NTS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
MECHANICAL PIPING DETAILS, CONTINUED

SCALE:
DATE 11/16/2023
PROJECT NUMBER S1.00.30
DRAWING NUMBER MP4
SHEET NUMBER 8 OF 43

7381648M

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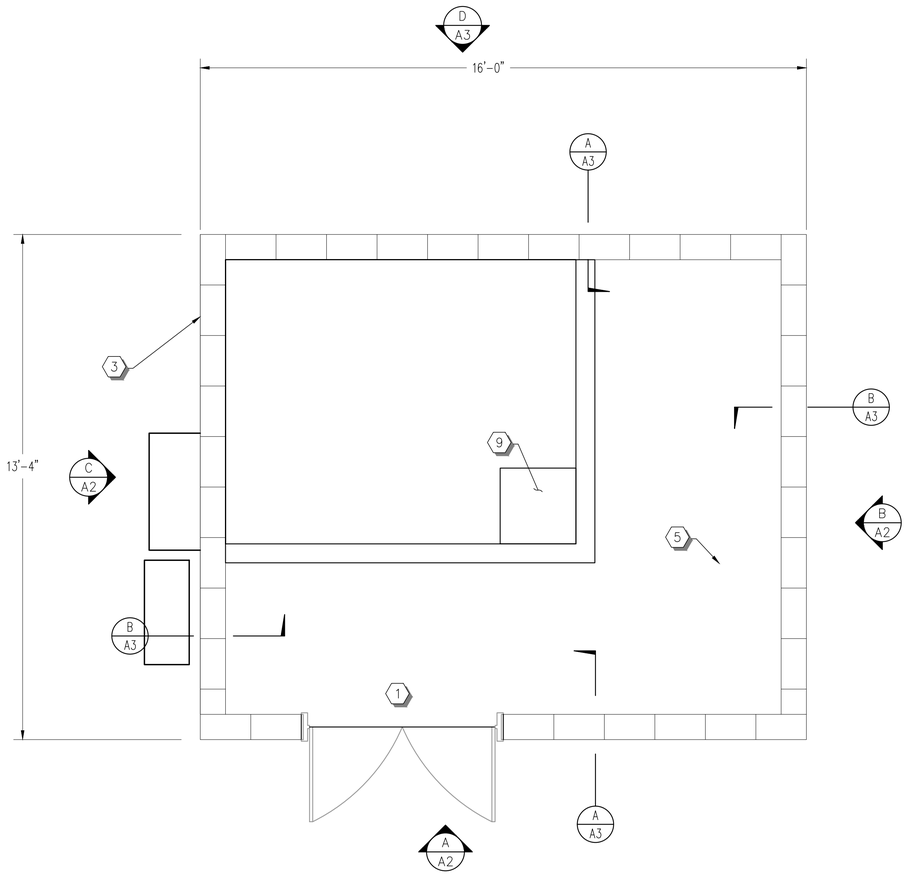
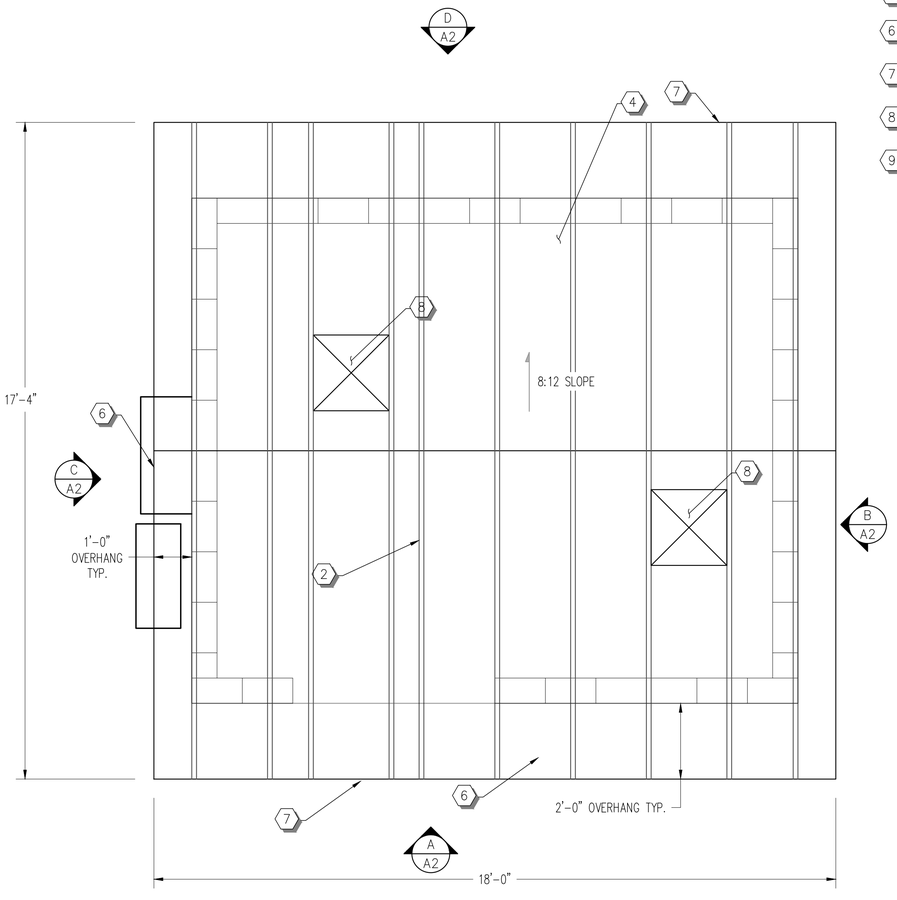


A CHLORINATION BLDG FLOOR PLAN (ROSECREST SITE)

SCALE: 1/2" = 1'-0" (22X34) 1/4" = 1'-0" (11X17)



B CHLORINATION BUILDING ROOF PLAN (ROSECREST SITE)

SCALE: 1/2" = 1'-0" (22X34) 1/4" = 1'-0" (11X17)

ARCHITECTURAL NOTES

1. 5'-0" x 6'-8" DOUBLE DOOR (A/A4) (D/A4) (E/A4)
2. PRE-FABRICATED ROOF TRUSSES AT 2'-0" O.C.
3. EXTERIOR MASONRY WALL ASSEMBLY (C/A4)
4. ROOF ASSEMBLY (B/A4)
5. FLOOR DRAIN PER MECHANICAL PIPING PLAN
6. EAVE REQUIREMENTS (C/A3)
7. METAL RAIN GUTTER
8. 2'-0" x 2'-0" CEILING ACCESS
9. 2'-0" x 2'-0" SUMP

CODE & DESIGN CRITERIA

TYPE OF CONSTRUCTION:	V-B
FIRE SPRINKLERS:	NO
OCCUPANCY:	U

ALLOWABLE BLDG HEIGHT AND STORIES

	ACTUAL	ALLOWABLE
STORIES/HEIGHT	1/12'-0"	1/40'-0"

ALLOWABLE AREA

Aa = At + (NS X If)
At = 5,500 (WORST CASE)
If = 0
Aa = 5,500 + (5,500 X 0)

Aa = 5,500

BUILDING AREA

ACTUAL ALLOWABLE RATIO
214/5500 = 0.0389

OCCUPANCY SEPARATIONS (IBC 508)

OCCUPANCY
U: NON-SEPARATED

OCCUPANT LOAD (IBC TABLE 1004.5)

OCCUPANCY	LOAD FACTOR	OCC. LOAD
U	100	2

MEANS OF EGRESS (IBC TABLE 1006.2.1, 1017.2)

	ALLOWED	ACTUAL
MAX. COMMON PATH	100 FT.	15 FT.
EXIT TRAVEL DIST.	300 FT.	10 FT.

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
ROOF AND FLOOR PLAN

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER A1
SHEET NUMBER 9 OF 43

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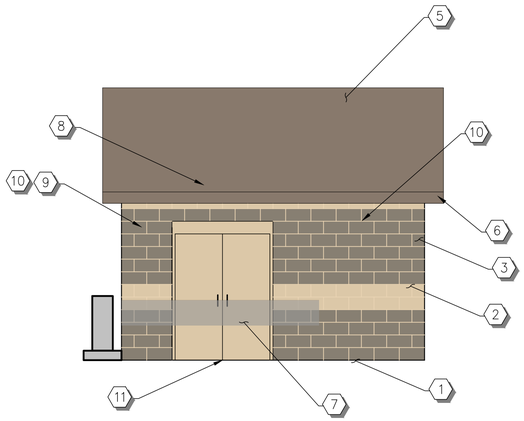
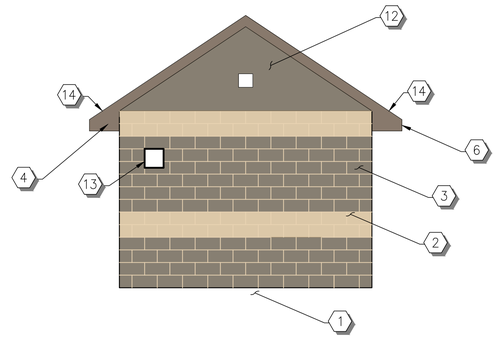


A ELEVATION - SOUTH SIDE
NTS

TOP OF ROOF ELEVATION: 14'-5"

TOP OF WALL ELEVATION: 9'-4"

FINISHED FLOOR ELEVATION: 0'-0"

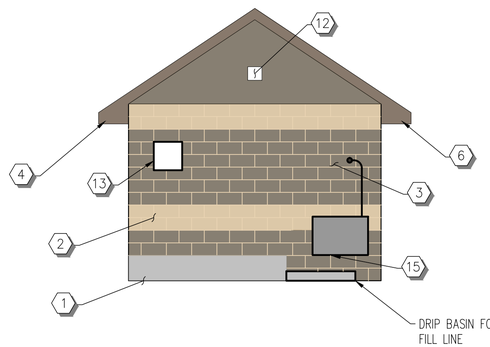


B ELEVATION - EAST SIDE
NTS

ARCHITECTURAL NOTES

1. CONCRETE FOUNDATION WALL WITH WATER-PROOFING MEMBRANE (ECO BASE II OR EQUAL) PER STRUCTURAL
2. 8X8X16 CENTER SCORE CMU. TAN COLOR PER COLOR SCHEME BELOW. PROVIDE CLEAR SURFACE WATER REPELLANT PER SPEC 07 19 00
3. 8X8X16 SPLIT FACE CMU. BRICK COLOR PER COLOR SCHEME BELOW. PROVIDE CLEAR SURFACE WATER REPELLANT PER SPEC 07 19 00
4. SOFFIT TO MATCH ROOFING
5. ROOF ASSEMBLY (B/A4)
6. RAIN GUTTER AND DOWN SPOUT
7. 5'-0" x 6'-8" DOUBLE DOOR (A/A4, D/A4, E/A4)
8. PROVIDE ICE AND WATER SHIELD AT ALL EAVES AND VALLEYS
9. EXTERIOR MOTION SENSORED FLOOD LIGHT
10. WALL-PACK EXTERIOR LIGHTING, SHIELDED DOWNWARD
11. CONCRETE PAD IN FRONT OF DOOR. PER CIVIL
12. STUCCO FINISH OVER PRE-FAB STRUSS
13. WALL VENT PER MECHANICAL AND ELECTRICAL
14. SNOW GAURD
15. HEAT PUMP

NOTES
1- COLOR SCHEME FOR ALL ITEMS CHOSEN BY DISTRICT. SIMILAR TO BUILDING BELOW

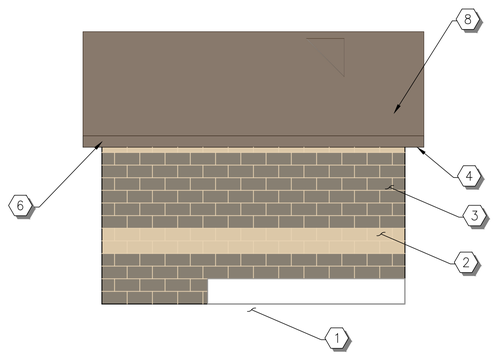


C ELEVATION - WEST SIDE
NTS

TOP OF ROOF ELEVATION: 14'-5"

TOP OF WALL ELEVATION: 9'-4"

FINISHED FLOOR ELEVATION: 0'-0"



D ELEVATION - NORTH SIDE
NTS

E MATCH ROSECREST BOOSTER STATION STYLE
NTS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
BUILDING ELEVATIONS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S1.0030
DRAWING NUMBER A2
SHEET NUMBER 10 OF 43

3166609M

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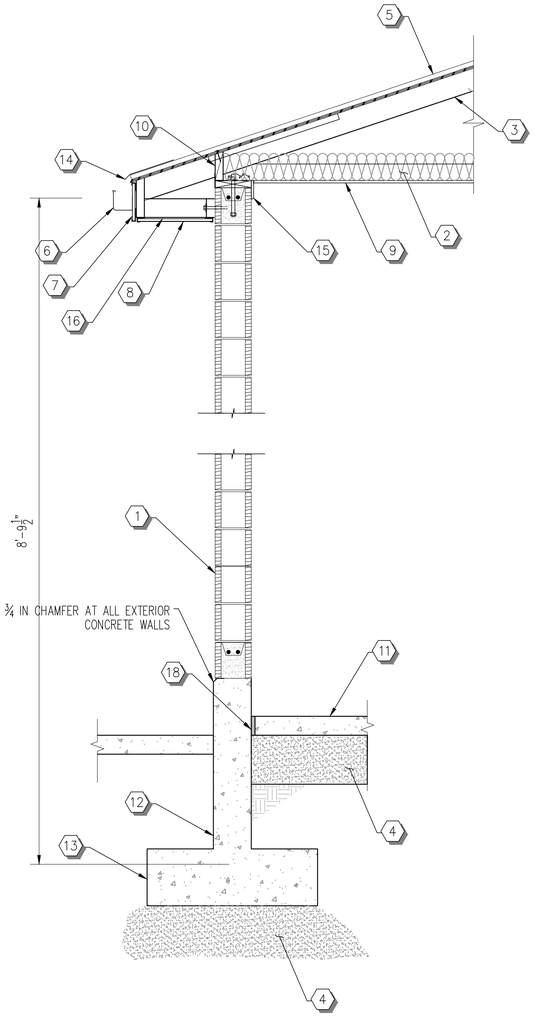
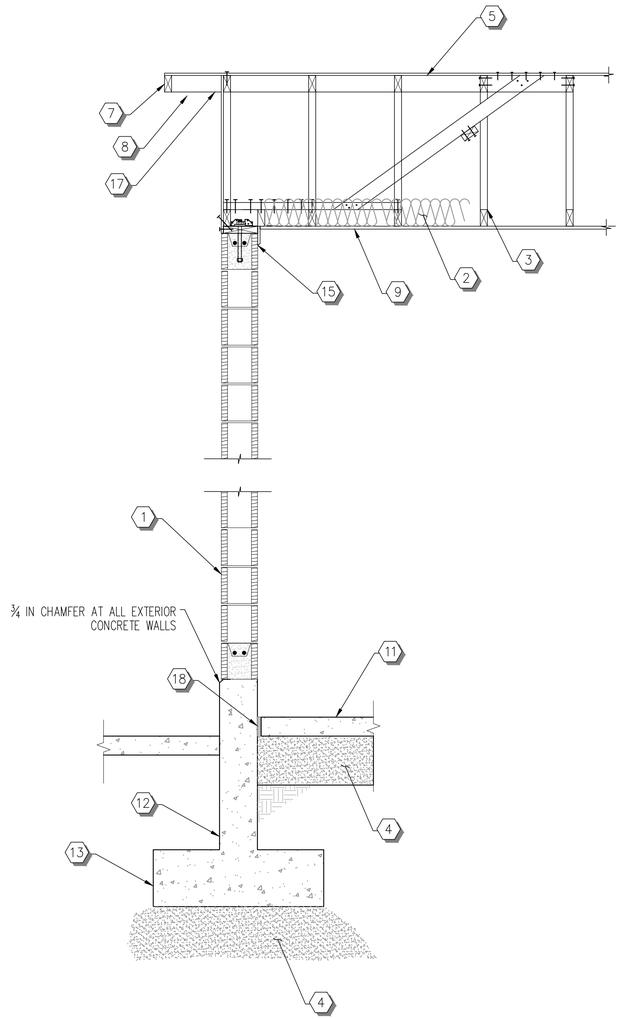
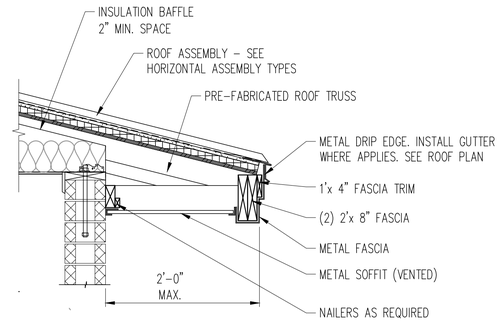


A WALL SECTION - EAST / WEST SIDE
NTS



B WALL SECTION - NORTH / SOUTH SIDE
NTS



C EAVE REQUIREMENTS
NTS

NOTE:
METAL SOFIT AND FASCIA SHALL NOT BE LESS THAN 24-GA. GALVANIZED STEEL WITH INTERLOCKING FLUSH PANEL SEAMS.

ARCHITECTURAL NOTES

1. CMU WALL ASSEMBLY PER DETAIL C SHEET A4
2. R-38 MIN. FIBERGLASS BATT INSULATION
3. PRE-FABRICATED WOOD TRUSSES
4. STRUCTURAL FILL PER GEOTECHNICAL REPORT
5. ROOF ASSEMBLY PER B/A4
6. RAIN GUTTER, TAN COLOR TO MATCH COLOR SCHEME FOR BUILDING
7. METAL FACIA TO MATCH COLOR SCHEME FOR BUILDING
8. VENTED EXTERIOR SOFFIT. TO MATCH COLOR SCHEME FOR BUILDING
9. ⅝ IN GYP. BOARD CEILING PAINTED PER SPECIFICATION
10. OMIT EVERY 3RD ROOF BLOCK AND PROVIDE INSULATION BAFFLE FOR VENTING
11. CONCRETE SLAB PER STRUCTURAL, SLOPE FLOOR TO TRENCH DRAIN 1/8" PER FOOT
12. CONCRETE FOUNDATION WALL WITH WATER-PROOFING MEMBRANE (ECO BASE II OR EQUAL)
13. CONCRETE FOOTING PER STRUCTURAL SHEETS
14. PRE FINISHED METAL DRIP EDGE BETWEEN ICE SHIELD AND WATER SHIELD.
15. SEALANT CAULK AT JOINT
16. SOFFIT SUPPORT PER STRUCTURAL
17. ROOF OUTLOOKER JOIST PER STRUCTURAL
18. ½ IN EXPANSION BOARD BETWEEN SLAB AND MASONRY

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
TYPICAL WALL SECTIONS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER A3
SHEET NUMBER 11 OF 43

3165609M

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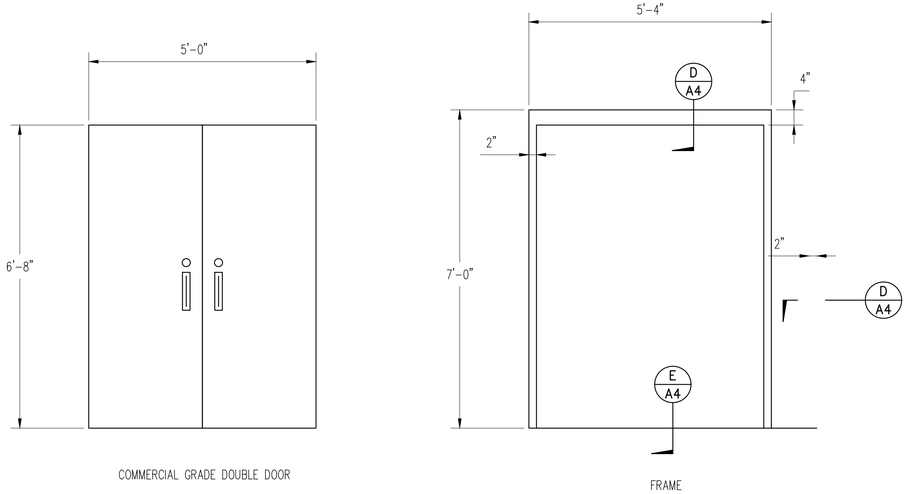


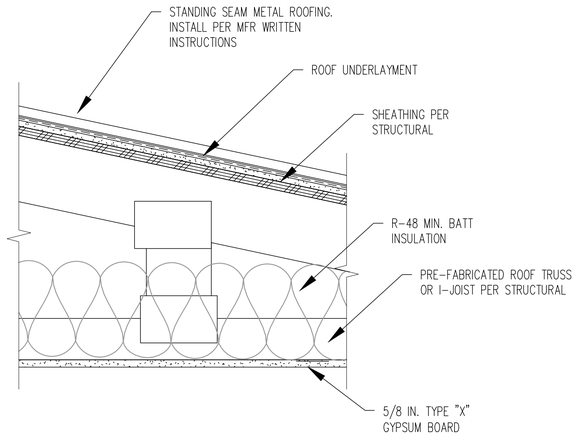
COMMERCIAL GRADE DOUBLE DOOR

FRAME

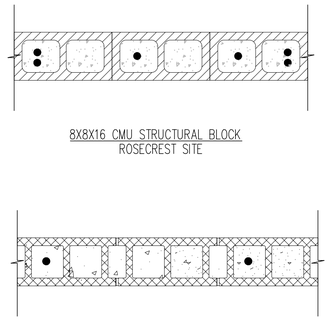
A TYP DOUBLE DOOR AND FRAME
NTS

NOTES:

1. DOOR AND FRAME SHALL BE STEEL WITH POWDER COATED FINISH
2. FINISH COLOR: TO BE DETERMINED BY OWNER
3. DOOR HEIGHT MAY BE RAISED TO MATCH FLUSH WITH CMU WALL AT CONTRACTORS EXPENSE

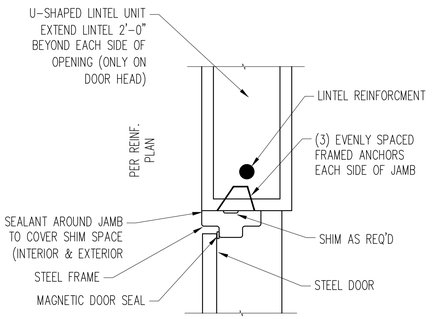


B ~ ROOF ASSEMBLY
NTS

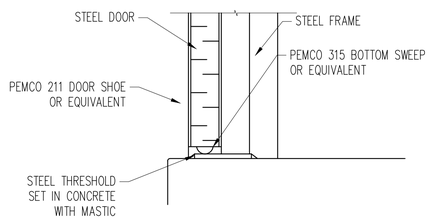


MASONRY WALL REQUIREMENTS:
- EXTERIOR WATER PROOFING SEALANT (DRYLOK EXTREME MASONRY WATER-PROOFER) OR EQUAL
- GROUT AND REINF. WALL PER STRUCTURAL
- INSULATE ALL UN-GROUTED CELLS

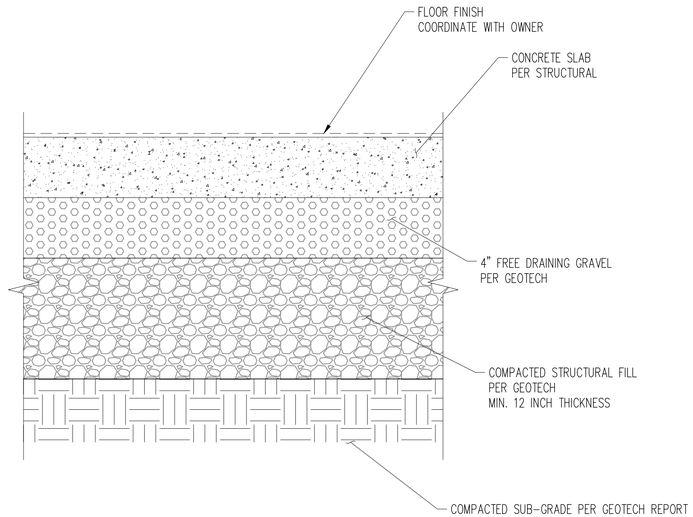
C ~ WALL ASSEMBLY
NTS



D ~ DOOR HEAD AND DOOR JAMB
NTS



E ~ DOOR THRESHOLD
NTS



F ~ FLOOR ASSEMBLY
NTS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
ARCHITECTURAL DETAILS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S1.00.30
DRAWING NUMBER A4
SHEET NUMBER 12 OF 43

3165609M

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STRUCTURAL SPECIFICATIONS & REQUIREMENTS

A. DESIGN CRITERIA:

1. BUILDING CODES:
   2021 INTERNATIONAL BUILDING CODE
   ACI 318-14 "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE AND COMMENTARY"
   ASCE 7-16 "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES"
   MASONRY STRUCTURES TMS 402-16/ACI 530-16/ASCE 5-16
   2018 NATIONAL DESIGN SPECIFICATION for WOOD CONSTRUCTION WITH COMMENTARY
2. RISK CATEGORY II PER IBC TABLE 1604.5
3. DESIGN DEAD LOADS:
   ROOF DL = 15 PSF
   MASONRY WALL DL = 95 PSF (SOLID GROUTED)
4. LIVE LOAD:
   ROOF LL = 20 PSF
5. SNOW LOAD: PER ASCE 7-16
   IMPORTANCE FACTOR I_s = 1.0
   GROUND SL = 46 PSF
   FLAT/SLOPED ROOF SL USED FOR DESIGN = 28.9 PSF
6. WIND LOADING: PER ASCE 7-16
   BASIC WIND SPEED V = 103 MPH, IMPORTANCE FACTOR I_w = 1.0
   K_D = 0.85
   EXPOSURE CATEGORY = C
   TOPOGRAPHIC FACTOR K_{ZT} = 1.0
   GUST EFFECT FACTOR G = 0.85
   BUILDING = ENCLOSED
   FOR WIND PRESSURES USED IN DESIGN, SEE CALCULATIONS
7. SEISMIC LOADING: PER ASCE 7-16
   SITE CLASS D "STIFF SOIL", SEISMIC IMPORTANCE FACTOR I_e = 1.0
   S_S = 0.895g
   S_1 = 0.323g
   S_{DS} = 0.716g
   S_{D1} = 0.426g
   SEISMIC DESIGN CATEGORY PER ASCE 7-16 TABLE 11.6-2
   LATERAL FORCE RESISTING SYSTEM IS AS FOLLOWS:
   A.7 SPECIAL REINFORCED MASONRY SHEAR WALLS

B. GENERAL REQUIREMENTS:

1. DIMENSIONS: CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES TO THE ENGINEER OF RECORD.
2. THE CONTRACTOR MUST SUBMIT IN WRITING ANY REQUESTS FOR MODIFICATIONS TO THE PLANS AND SPECIFICATIONS. SHOP DRAWINGS SUBMITTED TO THE STRUCTURAL ENGINEER FOR REVIEW DO NOT CONSTITUTE "IN WRITING" UNLESS IT IS CLEARLY NOTED THAT SPECIFIC CHANGES ARE BEING REQUESTED.
3. LOADS FROM CONSTRUCTION MATERIALS SHALL BE SPREAD OUT IF PLACED ON FRAMED FLOORS OR ROOFS. CONSTRUCTION LOADS SHALL NOT EXCEED THE DESIGN LIVE LOAD PER SQUARE FOOT LISTED IN THE DESIGN CRITERIA. CONTRACTOR SHALL PROVIDE ADEQUATE SHORING AND OR BRACING WHERE STRUCTURE HAS NOT ATTAINED DESIGN STRENGTH.
4. THESE DOCUMENTS HAVE BEEN PREPARED USING STANDARDS OF PROFESSIONAL CARE AND COMPLETENESS AS REQUIRED FOR THIS OR SIMILAR LOCALITIES. THEY ASSUME THAT THE WORK DEPICTED WILL BE PERFORMED BY AN EXPERIENCED CONTRACTOR AND/OR WORKMEN WHO HAVE A WORKING KNOWLEDGE OF THE APPLICABLE CODE STANDARDS AND REQUIREMENTS AND OF INDUSTRY ACCEPTED STANDARD GOOD PRACTICE. AS NOT EVERY CONDITION OR ELEMENT IS (OR CAN BE) EXPLICITLY SHOWN ON THESE DRAWINGS, THE CONTRACTOR SHALL USE INDUSTRY ACCEPTED STANDARD GOOD PRACTICE FOR MISCELLANEOUS WORK NOT EXPLICITLY SHOWN.
5. THESE DRAWINGS REPRESENT THE FINISHED STRUCTURE. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, PROCEDURES, LAGGING, SHORING, BRACING, FORM-WORK, ETC. AS REQUIRED FOR THE PROTECTION OF LIFE AND PROPERTY DURING CONSTRUCTION.

C. FOUNDATION REQUIREMENTS:

1. FOUNDATIONS FOR THE STRUCTURES SHOWN IN THE PLANS WERE DESIGNED BASED ON THE GEOTECHNICAL INVESTIGATION REPORT _____, DATED ___ __, 202_. LOAD-BEARING VALUES OF THE SOILS ARE PROVIDED IN THE REPORT. CONTINUOUS AND SPREAD FOOTINGS DESIGNED FOR ALLOWABLE BEARING PRESSURE OF ____ PSF PER THE SOILS REPORT. IF SOIL CONDITIONS ARE FOUND TO BE DIFFERENT THAN THE TYPES LISTED ABOVE OR OF UNUSUAL MAKE-UP, OR SUB-STANDARD, PLEASE CONTACT THE ENGINEER OF RECORD.

D. CONCRETE REQUIREMENTS:

1. ALL CONCRETE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH ACI 318 AND ACI 301, EXCEPT AS MODIFIED BY THE CONSTRUCTION DOCUMENTS.
2. CONCRETE SHALL HAVE THE FOLLOWING COMPRESSIVE STRENGTHS:

CONCRETE	MIN. f'c (28 DAYS)	SLUMP	W/C RATIO	CLASS
FOUNDATIONS	4500 PSI	3" TO 5"	0.45	F2
INT. SLAB-ON-GRADE	4000 PSI	3" TO 5"	0.45	F2
CONCRETE NOT NOTED	4500 PSI	3" TO 5"	0.45	F2

   SLUMP: CONCRETE w/ ADMIXTURES SHALL HAVE A MAXIMUM SLUMP OF 5".
3. ADMIXTURES:
   3.1. AIR ENTRAINMENT ASTM C-260
   3.2. CALCIUM CHLORIDE NOT PERMITTED
   3.3. ALUMINUM PRODUCTS NOT PERMITTED
4. CONCRETE MIXES SHALL BE DESIGNED BY A CERTIFIED LABORATORY, STAMPED BY AN APPROPRIATELY LICENSED SPECIALTY ENGINEER, AND APPROVED BY THE ENGINEER OF RECORD. MIX DESIGNS SHALL INCLUDE THE PROJECT NAME AND INDICATE THEIR USE WITHIN THE STRUCTURE. MIX DESIGNS SHALL BE PROPORTIONED TO MINIMIZE SHRINKAGE AND HAVE PROVEN SHRINKAGE CHARACTERISTICS OF 0.05% OR LESS BASED ON TESTING PER ASTM C157.
5. IF USED, EARLY STRENGTH CONCRETE SHALL BE PROPORTIONED TO DEVELOP THE 28 DAY COMPRESSIVE STRENGTH AT THE AGE REQUIRED BY THE CONTRACTOR. CONTRACTOR SHALL SUBMIT TEST DATA FOR REVIEW BY THE STRUCTURAL ENGINEER TO SUBSTANTIATE THE CONCRETE STRENGTH AT THE REQUIRED AGE.
6. ALL CONCRETE SHALL BE NORMAL WEIGHT OF 145 POUNDS PER CUBIC FOOT USING HARD ROCK AGGREGATES CONFORMING TO ASTM C33 U.N.O. WHERE LIGHTWEIGHT CONCRETE IS SPECIFIED, CONCRETE SHALL BE 110 POUNDS PER CUBIC FOOT USING AGGREGATES CONFORMING TO ASTM C330. LARGEST NOMINAL AGGREGATE SIZE SHALL BE 1-1/2" OR GREATER FOR SLABS ON GRADE AND 3/4" OR GREATER FOR ALL OTHER CONCRETE U.N.O.
7. PORTLAND CEMENT SHALL CONFORM TO ASTM C150. TYPE V CEMENT SHALL BE USED FOR CONCRETE IN CONTACT WITH EARTH. TYPE II CEMENT MAY BE USED ELSEWHERE. CEMENT SHALL BE TYPE V WITH POZZOLAN WHERE CONCRETE IS IN CONTACT WITH SOIL CONTAINING VERY SEVERE SULFATE EXPOSURE.
8. FLY ASH MAY BE USED IN CONCRETE, SUBJECT TO APPROVAL BY THE ARCHITECT AND ENGINEER, PROVIDED THE FOLLOWING CONDITIONS ARE MET:
   8.1. FLY ASH SHALL COMPLY WITH ASTM C618.
   8.2. CEMENT CONTENT SHALL BE REDUCED A MINIMUM OF 15 PERCENT UP TO A MAXIMUM OF 25 PERCENT WHEN COMPARED TO AN EQUIVALENT CONCRETE MIX DESIGN WITHOUT FLY ASH. FLY ASH CONTENT SHALL NOT COMPRISE MORE THAN 35 PERCENT OF THE TOTAL CEMENTITIOUS CONTENT. THE WATER-CEMENT RATIO SHALL BE CALCULATED BASED ON THE TOTAL CEMENTITIOUS MATERIAL IN THE MIX.
   8.3. CLASS F FLY ASH SHALL BE USED IN SULFATE RESISTANT CONCRETE WITH f'c EQUAL TO OR GREATER THAN 4000 PSI. CLASS C FLY ASH MAY BE USED ELSEWHERE.
9. WATER SOLUBLE CHLORIDE ION CONCENTRATIONS IN CONCRETE SHALL BE LIMITED PER ACI 318, SECTION 4.4.
10. ALL CONCRETE EXPOSED TO FREEZE/THAW CYCLES OR DEICING CHEMICALS SHALL CONFORM TO ACI 318, SECTION 4.2.
11. TIME BETWEEN CONCRETE BATCHING AND PLACEMENT SHALL BE IN ACCORDANCE WITH ASTM C94.
12. CONCRETE MIXING, PLACEMENT, AND QUALITY SHALL BE PER IBC SECTION 1905. MECHANICALLY VIBRATE ALL CONCRETE WHEN PLACED. SLABS ON GRADE NEED TO BE VIBRATED ONLY AROUND AND UNDER FLOOR DUCTS OR SIMILAR ELEMENTS. REMOVE ALL DEBRIS FROM FORMS BEFORE PLACING CONCRETE. CONCRETE SHALL NOT BE DROPPED THROUGH REINFORCING STEEL SO AS TO CAUSE SEGREGATION OF AGGREGATES. UNCONFINED FALL OF CONCRETE SHALL NOT EXCEED 5 FEET.
13. PROTECT CONCRETE FROM DAMAGE OR REDUCED STRENGTH DUE TO COLD OR HOT WEATHER IN ACCORDANCE WITH ACI 305 AND 306. CONTRACTOR SHALL TAKE SPECIAL CURING PRECAUTIONS TO MINIMIZE SHRINKAGE CRACKING OF CONCRETE SLABS.
14. ALL REINFORCING STEEL SHALL BE SET AND TIED IN PLACE PRIOR TO POURING OF CONCRETE, EXCEPT VERTICAL DOWELS FOR MASONRY WALL REINFORCING MAY BE "FLOATED" IN PLACE. DO NOT FIELD BEND BARS PARTIALLY EMBEDDED IN HARDENED CONCRETE UNLESS SPECIFICALLY INDICATED OR APPROVED BY THE ENGINEER OF RECORD.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PLACEMENT AND LOCATION OF ANY AND ALL EMBED ITEMS INCLUDING PLATES, BOLTS, AND OTHER INSERTS SPECIFIED IN THE DRAWINGS.
16. ALL ITEMS TO BE CAST IN CONCRETE SUCH AS REINFORCEMENT, DOWELS, BOLTS, ANCHORS, SLEEVES, ETC., SHALL BE SECURELY POSITIONED IN THE FORMS.

D. CONCRETE REQUIREMENTS CONTINUED:

17. MECHANICAL, ELECTRICAL, AND PLUMBING PENETRATIONS / EMBEDDED CONDUITS SHALL COMPLY WITH THE FOLLOWING:
    17.1. ELECTRICAL CONDUITS MAY BE EMBEDDED IN STRUCTURAL CONCRETE ONLY AS NOTED IN TYPICAL DETAILS FOR WALLS AND CAST-IN-PLACE ELEVATED SLABS (EMBEDDED CONDUITS IN CONCRETE OVER STEEL DECK ARE NOT PERMITTED) OR WHERE SPECIFICALLY APPROVED IN WRITING BY THE ENGINEER. PIPING SHALL NOT BE EMBEDDED IN STRUCTURAL CONCRETE U.N.O. EMBEDDED ITEMS SHALL NOT IMPAIR THE STRENGTH OF THE MEMBER.
    17.2. REFER TO TYPICAL DETAILS FOR ACCEPTABLE CONDUIT, PIPING, AND DUCT PENETRATIONS THRU SLABS AND WALLS. DO NOT CUT ANY REINF. THAT MAY INTERFERE WITH PERMITTED PENETRATIONS. OPENINGS SHALL NOT BE CORED WITHOUT PRIOR WRITTEN APPROVAL OF ENGINEER. PENETRATIONS THRU BEAMS AND COLUMNS ARE PERMITTED ONLY WHERE SPECIFICALLY DETAILED.
    17.3. CONTRACTOR SHALL SUBMIT SHOP DRAWING SHOWING SIZES AND DIMENSIONED LOCATIONS OF ALL PENETRATIONS AND EMBEDDED CONDUITS IN WALLS AND ELEVATED SLABS. SHOP DRAWING MUST BE APPROVED BY ENGINEER PRIOR TO CONCRETE PLACEMENT. PENETRATIONS AND EMBEDDED CONDUITS NOT SHOWN ON APPROVED SHOP DRAWING WILL NOT BE PERMITTED UNLESS SPECIFICALLY APPROVED IN WRITING BY THE ENGINEER.
18. FORMWORK, SHORING, AND RESHORING SHALL BE DESIGNED PER ACI 347 RECOMMENDATIONS BY AN APPROPRIATELY LICENSED SPECIALTY ENGINEER EXPERIENCED IN THIS TYPE OF WORK AND SHALL BE SUBMITTED TO ENGINEER OF RECORD FOR REVIEW. FOR MULTISTORY CONSTRUCTION, SHORING/RESHORING DESIGN SHALL DEMONSTRATE THAT SHORES/RESHORES WILL BE PROVIDED FOR A SUFFICIENT NUMBER OF FLOORS TO DISTRIBUTE IMPOSED CONSTRUCTION LOADS TO SEVERAL SLAB LEVELS WITHOUT CAUSING EXCESSIVE STRESSES AND SLAB DEFLECTIONS. FOR PURPOSES OF SHORING/RESHORING CALCULATIONS, MAGNITUDES OF REDUCED LIVE LOADS SHALL BE TAKEN TO BE 60% OF VALUES INDICATED IN BASIS FOR DESIGN U.N.O.
19. CONSTRUCTION JOINTS OR POUR JOINTS IN STRUCTURAL ELEMENTS (BEAMS, COLUMNS, ELEVATED SLABS, ETC.) NOT SPECIFICALLY SHOWN OR NOTED ON THE DRAWINGS REQUIRE PRIOR APPROVAL OF THE ENGINEER. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS SHOWING PROPOSED JOINTS TO ENGINEER FOR APPROVAL.
20. CONSTRUCTION JOINT SURFACES SHALL BE CLEANED AND LAITANCE REMOVED. HORIZONTAL JOINT SURFACES SHALL BE ROUGHENED TO 1/4" AMPLITUDE. THOROUGHLY WET ALL JOINT SURFACES AND REMOVE STANDING WATER IMMEDIATELY PRIOR TO NEW CONCRETE PLACEMENT.
21. CONCRETE SHALL BE CURED IN ACCORDANCE WITH ACI 318, SECTIONS 5.11.1 OR 5.11.2, WHICHEVER IS APPLICABLE, UNLESS ALTERNATE METHODS HAVE BEEN APPROVED BY THE ARCHITECT AND ENGINEER. WHERE CURING COMPOUNDS HAVE BEEN APPROVED FOR SLAB CURING, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING COMPATIBILITY OF COMPOUNDS WITH ANTICIPATED FLOOR FINISH (e.g., RESILIENT TILE) PRIOR TO CURING COMPOUND APPLICATION.
22. CONCRETE FINISH DESIGNATION:
    F1 – AS CAST FORM FINISH
    F2 – ROUGH FINISH
    F3 – SMOOTH FINISH
    F4 – SMOOTH RUBBED FINISH
    F5 – GROUT CLEANED RUBBED FINISH
    F6 – CORK FLOATED RUBBED FINISH
    F7 – UNFORMED FINISH
    F8 – BLASTED FINISH
    F9 – ARCHITECTURAL FINISH
    F10 – TOOLED FINISH
    S1 – FLOATED FINISH
    S2 – TROWEL FINISH
    S3 – BROOM FINISH
    S4 – EXPOSED AGGREGATE FINISH
    S5 – CHEMICAL HARDENER FINISH

E. REINFORCING STEEL REQUIREMENTS:

1. REINFORCING STEEL SHALL BE DETAILED AND PLACED IN ACCORDANCE WITH ACI 318 AND CRSI'S MANUAL OF STANDARD PRACTICE.
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615 OR ASTM A706 (A706 REQUIRED FOR ALL REINFORCING TO BE WELDED) AND SHALL BE GRADE 60 (fy = 60 KSI) DEFORMED BARS U.N.O. REINFORCING IN SLABS ON GRADE MAY BE GRADE 40 (fy = 40 KSI) DEFORMED BARS FOR ALL BARS #4 AND SMALLER U.N.O. ON PLANS OR DETAILS.
3. LAP SPLICES OF REINFORCING STEEL SHALL CONFORM TO TYPICAL REBAR LAP SCHEDULE U.N.O. NO TACK WELDING OF REINFORCING BARS ALLOWED. LATEST ACI CODE AND DETAILING MANUAL APPLY. AT WALLS AND FOOTINGS, PROVIDE BENT CORNER BARS TO MATCH AND LAP WITH HORIZ. BARS AT ALL CORNERS AND INTERSECTIONS U.N.O. VERT. WALL BARS SHALL BE SPLICED AT OR NEAR FLOOR LINES. SPLICE TOP BARS AT CENTER LINE OF SPAN AND BOTTOM BARS AT THE SUPPORT IN SPANDRELS, BEAMS, GRADE BEAMS, ETC., U.N.O. ON PLANS OR DETAILS.

E. REINFORCING STEEL REQUIREMENTS CONTINUED:

4. ALL DIMENSIONS SHOWING THE LOCATION OF REINFORCING STEEL NOT NOTED AS "CLEAR" OR "CLR." ARE TO CENTER OF STEEL. CLEAR COVER FOR NON-PRESTRESSED CONCRETE REINFORCING SHALL BE AS NOTED BELOW, U.N.O. ON PLANS OR DETAILS. CLEAR COVER FOR PRESTRESSED CONCRETE AND FOR PRECAST CONCRETE MANUFACTURED UNDER PLANT CONTROL CONDITIONS SHALL BE PER ACI 318, SECTIONS 7.7.2 AND 7.7.3, RESPECTIVELY.

EXPOSURE CONDITION:	COVER:
CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH	3"
EXPOSED TO WEATHER (INCLUDES SLABS ON GRADE)	
NO. 5 AND SMALLER	1 1/2"
NO. 6 AND LARGER	2"
NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND	
STRUCTURAL SLABS, WALLS, JOISTS	
NO. 11 AND SMALLER	3/4"

5. MECHANICAL SPLICE COUPLERS SHALL HAVE CURRENT ICC APPROVAL AND SHALL BE CAPABLE OF DEVELOPING 125% OF THE SPLICED BAR'S YIELD STRENGTH.
6. ALL REINFORCING SHALL BE BENT COLD. BARS SHALL NOT BE UN-BENT AND RE-BENT. FIELD BENDING OF REBAR SHALL NOT BE ALLOWED UNLESS SPECIFICALLY NOTED.
7. WELDING OF REINFORCING BARS, METAL INSERTS, AND CONNECTIONS SHALL BE MADE ONLY AT LOCATIONS SHOWN ON PLANS OR DETAILS. SEE WELDING SECTION OF G.S.N. FOR ADDITIONAL REQUIREMENTS.
8. REINFORCING BAR SPACINGS SHOWN ON PLANS ARE MAX. ON CENTER DIMENSIONS. DOWEL ALL VERT. REINFORCING TO FOUNDATION. SECURELY TIE ALL BARS IN LOCATION BEFORE PLACING CONCRETE. MIN. CLEAR SPACING BETWEEN PARALLEL REINFORCEMENT SHALL BE THE LARGER OF 1-1/2 TIMES NOMINAL BAR DIA. OR 1-1/3 TIMES MAX. AGGREGATE SIZE OR 1-1/2". CLEAR SPACING LIMITATION APPLIES ALSO TO CLEAR DISTANCE BETWEEN A CONTACT LAP SPLICE AND ADJACENT SPLICES OR BARS.
9. MIN. REINFORCING AT EDGES OF CONCRETE WALL OPENINGS SHALL BE (2) #5 BARS. EXTEND THE GREATER OF THE DEVELOPMENT LENGTH OF THE BAR PER TYPICAL REBAR LAP SCHEDULE OR 24" MIN. PAST EDGES OF OPENING U.N.O. HOOK ENDS AT INTERFERENCE WITH EXTENSION.

F. PREFABRICATED WOOD TRUSS REQUIREMENTS:

1. PREFABRICATED WOOD TRUSSES SHALL BE DESIGNED, FABRICATED, AND ERECTED IN ACCORDANCE WITH THE TRUSS PLATE INSTITUTE "NATIONAL DESIGN STANDARD FOR METAL PLATE CONNECTED WOOD TRUSS CONSTRUCTION" AND SHALL BE PROVIDED BY AN APPROVED FABRICATOR. PREFABRICATED OPEN WEB TRUSSES SHALL BE DESIGNED, FABRICATED, AND SUPPLIED BY REDBUILT (ICC ESR-1774) OR OTHER ICC APPROVED FABRICATOR WITH THE PRIOR APPROVAL OF THE E.O.R. DESIGN LOADS FOR OPEN WEB TRUSSES SHOWN ON THE DRAWINGS ARE ALLOWABLE STRESS DESIGN (ASD) LOADS.
2. ALL MEMBERS RECEIVING FASTENERS PER STRUCTURAL DRAWINGS SHALL HAVE A SPECIFIC GRAVITY OF 0.42 OR HIGHER, U.N.O.
3. MAX. DEFLECTION LIMITS FOR TRUSSES/RAFTERS SHALL BE AS FOLLOWS:

LOCATION:	LIVE LOAD:	TOTAL LOAD:
ROOF	SPAN/360	SPAN/240

4. TRUSSES SHALL BE DESIGNED TO SUPPORT THEIR SELF WEIGHT, PLUS LIVE LOAD, SUPERIMPOSED DEAD LOAD (INCLUDING BUT NOT LIMITED TO ALL MECHANICAL AND OTHER EQUIPMENT), AND ATTIC LOADS AS REQUIRED PER IBC TABLE 1607.1 AND SHALL BE DESIGNED TO RESIST ALL DRAG FORCES, SHEAR WALL UPLIFT AND DOWNWARD LOADS, AND OTHER SPECIAL LOADS NOTED ON THE DRAWINGS.
5. ALL TRUSS TO TRUSS CONNECTIONS SHALL BE SPECIFIED BY THE TRUSS DESIGNER AND INCLUDED IN THE TRUSS DIAGRAMS. ALL CONNECTORS SHALL HAVE CURRENT ICC APPROVAL.
6. TRUSS DIAGRAMS AND KEYED LAYOUT SHALL BE AVAILABLE TO FIELD INSPECTOR AT THE JOB-SITE AT THE TIME OF ROOF NAILING AND FRAMING INSPECTION.
7. SHOP DRAWINGS, ERECTION DRAWINGS, AND DESIGN CALCULATIONS SEALED BY AN APPROPRIATELY REGISTERED ENGINEER SHALL BE SUBMITTED FOR REVIEW. SHOP DRAWINGS SHALL SHOW ANY SPECIAL DETAILS REQUIRED AT BEARING POINTS.
8. BRIDGING SIZE AND SPACING SHALL BE AS DESIGNATED BY THE TRUSS MANUFACTURER.

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
STRUCTURAL SPECIFICATIONS AND REQUIREMENTS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S0.1
SHEET NUMBER 13 OF 43

2569515M

P:\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\CIVIL DESIGN DRAWINGS\SHEETS\JVWCD-CB-ST-OLD ISH.DWG

STRUCTURAL SPECIFICATIONS & REQUIREMENTS CONTINUED...

G. MASONRY REQUIREMENTS:

1. MASONRY SHALL HAVE THE FOLLOWING MATERIALS UNLESS NOTED OTHERWISE:
   - 1.1. CONCRETE MASONRY UNITS (CMU): f'm = 2,000 psi (MIN. UNIT STRENGTH OF 2,000 psi)
   - 1.2. MORTAR: TYPE "S" (MIN. COMP. STRENGTH OF 1,800 psi)
   - 1.3. GROUT: MIN. COMP. STRENGTH OF 2,000 psi AT 28 DAYS
   - 1.4. REINFORCING STEEL: ASTM A-615 GRADE 60 (Fy = 60 ksi)
   - 1.5. DEFORMED BAR ANCHORS (DBA): ASTM A-496
   - 1.6. HEADED STUD ANCHORS (HAS): ASTM A-108
   - 1.7. ANCHOR BOLTS:
     - 1.7.a. GRAVITY BOLTS: ASTM F-1554
   - 1.8. HEAVY HEX NUTS & WASHERS: ASTM A-563

2. UNLESS NOTED OTHERWISE, THE FOLLOWING MINIMUM COVER SHALL BE PROVIDED FOR REINFORCEMENT:
   - 2.1. MASONRY EXPOSED TO THE SOIL: 1 1/2"
   - 2.2. TYPICAL MASONRY: ONE BAR DIAMETER OR 3/4" MINIMUM

3. MASONRY CONSTRUCTION SHALL CONFORM TO THE REQUIREMENTS OF THE "SPECIFICATIONS FOR MASONRY STRUCTURES (ACI 530).

4. UNLESS NOTED OTHERWISE, ALL WALLS SHALL BE LAID IN A RUNNING BOND. BOND CORNERS AND INTERSECTIONS OF LOAD-BEARING WALLS, AND OTHER WALLS INDICATED IN THE CONTRACT DOCUMENTS. ALL UNITS SHALL BE LAID WITH A FULL MORTAR BEDS ON THE FACE SHELLS. CELLS, WHICH ARE TO BE GROUTED, SHALL HAVE FULL HEAD JOINTS. HEAD JOINTS SHALL BE FILLED SOLIDLY WITH MORTAR FOR A DISTANCE IN FROM THE FACE OF THE UNITS NOT LESS THAN THE THICKNESS OF THE LONGITUDINAL FACE SHELL.

5. FILL ALL BOND BEAMS, REINFORCING CELLS, ANCHOR BOLTS, EMBEDS, ETC. SOLIDLY WITH GROUT PLACED BY MECHANICAL VIBRATION AT THE TIME OF PLACEMENT AND REVIBRATED AFTER EXCESS MOISTURE HAS BEEN ABSORBED BUT BEFORE WORKABILITY HAS BEEN LOST. PUDDLING OR RODDING OF GROUT IS NOT PERMITTED.

6. HORIZONTAL BOND BEAMS WITH CONTINUOUS VERTICAL REINFORCING AS INDICATED SHALL TERMINATE AT CONTROL JOINTS, EXCEPT FOR BOND BEAMS AT BEARING ELEVATIONS AT TOP AND BOTTOM OF WALL, AND AT BOND BEAMS USED FOR CHORDS. INTERMEDIATE BOND BEAMS SHALL BE PROVIDED AS SHOWN IN THE PLANS.

7. PROVIDE BOND BEAM LINTELS AND BRICK SHELF ANGLES ABOVE ALL WALL OPENINGS AS SPECIFIED IN THE CONTRACT DOCUMENTS. CONSULT THE ARCHITECTURAL DRAWINGS FOR WINDOW AND DOOR OPENINGS.

8. PROVIDE MASONRY CONTROL JOINTS AS INDICATED IN THE ARCHITECTURAL DRAWINGS, WITH ADDITIONAL JOINTS SUCH THAT THE SPACING BETWEEN JOINTS DO NOT EXCEED A SPACING OF 3 x THE WALL HEIGHT (35'-0" O.C. MAXIMUM). WHERE BEAMS OR LINTELS BEAR AT MASONRY CONTROL JOINTS CONSULT THE ARCHITECT/ ENGINEER FOR THE NEW LOCATION OF THE JOINT.

9. GROUT POURS SHALL BE LIMITED TO 5'-3" LIFTS UNLESS HIGH LIFT GROUTING PROCEDURES ARE FOLLOWED. CONTACT THE ARCHITECT & ENGINEER PRIOR TO ANY HIGH LIFT GROUTING PROCEDURES TO DISCUSS QUALIFICATIONS AND PROCEDURES.

10. ALL MASONRY LOCATED BELOW GRADE SHALL BE GROUTED SOLIDLY.

11. WHERE WALLS ARE NOT GROUTED SOLID, EACH GROUT POUR SHALL BE TERMINATE FLUSH WITH THE TOP OF THE GROUT POUR EXCEPT WHERE THE VERTICAL REINFORCEMENT OR OTHER GROUTED CELLS SHALL CONTINUE UP. THESE CELLS SHOULD HAVE THE GROUT TERMINATE 1 1/2" BELOW THE TOP OF THE POUR TO PROVIDE A CONSTRUCTION KEY IN THE WALL.

12. VERTICAL CELLS TO BE FILLED WITH GROUT SHALL HAVE VERTICAL ALIGNMENT SUFFICIENT TO MAINTAIN A CLEAR, UNOBSTRUCTED VERTICAL CELL NOT LESS THAN 2" BY 3". ALL STEEL REINFORCEMENT SHALL BE LOCATED WITH AN APPROVED LOCATOR AT 10'-0" O.C. MAXIMUM INTERVALS OR AT BAR SPLICE LOCATIONS. ALL VERTICAL WALL REINFORCING SHALL BE LOCATED AT THE CENTER OF THE WALL UNLESS NOTED OTHERWISE.

13. ALL VERTICAL REINFORCING SHALL TERMINATE IN THE SAME VERTICAL CELL FOR WHICH IT BEGAN IN. STEPPING REINFORCEMENT IS NOT PERMITTED. PROVIDE REBAR DOWELS FROM THE FOUNDATIONS TO MATCH THE VERTICAL REINFORCEMENT SIZE AND SPACINGS. FOUNDATION DOWELS SHALL HAVE STANDARD 90-DEGREE HOOKS AND LAP WITH THE FIRST LIFT REINFORCING.

14. REINFORCING BARS SHALL NOT BE WELDED OR SUBSTITUTED FOR ANY OTHER FORM OF REINFORCING WITH OUT WRITTEN CONSENT FROM THE ENGINEER.

15. ALL EMBED PLATES AND CHANNELS SHALL BE PLACED FLUSH WITH THE FACE OF THE WALL THEY ARE BEING PLACED IN. ANCHOR BOLTS AND HEADED STUD ANCHORS SHALL BE PLACED SUCH THAT THE SHANK OF THE BOLT OR STUD IS SET WITH A 1" OF SOLID GROUT SURROUNDS THE SHANK. ALL BOLTS AND STUDS SHALL BE PLACED IN SOLID GROUTED CELLS.

16. DETAIL ALL MASONRY REINFORCING SUCH THAT ALL LAP SPLICES ARE AS INDICATED IN THE REINFORCING BAR LAP SPLICE SCHEDULE. HORIZONTAL REINFORCEMENT SHALL BE CONTINUOUS AT ALL INTERSECTING WALLS AND CORNERS. CORNER BARS SHALL BE PROVIDED AT STANDARD LAP LENGTHS TO MAKE WALLS CONTINUOUS. VERTICAL REINFORCEMENT SHALL START AND STOP ABOVE AND BELOW OPENINGS AS SHOWN IN THE CONTRACT DOCUMENTS. VERTICAL JAMB COLUMNS SHALL EXTEND PAST THE TOP OF THE OPENING UP THRU THE NEXT SUPPORTING FLOOR OR ROOF BEARING BOND BEAM. HORIZONTAL REINFORCEMENT ABOVE AND BELOW OPENINGS SHALL EXTEND 48 BAR DIAMETERS PAST THE OPENING WERE POSSIBLE. WHERE NOT POSSIBLE TERMINATE HORIZONTAL REINFORCEMENT IN A STANDARD ACI 90 DEGREE HOOK.

G. MASONRY REQUIREMENTS CONTINUED:

17. HORIZONTAL WALL REINFORCING SHALL TERMINATE AT ALL OPENINGS, CONTROL JOINTS (EXCEPT AT FLOORS AND ROOF LEVELS), LINTELS, BEAMS AND AT THE TOP OF THE PARAPETS IN A STANDARD 180-DEGREE HOOK PLUS 6 BAR DIAMETER EXTENSION WITH A 4" MINIMUM EXTENSION.

18. ALL MASONRY COLUMN TIES SHALL TERMINATE IN A 135 DEGREE HOOK PLUS 6 BAR DIAMETERS (4" MINIMUM).

19. MASONRY STRENGTH f'm SHALL BE VERIFIED USING THE UNIT STRENGTH METHOD PER THE IBC 2018 CODE SECTION 2105.3.2.2.1 AND AS DESCRIBED BELOW:
   - 19.1. PRIOR TO CONSTRUCTION, THE SUPPLIERS CERTIFICATE OF STRENGTH OF THE MASONRY UNITS AND GROUT SHALL BE SUBMITTED.
   - 19.2. THE GROUT AND MORTAR SHALL BE TESTED, DURING CONSTRUCTION, FOR EVERY 5,000 SQUARE FEET OF MASONRY CONSTRUCTED.

20. THE CONTRACTOR HAS THE OPTION OF USING THE "MASONRY PRISM TEST METHOD" AS SPECIFIED IN SECTION 2105.2.2.2 OF THE IBC 2021 CODE IN LIEU OF THE "UNIT STRENGTH METHOD".

H. EARTHWORK REQUIREMENTS:

1. CONSULT THE PROJECT SPECIFICATIONS AND THE GEOTECHNICAL REPORT FOR EARTHWORK REQUIREMENTS.

2. ALL SOFT SPOTS SHALL BE REMOVED AND REPLACED WITH COMPACTED STRUCTURAL FILL.

3. STRUCTURAL FILL SHALL BE AS DEFINED IN THE GEOTECHNICAL REPORT. THE CONTRACTOR SHALL HAVE ALL FILL TESTED.

4. ALL INTERIOR CONCRETE SLABS-ON-GRADE SHALL BE UNDERLAIN WITH FREE DRAINING GRANULAR FILL PER THE GEOTECHNICAL REPORT.

5. ALL STRUCTURES SHALL HAVE STRUCTURAL FILL PLACED BENEATH FOOTING/SLAB PER GEOTECHNICAL REPORT.

6. ALLOWABLE DEAD PLUS LIVE LOAD SOIL PRESSURE = 2,500 PSF.

7. TRENCHES AND EXCAVATIONS UNDER OR ADJACENT TO FOUNDATIONS SHALL BE PROPERLY BACKFILLED AND COMPACTED.

8. REFER TO GEOTECHNICAL REPORT FOR ON-SITE SOIL CORROSION POTENTIAL ON METAL CONSTRUCTION MATERIALS. CONSULT A QUALIFIED CORROSION ENGINEER FOR RECOMMENDATIONS FOR MITIGATING CORROSIVE EFFECTS, IF NECESSARY.

9. WATER PROOFING AS MAY BE REQUIRED AT SOIL FACE OF WALLS BELOW GRADE SHALL BE BY OTHERS.

J. QUALITY CONTROL AND INSPECTION REQUIREMENTS:

1. QUALITY CONTROL AND INSPECTIONS SHALL BE PERFORMED AS REQUIRED IN IBC 2021 CHAPTER 17. AS STATED IN IBC 2021 1704.2.1, "THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE AND ENGINEERS OF RECORD INVOLVED IN THE DESIGN OF THE PROJECT ARE PERMITTED TO ACT AS THE APPROVED AGENCY AND THEIR PERSONNEL ARE PERMITTED TO ACT AS THE SPECIAL INSPECTORS FOR THE WORK DESIGNED BY THEM, PROVIDED THEY QUALIFY AS SPECIAL INSPECTORS."

K. SPECIAL INSPECTION REQUIREMENTS:

1. SPECIAL INSPECTION AND QUALITY ASSURANCE, AS REQUIRED BY SECTION 1705 OF THE IBC, SHALL BE PROVIDED BY AN INDEPENDENT AGENCY EMPLOYED BY THE OWNER UNLESS WAIVED BY THE BUILDING OFFICIAL. THE CONTRACTOR SHALL COORDINATE AND COOPERATE WITH THE REQUIRED INSPECTIONS. ALL TESTING AND INSPECTION REPORTS SHALL BE SENT TO THE ENGINEER OF RECORD FOR REVIEW. ITEMS REQUIRING SPECIAL INSPECTION AND QUALITY ASSURANCE ARE SHOWN IN THIS SECTION.

2. SOILS PER IBC SECTION 1705.6 AND TABLE 1705.6 BELOW:
   - 2.1. SPECIAL INSPECTION SHALL BE PROVIDED PRIOR TO POURING CONCRETE FOOTINGS.
   - 2.2. SPECIAL INSPECTION SHALL BE PROVIDED PRIOR TO PLACEMENT OF FILL AND DURING PLACEMENT OF FILL.

TABLE 1705.6
REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS

TYPE OF INSPECTION OR TEST	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. VERIFY MATERIALS BELOW SHALLOW FOUNDATIONS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY.	–	X
2. VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL.	–	X
3. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS.	–	X
4. VERIFY USE OF PROPER MATERIALS, DENSITIES AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF COMPACTED FILL.	X	–
5. PRIOR TO PLACEMENT OF COMPACTED FILL, INSPECT SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY.	–	X

K. SPECIAL INSPECTION REQUIREMENTS CONTINUED:

3. CONCRETE CONSTRUCTION PER IBC SECTION 1705.3:
   - 3.1. SPECIAL INSPECTIONS NOT REQ'D. PER SECTION 1705.3, EXCEPTION 2.3 (STRUCTURAL DESIGN OF FOUNDATIONS IS BASED ON COMPRESSIVE STRENGTH f'_c = 2,500 psi)

L. DEFERRED SUBMITTAL REQUIREMENTS:

1. SHOP DRAWINGS OR REPORTS FOR THE FOLLOWING ITEMS SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER OF RECORD PRIOR TO FABRICATION OR CONSTRUCTION (AS APPLICABLE) U.N.O.

   CONCRETE CYLINDER TESTS
   REINFORCING STEEL
   CONCRETE MIX DESIGN
   ADMIXTURE SPECIFICATIONS
   CURING AGENT SPECIFICATIONS
   STRUCTURAL STEEL

2. CONTRACTOR SHALL REVIEW AND STAMP SHOP DRAWINGS PRIOR TO SUBMITTING. CONTRACTOR'S REVIEW SHALL CHECK FOR COMPLETENESS/COMPLIANCE WITH CONTRACT DOCUMENTS.

3. SHOP DRAWINGS ARE REVIEWED BY ENGINEER ONLY FOR GENERAL COMPLIANCE WITH THE STRUCTURAL DRAWINGS. RESPONSIBILITY FOR CORRECTNESS SHALL REST WITH THE CONTRACTOR. SHOP DRAWINGS DO NOT SUPERSEDE OR REPLACE THE CONTRACT DRAWINGS OR SPECIFICATIONS. CHANGES, SUBSTITUTIONS, OR DEVIATIONS FROM CONTRACT DRAWINGS AND/OR SPECIFICATIONS WILL NOT BE ACCEPTED VIA SHOP DRAWING REVIEW. ALL SUCH MODIFICATIONS SHALL BE SUBMITTED SEPARATELY FOR ENGINEER'S REVIEW.

4. PREFABRICATED COMPONENTS, SPECIALTY ITEMS, OR DESIGN-BUILD ELEMENTS NOTED ON THE STRUCTURAL DRAWINGS, BUT WHICH REQUIRE THE MFR. OR SUPPLIER TO PROVIDE THE DESIGN, SHALL BE SUBMITTED BY THE CONTRACTOR TO THE ARCHITECT AND/OR ENGINEER FOR REVIEW AS A DEFERRED SUBMITTAL. DEFERRED SUBMITTALS REQ'D. BY THE STRUCTURAL ENGINEER OF RECORD SHALL INCLUDE, BUT NOT BE LIMITED TO, THE FOLLOWING:

   STEEL JOISTS/JOIST GIRDERS
   STEEL RAILING

5. DEFERRED SUBMITTALS SHALL INCLUDE CALCULATIONS AND DRAWINGS PREPARED AND STAMPED BY AN APPROPRIATELY LICENSED ENGINEER (SPECIALTY ENGINEER) SHOWING LOCATION AND MAGNITUDE OF LOADS, CONFIGURATION AND SIZE OF MEMBERS, AND COMPATIBILITY OF SUBMITTAL ITEM WITH THE PRIMARY STRUCTURAL SYSTEM.

6. THE PURPOSE OF THE STRUCTURAL ENGINEER'S REVIEW OF DEFERRED SUBMITTALS SHALL BE LIMITED TO DETERMINING THAT THE DRAWINGS AND CALCULATIONS HAVE BEEN PROPERLY SEALED, THAT THE LOAD CRITERIA IS IN GENERAL CONFORMANCE WITH THE CONTRACT DOCUMENTS AND WITH THE REFERENCED BUILDING CODE, THAT CONNECTIONS TO THE PRIMARY STRUCTURE ARE COMPATIBLE WITH THE PRIMARY DESIGN, AND THAT THE PRIMARY STRUCTURE IS CAPABLE OF SUPPORTING THE IMPOSED LOADS.

7. THE STRUCTURAL ENGINEER WILL RELY UPON THE SPECIALTY ENGINEER'S SEAL AS CERTIFICATION THAT THE ITEMS DESIGNED BY THE SPECIALTY ENGINEER COMPLY WITH THE CRITERIA SET FORTH IN THE CONTRACT DOCUMENTS AND APPLICABLE CODES AND STANDARDS. THE STRUCTURAL ENGINEER SHALL NOT BE RESPONSIBLE FOR THE ADEQUACY OF DESIGNS PROVIDED BY OTHERS.

8. FOR ALL SUBMITTALS, ANY CORRECTIONS NOTED WILL BE MARKED ON ONE (1) COPY SET ONLY AND RETURNED. ADDITIONAL COPIES OF ANY SUBMITTAL WILL BE RETURNED UNMARKED. CONTRACTOR SHALL BE RESPONSIBLE FOR REPRODUCING ENGINEER'S CORRECTIONS ON ADDITIONAL COPIES REQ'D. ONE COPY SET MAY BE RETAINED FOR THE ENGINEER'S RECORDS. ALLOW FIVE (5) TO TEN (10) WORKING DAYS FOR THE ENGINEER'S REVIEW.

9. REFER TO APPLICABLE G.S.N. SECTIONS FOR FURTHER REQUIREMENTS SPECIFIC TO INDIVIDUAL SUBMITTALS.

ABBREVIATIONS

A.C.I.	AMERICAN CONCRETE INSTITUTE
BOT.	BOTTOM
C.M.U.	CONCRETE MASONRY UNIT
CLR.	CLEAR
C.F.S.	COLD FORMED STEEL
COL.	COLUMN
CONC.	CONCRETE
CONT.	CONTINUOUS
D.B.A.	DEFORMED BAR ANCHORS
DIA.	DIAMETER
DBL.	DOUBLE
D.F.	DOUGLAS FIR/LARCH
E.F.	EACH FACE
E.W.	EACH WAY
E.O.R.	ENGINEER OF RECORD
EXT.	EXTERIOR
GA.	GAUGE
GLB.	GLU-LAMINATED BEAM
G.S.N.	STRUCTURAL REQUIREMENTS AND SPECIFICATIONS (GENERAL STRUCTURAL NOTES)
H.S.A.	HEADED STUD ANCHORS
HORIZ.	HORIZONTAL
I.M.F.	INTERMEDIATE MOMENT FRAME
IN.	IN.
I.C.C.	INTERNATIONAL CODE COUNCIL
L.F.R.S.	LATERAL FORCE RESISTING SYSTEM
L.L.V.	LONG LEG VERTICAL
L.L.H.	LONG LEG HORIZONTAL
K.S.	KING STUD
MAX.	MAXIMUM
MIN.	MINIMUM
N/A	NOT APPLICABLE
NO.	NUMBER
O.C.	ON CENTER
O.M.F.	ORDINARY MOMENT FRAME
REINF.	REINFORCING
R.S.	ROUGH SAWN LUMBER
S.E.I.	SUNRISE ENGINEERING, INC.
SIM.	SIMILAR
S.M.F.	SPECIAL MOMENT FRAME
S.O.G.	SLAB-ON-GRADE
STD.	STANDARD
STRUCT'L	STRUCTURAL
T.S.	TRIMMER STUD
TYP.	TYPICAL
U.N.O.	UNLESS NOTED OTHERWISE
V.I.F.	VERIFY IN FIELD
VERT.	VERTICAL
WT.	WEIGHT
W/	WITH
W/C	WATER TO CEMENT RATIO
(E)	(E)
(N)	NEW

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
11/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
STRUCTURAL SPECIFICATIONS AND REQUIREMENTS, CONTINUED

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S0.2
SHEET NUMBER 14 OF 43

2569515M

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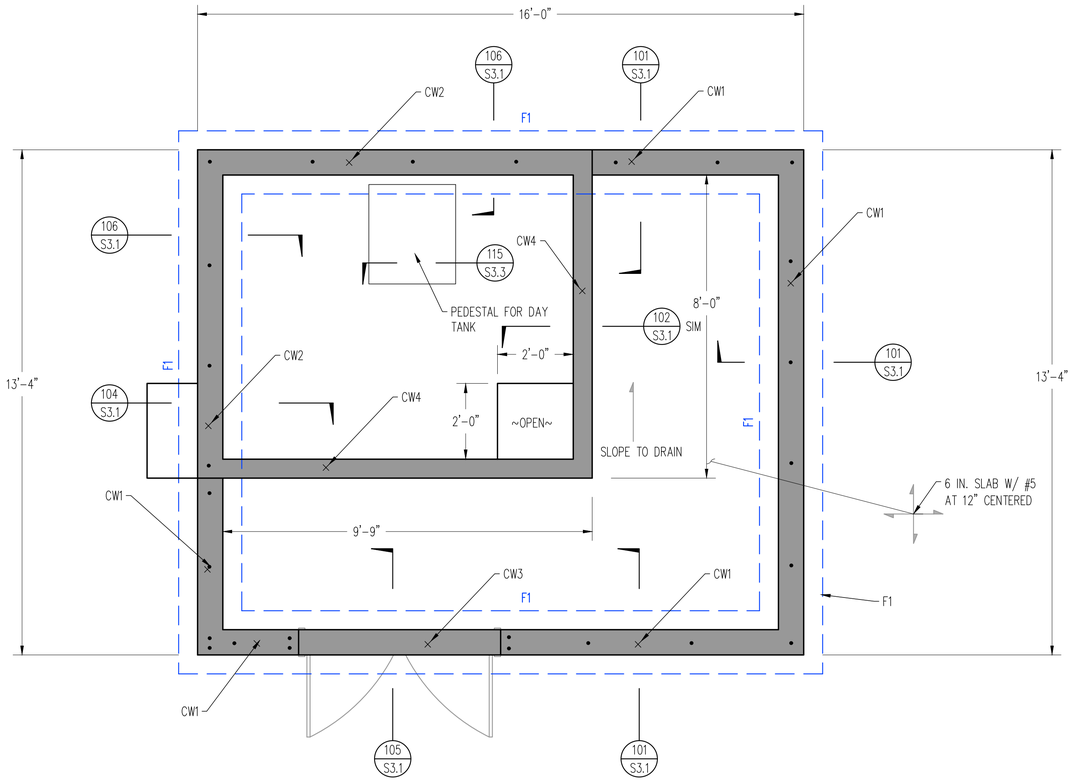


B ~ FOUNDATION PLAN (BUILDING)

FOUNDATION REQUIREMENTS

F1. VERIFY LOCATION AND SIZE OF ALL INSERTS AND OPENINGS IN SLAB, WALLS, AND FLOORS WITH ARCH'L, MECH, PLUMBING, AND ELECT. PRIOR TO CONSTRUCTION.

F2. ALL FOOTINGS AND SLABS SHALL BE PLACED ON STRUCTURAL FILL AS DEFINED IN THE GEOTECHNICAL REPORT. THE MOISTURE CONTENT OF STRUCTURAL FILL SHOULD BE CONDITIONED TO NEAR OPTIMUM WATER CONTENT, PLACED IN UNIFORM LIFTS NOT EXCEEDING 8 INCHES IN LOOSE THICKNESS, AND COMPACTED PER REQUIREMENTS OF THE GEOTECHNICAL REPORT.

F3. ALL STANDARD WALL FOOTINGS SHALL EXTEND TO AT LEAST 24 INCHES BELOW FINISHED GRADE FOR FROST PROTECTION.

F4. F1 AND F2 DENOTES FOOTING PER FOOTING SCHEDULE ON THIS SHEET.

F5. CW1, CW2, CW3 ... DENOTES CONCRETE WALL PER CONCRETE WALL SCHEDULE ON THIS SHEET.

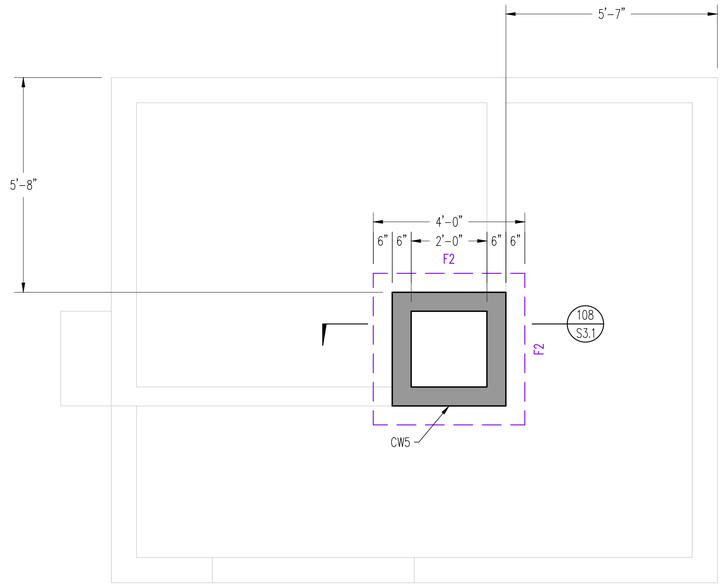
F6. CONCRETE CONTROL JOINTS SHOULD BE AS SHOWN ON THESE PLANS AND PER THE REFERENCED DETAILS.

F7. PLACE SLABS ON GRADE OVER VAPOR BARRIER (AS REQ'D) PER THE GEOTECHNICAL REPORT.

F8. INTERIOR CONCRETE SLAB SHALL BE 6 INCHES THICK WITH REINFORCEMENT AS SHOWN ON THE PLANS, UNLESS NOTED OTHERWISE.

F9. FOR SMALL PIPES/CONDUITS, THROUGH FOUNDATION WALLS/FOOTINGS, SEE DETAIL 109 ON SHEET S3.2

F10. CONCRETE LAP SPLICE REQUIREMENTS PER DETAIL 114 SHEET S3.3



A ~ SUMP FOUNDATION PLAN

CONCRETE WALL SCHEDULE

MARK	THICKNESS	HEIGHT	VERTICAL REINFORCING	HORIZONTAL REINFORCING	TOP OF WALL EL
CW1	8"	2'-2"	#5 AT 16" O.C. CENTERED	(3) #5 CONT.	0.00'
CW2	8"	3'-6"	#5 AT 12" O.C. CENTERED	(5) #5 CONT.	1.33'
CW3	8"	1'-2"	#5 AT 16" O.C. CENTERED	(2) #5 CONT.	-1.00'
CW4	6"	1'-4"	#5 AT 12" O.C. CENTERED	(3) #5 CONT.	1.33'
CW5	6"	1'-9"	#5 AT 12" O.C. CENTERED	(2) #5 CONT.	-0.5'

FOOTING SCHEDULE

MARK	WIDTH	LENGTH	THICKNESS	REINFORCEMENT
F1	1'-8"	CONT.	10"	#5 AT 18" o.c. TRANSVERSE BOT. (3) #5 CONT. LONGITUDINAL BOT.
F2	4'-0"	4'-0"	10"	

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
FOUNDATION PLAN

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S2.1
SHEET NUMBER 15 OF 43

2693478M

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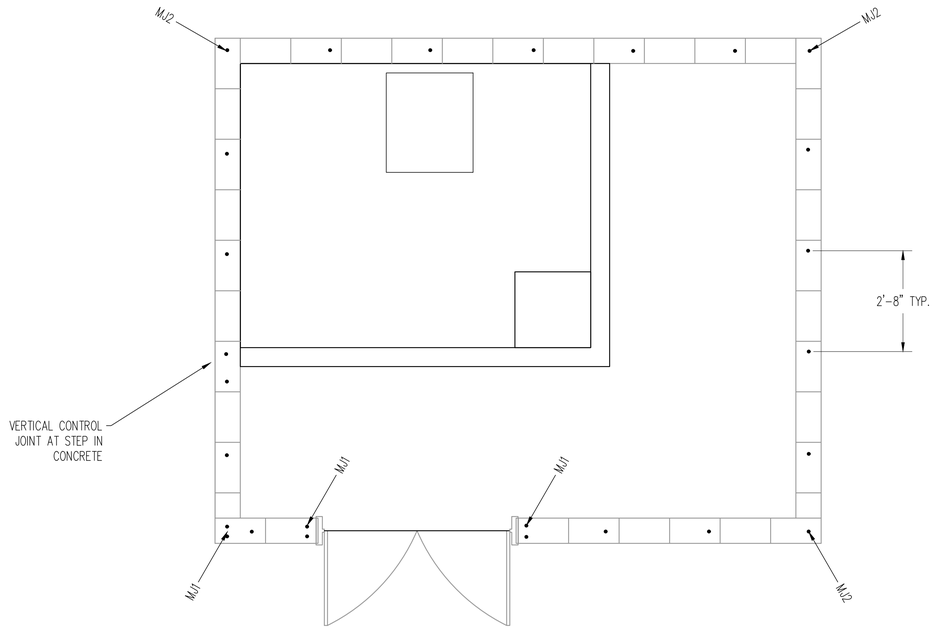
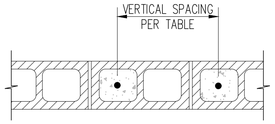
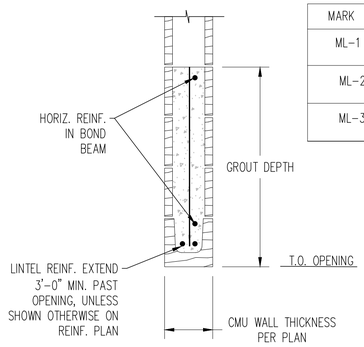


A MASONRY WALL PLAN
NTS



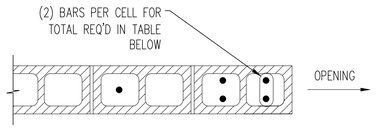
MARK	VERT. SPACING	GROUTING	NOM. CMU SIZE	HEIGHT	ANCHORS AT TOP OF WALL
MW1	#5 AT 32" O.C.	32" O.C.	8"	8'-0"	1/2" DIA. x 12" AT 16" O.C.
* ALL MASONRY WALLS REQUIRE HORIZ BOND BEAM WITH #5 AT 48" O.C. PROVIDE (2) #5 AT TOP OF WALL AND (1) #5 AT BOTTOM AND INTERMEDIATE BOND BEAMS					

B MASONRY WALL REINF.
NTS



MARK	LINTEL REINF.	GROUT DEPTH
ML-1	(1) #5	SOLID
ML-2	-------	---------
ML-3	-------	---------

C MASONRY LINTEL AT OPENING
NTS



MARK	JAMB REINF.
MJ1	(2) #5
MJ2	(1) #5
MJ3	---------
MJ4	---------
MJ5	-------

D MASONRY JAMB AT OPENING
NTS

MASONRY REQUIREMENTS

M1. ML DENOTES MASONRY LINTEL PER DETAIL C / S2.2

M2. MJ DENOTES MASONRY JAMB PER DETAIL D / S2.2

M3. MASONRY CONTROL JOINTS (MCJ) SHALL BE PLACED IN MASONRY WALLS WHERE SPECIFICALLY SHOWN ON PLANS AND AT ALL INTERIOR TO EXTERIOR WALL INTERSECTIONS. SEE DETAIL 202 ON SHEET ST10 TO COORDINATE EXACT LOCATION OF CONTROL JOINTS WITH ARCHITECTURAL PLANS.

M4. SEE "A" ON THIS SHEET FOR VERTICAL REINFORCEMENT REQUIREMENTS AT CORNERS. SEE NOTE ON THIS PAGE, AND DETAIL 204 ON SHEET S4.1, FOR HORIZONTAL REINFORCEMENT REQUIREMENTS AT WALL AND INTERSECTIONS.

M5 VERIFY ALL DIMENSIONS, ELEVATIONS, SLOPES, ETC. W/ ARCHITECTURAL AND/OR CIVIL PLANS PRIOR TO CONSTRUCTION. RESOLVE DISCREPANCIES AND CONFLICTS WITH ENGINEER OF RECORD.

M6. REINFORCING IN MASONRY WALL SHALL BE LAPPED WITH REINFORCEMENT FROM CONCRETE WALL BELOW AS OCCURS.

M7. HORIZONTAL REINFORCING IN WALL SHALL BE CONTINUOUS, EXCEPT AT CONTROL JOINTS. BOND BEAMS AT TOP AND BOTTOM OF WALL TO RUN CONTINUOUS THROUGH CONTROL JOINTS.

M8. EXTERIOR WALLS AND PUMP ROOM SEPARATION WALL SHALL BE SOLID GROUTED. INTERIOR WALLS TO BE GROUTED AT ALL VERTICAL REINFORCING AND BOND BEAMS PER GENERAL STRUCTURAL NOTES, UNLESS NOTED OTHERWISE.

M9. ANCHOR BOLTS AT TOPS OF WALL SHALL BE PER MASONRY WALL SCHEDULE

M10. SEE MASONRY REINFORCING SPLICE SCHEDULE DETAIL 203 ON SHEET S4.1

M11. SOLID GROUT MASONRY

MASONRY WALL REINFORCEMENT NOTE:

MASONRY WALL UNITS SHALL BE 8"X 8"X 16" C.M.U. TYPICAL VERTICAL REINFORCEMENT SHALL BE #5 WITH SPACING SHOWN IN TABLE. MASONRY LINTEL AND JAMB TABLES PROVIDED AND SHOWN ON PLANS. PROVIDE (1) #5 IN BOND BEAM AT BOTTOM AND AT 4'-8" LIFT. PROVIDE (2) #5 IN BOND BEAM AT TOP COURSE OF WALL

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
MASONRY WALL PLAN

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S2.2
SHEET NUMBER 16 OF 43

2693478M

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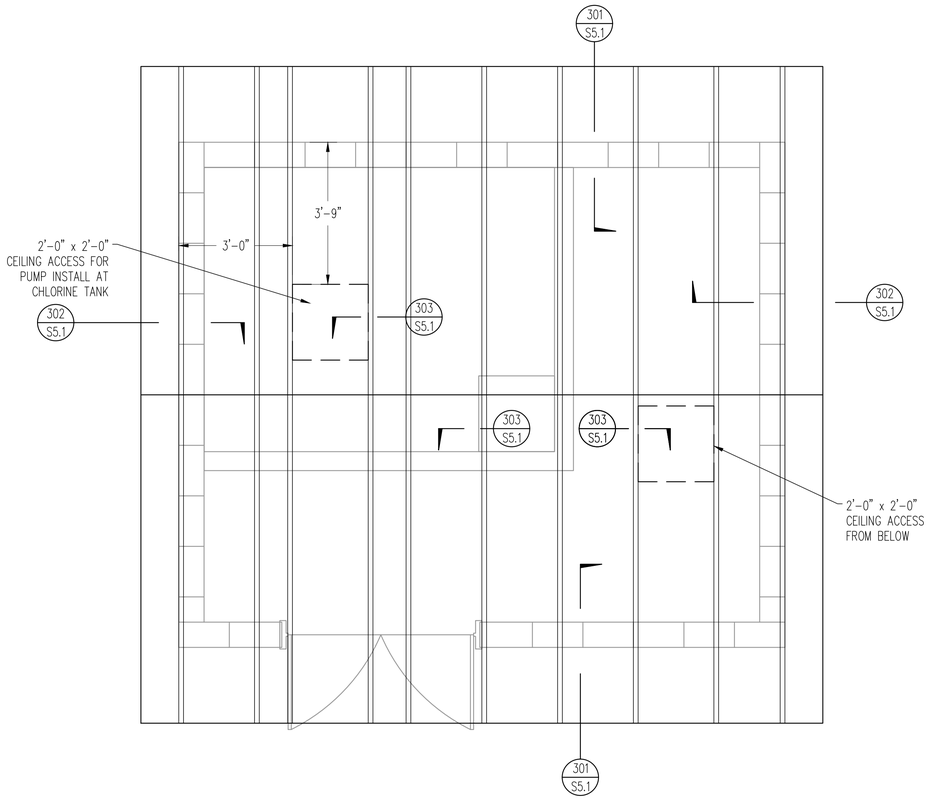

A ~ PLAN- ROOF FRAMING

SCALE: 1/2" = 1'-0" (22X34) 1/4" = 1'-0" (11X17)

ROOF SHEATHING REQUIREMENTS:

1- 15/32" O.S.B PLYWOOD OR O.S.B. PER GENERAL STRUCTURAL NOTES
2- 8D AT 6" O.C. BOUNDARY FASTENERS (DIAPHRAGM BOUNDARIES, SHEAR PANEL BLOCKING, SOLID BLOCKING, AND DRAG MEMBERS AS NOTED ON FRAMING DETAILS)
3- 8D AT 6" O.C. EDGE FASTENERS (AT SUPPORTED PANEL EDGES)
4- 8D AT 12" O.C. FIELD FASTENERS (ALONG INTERMEDIATE FRAMING MEMBERS)
5- ALT. FASTENERS #8 X 2" MIN. ZINC COATED, FLAT/BUGLE HEAD SCREWS W/ SPACING NOTED ABOVE. SCREWS SHALL BE QUICK DRIVE WSNTL WOOD SCREWS, GRABBER PLYWOOD SCREWS, OR GRABBER COARSE THREAD SCREWS.

ROOF AND FLOOR FRAMING REQUIREMENTS

R1. NOTIFY ENGINEER OF RECORD FOR PENETRATIONS THROUGH BEAMS, JOISTS, COLUMNS AND OTHER STRUCTURAL MEMBERS. PENETRATIONS SHALL COMPLY WITH THE REQUIREMENTS OF THE ENGINEER AND MANUFACTURER OF THE STRUCTURAL ELEMENT.

R2. ALL BEAMS, HEADERS, JOISTS, AND TRUSSES SHALL HAVE SUFFICIENT BEARING AREA PER REQUIREMENTS OF THE AMERICAN WOOD COUNCIL NATIONAL DESIGN SPECIFICATION (NDS) 2015. ALL BEARING POINTS SHALL HAVE A CONTINUOUS LOAD PATH TO FOUNDATIONS.

R3. ALL FINISHES SHALL BE PER THE ARCHITECT, CONTRACTOR, AND OWNER. ENGINEER OF RECORD IS NOT RESPONSIBLE FOR WATER PROOFING AND CORROSION PROTECTION OF STRUCTURAL ELEMENTS. THIS RESPONSIBILITY FALLS SOLELY UPON THE CONTRACTOR AND ARCHITECT.

R4. ALL HARDWARE SHOWN ON THE PLANS SHALL BE SIMPSON STRONG TIE OR APPROVED EQUAL. SEE G.S.N. FOR REQUIREMENTS.

R5. DIMENSIONS SHOWN ON THE PLANS ARE APPROXIMATIONS BASED OFF OF FIELD MEASUREMENTS. CONTRACTOR TO VERIFY ALL DIMENSIONS AND FIELD FIT TO THE EXISTING STRUCTURE. BEAM AND HEADER LENGTHS ARE ALLOWED TO BE 6 INCHES LONGER THAN SHOWN ON THE PLAN. IF IT IS NECESSARY TO INCREASE LENGTH OF THE BEAMS OR HEADERS BY MORE THAN 6 INCHES, APPROVAL MUST BE OBTAINED FROM THE ENGINEER OF RECORD.

R6. FOR SMALL PIPES/CONDUITS, THROUGH FOUNDATION WALLS/FOOTINGS, SEE DETAIL 109 ON SHEET S3.2.

NAILING SCHEDULE	
CONNECTION	MINIMUM NAILING, ONE ON PLANS OR DETAILS
JOINT OR TRUSS TO TOP PLATE SILL, ETC.	(3) 16d or (3) x 0.131" TOENAIL
BRIDGING TO JOIST	(2) 8d COMMON OR (2) 3" x 0.131" TOENAIL EA. END
BOTTOM PLATE TO JOIST OR BLOCKING (AT SHEAR WALLS, SEE SHEAR WALL SCHEDULE).	16d AT 16" o.c. OR 3" x 0.131" AT 8" o.c. FACE NAIL
TOP AND BOTTOM PLATE TO POST	(2) 16d COMMON, (3) 3" x 0.131", END NAIL
TOP PLATE TO STUD	(2) 16d COMMON, (3) 3"x 0.131", END NAIL
STUD TO BOTTOM PLATE	TOENAILS: (4) 8d COMMON OR (4) 3" x0.131", (4) 16d AT 3x AND LARGER. END NAILS: (2) 16d COMMON OR (3) 3" x 0.131", (2) 20d AT 3x
DOUBLE OR MULTIPLE BUILT-UP STUDS (POSTS) o.c., FACE NAIL	(2) 16d COMMON AT 16" o.c., OR (3) 3" 0.131", AT 8"
DOUBLE OR MULTIPLE TOP PLATES o.c., FACE NAIL	(2) 16d COMMON AT 16" o.c., OR (3) 3" 0.131", AT 12"
BLOCKING BTWN. JOIST OR RAFTERS TO TOP PLATE	(3) 16d COMMON, (3) 3" x 0.131", TOENAIL
RIM JOISTS TO TOP PLATE	16d AT 6" o.c. OR 3" x 0.131" AT 6" o.c., TOENAIL
TOP PLATES, LAPS & INTERSECTIONS	(2) 16d COMMON OR (3) 3" x 0.131", FACE NAIL
CONT. HEADER, TWO OR MORE LAMINATIONS	16d COMMON AT 16" o.c. ALONG EACH EDGE
CEILING JOIST TO PLATE	(3) 16d OR (5) 3" x 0.131", FACENAIL
CONT. HEADER TO INTERMEDIATE SUPPORT(S)	(4) 8d COMMON TOENAILCEILING JOISTS,
LAPS OVER PARTITIONS	(3) 16d OR (4) 3" x 0.131", FACENAIL
CEILING JOISTS TO PARALLEL RAFTERS	(3) 16d OR (4) 3" x 0.131", FACENAIL
RAFTER OR TRUSS TO PLATE	(2) 16d COMMON, (3) 3" 0.131", TOENAIL
CORNER GT/RAFTER TO PLATE	(4) 16d, TOENAILBUILT-UP CORNER STUDS16d AT 16" o.c. OR 3" x 0.131" AT 16" o.c.

A: SEE PLAN OR GSN FOR TOP PLATE SPLICE CONNECTION
B: MISC. NAILING SHALL BE PER IBC TABLE 2304.5.1

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
ROOF FRAMING PLAN

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S2.3
SHEET NUMBER 17 OF 43

2693478M

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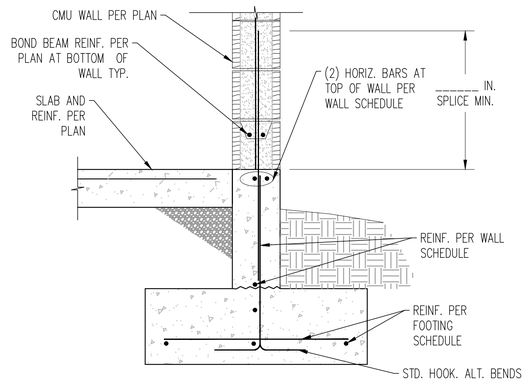
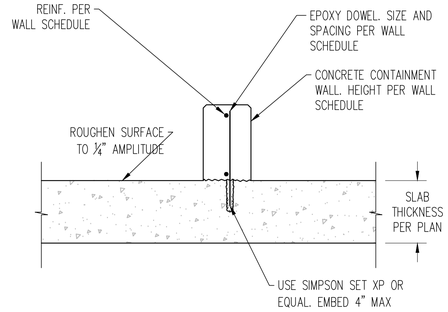
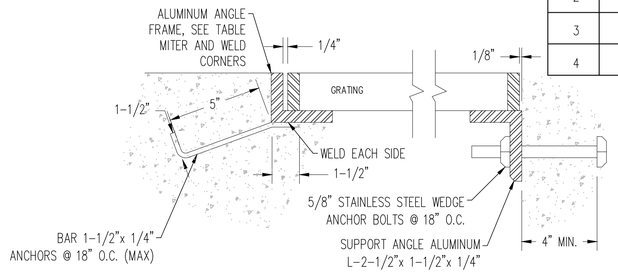


101 ~ FOOTING AT CMU WALL
NTS



102 TYP CONTAINMENT WALL AT FLOOR SLAB
NTS



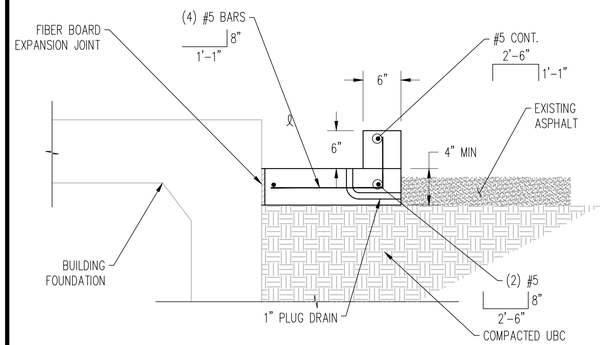
103 TYP ALUMINUM GRATING
NTS

GRATING FRAME TABLE

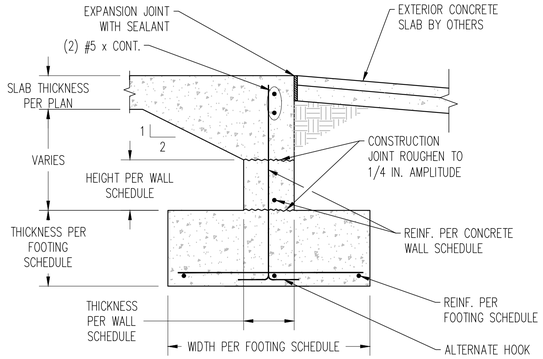
TYPE	GRATING DEPTH "T"	MAXIMUM SPAN	FRAME ANGLE	TYPE	GRATING DEPTH "T"	MAXIMUM SPAN	FRAME ANGLE
1	1"	3'	1-3/4"X1-1/4"X1/4"	5	2"	6'	2-1/2"X2-1/2"X1/2"
2	1-1/4"	3.5'	2"X1-1/2"X1/4"	6	2-1/4"	6.5'	2-1/2"X2-1/2"X1/2"
3	1-1/2"	4.5'	1-3/4"X1-3/4"X1/4"	7	2-1/2"	7.0'	3"X2-1/2"X1/2"
4	1-3/4"	5.5'	2"X2"X1/4"	8			

NOTES:

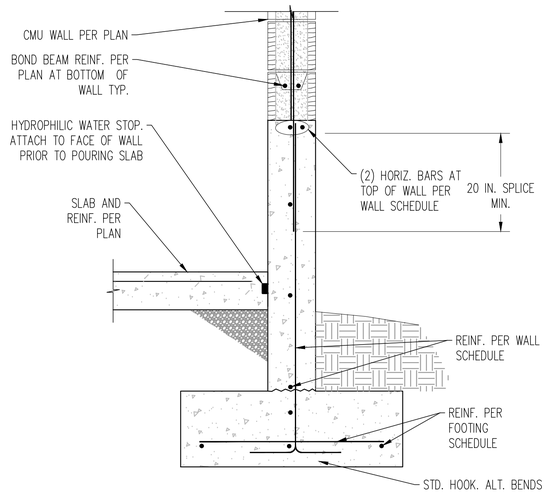
1. GRATING OF DEPTH "T" AS NOTED ON DRAWINGS SHALL BE AS SPECIFIED HEREIN.
2. ALL ENDS AND OPENINGS SHALL BE BANDED.
3. ALL GRATINGS SHALL BE SECURED IN PLACE WITH REMOVABLE FASTENERS.
4. WEIGHT OF GRATING SECTION SHALL NOT EXCEED 80 LBS.
5. BEARING BARS: DEPTH "T" X 3/16"@1-3/16" O.C. CROSS BARS @ 4" O.C. USE ALUM. ANGLE SUPPORTS AND BOLTS.
6. COAT ALUMINUM IN CONTACT WITH GROUT OR CONCRETE PER SPECS.
7. GRATING SHALL SUPPORT 180 PSF OF ENTIRE AREA.
8. THE MAXIMUM DEFLECTION UNDER THIS LOAD SHALL NOT BE MORE THAT /240 OF CLEAR SPAN.



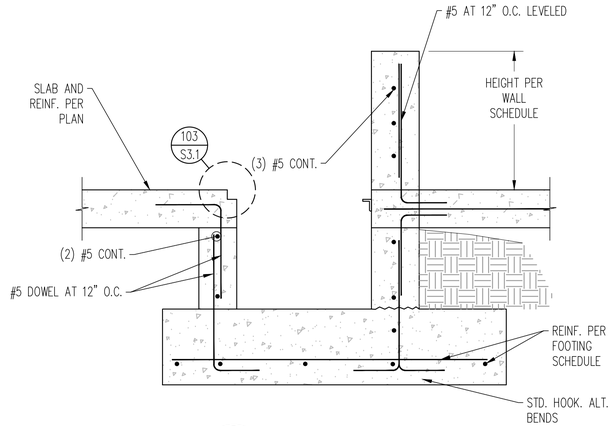
104 TYP DRIP CONTAINMENT CONCRETE
NTS



105 TYP FOOTING AT OPENING
NTS



106 ~ FOOTING AT CMU WALL
NTS



108 ~ FOUNDATION AT SUMP
NTS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
FOUNDATION DETAILS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S3.1
SHEET NUMBER 18 OF 43

2693478M

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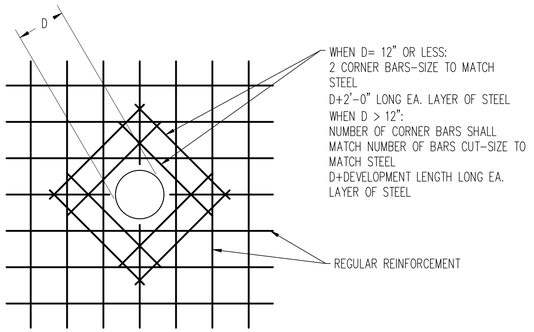
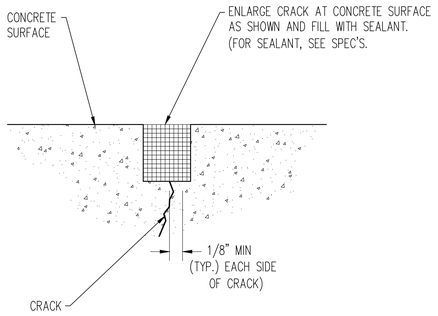
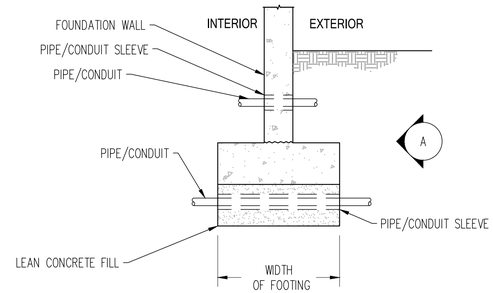
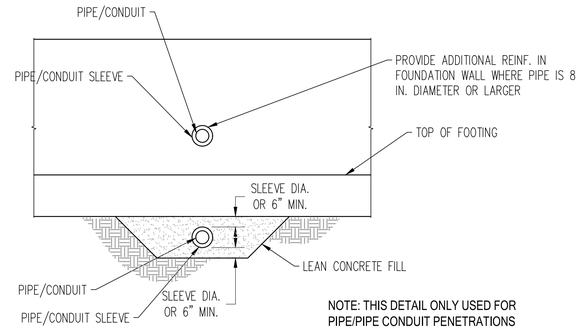


107B EXTRA REINF. AT PIPE PENETRATIONS
NTS



108B CONCRETE CRACK REPAIR
NTS

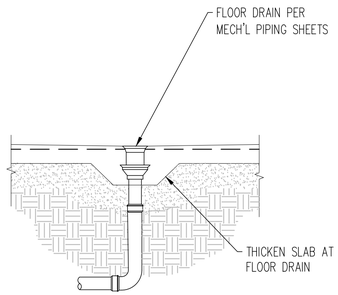




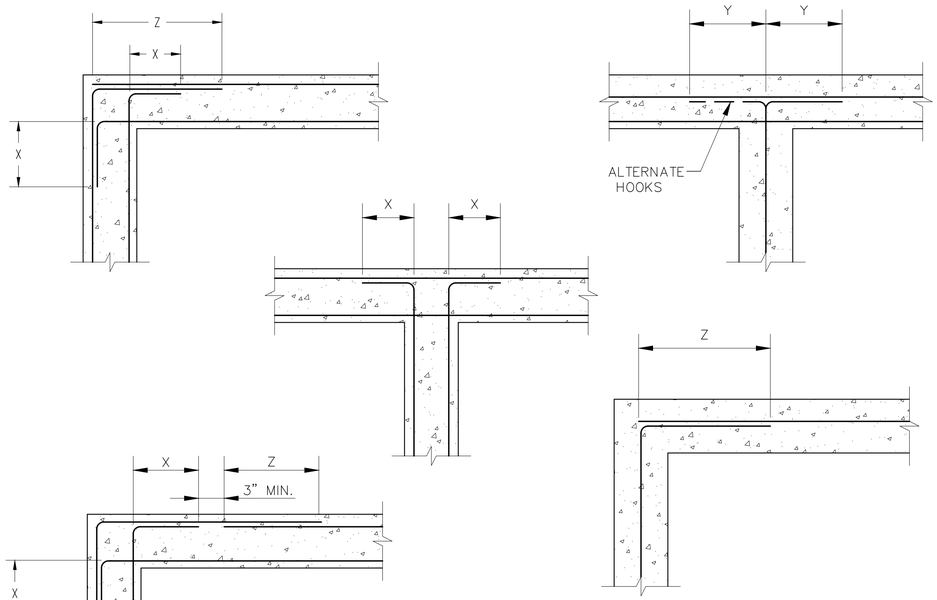
SECTION A

NOTE: THIS DETAIL ONLY USED FOR PIPE/PIPE CONDUIT PENETRATIONS THROUGH TRADITIONAL WALL AND FOOTING SIMILAR TO DETAIL 100 ON SHEET S3.1

109 PIPE CONDUIT AT FOOTING
NTS



110 FLOOR DRAIN AT SLAB
NTS



BAR SIZE	GRADE 40		GRADE 60	
	Y	Z	Y	Z
# 4	12"	20"	12"	20"
# 5	12"	20"	15"	26"
# 6	13"	22"	18"	31"

BAR SIZE	GRADE 40		GRADE 60	
	Y	Z	Y	Z
# 7	18"	31"	23"	39"
# 8	23"	39"	30"	51"
# 9	29"	49"	38"	65"

111 HORIZ. REINF. AT WALL INTERSECTIONS
NTS

* THIS DETAIL TO BE USED ONLY WHEN NO OHTER DETAIL IS INDICATED ON THE DRAWINGS.

TYPE	BAR SIZE	MIN. INSIDE BEND DIA. (IN)	STRAIGHT EXTENSION(1) ℓ_{ext} (IN)	TYPE OF STANDARD HOOK
90 DEG. HOOK	NO. 3 TO NO. 8	$6d_b$	$12d_b$	POINT AT WHICH BAR IS DEVELOPED; d_b; 90 DEG BEND; DIAMETER; ℓ_{dh}; ℓ_{ext}
	NO. 9 TO NO. 11	$8d_b$		
	NO. 14 & NO. 18	$10d_b$		
180 DEG. HOOK	NO. 3 TO NO. 8	$6d_b$	GREATER OF $4d_b$ AND 2.5 IN.	POINT AT WHICH BAR IS DEVELOPED; d_b; 180 DEG BEND; DIAMETER; ℓ_{ext}; ℓ_{dh}
	NO. 9 TO NO. 11	$8d_b$		
	NO. 14 & NO. 18	$10d_b$		

(1)– A STANDARD HOOK FOR DEFORMED BARS IN TENSION INCLUDES THE SPECIFIC INSIDE BEND DIAMETER AND STRAIGHT EXTENSION LENGTH. IT SHALL BE PERMITTED TO USE A LONGER STRAIGHT EXTENSION AT THE END OF A HOOK. A LONGER EXTENSION SHALL NOT BE CONSIDERED TO INCREASE THE ANCHORAGE CAPACITY OF THE HOOK.

112 STD. HOOK GEOMETRY
DEFORMED BARS IN TENSION IN CONCRETE

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
FOUNDATION DETAILS, CONTINUED

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S3.2
SHEET NUMBER 19 OF 43

2693478M

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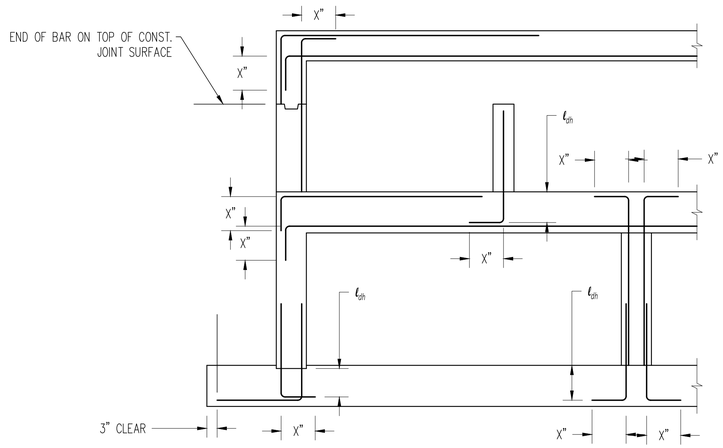


BAR SIZE	90° HOOKS "X"	BAR SIZE	90° HOOKS "X"
# 3	6"	# 8	12"
# 4	6"	# 9	14"
# 5	8"	# 10	16"
# 6	9"	# 11	17"
# 7	11"		

NOTE:

UNLESS OTHERWISE NOTED ON THE DRAWINGS ALL LENGTHS OF BAR HOOKS IN FOOTINGS, COLUMNS, WALLS AND SLABS SHALL BE AS GIVEN IN THE TABLE HEREIN. THE HOOK LENGTH "X" IS THE STANDARD 90° BAR HOOK LENGTH FOR GRADE 40 OR GRADE 60 REINFORCEMENT STEEL.

113 ~ STANDARD FOR 90 BAR HOOKS
NTS

CONCRETE LAP AND DEVELOPMENT SCHEDULE

BAR SIZE #	F'c = 4000 PSI TENSION LTE TOP ⟨1⟩	LTE OTHER	LTS TOP ⟨1⟩	LTS OTHER
#3	15	12	20	15
#4	20	16	26	20
#5	25	19	32	25
#6	30	23	39	30
#7	54	42	71	54
#8	62	48	81	62

A. ALL TABULATED VALUES ARE IN UNITS OF INCHES U.N.O.

B. AT CONTRACTOR'S OPTION, MECHANICAL SPLICE COUPLERS PER G.S.N. MAY BE USED IN LIEU OF LAP SPLICES

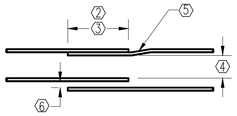
C. SEE G.S.N. FOR ACTUAL CONCRETE SPECIFICATIONS AND MIN. CLR. COVER / CLR. SPACING REQUIREMENTS

D. SCHEDULED VALUES ARE BASED ON CLASS "B" TENSION LAP SPLICES U.N.O., NORMAL WT. CONCRETE, AND UNCOATED GRADE 60 REINF. FOR OTHER CONDITIONS NOTED BELOW, MODIFY TABULATED VALUES AS INDICATED:

E. E.1 FOR DEVELOPMENT LENGTH AND CLASS "A" LAP SPLICES, WHERE SPECIFICALLY NOTED ON PLANS OR DETAILS, DIVIDE TABULATED VALUES BY 1. 3. CLASS "A" SPLICES SHALL BE LOCATED SUCH THAT NO MORE THAN 1/2 OF THE TOTAL REINF. IS LAPPED WITHIN THE REQUIRED LAP LENGTH
E.2 FOR LIGHTWEIGHT CONCRETE, MULTIPLY TABULATED VALUES BY 1. 3
E.3 FOR EPOXY COATED REBAR, MULTIPLY TABULATED VALUES BY 1. 5
E.4 FOR GRADE 75 REINF., MULTIPLY TABULATED VALUES BY 1. 25

F. LCE = COMPRESSION EMBEDMENT LENGTH
LCS = COMPRESSION LAP SPLICE LENGTH
LTE = TENSION EMBEDMENT LENGTH
LTS = TENSION LAP SPLICE LENGTH

G. "TOP" BARS ARE HORIZONTAL BARS PLACED SUCH THAT MORE THAN 12 IN. OF FRESH CONCRETE IS CAST BELOW BAR. ALL BARS THAT ARE NOT "TOP" BARS ARE "OTHER" BARS UNLESS NOTED OTHERWISE ALL HOOKS SHALL EXTEND TO THE FAR FACE (LESS 2" COVER)



CONCRETE LAP AND DEVELOPMENT NOTES

⟨1⟩ TOP BARS ARE HORIZ. BARS PLACED SUCH THAT MORE THAN 12" OF FRESH CONCRETE IS CAST IN MEMBER BELOW SPLICE

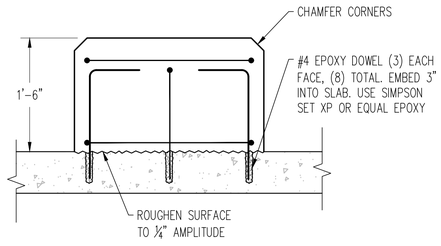
WHERE BARS OF UNEQUAL SIZE LAP ONE ANOTHER, USE TABULATED LAP LENGTH FOR SMALLER BAR U.N.O.

⟨3⟩ LAP SPLICE LENGTH PER SCHEDULE

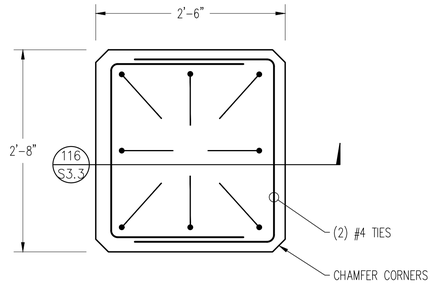
⟨4⟩ CLEAR DISTANCE BETWEEN ADJACENT BARS OR SPLICES TO BE USED IN DETERMINING APPLICABLE LAP LENGTH FROM SCHEDULE

⟨5⟩ OPTIONAL OFFSET. SEE STANDARD REBAR BEND DETAILS FOR OFFSET REQUIREMENTS

⟨6⟩ FOR NON-CONTACT LAP SPLICES, MIN. CLEAR DISTANCE BETWEEN SPLICED BARS SHALL BE PER GENERAL STRUCTURAL NOTES. MAX. CLEAR DISTANCE SHALL BE 1/5 THE TABULATED LAP LENGTH OR (6". "DB"), WHICHEVER IS LESS, WHERE "DB" = BAR DIA.



116 ~ CONCRETE PEDESTAL SECTION VIEW
NTS



115 ~ CONCRETE PEDESTAL
NTS

114 ~ CONCRETE LAP/DEVELOPMENT SCHEDULE
NTS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
11/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
FOUNDATION DETAILS, CONTINUED

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S3.3
SHEET NUMBER 20 OF 43

2693478M

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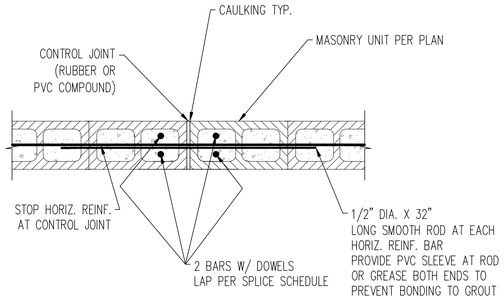
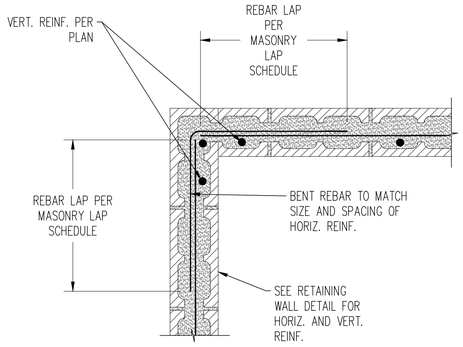


201 ~ MASONRY CONTROL JOINT
NTS



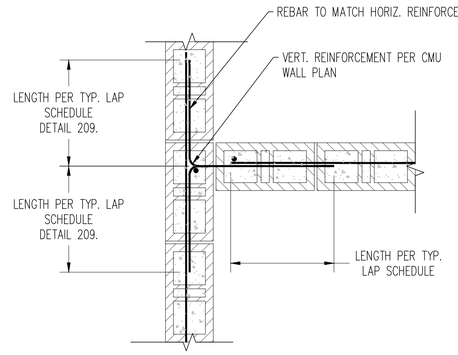
202 ~ MASONRY JAMB AT CORNER
NTS

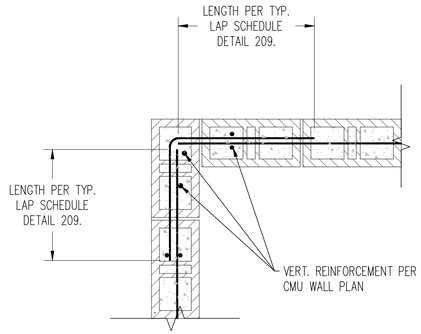
* MASONRY REINFORCING SPLICE SCHEDULE
MIN. LAP SPLICE LENGTH, IN. BASED ON:

BAR SIZE	BAR CENTERED IN WALL			K	
	8 IN.	10 IN.	12 IN.	1.5 IN.	2.0 IN.
3	16	16	16	19	16
4	21	21	21	34	26
5	26	26	26	53	40
6	43	40	40	99	74
7	60	46	46	134	101
8	NP	71	61	202	151

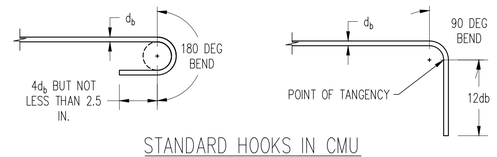
K IS DEFINED AS THE MINIMUM OF:
A) THE MIN MASONRY COVER
B) CLEAR SPACING BETWEEN ADJACENT REINFORCING SPLICES
C) 9db

203 ~ MASONRY REINF. SPLICE SCHEDULE
NTS

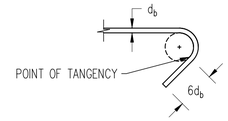




204 ~ HORIZ. REINF. AT MASONRY INTERSECTION
NTS



STANDARD HOOKS IN CMU



STANDARD HOOK FOR TIE ANCHORAGE IN CMU

205 ~ STANDARD HOOKS IN MASONRY
NTS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
MASONRY DETAILS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S4.1
SHEET NUMBER 21 OF 43

2693478M

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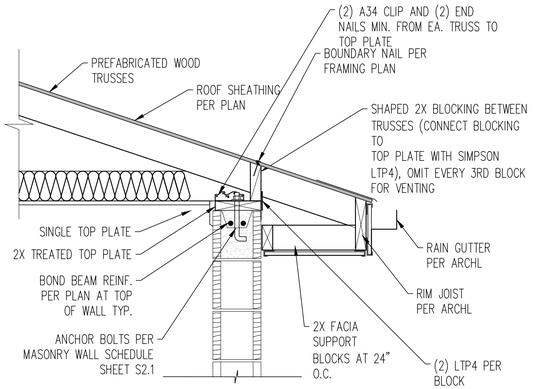
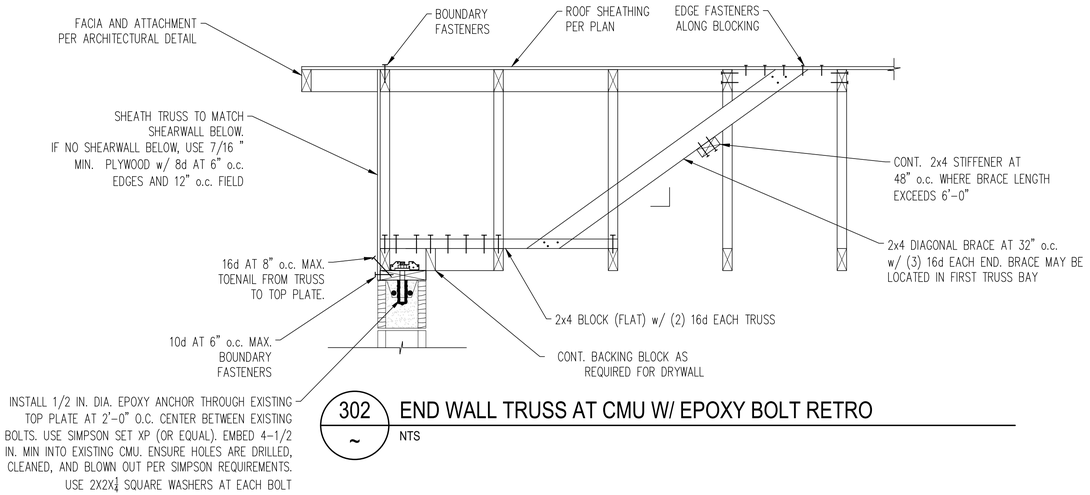


301 ~ WOOD TRUSS AT CMU WALL

NTS



302 ~ END WALL TRUSS AT CMU W/ EPOXY BOLT RETRO

NTS

303 ~ ATTIC ACCESS THROUGH CEILING

NTS

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: EL
DRAWING: EL
REVIEW: SH
APPROVAL: SH

PROFESSIONAL STRUCTURAL ENGINEER
No. 5048199-2203
STEVEN M. HANSEN
4/11/2024
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH ZONE C RESERVOIRS
CHLORINE BUILDING
FRAMING DETAILS

SCALE:
DATE 11/16/2023
PROJECT NUMBER S10030
DRAWING NUMBER S5.1
SHEET NUMBER 22 OF 43

2693478M

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ELECTRICAL STANDARDS LEGEND

(ALL SYMBOLS MAY NOT BE USED IN DRAWINGS)

- DIRECT BURIED OR CONCRETE EMBEDDED CONDUIT
- CONDUIT RUN EXPOSED
- PROCESS FLOW
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- PANEL OR ENCLOSURE
- ???KW G XXXA — STAND–BY GENERATOR ??? DENOTES SIZE
- GENERATOR MAIN BREAKER XXX DENOTES BREAKER SIZE
- WP — WALL PACK FIXTURE. MOUNTING HEIGHT AS INDICATED IN DRAWINGS
- FL — FLOOD LIGHT 7'–2" ABOVE FLOOR
- EXIT — EMERGENCY EXIT SIGN 7'–2" ABOVE FLOOR
- EM — EMERGENCY LIGHTING PACK 7'–2" ABOVE FLOOR
- HIGH/LOW BAY LED FIXTURE AS INDICATED IN DRAWINGS AND EQUIPMENT SCHEDULE
- 1' X 4' LED FIXTURE AS INDICATED IN DRAWINGS AND EQUIPMENT SCHEDULE
- G — INDICATOR LAMP – LETTER INDICATES COLOR
- R — FLASHING BEACON – LETTER INDICATES COLOR
- MS — MOTION SENSOR
- EXHAUST FAN
- OTHER LIGHT FIXTURE AS INDICATED IN DRAWINGS.
- AUDIBLE ALARM OR HORN
- JB — UNDERGROUND JUNCTION/PULLBOX – SIZE 5 UNLESS OTHERWISE INDICATED
- J — STEEL JUNCTION/PULLBOX
- E — ELECTRIC MANHOLE
- XX — FUSE; XX – DENOTES AMPERAGE
- GFCI — 120 V GROUND FAULT INTERRUPTER DUPLEX RECEPTACLE
- WP — 120 V DUPLEX RECEPTACLE, WP (WEATHERPROOF)

- 240 V RECEPTACLE
- DISCONNECT SWITCH
- 20A / 3P — CIRCUIT BREAKER – UPPER NUMBER INDICATES AMP TRIP RATING – LOWER NUMBER INDICATES POLES
- MOTOR OVERLOAD
- EQUIPMENT GROUND
- LIGHT SWITCH, SINGLE POLE, MOUNT 4'–6" ABOVE FLOOR ON BUILDING WALL
- WP — LIGHT SWITCH, SINGLE POINT MOUNT 4'–6" ABOVE FLOOR ON BUILDING WALL, WEATHER PROOF
- R — RELAY
- TR1 — TIMING RELAY
- TDR — TIMING DELAY RELAY
- CR — CONTROL RELAY COIL
- M — MAGNETIC RELAY
- MOMENTARY PUSH–BUTTON SWITCH
- OFF / HAND / AUTO — HAND–OFF–AUTO SELECTOR SWITCH
- NORMALLY CLOSED PUSHBUTTON
- NORMALLY OPEN PUSHBUTTON
- RTM — RUNNING TIME METER
- OR — MOTOR STARTER – NUMBER INDICATES SIZE
- NORMALLY CLOSED CONTACTS
- NORMALLY OPEN CONTACTS
- CONTACTOR OR STARTER, NUMBER DENOTES NEMA SIZE
- 10 — MOTOR – NUMBER INDICATES HORSEPOWER RATING

- FM — FLOW METER
- ETM — ELAPSED TIME METER
- LIMIT SWITCH
- INSTRUMENT TRANSFORMER
- CT — CURRENT TRANSFORMER
- POWER TRANSFORMER
- T — THERMOSTAT
- G.F.I. — GROUND FAULT INTERRUPTER
- AUXILIARY CONTACT
- INTERLOCK
- PUMP
- S OR S — SOLENOID VALVE
- VALVE WITH MANUAL OPERATOR
- M — ELECTRIC MOTOR OPERATED VALVE (MODULATING OR NON–MODULATING)
- M — MOTOR OPERATED VALVE WITH LIMIT SWITCH ASSEMBLY
- I — COMPUTER/CONTROL INPUT
- O — COMPUTER/CONTROL OUTPUT
- LP1–XX — CIRCUIT LABEL: LP1 – PANEL NAME, XX – CIRCUIT NUMBER
- EXPLOSION PROOF SEAL OFF
- C–YYY — CONDUIT IDENTIFICATION, REFER TO CONDUIT AND CONDUCTOR SCHEDULE FOR QUANTITY AND FILL: YYY = ID
- --- — OTHER SYMBOLS AS SHOWN ON DRAWINGS

GENERAL ELECTRICAL ABBREVIATIONS

ACB	AIR CIRCUIT BREAKER	IC	INSTRUMENTATION CONDUIT	NC	NORMALLY CLOSED	SPIC	SPARE INSTRUMENT CONDUIT
AFF	ABOVE FINISHED FLOOR	IER	INTEGRATED EQUIPMENT RATING	NO	NORMALLY OPEN	SSSS	SOLID STATE SOFT START
AFG	ABOVE FINISHED GRADE	INST	INSTRUMENTATION CONDUIT	OL	MOTOR OVERLOAD	TSP	TWISTED SHILDED PAIR
ATS	AUTOMATIC TRANSFER SWITCH	JB	JUNCTION BOX	PB	PULL BOX	TVSS	TRANSIENT VOLTAGE SURGE SUPRESSOR
C	CONDUIT	LCP	LOCAL CONTROL PANEL	PCP	PUMP CONTROL PANEL	VFD	VARIABLE FREQUENCY DRIVE
CB	CIRCUIT BREAKER	LP	LIGHTING PANEL	PLC	PROGRAMMABLE LOGIC CONTROLLER		
CTRL	CONTROL	MCB	MAIN CIRCUIT BREAKER	PP	POWER PANEL		
DS	DISCONNECT SWITCH	MCP	MOTOR CIRCUIT PROTECTOR	RTU	REMOTE TERMINAL UNIT		
EMG	ELECTRICAL MANHOLE	MLO	MAIN LUG ONLY	SPC	SPARE CONDUIT		
HMI	HUMAN MACHINE INTERFACE	MTU	MASTER TERMINAL UNIT	SPD	SURGE PROTECTIVE DEVICE		

GENERAL ELECTRICAL REQUIREMENTS

1. THE COMPLETED INSTALLATION SHALL CONFORM TO ALL APPLICABLE FEDERAL, STATE AND LOCAL CODE ORDINANCES AND REGULATIONS. CONTRACTOR SHALL OBTAIN NECESSARY PERMITS AND INSPECTIONS REQUIRED BY THE GOVERNING AUTHORITIES. ALL WORK SHALL BE DONE IN A NEAT, PROFESSIONAL, FINISHED AND SAFE MANNER, UNDER COMPETENT SUPERVISION. INSTALL GROUNDING AND ALL ELECTRICAL WORK AS REQUIRED BY THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AS WELL AS ANY OTHER APPLICABLE CODES.
2. MATERIAL, EQUIPMENT AND INSTALLATION SHALL BE IN ACCORDANCE WITH PROJECT SPECIFICATIONS WHICH ARE PART OF THE CONTRACT DOCUMENTS FOR THIS PROJECT.
3. VISIT THE SITE PRIOR TO BIDDING TO BECOME FAMILIAR WITH EXISTING CONDITIONS AND ALL OTHER FACTORS WHICH MAY AFFECT THE EXECUTION OF THIS WORK. INCLUDE ALL RELATED COSTS IN THE INITIAL BID PROPOSAL.
4. ALL MATERIALS SHALL BE NEW AND OF THE BEST QUALITY, MANUFACTURED IN ACCORDANCE WITH NEMA, ANSI, U.L. OR OTHER APPLICABLE STANDARDS. THE USE OF MANUFACTURER'S NAMES, MODELS AND NUMBERS IS INTENDED TO ESTABLISH STYLE, QUALITY, APPEARANCE, USEFULNESS AND BID PRICE. PROPOSED SUBSTITUTIONS SHALL BE SUBMITTED IN WRITING AND APPROVED BY THE ENGINEER BEFORE ORDERING.
5. PROTECT ALL ELECTRICAL MATERIAL AND EQUIPMENT INSTALLED UNDER THIS PROJECT AGAINST DAMAGE BY OTHER TRADES, WEATHER CONDITIONS OR ANY OTHER CAUSES. EQUIPMENT FOUND DAMAGED OR IN OTHER THAN NEW CONDITIONS WILL BE REJECTED AS DEFECTIVE.
6. LEAVE THE SITE CLEAN, REMOVE ALL DEBRIS, EMPTY CARTONS, TOOLS, CONDUIT, WIRE SCRAPS AND ALL MISCELLANEOUS SPARE EQUIPMENT AND MATERIALS USED IN THE WORK DURING CONSTRUCTION. ALL COMPONENTS SHALL BE FREE OF DUST, GRIT AND FOREIGN MATERIALS, LEFT AS NEW BEFORE FINAL ACCEPTANCE OF WORK.
7. ALL CONDUCTORS SHALL BE THHN/THWN COPPER, STRANDED RATED AT 600 VOLTS UNLESS OTHERWISE NOTED. ALUMINUM WIRE WILL NOT BE ALLOWED.
8. ALL CONDUCTORS SHALL BE INSTALLED IN A CONDUIT SYSTEM EXCEPT WHERE NOTED IN DRAWINGS. REFER TO CONDUIT AND CONDUCTOR SCHEDULE FOR CONDUIT TYPE AND SIZE. WHERE CONDUIT SIZE IS NOT CALLED OUT, CONDUIT SHALL BE INSTALLED PER SPECIFICATION 16010 AND SIZED PER LATEST ADOPTED EDITION OF THE NEC.
9. ALL UNDERGROUND CONDUIT TO BE SCHEDULE 40 PVC. MINIMUM DEPTH 30", MINIMUM SIZE 3/4" EXCEPT AS NOTED IN DRAWINGS AND SPECIFICATIONS. ALL UNDERGROUND ELBOWS SHALL BE RIGID LONG SWEEP WRAPPED WITH 3M–50 10 MIL PIPE WRAP OR APPROVED EQUAL EXCEPT FOR COMMUNICATIONS CABLE AND CONDUIT WHEN SPECIFIED DIFFERENTLY ON THE DETAILED ELECTRICAL DRAWINGS.
10. ALL EXPOSED CONDUIT BELOW 4' SHALL BE IMC OR RIGID STEEL CONDUIT, WITH A MINIMUM SIZE OF 1" EXCEPT AS NOTED IN DRAWINGS AND SPECIFICATIONS. EMT WILL BE PERMITTED, ONLY IN WALLS OR ABOVE 4' AFF. EXPOSED PVC CONDUIT SHALL NOT BE PERMITTED UNLESS NOTED OTHERWISE IN DRAWINGS.
11. ALL SAFETY SWITCHES AND OTHER DISTRIBUTION AND CONTROL ELECTRICAL EQUIPMENT SHALL BE RATED FOR HEAVY DUTY SERVICE.
12. ALL WIRING DEVICES SHALL BE SPECIFICATION GRADE GROUNDED BODY TYPE DEVICES.
13. THE CONTRACTOR SHALL INSTALL ALL INSTRUMENTS AND CONTROLS, INCLUDING HVAC AND CONTROL PANELS. THE CONTRACTOR SHALL OBTAIN AND REVIEW ALL INSTRUMENT, CONTROL AND HVAC DRAWINGS FOR TOTAL SCOPE OF WORK.
14. ALL PANELS, DISCONNECTS AND SWITCHGEAR ON THE OUTSIDE OF THE BUILDING SHALL BE NEMA 3R TYPE ENCLOSURES UNLESS OTHERWISE SPECIFIED. CT CABINET AND METER BASE SHALL BE OUTSIDE THE BUILDING AS SHOWN IN VOLUME 2 OF 3 DRAWINGS, REFER TO DRAWING E–02.
15. SURGE PROTECTIVE DEVICES (SPD) SHALL BE SIZED FOR 160KA UNLESS OTHERWISE NOTED.
16. ALL CONDUIT FOR ALL EQUIPMENT, INCLUDING EQUIPMENT FURNISHED BY OTHERS, SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR.
17. ALL CONDUIT, WHERE LEAVING ELECTRICAL EQUIPMENT TO GO UNDERGROUND, MUST BE ANCHORED TO THE FOUNDATION WITH STAND–OFF BRACKETS TO ALLOW FOR SUFFICIENT CLEARANCE FOR FOOTINGS AND WALL STUDS ON THE WALLS IN THE BUILDING. ALL RGS CONDUIT AND ELBOWS USED UNDERGROUND WILL BE WRAPPED WITH AN APPROVED PIPE WRAP. (TYP. FOR ALL BUILDINGS)
18. ALL WIRING IN CLASS I HAZARDOUS LOCATIONS SHALL COMPLY WITH NEC 501. WET WELL SHALL BE CONSIDERED CLASS I DIV 1, GROUPS C&D.

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: JRK
DRAWING:
REVIEW: JRK
APPROVAL:

REGISTERED PROFESSIONAL ENGINEER — 12-Apr-2024 — No. 362066 — J. RANDALL KNAPP — STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT

11800 SOUTH ZONE C RESERVOIRS
ELECTRICAL NOTES AND SYMBOLS

SCALE: N.A.
DATE 1/29/2024
PROJECT NUMBER S10030
DRAWING NUMBER E1
SHEET NUMBER 23 OF 27

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CONDUIT AND CONDUCTOR SCHEDULE

CONDUIT TAG	DESCRIPTION	ROUTING		MIN. CONDUIT		CONDUCTORS (CU) PER C.		VOLTAGE	REMARKS OR REFERENCE DRAWING
		FROM	TO	QTY	SIZE	(QTY) & SIZE	GND		
P-001	POWER TO RTU	118R-LP-3	RTU	1	3/4"	(4) #12 AWG CU	#12	120	RTU POWER & BULK TANK PUMP POWER
P-002	POWER TO WATER HEATER	118R-LP-3	WATER HEATER	1	3/4"	(2) #8 AWG CU	#10	240	
P-003	POWER TO BUILDING HVAC DISCONNECT	118R-LP-3	BUILDING HVAC DISCONNECT	1	3/4"	(2) #12 AWG CU	#12	240	
P-004	POWER TO FLOW METER DISPLAY #1 & #2	118R-LP-3	FLOW METER DISPLAY #1 & #2	1	3/4"	(2) #12 AWG CU	#12	120	ROUTE CONDUCTORS THROUGH JUNCTION BOX AS SHOWN IN DRAWINGS
P-005	POWER TO FAN CONTROL PANEL (FCP)	118R-LP-3	FCP	1	3/4"	(2) #12 AWG CU	#12	120	
P-006	POWER TO INTAKE LOUVER	FCP	INTAKE LOUVER	1	3/4"	(2) #12 AWG CU	#12	120	
P-007	POWER TO EXHAUST FAN (EF-1)	FCP	EXHAUST FAN	1	3/4"	(2) #12 AWG CU	#12	120	
P-008	POWER TO SECURITY PANEL	118R-LP-3	SECURITY PANEL	1	3/4"	(2) #12 AWG CU	#12	120	
P-009	POWER TO EYEWASH BOOSTER PUMP	118R-LP-3	EYEWASH BOOSTER RECEPTACLE	1	3/4"	(2) #12 AWG CU	#12	120	
C-001	WEIGHT SCALE INTERCONNECT	SCALE DISPLAY UNIT	WEIGHT SCALE	1	3/4"			CTRL	INSTALL MANUFACTURER SUPPLIED CABLE
C-002	WEIGHT SCALE SCADA REPORTING	SCALE DISPLAY UNIT	RTU	1	3/4"	(1) #16 AWG TSP		CTRL	
C-003	CHLORINE RESIDUAL REPORTING	CHLORINE RESIDUAL ANALYZER	RTU	1	3/4"	(1) #16 AWG TSP		CTRL	
C-004	CHLORINE DOSING METER REPORTING	CHLORINE DOSING METER	RTU	1	3/4"	(2) #14 AWG CU (1) #16 AWG TSP	#14	CTRL	
C-005	DAY TANK LEVEL SENSOR	DAY TANK LEVEL SENSOR	RTU	1	3/4"	(1) #16 AWG TSP		CTRL	
C-006	STORAGE TANK LEVEL SENSOR	STORAGE TANK LEVEL SENSOR	RTU	1	3/4"	(1) #16 AWG TSP		CTRL	
C-007	MAG LOCKS, REX & INTRUSION SENSORS	SECURITY PANEL	J-BOX ABOVE DOOR	1	3/4"	(1) 6-STRAND MULTI-MODE FIBER-OPTIC CABLE			REFER TO VOLUME 2 OF 3 DRAWINGS, E-01 FOR EXISTING RTU LOCATION
C-008	CONTAINMENT AREA LEVEL SWITCH	SUMP PUMP AREA	RTU	1	3/4"	(2) #14 AWG CU	#14	CTRL	CONTRACTOR TO SUPPLY WALL MOUNT KIT THAT WILL ANCHOR TO CONCRETE
C-009	FIBER CONNECTION BETWEEN RTUs	EXISTING SITE RTU	RTU	1	1"				CONDUIT ONLY. FIBER BY JVWCD
C-010	FLOW METER DISPLAY #1 REPORTING	FLOW METER DISPLAY #1	RTU	1	3/4"	(2) #14 AWG CU (1) #16 AWG TSP	#14	CTRL	
C-011	FLOW METER DISPLAY #2REPORTING	FLOW METER DISPLAY #2	RTU	1	3/4"	(2) #14 AWG CU (1) #16 AWG TSP	#14	CTRL	
C-012	FLOW METER CONTROL #1	FLOW METER #1	FLOW METER DISPLAY #1	2	1-1/2"				INSTALL MANUFACTURER SUPPLIED CABLES
C-013	FLOW METER CONTROL #2	FLOW METER #2	FLOW METER DISPLAY #2	2	1-1/2"				INSTALL MANUFACTURER SUPPLIED CABLES
C-014	ROOM TEMPERATURE SENSOR	TEMPERATURE SENSOR	RTU	1	3/4"	(1) #16 AWG TSP		CTRL	SENSOR PROVIDED BY JVWCD
C-015	INDOOR SECURITY CAMERA	INDOOR SECURITY CAMERA	SECURITY PANEL	1	3/4"	(1) CAT6 ETHERNET			
C-016	INDOOR SECURITY CAMERA	INDOOR SECURITY CAMERA	SECURITY PANEL	1	3/4"	(1) #18/2 SECUR. PWR CBL		24V	
C-017	OUTDOOR SECURITY CAMERA	OUTDOOR SECURITY CAMERA	SECURITY PANEL	1	3/4"	(2) CAT6 ETHERNET			WIRING FOR (2) OUTDOOR CAMERAS
C-018	OUTDOOR SECURITY CAMERA	OUTDOOR SECURITY CAMERA	SECURITY PANEL	1	3/4"	(2) #18/2 SECUR. PWR CBL		24V	WIRING FOR (2) OUTDOOR CAMERAS
C-019	MAG LOCK OVERRIDE & PUSH TO EXIT	PUSH TO EXIT, MAG LOCK O.R.	SECURITY PANEL	1	3/4"				CONDUIT ONLY. CONDUCTOR BY JVWCD
C-020	ACCESS CARD READER	ACCESS CARD READER	SECURITY PANEL	1	3/4"				CONDUIT ONLY. CONDUCTOR BY JVWCD

NOTES:

1. CONTRACTOR SHALL ROUTE CONDUITS IN A CLEAN MANNER AND TO AVOID ANY OBSTACLES.
2. SCHEDULE 80 PVC CONDUIT AND PVC BOXES ARE TO BE USED IN THE CHLORINE BUILDING DUE TO THE CORROSIVE ATMOSPHERE. ANY FLEXIBLE CONDUIT SHALL BE LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC). MINIMUM CONDUIT SIZE SHALL BE 3/4". CONDUITS SHALL BE SUPPORTED AT INTERVALS NO LESS THAN 3' BETWEEN SUPPORTS.
3. CONDUITS TO LIGHTING AND RECEPTACLE CIRCUITS ARE NOT TYPICALLY SHOWN IN CONDUIT/CONDUCTOR SCHEDULES.

ELECTRICAL EQUIPMENT SCHEDULE (CHLORINE BUILDING)

(X)	DESCRIPTION	QUANTITY	MODEL / SPECIFICATION	MANUFACTURER	COMMENTS
1	LED WALL PACK LIGHT	1	DSXW1 LED 10C 700 40K T3M MVOLT DDBXE PE	LITHONIA OR APPROVED EQUAL	FIXTURES TO BE ORDERED WITH PHOTOCELL (PE)
2	LED 4' SURFACE MOUNT STRIP LIGHT	2	FEM L48 6000LM LPACL MD MVOLT GZ10 40K 80CRI	LITHONIA OR APPROVED EQUAL	
3	120V TIMER	1	8009A	TORK	
4	EXHAUST FAN (EF-1), 200 CFM, WALL MOUNT	1	FADE 8-4	FANTECH OR APPROVED EQUAL	CONTRACTOR SHALL SUPPLY AND INSTALL FAN WITH GRAVITY LOUVER AND BIRDSCREEN
5	INTAKE LOUVER (L-1), 18" X 18"	1	ELC6375DAX	RUSKIN OR APPROVED EQUAL	CONTRACTOR SHALL SUPPLY AND INSTALL MOTORIZED ACTUATOR (120V)
6	20 AMP RECEPTACLES (GFCI PROTECTED)	7	GFRST20W	HUBBELL OR APPROVED EQUAL	INSTALL WITH INDUSTRIAL RECEPTACLE COVERS
7	20 AMP SWITCH	2	1221W	HUBBELL OR APPROVED EQUAL	INSTALL WITH INDUSTRIAL SWITCH COVERS
8	RTU AND SECURITY ENCLOSURES (30" X 36" X 12" STAINLESS STEEL)	2	A36H3012SSLP3PT	HOFFMAN OR APPROVED EQUAL	PROVIDE AND INSTALL WITH A36P30 PANEL
9	SPLIT SYSTEM HEATING/COOLING WALL MOUNT INDOOR UNIT	1	MSZ-GL18NA-U1	MITSUBISHI OR APPROVED EQUAL	CONTRACTOR SHALL SUPPLY AND INSTALL CU LINE-SET & MANUFACTURER SUPPLIED CABLE BETWEEN INDOOR/OUTDOOR UNITS. INSTALL WITH WIRED WALL MOUNTED THERMOSTAT.
10	SPLIT SYSTEM HEATING/COOLING OUTDOOR HEAT PUMP UNIT	1	MUZ-GL18NA-U1	MITSUBISHI OR APPROVED EQUAL	
11	FAN CONTROL PANEL (FCP)	1	A16148CHQRFG & A16P14	HOFFMAN OR APPROVED EQUAL	CONTRACTOR SHALL INSTALL TIMER AS SHOWN IN SCHEMATIC ON EXHIBIT 1- STANDARD EXHAUST FAN ELECTRICAL SHEET
12	HVAC SYSTEM DISCONNECT SWITCH	1	QO200TR	SQUARE D OR APPROVED EQUAL	
13	ROOM TEMPERATURE SENSOR	1	d-RTTi	DEVAR INC. OR APPROVED EQUAL	SEE SPECIFICATION SP 11232
14	CONTAINMENT AREA LEVEL SWITCH	1	43765	GEMS OR APPROVED EQUAL	SEE DETAIL L ON SHEET MP4
15	PANEL LP-3, 120/240V, 1ø, 3W, 100A MAIN BREAKER, STAINLESS STEEL ENCLOSURE, CU BUS	1	16400	EATON OR APPROVED EQUAL	PROVIDE A MINIMUM OF FOUR (4) SPARE 20A, 1-POLE BREAKERS

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: JRK
DRAWING:
REVIEW: JRK
APPROVAL:

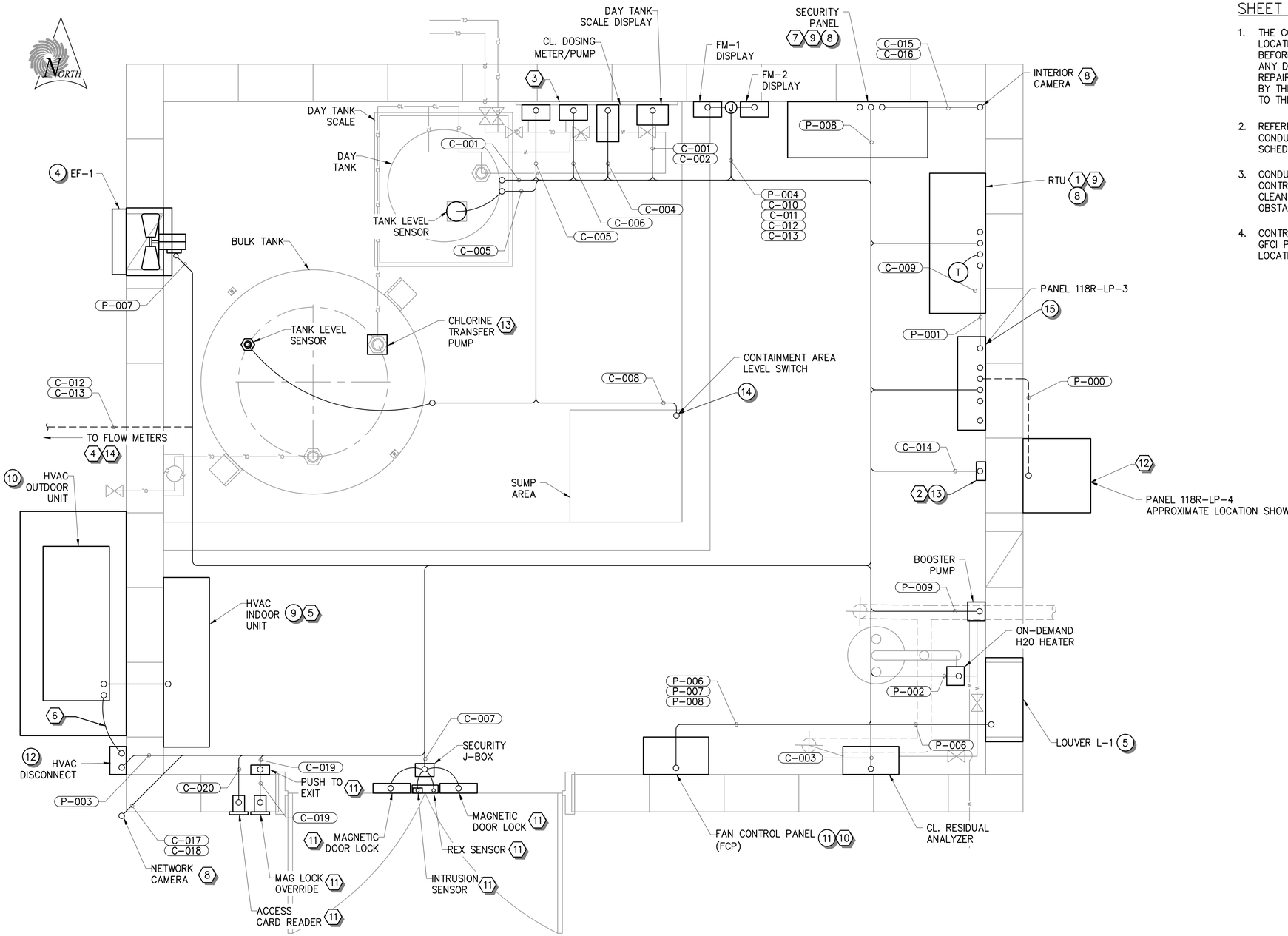
REGISTERED PROFESSIONAL ENGINEER
12-Apr-2024
No. 362066
J. RANDALL KNAPP
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT

11800 SOUTH ZONE C RESERVOIRS
ELECTRICAL SCHEDULES

SCALE: N.A.
DATE 1/29/2024
PROJECT NUMBER S10030
DRAWING NUMBER E2.1
SHEET NUMBER 24 OF 27

\\SESLC02\PROJECTS\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\ELECTRICAL\DWG\ELECTRICAL ONE-LINE DIAGRAM & SCHEDULES.DWG



SHEET NOTES:

1. THE CONTRACTOR WILL BE RESPONSIBLE TO LOCATE ALL EXISTING UNDERGROUND UTILITIES BEFORE ANY EXCAVATION IS PERFORMED. ANY DAMAGE TO EXISTING UTILITIES SHALL BE REPAIRED TO NEW CONDITION OR REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
2. REFERENCE SHEET E2.1 FOR CONDUIT / CONDUCTOR SCHEDULE AND FOR EQUIPMENT SCHEDULE.
3. CONDUITS SHOWN AS SCHEMATIC ONLY. CONTRACTOR SHALL ROUTE CONDUITS IN A CLEAN MANNER AND TO AVOID ANY OBSTACLES.
4. CONTRACTOR SHALL PROVIDE AND INSTALL GFCI PROTECTED RECEPTACLES AT ALL LOCATIONS IN THE BUILDING.

KEY NOTES

1. CONTRACTOR SHALL SUPPLY AND INSTALL RTU ENCLOSURE AND BACK PANEL. JVWCD SHALL SUPPLY AND INSTALL INTERNAL COMPONENETS AND MAKE CONNECTIONS NECESSARY FOR A FULLY FUNCTIONAL SCADA SYSTEM.
2. CONTRACTOR SHALL SUPPLY AND INSTALL ROOM TEMPERATURE SENSOR PER JVWCD RECOMMENDATION. SEE SPECIFICATION SP 11232. CONDUIT AND CONDUCTOR BY CONTRACTOR AS SHOWN IN CONDUIT SCHEDULE ON SHEET E2.1.
3. --CONTRACTOR SHALL SUPPLY AND INSTALL NECESSARY RACK TO SUPPORT ALL CHLORINATION EQUIPMENT AND WATER HEATER. CONTRACTOR SHALL VERIFY REQUIREMENTS FOR CHLORINATION RACK WITH JVWCD BEFORE CONSTRUCTION.
4. CONTRACTOR SHALL VERIFY LOCATION OF FLOW METER WITH JVWCD PRIOR TO CONSTRUCTION.
5. CONTRACTOR SHALL SUPPLY AND INSTALL HVAC INDOOR AND OUTDOOR UNITS. CONTRACTOR SHALL SUPPLY AND INSTALL LINE SET AND MANUFACTURER SUPPLIED CABLE BETWEEN INDOOR AND OUTDOOR UNIT.
6. CONTRACTOR SHALL PROVIDE AND INSTALL A/C WHIP WITH CONDUCTORS RATED AT 20 AMPS.
7. CONTRACTOR SHALL SUPPLY AND INSTALL SECURITY PANEL ENCLOSURE AND BACK PANEL. SECURITY PANEL COMPONENTS PROVIDED BY JVWCD. CONTRACTOR SHALL PROVIDE AND INSTALL CONDUIT AND CONDUCTORS TO SECURITY PANEL AS LISTED IN CONDUIT/CONDUCTOR SCHEDULE ON SHEET E2.1.
8. CAMERAS SHALL BE PROVIDED AND INSTALLED BY JVWCD. CONDUIT AND CONDUCTOR PLACEMENT SHALL BE COORDINATED WITH JVWCD.
9. REFER TO SHEET E2.2 FOR ENCLOSURE REQUIREMENTS.
10. REFER TO EXHIBIT 1 – JVWCD STANDARD EXHAUST FAN ELECTRICAL SHEET AT THE END OF PLAN SET FOR FAN CONTROL PANEL REQUIREMENTS. PANEL SHALL BE MOUNTED AT 5' ABOVE FINISHED FLOOR. INSTALL HOA SWITCH IN THE COVER OF EXHAUST FAN CONTROL PANEL.
11. SECURITY SYSTEM COMPONENTS, AND CONDUCTORS SHALL BE PROVIDED AND INSTALLED BY JVWCD. CONTRACTOR SHALL PROVIDE AND INSTALL BOXES FOR SECURITY DEVICES. COORDINATE WITH JVWCD FOR BOX REQUIREMENTS.
12. DISTRIBUTION PANEL 118R-LP-4 INCLUDED IN VOLUME 2 OF 3 DRAWINGS. REFER TO DRAWING E-05 IN VOLUME 2 AND DRAWING E3.2 IN THIS SET FOR ADDITIONAL CIRCUIT INFORMATION.
13. SEE DRAWING E3.2 FOR CL TRANSFER PUMP CONTROL INFORMATION.
14. REFER TO VOLUME 2 OF 3 DRAWINGS FOR METER VAULT DRAWINGS AND SPECIFICATIONS.

A ELECTRICAL LIGHTING AND RECEPTACLE PLAN

1/2" = 1' (AT 11" X 17"), 1" = 1' (AT 22" X 34")

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: JRK
DRAWING:
REVIEW: JRK
APPROVAL:

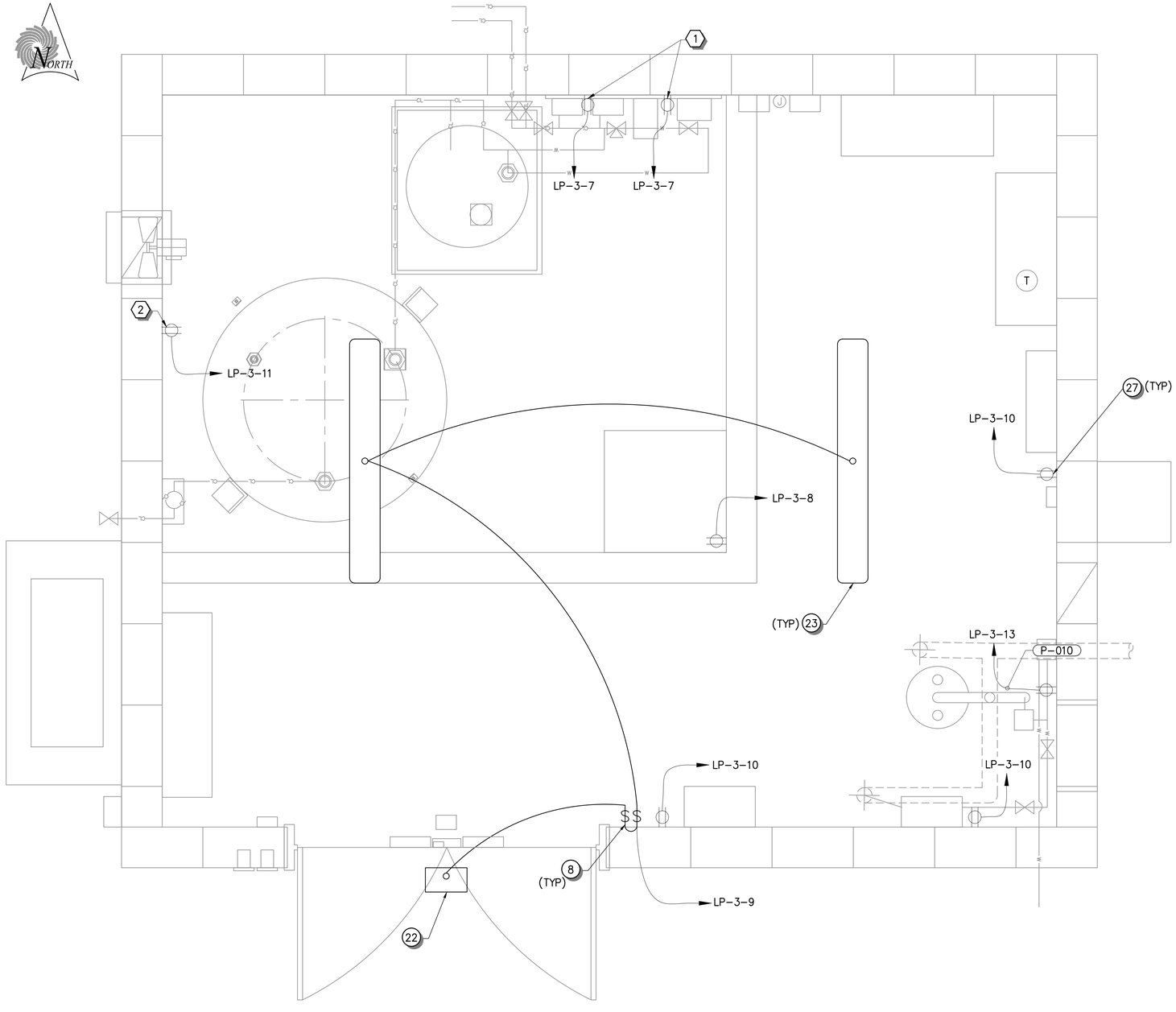
REGISTERED PROFESSIONAL ENGINEER
12-Apr-2024
No. 362066
J. RANDALL KNAPP
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT

11800 SOUTH ZONE C RESERVOIRS
ELECTRICAL POWER AND CONTROL PLAN

SCALE: N.A.
DATE 1/29/2024
PROJECT NUMBER S10030
DRAWING NUMBER E3.1
SHEET NUMBER 25 OF 27

\\SEISLC02\PROJECTS\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\ELECTRICAL\DWG\ELECTRICAL BUILDING PLAN.DWG



SHEET NOTES:

1. THE CONTRACTOR WILL BE RESPONSIBLE TO LOCATE ALL EXISTING UNDERGROUND UTILITIES BEFORE ANY EXCAVATION IS PERFORMED. ANY DAMAGE TO EXISTING UTILITIES SHALL BE REPAIRED TO NEW CONDITION OR REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
2. CONDUITS SHOWN AS SCHEMATIC ONLY. CONTRACTOR SHALL ROUTE CONDUITS IN A CLEAN MANNER AND TO AVOID ANY OBSTACLES.
3. CONTRACTOR IS RESPONSIBLE FOR PROPERLY LABELING PANELS ONCE WORK IS COMPLETE.
4. CONTRACTOR SHALL PROVIDE AND INSTALL GFCI PROTECTED RECEPTACLES AT ALL LOCATIONS IN THE BUILDING.

KEY NOTES

(1) CONTRACTOR SHALL SUPPLY TWO DUPLEX RECEPTACLES AT THIS LOCATION TO SUPPORT POWERING THE CHLORINE SYSTEM DEVICES (SCALE, RESIDUAL ANALYZER, DOSING METER/PUMP).

(2) CONTRACTOR SHALL ROUTE CONDUIT AND CONDUCTORS FROM RECEPTACLE BOX TO RTU. RECEPTACLE SHALL BE SWITCHED ON BY SCADA SYSTEM. JVWCD SHALL BE RESPONSIBLE FOR CONNECTIONS INSIDE RTU CABINET FOR RELAY CONTROL.

(3) PANEL LP-3 IS A SUB-PANEL TO PANEL LP-4. DRAWINGS FOR PANEL LP-4 ARE INCLUDED IN VOLUME 2 OF 3. REFER TO DRAWING E-05.

JORDAN VALLEY WATER CONSERVANCY DISTRICT
11800 SOUTH CHLORINATION BUILDING

CU Bus
PANEL 118R-LP-3

VOLTAGE: 240/120 | PH: 1 | WIRE: 3 -WIRE | PANEL SCHEDULE CIRCUIT | 100 AMP MAIN BREAKER

CKT NO.	AMPS	POLE	DESCRIPTION	LOAD (VA) LIGHT	LOAD (VA) RECEP	LOAD (VA) OTHER	AMPS A	AMPS A	AMPS B	AMPS B	LOAD (VA) OTHER	LOAD (VA) RECEP	LOAD (VA) LIGHT	DESCRIPTION	POLE	AMPS	CKT NO.
1	50	2	EYEWASH WATER HEATER	0	0	8000	33.3	5.0			600	0	0	FLOW METER DISPLAY 1&2	1	20	2
3	–	–	" "	0	0	0			33.3	11.2	2685	0	0	BUILDING HEAT / AC	2	20	4
5	20	1	RTU POWER	0	0	400	3.3	11.2			0	0	0	" "	–	–	6
7	20	1	CHLORINE EQUIP RECEPTACLES	0	360	0			3.0	6.7	800	0	0	SUMP PUMP	1	20	8
9	20	1	BUILDING LIGHTS	200	0	0	1.7	1.5			0	180	0	BUILDING RECEPTACLES	1	20	10
11	20	1	CHLORINE REFILL PUMP	0	0	925			7.7	2.5	300	0	0	SECURITY PANEL	1	20	12
13	20	1	EYEWASH BOOSTER PUMP	0	0	100	0.8	4.6			550	0	0	FAN/LOUVER CONTROL PANEL	1	20	14
15		–		0	0	0			0.0	0.0	0	0	0	SPARE	1	20	16
17		–		0	0	0	0.0	0.0			0	0	0	SPARE	1	20	18
19		–		0	0	0			0.0	0.0	0	0	0	SPARE	1	20	20
21		–		0	0	0	0.0	0.0			0	0	0	SPARE	1	20	22
23		–		0	0	0			0.0	0.0	0	0	0		–		24
				200	360	9425	61		64		4935	180	0		Total AMPS		
			Subtotal Watts			9985							5115	Subtotal Watts			
			Total Watts			15100							63	Average Amps			

NEC DIVERSIFIED LOAD CALCULATIONS — PANEL NAME: LP-3

LIGHTING AND CONTINOUS LOADS: (100% CONNECTED LOAD PLUS 25%)	0.2 kVA	Lighting Total Calculated kVA:	0.3
RECEPTACLES: (FIRST 10kVA @ 100%, REMAINDER @50%)	0.5 kVA	Receptacles Total Calculated kVA:	0.5
ALL OTHER LOADS @ 100%: MOTOR TOTALS INCLUDED IN ALL OTHER LOADS WITH LARGEST MOTOR CALCULATED AT 125% PER NEC	14.4 kVA	Other Loads Total Calculated kVA:	14.4
		DIVERSIFIED TOTAL kVA	15.2
		AVERAGE AMPS PER PHASE	63.1

A ELECTRICAL LIGHTING AND RECEPTACLE PLAN

1/2" = 1' (AT 11" X 17"), 1" = 1' (AT 22" X 34")

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN: JRK
DRAWING:
REVIEW: JRK
APPROVAL:

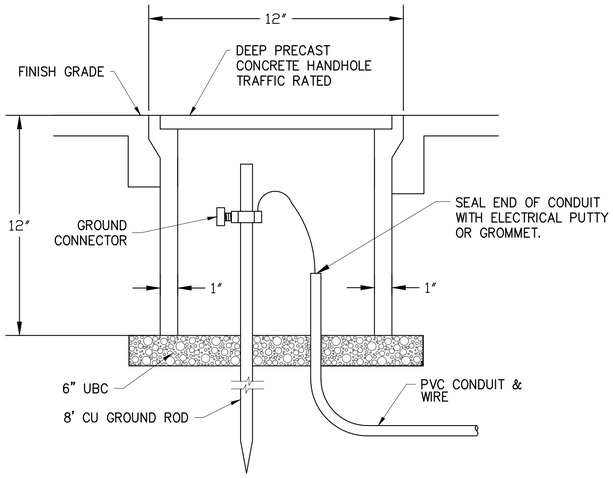
REGISTERED PROFESSIONAL ENGINEER — 12-Apr-2024 — No. 362066 — J. RANDALL KNAPP — STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT

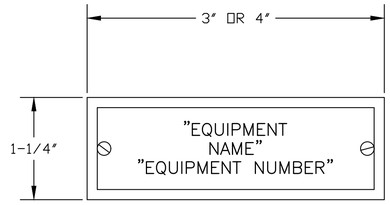
11800 SOUTH ZONE C RESERVOIRS
ELECTRICAL LIGHTING AND RECEPTACLE PLAN

SCALE: N.A.
DATE: 1/29/2024
PROJECT NUMBER: S10030
DRAWING NUMBER: E3.2
SHEET NUMBER: 26 OF 27

\\SESLCO2\PROJECTS\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\ELECTRICAL\DWG\ELECTRICAL BUILDING PLAN.DWG

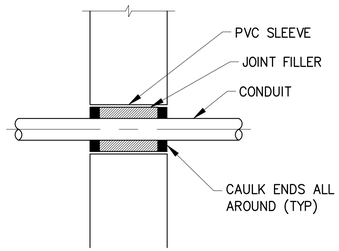


A DETAIL - GROUND WELL
N.T.S.



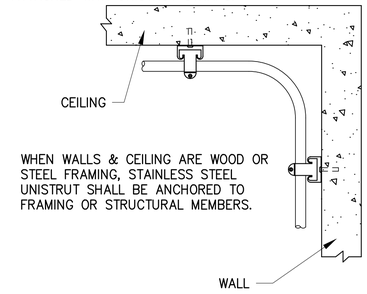
1. ALL LETTERS TO BE WHITE 1/4" HIGH, ON A BLACK BACKGROUND UNLESS NOTED OTHERWISE.
2. ALL NAMEPLATES TO BE MOUNTED ON THE VERTICAL CENTER LINE OF THE CUBICLE OR DEVICE.
3. ATTACH ALL NAMEPLATES WITH STAINLESS STEEL SCREWS.
4. PROVIDE BLANK NAMEPLATES FOR ALL SPARE CUBICLES.

B DETAIL - NAMEPLATE
N.T.S.



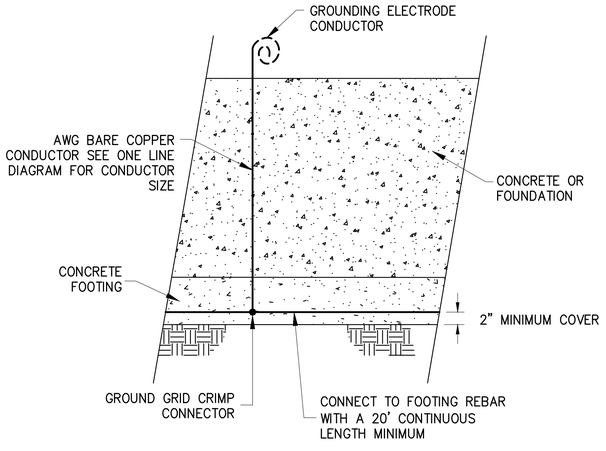
C CONDUIT PENETRATION
N.T.S.

7/8" STAINLESS STEEL UNISTRUT TO BE ANCHORED TO THE WALL & CEILING, THEN CONDUIT SHALL BE RUN AND ATTACHED WITH UNISTRUT STRAPS.

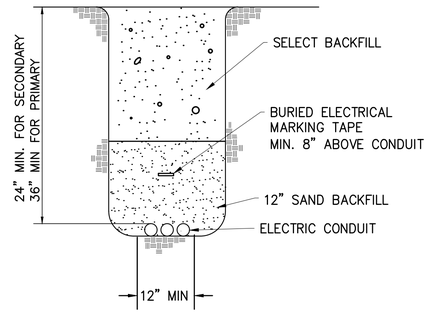


1. USE BACKSTRAP CLAMPS WITHOUT UNISTRUT WHENEVER POSSIBLE.

D DETAIL - CONDUIT MOUNT
N.T.S.



E DETAIL - UFER CONCRETE ENCASED
N.T.S.



1. WARNING TAPE SHALL BE PLACED ON TOP OF CONDUIT (5 MILS THICKNESS)
2. ALL TRENCHES SHALL BE INSPECTED PRIOR TO BACKFILLING
3. TRENCHES SHALL BE SPOT BACKFILLED TO PREVENT MOVEMENT OF TAPE DURING BACKFILL.
4. SELECT BACKFILL SHALL BE COMPACTED IN 1 FOOT LIFTS TO PREVENT SETTLING.

F DETAIL - UNDERGROUND CONDUIT POWER CABLE TRENCH
N.T.S.

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

SUNRISE ENGINEERING

DESIGN:	JRK
DRAWING:	
REVIEW:	JRK
APPROVAL:	

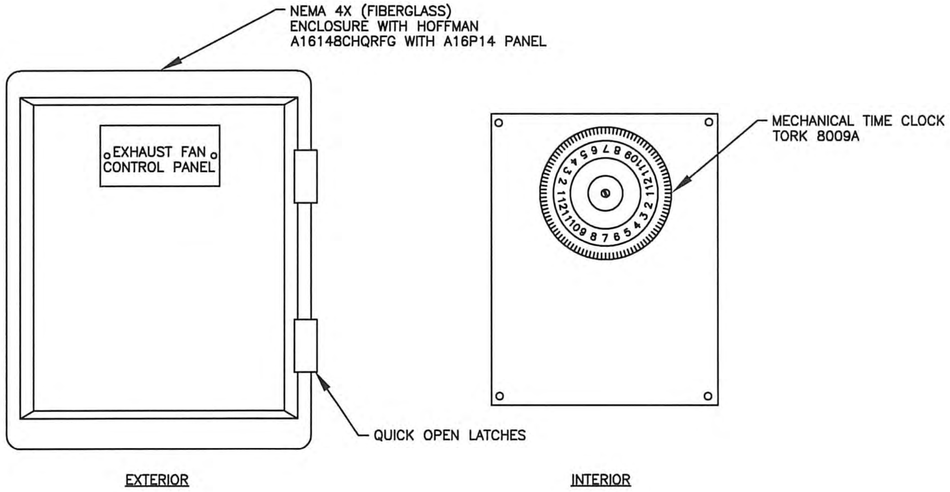
REGISTERED PROFESSIONAL ENGINEER
12-Apr-2024
No. 362066
J. RANDALL KNAPP
STATE OF UTAH

JORDAN VALLEY WATER CONSERVANCY DISTRICT

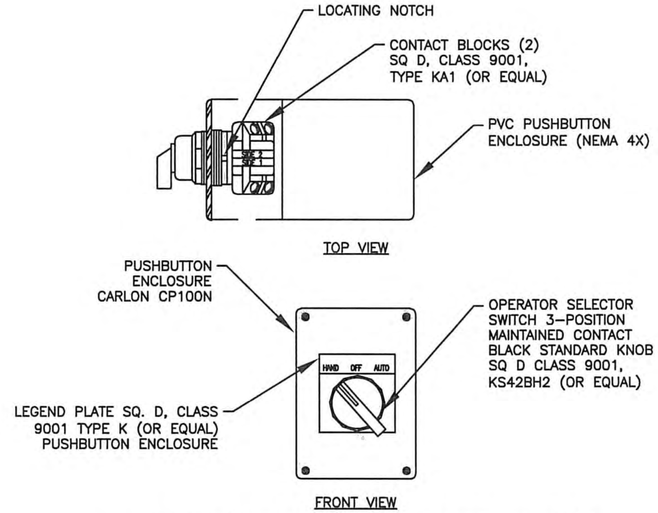
11800 SOUTH ZONE C RESERVOIRS
ELECTRICAL DETAILS

SCALE: N.A.
DATE 1/29/2024
PROJECT NUMBER S10030
DRAWING NUMBER E4
SHEET NUMBER 27 OF 27

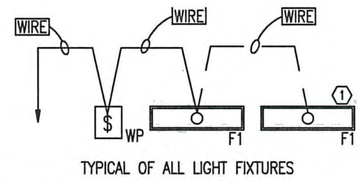
\\SEISLC02\PROJECTS\JVWCD JORDAN VALLEY WATER CONSERVANCY DISTRICT\JORDAN VALLEY BOOSTER STATION\ELECTRICAL\DWG\ELECTRICAL DETAILS.DWG



A EXHAUST FAN CONTROL PANEL

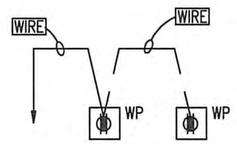


F EXHAUST FAN HAND-OFF-AUTO SWITCH



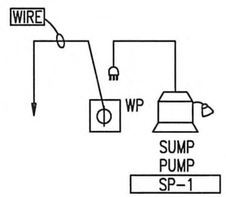
TYPICAL OF ALL LIGHT FIXTURES

B TYPICAL LIGHTING WIRING DIAGRAM

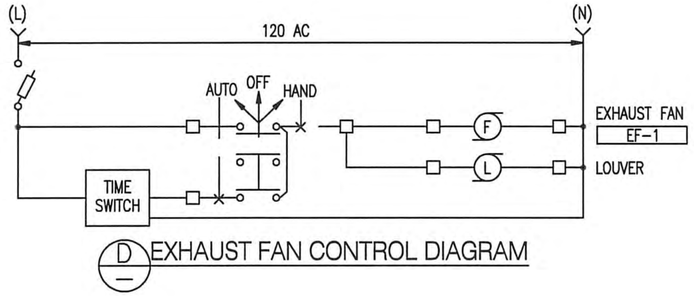


TYPICAL OF ALL CONVENIENCE RECEPTACLES

C TYPICAL CONVENIENCE RECEPTACLE WIRING DIAGRAM



E TYPICAL SUMP PUMP RECEPTACLE WIRING DIAGRAM



D EXHAUST FAN CONTROL DIAGRAM

REVISIONS			
REV.	DESCRIPTION	BY	DATE

JORDAN VALLEY WATER
CONSERVANCY DISTRICT
8215 South 1300 West
West Jordan, UT 84088
801-565-4300

LINE IS 1 INCH AT FULL SIZE (IF NOT 1" - SCALE ACCORDINGLY) | ORIGINAL SIZE B

SCALE: NTS

DESIGN: DRM
DRAWING: TMP
PROJ. MGR:
APPROVAL:

JVWCD STANDARD WHOLESALE METER VAULT TYPICAL

STANDARD EXHAUST FAN ELECTRICAL

DATE 9/1/21

PROJECT NUMBER TYP

DRAWING NUMBER EXHIBIT 1

SHEET NUMBER EXHIBIT 1

1.38M

I:\RESERVOIR\4198 - RESERVOIR CHLORINE BOOSTERS\1_ENGINEERING\EXHAUST FAN.DWG

CONTRACT DOCUMENTS, STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS

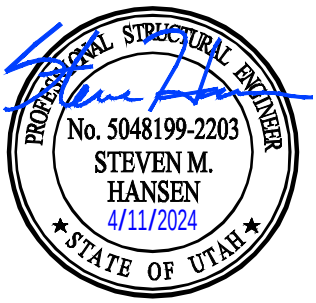
For the

Jordan Valley Water Conservancy District
11800 South Zone C Reservoirs
JVWCD Project #10030
*Date: **4-12-2024***

Prepared By: Emma Lyon

SUNRISE ENGINEERING, INC.

Address: 6875 S 900 E
Website: www.sunrise-eng.com
Telephone: 801-523-0100
Fax: 801-523-0900



REFERENCE SPECIFICATIONS (Sunrise Engineering)

DIVISION 9-FINISHES

DIVISION 10-BUILDING SPECIALTIES

DIVISION 11-PROCESS AND MECHANICAL EQUIPMENT

DIVISION 15-MECHANICAL

DIVISION 16-ELECTRICAL

SUPPLEMENTAL SPECIAL PROVISIONS — No. of Pages

DIVISION 3

CONCRETE

SUNRISE
ENGINEERING

03600.1 DESCRIPTION

This section covers furnishing materials and placing Portland cement grout, epoxy grout, and mortar for finishing concrete surfaces, leveling beds for structural steel plates, sealing joints between piping and structures, and sealing joints between construction components.

03600.1.1 RELATED WORK

Section 03100 - Concrete Forming Finishing, and Curing
Section 03300 - Concrete Structures and Slabwork
Section 04100 - Brick Masonry
Section 04810 – Unit Masonry Assemblies

03600.1.2 SUBMITTALS

Provide description of mix components, which indicates proportions to be used, environmental conditions expected and ad mixture limitations. Indicate type, grade and class of materials which suit the requirements in accordance with Section 01300. Manufacturer's data shall be provided to the Engineer for all materials.

03600.1.3 DEFINITIONS

Not used

03600.2 MATERIALS

03600.2.1 PORTLAND CEMENT

Shall meet ASTM C-150, natural color, Type II (normal) or Type IIA (air entraining).

03600.2.2 HYDRATED LIME

Shall meet ASTM C-207, Type S.

03600.2.3 WATER

Shall be potable, or water which meets the requirements of AASHTO T-26.

03600.2.4 GROUT AGGREGATE

Shall be fine aggregate (generally masonry type sand), which meets the requirements of Section 03050 with a maximum particle size specified therein or on the DRAWINGS.

03600.2.5 PORTLAND CEMENT GROUT

Shall be one part Portland Cement to one part grout aggregate proportioned by volume. Mix for 5 minutes with sufficient water to achieve the consistency of thick cream. Minimum Compressive Strength - ASTM C-109, 2800 psi in 28 days.

03600.2.6 SHRINKAGE RESISTANT GROUT

Shall be a pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland Cement, shrinkage compensating agents, plasticizing and water reducing agents.

Minimum Compressive Strength - ASTM C-109, 6500 psi in 28 days. Maximum Shrinkage - ASTM C-827 and ASTM C-157, shall not exceed 0.5 per cent.

03600.2.7 EPOXY ADHESIVE GROUT

Shall be two component material suitable for use on dry or damp surfaces and shall comply with ASTM C-881. Minimum Pot Life shall be 5 minutes at 70°F. Minimum Tensile strength - ASTM D-638, 5000 psi in 14 days. Minimum Tensile Elongation - ASTM D-638, 2 per cent. Minimum Compressive Strength - ASTM D-695, 6500 psi in 24 hours at 70°F, 12,500 psi in 28 days at 70°F. Maximum Water Absorption - ASTM D-570, 1 percent. Minimum Bond Strength shall be: in Direct Shear - 400 psi; in Direct Tension - 250 psi; in Beam Break - 800 psi.

03600.2.8 MORTAR

Shall be a mixture of grout aggregate, all of which passes the No. 4 sieve size, Portland Cement, hydrated lime, and water blended to form a plastic putty meeting the requirements of ASTM C-270. Mortars for brick or concrete block masonry construction shall be Type S or M, mixed in the proportions indicated in the table shown below and manufactured in accordance with the Uniform Building Code. Type S mortar shall be used in masonry sections above grade and not subject to water submergence. Type M mortar shall be used in locations below grade and/or where water contact potential is high.

MORTAR MIXING PROPORTIONS (by volume)

Mortar	Portland Cement	Hydrated Lime	Clean Sand
Type “S”	1	½	4½
Type “M”	1	0	2½

03600.3 CONSTRUCTION REQUIREMENTS

The Contractor shall prepare and install grout and mortar materials in accordance with these Specifications. The materials shall be mixed in clean containers, which will not allow contamination from deleterious materials. After mixing, the Contractor shall immediately install the grout or mortar. Grout or mortar left unused one hour after mixing shall be discarded.

03600.4 METHOD OF MEASUREMENT

03600.4.1 NO MEASUREMENT

Grout for leveling of structural components, sealing joints and gaps, finishing concrete surfaces, and filling masonry cells for structures shall not be measured separately for payment.

Mortar used for installing brick or concrete masonry units, or for finishing concrete surfaces, shall not be measured separately for payment.

03600.4.2 SEPARATE MEASUREMENT

Grout installed under pressure for filling voids and pockets under footings and supporting sections and for sealing ground water movement shall be measured by the cubic foot of grout injected in place.

03600.5 BASIS OF PAYMENT

The accepted quantities shall be paid for at the contract unit price for:

PAY ITEM	UNIT
Grout *(Description)*	Cubic Foot

DIVISION 4

MASONRY

SUNRISE
ENGINEERING

04100.1 DESCRIPTION

Includes furnishing materials, anchorage, accessories and labor required to construct walls and structural features of buildings.

04100.1.1 RELATED WORK

Section 03600 - Grout and Mortar

04100.1.2 SUBMITTALS

04100.1.2.1 DRAWINGS - When called for in these Specifications, the Contractor shall furnish drawings of general construction of forms, jointing, location of ties and other items affecting visibility. Where special shapes of brick units, or pre-cast concrete units are shown on the Drawings, the Contractor shall furnish drawings and detail descriptions of these units for approval by the Engineer.

04100.1.2.2 MANUFACTURER'S INFORMATION - Submit name of manufacturer, type, size, grade and color samples of brick units for selection by the Engineer.

04100.1.3 DEFINITIONS

Facing Brick - brick specifically manufactured and finished for exposure in exterior and/or visible wall surfaces.

Building Brick - Some times referred to as "common" brick and specifically designed for use as interior units in structural wall components without exposure.

Flashing - Sheet metal or plastic placed in brick walls to deflect surface water accumulation onto or away from joints with other structural components such as roof surfaces, foundations, etc.

Weep Holes - openings fabricated into the bottom of brick walls to allow drainage of any moisture accumulation inside the wall interior.

Wall Ties - metal connectors placed strategically to connect exterior brick wall veneer sections to interior faces or other structural components.

Lintels - Steel or reinforced concrete units installed horizontally over openings in wall sections to support the brickwork places over the opening.

04100.2 MATERIALS

04100.2.1 FACING BRICK

Shall be manufactured to meet the requirements of ASTM C 216. Unless otherwise indicated on the drawings or in these Specifications, the Contractor shall provide Type FBS, Grade SW, with the color selected by the Engineer.

04100.2.2 BUILDING BRICK

Shall be manufactured to meet the requirements of ASTM C 62 Unless otherwise indicated on the drawings or in these Specifications, the Contractor shall provide Type F, Grade SW with the color selected by the Engineer.

04100.2.3 MORTAR AND GROUT

Shall meet the requirements of Section 03600.

04100.2.4 FLASHINGS

Unless shown otherwise on the Drawings or in these Specifications, all material used for masonry flashings shall be 22 gage (minimum) galvanized steel sheet.

04100.2.5 JOINT REINFORCEMENT

Shall be truss type galvanized steel, with 3/16-inch side rods and No. 9 cross ties.

04100.2.6 WALL TIES

Shall be galvanized bent wire, 0.1875-inch (minimum), but not greater than one-half of the mortar joint thickness.

04100.2.7 REINFORCEMENT

Shall be deformed steel bars of the size shown on the Drawings meeting the requirements for reinforcement steel in Section 03200.

04100.2.8 CONTROL JOINT FILL MATERIAL

Fill material inside control joints shall be sponge rubber, 3/8-inch thick.

04100.2.9 WEEP HOLES

Shall be formed with 5/16-inch (minimum) PVC tubing between brick units on the bottom course.

04100.3 CONSTRUCTION

04100.3.1 MORTAR

With the exception of lime putty, all mortar shall be mixed on the job, and no mixing off the job, either complete or in part, will be allowed. Materials for the mortar mix shall be measured by volume. Mortar shall be mixed in a mechanical mixer and only in such quantities as are needed for immediate use. Mortar shall be mixed for at least five minutes after all materials have been added to the mixer. No mortar which has been mixed for more than one hour shall be used

04100.3.2 HANDLING AND STORAGE OF MASONRY UNITS

All masonry units shall be transported and handled in such manner as to prevent chipping and breakage. Storage piles, stacks, or bins shall be located to protect materials from heavy traffic. Chipped, cracked, or otherwise defective units shall not be laid in the wall where exposed to view.

04100.3.3 LAYING

04100.3.3.1 PREPARATION – Preparations for laying shall include the following:

- The foundation on which a masonry wall is to be built shall have a clean surface. Sandblasting shall be done if there is latent foreign material lodged in the pores of the foundation surface.

- All sills, ledges, offsets and other projections shall be protected from spills or drops of mortar, and all construction by other trades shall be protected from damage which may result from the masonry work.

- Masonry units shall be cured and dried before being used. The surface of all brick shall be clean and free of dust, dirt or other foreign material before laying.

- Depending on the weather and other conditions, the Contractor may be instructed to lay brick masonry units up either wet or dry. Instructions in this regard will be included in the Special Provisions or will be given directly by the Engineer. When instructed to lay the masonry units up wet, at the time of laying all brick shall have been dampened until it reaches an absorption rate of not over 1.4-ounces per minute as determined in accordance with ASTM C-67.

- Before starting work, the mason shall measure the foundation wall and determine the joint..

04100.3.3.2 CONSTRUCTION TOLERANCES - All masonry walls shall be laid in uniform and true courses, level and plumb. Walls shall be plumb within plus or minus ¼-inch per 12 feet. Walls shall be straight horizontally within plus or minus ¼-inch in 50 feet. Wall thickness shall be as shown on the Plans with a tolerance of plus ¼-inch, minus 1/8-inch. Variation from level coursing shall not exceed ¼-inch in 10 feet.

04100.3.3.3 BOND PATTERN - Bond pattern for all masonry walls shall be running bond unless otherwise indicated on the Plans or specified herein. No jumping of bond will be allowed. Bond shall be plumb throughout.

04100.3.3.4 APPLICATION OF MORTAR – Mortar shall be applied as follows:

- Mortar joints shall be straight, cleaned and uniform in thickness and shall be tooled as indicated on the Drawings and/or as herein specified.

- Joint thickness is to be ½-inch both vertical and horizontal, unless otherwise shown.

- Full mortar bedding shall be used for the first course on the foundation. Full mortar coverage shall be provided on the face.

- Vertical head joints shall be well buttered and these joints shall be shoved tightly so that the mortar bonds well to both units.

041003.3.5 PLACEMENT OF MASONRY – Masonry units shall be placed as follows:

- Masonry units shall be laid in the wall to the desired height with joints of uniform thickness.

- Units shall be leveled, plumbed and straightened \before the mortar has stiffened.

- Masonry units shall be adjusted to their final position in the wall while the mortar is still soft and plastic enough to ensure a good bond.

- If the position of the unit is shifted after the mortar has stiffened, or bond is broken or cracks are formed, the unit shall be relayed in new mortar.

- Where fresh masonry joins totally or partially set masonry, the set masonry shall be cleaned before layering new work.

04100.3.3.6 CONSTRUCTING AND GROUTING VERTICAL CELLS – This work shall proceed as follows:

- All masonry shall be laid to preserve the unobstructed vertical continuity of cells to be filled with reinforcement and grout.

- Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.

- Walls and cross webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. All head (or end0 joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

- Vertical reinforcement shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

- All vertical cells containing reinforcement shall be filled solidly with grout in lifts not exceeding 4 feet in height.

- When the grouting is to be stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1½" below the top of the uppermost unit.

04100.3.4 BEAMS AND BEARING PLATES

Two courses of grouted hollow masonry shall be provided below all steel bearing plates or beams bearing on masonry walls. Place external bearings on each side of contact with load as required to properly transfer load to the masonry wall, as indicated on the plans.

04100.3.5 OPENINGS

04100.3.5.1 METAL DOORFRAMES - Jambs and heads of metal doorframes connected to masonry shall be anchored and fully grouted. Filling of frames shall be done as each two feet of masonry is laid.

04100.3.5.2 CUTOUTS - All necessary cutting of masonry units to form chases, etc., for anchorage or other appurtenances shall be required. All cutting and fitting of exposed masonry units shall be done with a power driven carborundum or diamond disc blade saw.

Where masonry is to enclose conduits, pipes, stacks, ducts, and similar items, slots, chases, cavities, and similar spaces shall be constructed as required, whether indicated on the plans or not. No such work shall be covered until advised that work has been inspected and tested.

All openings in exterior masonry for pipes, conduits, etc., shall be caulked weather tight with silicone rubber caulking colored to match the mortar.

04100.3.6 COMPLETION AND CLEANUP

At the completion of the work, all holes or defective mortar joints on exposed masonry shall be pointed. Where necessary, defective joints shall be cut out and re-pointed. After completion of the masonry work, all mortar drippings and other foreign substances shall be removed with a stiff brush. All exposed block surfaces shall be thoroughly wetted with clean water and then be uniformly and thoroughly washed down with a solution of one part commercial muriatic acid mixed with 8 to 10 parts of clean water. The surface shall be brushed with a stiff brush during the washing. The cleaned surface shall be entirely free of streaks and stains of any kind. All material liable to damage shall be protected. Brickwork shall be washed down with clean, fresh water immediately after acid cleaning.

04100.3.7 ANCHORS

Anchorage of intersecting walls, veneer, floor and roof shall be made in accordance with the Uniform Building Code.

04100.3.8 MASONRY FLASHING

Extend flashing through veneer, turn up minimum 8-inches and bed into mortar joints of masonry; seal to substrate as required. Lap end joints minimum 6-inches and seal watertight.

04100.3.9 LINTELS

Where steel or pre-cast concrete lintels are not scheduled, install reinforced unit masonry lintels over all openings as shown on the Drawings or prescribed herein. Construct or shop fabricate masonry lintels of like units, using grout, filled solidly, and reinforcing to properly span opening. Maintain minimum 8-inches bearing on each side of opening. Use reinforcing bars of one-piece lengths only. Place and consolidate grout fill without disturbing reinforcing. Allow lintel construction to reach strength before removing temporary supports.

04100.3.10 CONTROL JOINTS

04100.3.10.1 LOCATION - Control joints with filler shall be located as shown on the Plans or as otherwise specified. Control joints, as detailed, shall be provided at all vertical masonry walls where such walls exceed 40 feet in length. In long lengths of walls, joints shall be provided at least every 30 feet or as indicated on the Plans.

04100.3.10.2 INSTALLATION - Control joints shall be continuous full height of walls. At bond beams, control joints shall separate masonry and grout and horizontal joint reinforcement shall not be continuous. Do not continue horizontal joint reinforcing across control joints.

04100.3.10.3 FILL - Install resilient control joint in continuous lengths Heat or solvent weld butt and corner joints in accordance with manufacturer's instructions. Fill material shall be held back from finished surface and the remainder of the joint shall be caulked with silicone rubber compound with a color which matches the mortar.

04100.3.11 ACCESSORIES

All items as required and/or directed, including all anchors, flashings, sleeves, frames, structural steel, anchor bolts, miscellaneous iron and all other items required shall be set tight and caulked as necessary to seal any exterior joints or contact surfaces. Do not build in organic materials.

04100.3.12 CUTTING AND FITTING

Modify completed work for chases, pipes, conduit, sleeves, grounds and other items as required. Obtain approval prior to modifying any area not indicated or where appearance or strength of masonry work may be impaired. Cooperate with other sections of work to provide correct size, shape and location.

04100.3.13 PATCHING

Patching of exposed masonry units shall be done at the conclusion of the general work and shall be done in such a manner that the patching will be indistinguishable from similar surroundings or adjoining work.

04100.3.14 PROTECTION OF MASONRY WORK

Temporary protection shall be provided for all exposed masonry corners subject to injury. Masonry shall be protected against rapid drying by frequently fogging and sprinkling the work sufficiently that walls will be visibly wet for a period of not less than 3 days.

04100.3.15 COLD WEATHER CONSTRUCTION

Masonry work shall be allowed to proceed in cold weather only when air temperature is maintained at 40° or greater and the following temperatures in masonry components are attained. Heat the mixing water and aggregate to a minimum of 70°F and not over 160°F. The temperature of masonry units shall be at least 35°F when laid. Provide sufficient measures to maintain masonry temperature above 40°F for 24-hours after laying.

04100.3.16 INSULATING FILL IN WALLS

Exterior walls of all buildings which have brick cells that are not filled with grout shall be filled with insulation. Insulation shall be foamed-in-place insulation as specified in Division 7. The cells in the brick wall shall be kept as free of mortar as possible as the masonry goes up. The brick laying shall not be carried more than four feet vertically ahead of the insulation fill. That is, the insulation shall be foamed in place in lifts not to exceed four feet. Care shall be taken that no insulating fill gets into cells which are to be filled with grout and that no grout gets into cells that are to be filled with insulation.

04100.4 METHOD OF MEASUREMENT

Unless provided otherwise in Special Provisions, brick masonry will be measured as part of the building or structure listed in the Bid Schedule and no separate measurement will be made for brick masonry.

04100.5 BASIS OF PAYMENT

Separate payment will not be made for brick masonry unless provided otherwise in the Special Provisions.

04200.1 DESCRIPTION

This section covers furnishing materials, fasteners, and anchoring devices, accessories, and the labor required to construct masonry walls and other masonry structural features of buildings.

04200.1.1 RELATED WORK

Section 03200 - Concrete Reinforcement
Section 03600 - Grout and Mortar

04200.1.2 SUBMITTALS

04200.1.2.1 DRAWINGS - When called for in these Specifications, the Contractor shall furnish drawings of general construction of forms, jointing, location of ties, and other items affecting visibility. Where special shapes of concrete units are shown on the Drawings, the Contractor shall furnish drawings and detailed descriptions of these units for approval by the Engineer.

04200.1.2.2 MANUFACTURER'S INFORMATION - Submit name of manufacturer, type, size, and grade along with color samples of block units for selection by the Engineer.

04200.1.3 DEFINITIONS

Flashing - sheet metal or plastic placed in brick walls to deflect surface water accumulation onto or away from joints with other structural components such as roof surfaces, foundations, etc.

Wall Ties - metal connectors placed strategically to connect exterior wall veneer sections to interior faces or other structural components.

Lintels - steel or reinforced concrete units installed horizontally over openings in wall sections to support masonry units placed over the opening.

Wythe - a single width of masonry wall units.

04200.2 MATERIALS

04200.2.1 CONCRETE BLOCK UNITS

Shall be hollow, lightweight, Grade N, Type I units meeting the requirements of ASTM C 90.

04200.2.2 MORTAR AND GROUT

Shall meet the requirements of Section 03600. When block opening sizes will allow adequate clearance, aggregate particle size in grout used for bond beams and vertical reinforcement may be increased to 1/2-inch (maximum).

04200.2.3 FLASHINGS

Unless otherwise shown on the Drawings or described in these Specifications, all material used for masonry flashings shall be 22 gauge (minimum) galvanized sheet steel.

04200.2.4 JOINT REINFORCEMENT

Shall be truss type galvanized steel, with 3/16-inch side rods and No. 9 cross ties.

04200.2.5 WALL TIES

Shall be galvanized bent wire, 0.1875-inch (minimum), but not greater than one-half of the mortar joint thickness.

04200.2.6 REINFORCEMENT

Shall be of deformed steel bars of the size shown on the Drawings, meeting the requirements for reinforcement steel in Section 03200.

04200.2.7 CONTROL JOINT FILL MATERIAL

Fill material shall be fully compressible 3/8-inch thick sponge rubber, meeting the requirements of IAW ASTM D-1782, with a minimum resiliency recovery rate of 90% or better, or approved equal.

04200.2.8 SEALER

Shall be a penetrating sealer, such as Pre-Prime 167 manufactured by Devoe Coatings or approved equal.

04200.3 CONSTRUCTION

04200.3.1 MORTAR

All mortar shall be mixed on the job and, with the exception of putty, no mixing off the job, either complete or in part, will be allowed. Materials for mortar shall be measured by volume. Mortar shall be mixed in a mechanical mixer and only in such quantities as are needed for immediate use. Mortar shall be mixed for five minutes after all materials have been placed in the mixer. No mortar which has been mixed for more than one hour shall be used.

04200.3.2 HANDLING AND STORAGE OF MASONRY UNITS

All masonry units shall be transported and handled in such manner as to prevent chipping and breakage. Storage piles, stacks, or bins shall be placed in locations where materials will be protected from damage. Chipped, cracked, or otherwise defective units shall not be laid in the wall where defects may be exposed to view.

04200.3.3 LAYING UP

04200.3.3.1 PREPARATION - Preparation for laying up the masonry work shall proceed as follows:

- The foundation surface on which a masonry wall is to be built shall be clean. When residual material, such as dust, dirt, chips, concrete splatter, etc., is found to be present on the top surface of the foundation wall, the Contractor shall take appropriate measures as deemed necessary by the Engineer to remove such material before starting any masonry course.

- All sills, ledges, offsets and other projections shall be protected from spills or drops of mortar, and all construction by other trades shall be protected from damage which may result from the masonry work.

- Masonry units shall be cured and dried before being used and surface shall be clean and free from dust, dirt, or other foreign matter when laid in the wall. Masonry units shall not be wetted before being used but shall be laid dry.

04200.3.3.2 CONSTRUCTION TOLERANCES - All masonry walls shall be laid in uniform and true courses that are level and plumb. Walls should be plumb to within plus or minus ½-inch per 20 feet. Walls shall be straight horizontally to within plus or minus ¼-inch in 50 feet. Wall thickness shall be as shown on the Drawings with a tolerance of ¼-inch.

04200.3.3.3 BOND PATTERN - Bond pattern for all masonry walls shall be running bond unless otherwise indicated on the Drawings. No jumping of bond will be allowed. Bond shall be plumb throughout.

04200.3.3.4 APPLICATION OF MORTAR – Mortar shall be applied as follows:

- Full mortar bedding shall be used for the first course on the foundation.
- Joint thickness is to be ½ inch both vertically and horizontally unless otherwise shown.
- Full mortar coverage shall be provided on all face shells and on the webs surrounding cells to be filled.
- Vertical head joints shall be well buttered for a thickness equal to the face shell, and these joints shall be shoved together tightly so that the mortar bonds well to both units.
- Joints shall be solidly filled from the face of the units to the depth of the face shell.
- Mortar joints shall be straight, clean and uniform in thickness and shall be tooled concave unless indicated otherwise on the Drawings. However, when walls are to be coated with bitumen damp proofing, mortar joints shall be struck flush with masonry unit faces.

04200.3.3.5 PLACEMENT OF MASONRY – Masonry units shall be placed as follows:

- Before starting the actual lay-up work, masonry shall be laid dry on the foundation wall and bond adjusted to openings, angles and corners.
- No units smaller than ½ block shall be used.
- Masonry units shall be laid in the wall to the desired height with joints of uniform thickness.
- Masonry units shall be adjusted to their final position in the wall, level, plumb, and straight, while the mortar is still soft and plastic enough to ensure a good bond.
- If the position of a unit is shifted after the mortar has stiffened, or the bond is broken or cracks are formed, the unit shall be re-laid in fresh mortar.
- If work has been stopped long enough for mortar to set, both masonry and mortar shall be cleaned before new work is laid up.

04200.3.3.6 CONSTRUCTING AND GROUTING VERTICAL CELLS – This work shall proceed as follows:

- All masonry shall be laid so as to preserve a clear, unobstructed, vertical continuity of the cells to be filled with grout.
- The vertical opening shall measure not less than 2 inches by 3 inches.
- Walls and cross webs forming such cells shall be fully bedded in mortar, to prevent leakage of grout. See also subsection 04200.3.10 below. All head (or end) joints shall be solidly filled

with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

- Vertical reinforcement shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of the reinforcement material.

- All vertical cells containing reinforcement shall be filled solidly with grout in individual lifts not to exceed 4 feet in height each.

- Place and consolidate grout fill without disturbing reinforcing. Grout lifts greater than 8-inches shall be mechanically vibrated. Do not consolidate by shaking the vertical bars.

- Whenever grouting is to be stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1½" below the top of the uppermost unit.

04200.3.3.7 BEAMS AND BEARING PLATES - Two courses of grouted hollow masonry shall be provided below all steel bearing plates or beams bearing on masonry walls. At bearing points fill masonry cores with grout a minimum of 24-inches wide from bearing point to lower support member or bond beam. Place external bearings on each side of contact with load as required to properly transfer load to the masonry wall, as indicated on the plans.

Use "H" blocks for bond beams. Reinforce bond beams and pilasters as indicated on the Drawings.

04200.3.4 OPENINGS

04200.3.4.1 METAL DOORFRAMES - Jambs and heads of metal doorframes to be connected to masonry shall be anchored and fully grouted. Filling of doorframes with grout shall be done as each two vertical feet of masonry are laid. Bed anchors of metal doors and glazed frames in mortar joints. Fill frame voids solid with mortar. Fill masonry cores with grout for one core from framed openings.

04200.3.4.2 CUTOUTS - All necessary cutting of masonry units to form chases, etc., for anchorage or other appurtenances shall be part of the Contractor's required work.

- All cutting and fitting of exposed masonry units shall be done with a power driven carborundum or diamond disc blade saw.

- Where masonry is to enclose conduits, pipes, stacks, ducts, and similar items, the necessary slots, chases, cavities, and similar spaces for these items shall be constructed as required, whether indicated on the plans or not.

- The Contractor shall not cover such work until he has been informed that the work has been inspected and tested.

- All openings in exterior masonry around pipes, conduits, etc., shall be caulked weather tight with a silicone rubber product or compound designed for this purpose.

04200.3.5 LINTELS

Where steel or pre-cast concrete lintels are not scheduled, install reinforced masonry unit lintels over openings. Construct or shop-fabricate lintels using grout fill and reinforcing. Maintain 8 inches minimum bearing on each side of opening.. Door, window, and similar openings in

masonry walls, unless indicated or specified otherwise, shall have lintels made up of like material "U" block units reinforced and filled solidly with grout to properly span openings. Do not splice reinforcing bars in lintels. Allow lintels to reach full strength before removing temporary supports.

04200.3.6 REINFORCING

Reinforce as indicated. Lap splices at least 40 bar diameters.

04200.3.7 ANCHORS AND BRACING

Supply metal anchors as shown on the Drawings for anchoring the masonry work to other structural members. Provide temporary dry bracing required during erection of masonry work. Maintain in place until building structure provides permanent bracing.

04200.3.8 MASONRY FLASHINGS

Extend flashing through veneer, turn up a minimum of 8 inches, and bed into mortar joints of masonry or seal substrate as required. Lap end joints 8 inches minimum and seal watertight. Use the flashing manufacturer's recommended sealant.

04200.3.9 CONTROL JOINTS

Control joints, with filler, shall be as shown on the Drawings or as specified herein.

04200.3.9.1 LOCATION - Control joints shall be provided for all vertical masonry walls where such walls exceed 40 feet in length. In longer lengths of walls, joints shall be provided at least every 30 feet or as indicated on the plans. Control joints shall be continuous for the full height of walls.

04200.3.9.2 FORMING - Form control joints by using a sheet, building paper type bond breaker fitted to the hollow contour of the block unit end. Fill the void so created with grout. Rake the joint at the exposed faces of rod and sealant.

04200.3.9.3 REINFORCING - Horizontal joint reinforcing shall not cross control joints. However, at bond beams, control joints shall separate masonry and grout; and steel reinforcing shall be continuous.

04200.3.9.4 FILLER - Control joint fillers shall be installed in continuous lengths in accordance with the manufacturer's instructions. Fill materials shall be held below the finished surface, and the remainder of the joint shall be caulked with synthetic rubber.

04200.3.10 ACCESSORIES

Furnish and install steel or pre-cast concrete components as shown on the Drawings.

Set metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates and other items tight and caulk exterior joints with silicone rubber composition colored to match color of mortar. Place all anchor bolts in solid grouted cores. Build items plumb and level.

04200.3.11 COMPLETION, CLEANUP AND SEALING

04200.3.11.1 DEFECTIVE WORK - At the completion of the work, all defective mortar joints on exposed masonry shall be re-pointed. Where necessary, defective joints shall be cut out and re-pointed.

04200.3.11.2 CLEANING - Brush off excess mortar as work progresses. Dry brush at the end each day's work.

04200.3.11.3 FINAL CLEANING - After mortar is thoroughly set and cured and damaged surfaces are repaired, final cleaning of exposed masonry surfaces shall proceed as follows:

- Dry clean to remove large particles of mortar using wood paddles and scrapers. Use a chisel or wire brush if necessary.
- Scrub down wall with stiff fiber brush and either a solution of ½ cup of trisodium phosphate and ½ cup of household detergent dissolved in 1 gallon of water, or commercial muratic acid mixed in 8-10 parts of clean water, or other approved masonry cleaner.
- Rinse walls by washing off cleaning solution, dirt and mortar crumbs using clean, 100 percent soluble pressurized water.

04200.3.11.4 SEALER – A penetrating sealer shall be applied to concrete block masonry surfaces as shown on the Drawings.

04200.3.12 INSULATING FILL IN WALLS

Exterior walls of all buildings having internal cells in the block and that are not filled with grout shall be filled with insulation. Insulation shall be foamed-in-place insulation as specified in Division 7. The cells in the block wall shall be kept as free of mortar as possible as the work goes up. The brick laying shall not be carried more than four feet vertically ahead of the insulation fill. That is, the insulation shall be foamed in place in lifts not to exceed four feet. Care shall be taken that no insulating fill gets into cells which are to be filled with grout and that no grout gets into cells that are to be filled with insulation.

04200.4 METHOD OF MEASUREMENT

Unless provided otherwise in the Special Provisions, concrete block masonry will be measured as part of the building or structure listed in the Bid Schedule and no separate measurement will be made.

04200.5 BASIS OF PAYMENT

Separate payment for concrete block masonry will not be made unless indicated otherwise in the Special Provisions.

DIVISION 5

METALS

SUNRISE
ENGINEERING

05010.1 GENERAL

This section of the Specifications covers metals and metal work required to furnish, fabricate, and to install the following nonexclusive list of items:

- Aluminum and miscellaneous nonferrous metals
- Anchors and anchor bolts
- Bolts
- Cast-iron frames and covers
- Grating and frames
- Ladders
- Louvers
- Manhole frames and covers
- Metal roof decking
- Miscellaneous metal items shown on the Plans or specified
- Miscellaneous structural steel
- Pipe handrails, pipe sleeves, inserts, and chains
- Platforms
- Sheet metalwork
- Special supports, hangers, and anchors
- Stairs and treads
- Steel lintels
- Supports for mechanical equipment
- Tread plates and frames

05010.1.2 RELATED WORK

Not used.

05010.1.3 SUBMITTALS

Certified copies, in duplicate, of mill tests or reports from a recognized commercial laboratory shall be furnished when requested as to the chemical, tensile, and bending properties of each shipment of structural metal or part thereof having common properties. All tests and analyses shall be made in accordance with the applicable ASTM Specification.

05010.1.4 DEFINITIONS

Not used.

05010.2 MATERIALS

05010.2.1 ALUMINUM

05010.2.1.1 SHEET ALUMINUM - Except as otherwise specified or indicated on the Plans, sheet aluminum shall be alloy 50050H14 conforming to the requirements of ASTM B 209 and shall be not less than 0.025 inch in thickness.

05010.2.1.2 STRUCTURAL ALUMINUM - Structural aluminum shall be 6061-T6, and extruded aluminum shall be 6063-T42.

Aluminum shapes and appurtenant materials shall conform to the requirements of ASTM B 221 and ASTM B 308 and shall be of aluminum alloy known commercially as 6061-T6. Materials not otherwise specified shall conform to the latest applicable Specifications of ASTM.

05010.2.1.3 BOLTS - All bolts for bolting aluminum shall be Type 304 or 316 stainless steel of sizes indicated on the Plans.

05010.2.2 STEEL

05010.2.2.1 SHEET STEEL - Galvanized sheet iron or steel shall conform to ASTM A 525, 1.25-ounce coating; black steel to ASTM A 569.

05010.2.2.2 STRUCTURAL STEEL – Structural steel shall be as follows:

- Unless otherwise specified, structural steel shall conform to ASTM A 36.
- Cast iron shall conform to ASTM A 48, Class 40B.
- Galvanized structural steel or iron shall be “hot dipped” galvanized after fabrication. Electro-galvanizing shall not be used unless specified otherwise.
- All structural steel shall be delivered free from mill scale, rust, or pitting.
- Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting.

05010.2.2.3 STAINLESS STEEL - Stainless steel, unless specifically specified or indicated on the Plans otherwise, shall be Type 316 or Type 304, nonmagnetic.

05010.2.2.4 STEEL PIPE - Steel pipe shall conform to ANSI B 36.10, Table I.

05010.2.2.5 BOLTS - High tensile bolts shall conform to ASTM A 325.

05010.2.2.6 OTHER ITEMS

Other structural and miscellaneous metal items shall be as indicated on the Plans or as specified elsewhere.

05010.3 CONSTRUCTION (FABRICATION) REQUIREMENTS

05010.3.1 GENERAL

All structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made; and where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.

05010.3.1.1 INSTALLATION - Each structural item shall be installed true to level, plumb, alignment, and grade with all parts bearing or fitting the structure or equipment for which it is intended accurately and securely. It shall not be permitted to cock out of alignment, re-drill, reshape, or force to fit any fabricated item. It is the Contractor’s responsibility to place anchor bolts or other anchoring devices accurately and to make any surfaces, which bear against structural items smooth and true to level to preclude the necessity of any springing, re-drilling, or reshaping.

05010.3.1.2 SPECIAL ALIGNMENT - Pipe railings, posts, and structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced and kept braced until concrete, grout, or dry pack cement mortar has hardened for a period of not less than 48 hours.

05010.3.1.3 FIT - The Contractor shall be responsible for the correct fitting of all metalwork in the field. The Contractor shall take all measurements necessary to properly fit its work in the field, and it shall be governed by and be responsible for these measurements and the proper working out of all details.

05010.3.1.4 WELDING – General welding procedures are as follows (see also Subsections below):

- The Contractor shall notify the Engineer at least 24 hours before starting shop or field welding.
- A welding inspector may check the materials, the equipment, and the qualifications of the welders.
- The inspector may use gamma ray, magnetic particle, dye penetrant, trepanning, or any other aid to visual inspection which it may deem necessary to be assured of the adequacy of the welding.
- The costs of any tests and all re-tests on defective welds shall be borne by the Contractor. Cost in connection with qualifying welders shall also be borne by the Contractor.
- The cost of tests on sound welds will be borne by the Owner.
- Welders doing unsatisfactory work shall be removed or may be required to pass qualification tests again.

05010.3.1.5 MISCELLANEOUS METALWORK - Where anchors, connections, or other details of miscellaneous metalwork are not definitely shown or specified, its material, size, form, attachment, and location shall conform to best practice.

05010.3.1.6 HAZARDOUS PROJECTIONS - Sharp or hazardous projections shall be rounded off and ground smooth.

05010.3.1.7 CHIPS AND DEBRIS - All chips and other debris lodged between contacting surfaces shall be removed before assembly.

05010.3.2 ALUMINUM

05010.3.2.1 STRUCTURAL ALUMINUM

The Contractor shall furnish and install all structural aluminum items in accordance with the Plans and as specified. It shall provide all supplementary parts necessary to complete each item even though such work is not definitely covered by the Plans and Specifications. Its size, form, attachment, and location shall be such as to conform to the best of current practice.

05010.3.2.2 LAYOUT ON ALUMINUM - Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain visible on the surface of the fabricated material.

When critical dimensions exist, a temperature correction shall be applied in the layout as necessary. The coefficient of expansion shall be taken as 0.000013 per degree F.

05010.3.2.3 CUTTING AND DRILLING ALUMINUM – Aluminum may be cut and drilled as follows:

- Material 1/2 inch thick or less may be sheared, sawed, or cut with a router. Material more than 1/2 inch thick shall be sawed or routed.
- Cut edges shall be true, smooth, and free from excessive burrs or ragged breaks.
- Edges of plates carrying calculated stresses shall be planed to a depth of 1/4 inch. Sawn or routed edges will be acceptable when the finish is of equal quality to a planed edge.
- Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting.
- Rivet or bolt holes may be punched or drilled to finished size before assembly.
- The finished diameter of holes for unfinished bolts shall be not more than 1/16 inch larger than the nominal bolt diameter.
- All holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal.
- Flame cutting of aluminum alloys is not permitted.

05010.3.2.4 ALUMINUM FORMING AND ASSEMBLY - Structural aluminum material may not be heated except in forming operations where material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending. Such heating shall be done only when proper temperature controls and supervision are provided to insure that the limitations on temperature and time are carefully observed.

05010.3.2.5 WELDING ALUMINUM - This Specification shall apply to both field and shop welding operations. The general recommendations and regulations shown in the American Welding Society Specifications D1.1, "Structural Welding Code," apply to 6061-T6 structures. Detail requirements for welding aluminum alloy 6061-T6 are given as follows:

- Filler metal for welding shall be aluminum alloy welding rods conforming to the requirements of AWS A 5.10 and shall be AWS classification ER 4043, ER 5154, ER 5254, ER 5183, ER 5356, or ER 5556.
- The welding process and welding operators shall both meet a qualification tests. The method of qualification shall conform to the method described in the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications," Part B. Aluminum alloy 6061-T6 shall be used for the qualification test plates. Operators shall be qualified on the basis on bend tests and a fillet weld soundness test.
- Dirt, grease, forming or machining lubricants, or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding are required when the inert gas tungsten arc welding method is used. This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is done with the automatic or semi-automatic inert gas shielded metal arc.

- Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining or shearing may be used.

- Any welding of aluminum shall be done using a nonconsumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used unless prior approval has been obtained from the Engineer. Preheating for welding is permissible provided the temperature does not exceed 400° F for a total time of 30 minutes.

- Welding of any structure which is to be anodized shall be done using filler alloy rods that will not discolor when anodized. ER 5154, ER 5254, ER 5183, ER 5356, or ER 5556 filler alloy rods shall be used.

05010.3.2.6 PROTECTION OF ALUMINUM SURFACES - Aluminum surfaces to be placed in contact with wood, concrete, masonry, or dissimilar metals other than stainless steel shall be protected as specified in the appropriate sections of Division 9 – Finishes.

05010.3.2.7 BOLTING - Where aluminum comes in contact with steel it shall be bolted with stainless steel bolts and separated or isolated from the steel with neoprene gaskets or washers or as specified in Division 9.

05010.3.3 STEEL

05010.3.3.1 STRUCTURAL STEEL – The following shall apply:

- The Contractor shall furnish and install all structural steel items in accordance with the plans and as specified herein.

- The Contractor also shall provide all supplementary parts necessary to complete each item even though such work may not be specifically covered by the Plans and Specifications.

- Wherever applicable, all fabrication and erection of steel items shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" except as the same may be modified by applicable building codes, the General Conditions, and these Specifications.

05010.3.3.2 WELDING OF STEEL – Both the general recommendations and regulations shown in the American Welding Society Specifications D1.1, "Structural Welding Code," as well as the detail requirements in those specifications apply to welding of steel structures. Welding of steel shall adhere to the following:

- All welding of steel under this section shall be done by welders who have a current AWS certificate for the type of welding to be done by the welder.

- All welding of structural steel type ASTM A 36 shall be done using mild steel covered Arc Welding Electrodes conforming to ASTM A 233, Series E70, or shall be done using Electrodes and Fluxes for Submerged Arc Welding conforming to ASTM A 558, Classification F70-XXXXX, where XXXXX refers to any electrode referred to in ASTM A 558.

- Welding of stainless steels shall be done with electrodes and techniques as recommended in Welded Austenitic Chromium - Nickel Stainless Steels - Techniques and Properties as

published by the International Nickel Company, Inc., New York, New York. All welds shall be full penetration welds, unless specified otherwise.

05010.3.3.3 PROTECTION OF STEELWORK - The Contractor shall paint steel and miscellaneous ferrous metal items as specified in the appropriate sections of Division 9-Finishes.

05010.3.4 DUCTWORK

05010.3.4.1 DESIGN AND FABRICATION - Ducts shall be fabricated of aluminum or galvanized steel sheets with gauges of sheet metal, joint types, reinforcing, bracing, supporting, fabricating, installing, and other requirements in accordance with Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems of the Sheet Metal and Air Conditioning Contractors National Association, Inc. Ducts shall be designed for the appropriate pressure type as shown in the above mentioned Duct Manual. Details on the Plans in some cases call for sheet metal thicknesses greater than called for in the Duct manual. Sheet metal shall conform to whichever requirement calls for the greater thickness. Aluminum ducting shall be not less than 0.063 inches thick.

05010.3.4.2 HANGERS - Ducts shall be supported on both sides at all changes in direction and at not greater than eight foot intervals by suitable hangers as specified herein or as detailed on the Plans. For galvanized ducting, hangers for ducts 12-inch by 24-inch or smaller shall be galvanized sheet metal straps not lighter than 18-gauge by one inch secured to the structure by one 5/16-inch bolt and to the duct by not less than two No. 10 sheet metal screws or 3/16-inch stove bolts. Hangers for ducts larger than 12-inch by 24-inch shall be galvanized steel straps or rods not less than 0.13 square inches in net cross section, secured to the structure by a Grinnell Figure 152, Size 2, concrete insert, or approved equal, and to a duct pocket or reinforcing angle by two 1/4-inch stove bolts. For aluminum ducting, supports shall be equivalent to supports for galvanized ducting except that all fasteners, fittings, and shafting shall be stainless steel.

05010.3.4.3 FLEXIBLE CONNECTIONS - Where blowers or equipment containing blowers or other machine elements, which may cause vibration, are connected to ducts or housing, such connections shall be by means of flexible connections. These flexible connections shall be airtight at the pressures encountered and be flame proof and water proof. The flexible material shall be equivalent to 14 ounce canvas.

05010.4 METHOD OF MEASUREMENT

Not used.

05010.5 BASIS OF PAYMENT

Not used.

05050.1 DESCRIPTION

This section covers a generic list of miscellaneous metals specifications.

05050.1.1 RELATED WORK

Not used.

05050.1.2 SUBMITTALS

Not used.

05050.1.3 DEFINITIONS

Not used.

05050.2 MATERIALS

05050.2.1 LADDERS AND METAL STAIRS

All ladders shall be safety ladders conforming to OSHA standards. All ladders and stairways supplied to the project shall be of one manufacturer. All stair and ladder wells shall be adequately guarded, and all stairs shall have handrails as specified or shown on the Plans.

Ladders shall be secured to the supporting surface by bent plate chips providing not less than 7 inches between the supporting surface and center of rungs. If exit from the ladder is forward, over the top rung, side rails shall be extended not less than 3-feet-3 inches above, and returned to the landing. If exit from the ladder is to the side, the ladder shall extend not less than 5-feet 6-inches above the landing and be rigidly secured at the top.

05050.2.2 ALUMINUM LADDERS

Aluminum ladders shall be made of 6063-T5-aluminum alloy, of welding construction. Rungs shall be not less than 1-inch square bar with 1/8-inch grooves in the top and redivided edges. Side rails shall be no lighter than 3 inches by 3/8 inches. Ladders shall be of the size, shape, location, and details indicated on the Plans. Ladders greater than 20 feet in height shall have standard ladder cages designed in accordance with State and OSHA requirements. All aluminum surfaces, which will be in contact with concrete, shall be coated as specified in Division 9.

05050.2.3 ALUMINUM STAIRWAYS

Aluminum stairways shall be fabricated and installed as shown on the Plans. Stairway stringers shall be fabricated of aluminum alloy 6061-T6. Treads shall be aluminum as specified below. Handrail shall be fabricated of aluminum pipe as specified under aluminum handrail.

Stair treads shall be aluminum of the sizes called for on the Plans, and shall be of the same type and make as called for under GATING. All fasteners shall be of Type 304 or 316 stainless steel.

Stair treads shall be furnished with cast abrasive type safety nosing.

05050.2.4 ARCHITECTURAL AND MISCELLANEOUS SHEET METAL

Sheet metal flashing and counterflashing shall be installed as indicated on the Plans. Galvanized steel or anodized aluminum flashing shall be used when indicated and specified on the Plans.

Unless otherwise indicated flashing shall be 0.025-inches thick. The aluminum flashing shall receive a 215-R1 anodic finish after fabrication as indicated on the Plans. Exposed edges shall be folded back 1/2-inch to provide stiffness. Except as otherwise indicated and specified on the Plans, counterflash shall be provided over all base flashings.

Unless specifically noted, galvanized steel flashing shall be used in contact with structural steel and anodized aluminum flashing shall be used in contact with structural aluminum. This shall be done to protect against dissimilar metal action.

Surfaces to which sheet metal is to be applied shall be even, smooth, round, thoroughly clean and dry, and free from all defects that might affect the application. All cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed under this section. All accessories or other items essential to the completeness of this sheet metal installation, though not specifically shown or specified, shall also be provided under this section. Nails, screws, and bolts shall be of the types best suited for the intended purpose and shall be of a composition that will not support galvanic action in the installation. Where sheet metal abuts into adjacent materials, the juncture shall be executed in a manner satisfactory to the Engineer.

Sheet metal items not covered elsewhere shall be as indicated on the Drawings and as required to provide a watertight installation. Formed sheet metal for metal covered work shall accurately reproduce the detail and design shown and profiles, bends, and intersections shall be sharp, even, and true.

05050.2.5 ALUMINUM SHEET METAL WORK

Except as otherwise specified or indicated on the Plans, sheet aluminum shall be alloy 5005-H14 conforming to the requirements of ASTM B 209 and shall be not less than 0.025 inch in thickness and extruded aluminum shall be 6063-T42.

05050.2.6 MISCELLANEOUS STRUCTURAL STEEL

Miscellaneous steel items not specified herein shall be as shown on the Plans or specified elsewhere and shall be fabricated and installed in accordance with the best practices of the trade.

05050.2.7 LINTELS

Lintels for masonry construction shall be structural steel beams or angles, fabricated as indicated on the Plans.

05050.2.8 SUBMERGED ASSEMBLY BOLTS

Assembly bolts for wood baffles, collectors, and other assemblies in areas where stainless steel anchor bolts would be required shall be stainless steel bolts Type 304 or 316.

05050.2.9 ANCHOR BOLTS AND INSERTS

Wherever feasible, anchor bolts shall be cast in place when concrete is placed.

All anchor bolts and concrete anchors embedded in concrete shall be accurately spaced with bolts truly normal to the surfaces from which they project. Type 304 or Type 316 stainless steel anchor bolts and nuts shall be used under these circumstances:

- Any time they are submerged in water.

- In the case of structures customarily containing water, placed in walls, ceilings, or overheads, even if above water level.
- In the dry side of water bearing walls.
- Where securing aluminum to steel or concrete.

Anchor bolts not required by above conditions to be of stainless steel, may be of carbon steel conforming to ASTM A 307 or ASTM A 36. Carbon steel anchor bolts in the following locations shall be hot-dip galvanized.

- Anchor bolts exposed to the weather.
- In electrical manholes or pull boxes.
- In tunnels, passageways, galleries, vaults, or rooms below grade or enclosed in part by water bearing walls.

In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut. In all cases where steel anchor bolts are used, a liberal coating of nonoxidizing wax shall be applied to the threads before screwing on nuts.

All bolts, when indicated for future use, shall be first coated thoroughly with nonoxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with a waterproof polyvinyl tape.

05050.2.10 INSTALLATION

Anchor bolts shall be embedded not less than 12 diameters. Where shown on the Plans, anchor bolts shall be set in metal sleeves having an inside diameter approximately 3 times the bolt diameter and not less than 12-bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted.

05050.2.11 CONCRETE ANCHORS

Concrete anchors, where indicated on the Plans or specified, shall mean drilled in place anchors with integral anchor bolts. Concrete anchors shall be Phillips “Wedge Anchors” with integral anchor bolts, or Expansion Products Company “Wej-It” concrete anchors with integral anchor bolts, or approved equal.

The material of each concrete anchor, including its integral anchor bolt, shall be the same material as would be required, under these Specifications, for anchor bolts in the same location that the concrete anchor is to be used.

Concrete anchors shall have the following minimum embedment lengths:

EMBEDMENT OF CONCRETE ANCHORS

Size	Embedment Length
3/8”	1-1/2”
½”	2-1/4”
5/8”	2-3/4”
¾”	3-1/4”

If Wej-It expansion anchors are used they shall have the following minimum embedment length:

WEJ-IT ANCHORS

Size	Embedment Length
¼"	1-1/2"
½"	5"
5/8"	5"
¾"	5"

Anchor bolts, of the same material and size as required for the specified concrete anchors, may be cast in the concrete in lieu of using concrete anchors. Embedment of bolts in concrete shall be not less than 12-bolt diameter plus a standard hook.

No cast iron, lead cinch, or slug-in anchors will be permitted for use.

05050.2.12 MISCELLANEOUS CAST IRON

All castings shall be tough, gray iron, free from cracks, holes, swells, and cold shuts, and be of workmanlike finish, and shall conform to the Standard Details and with the ASTM Specification Designation A 48, Class 40 B. The quality shall be such that a blow from a hammer will produce an indentation on a rectangular edge of the casting without flaking the metal. Before leaving the foundry, all castings shall be thoroughly cleaned and subjected to a hammer inspection, after which they shall receive a coating of coal-tar pitch varnish in such a manner as to form a firm, tenacious coating.

05050.2.13 MANHOLE FRAMES AND COVERS

Manhole frames and covers shall be made from a superior quality gray iron, conforming to the requirements of ASTM A 159, Class G3000, or ASTM A 48, Class 30-B. Frames and covers shall have horizontal and vertical bearing surfaces machined to fit neatly, and the cover shall bear firmly in the frame without rocking and shall be easily removable. Frames and covers shall be heavy-duty traffic type designed for H-20 loading and shall have a combined set weight of at least 265 pounds.

Frames shall have a clear inside opening of 24 inches diameter and shall be of the bottom flange type. Frame height shall be approximately 4½" and bottom flange outside diameter shall be approximately 32 inches.

Covers shall have a skid resistant grid pattern design as recommended ASTM publication STP326.

The elevations at which manhole frames and covers are to be set shall conform to the requirements set forth on the Plans, but in all cases shall be governed by the Engineer in the field. Where the cover is in existing pavement or in the traveled way of the existing road shoulder, it is to be placed flush with the existing surface. Where the structure is outside the limits of the traveled shoulder but not in the roadside ditch, it should be placed 1/10 foot or more above the existing ground surface. Where the manhole cover falls in the existing roadside ditch or right of way, it is to be placed approximately 1-1/2 feet above the existing ground surface or as directed by the Engineer. Manhole frames shall be set at the required grade and shall be securely attached to the top precast manhole shaft unit. After the frames are securely set in the place provided herein, covers shall be installed and all necessary cleaning and scraping of foreign materials from the frames and covers shall be accomplished to ensure a fine satisfactory fit. All costs of setting and securing manhole frame and cover sets in place as herein provided, including all necessary concrete work shall be considered as included in applicable contract unit prices and no additional allowance will be made therefor.

Cast lettering on manhole covers shall be as shown on the Plans. Shop drawings of all manhole rings and covers shall be submitted to the Engineer.

05050.2.14 CAST IRON PRESSURE MANHOLE FRAME AND COVER

The Contractor shall furnish and install, ready for use as indicated on the Plans and as specified herein, rectangular pressure manholes and covers. Each pressure manhole shall have a clear opening of 18" X 30". The pressure plate shall be flat on top and shall not be less than 1/2 inch thick steel and fastened with 316 stainless steel studs and stainless steel nuts. A 1/8-inch thick neoprene gasket shall be supplied between the frame and pressure plate. Lifting shall be provided with a watertight pickhole. The frame shall be a seal-type with flanges at the base and at the top.

05050.2.15 MISCELLANEOUS ALUMINUM

Structural and other metal items fabricated from aluminum, not covered separately herein shall be fabricated in accordance with the best practices of the trade and shall be field assembled by riveting or bolting with no welding or flame cutting permitted except as approved by the Engineer.

05050.2.16 ALUMINUM STAIR NOSING

Stair nosings shall be installed on all treads of all concrete stairs including the top tread of the upper slab. Stair nosings shall be aluminum abrasive cast nosings with aluminum oxide granules integrally cast into the metal forming a permanent nonslip long wearing surface. The nosings shall be Type 101 Stair Tread by Wooster Products, Inc., Spruce Street, Wooster, Ohio 44691, Type A stair treads by American Abrasive Metals Company, or approved equal. The treads shall have integrally cast anchors. Stair nosings shall be cast in fresh concrete and shall be flush with the tread and riser faces. Stair nosing shall be coated with zinc chromate primer in accordance with the provisions of Division 9. Screws shall be 304 or 316 stainless steel.

05050.2.17 MANHOLE STEPS

Manhole steps shall consist of 3/4-inch diameter stainless steel or polyethylene rungs. Rungs shall extend 7-inches from the face of the wall to which they are anchored and shall have a minimum clear width of 16-inches. Rungs shall be designed such that the foot cannot slide off the end. Distance between rungs shall be 12-inches. Rungs shall be hook anchored into walls a minimum of 6-inches.

05050.3 CONSTRUCTION REQUIREMENTS

Not used.

05050.4 METHOD OF MEASUREMENT

Not used.

05050.5 BASIS OF PAYMENT

Not used

DIVISION 6

WOOD AND PLASTICS

SUNRISE
ENGINEERING

06100.1 DESCRIPTION

Carpentry shall include furnishing and installing wood, metal, and other materials typically used for wood framed buildings or building components.

06100.1.1 RELATED WORK

Section 08110 – Doors, Frames, and Hardware
Section 08210 - Metal Windows
Section 09910 - Painting

06100.1.2 SUBMITTALS

The Contractor shall submit information which indicates size, grade and source of lumber materials for review and approval by the Engineer. Information which describes materials, thickness, size, model number, manufacturer's name, etc. shall be submitted for review for all other materials, including its fasteners, required to complete the building or its component as shown on the Drawings and described herein. All such information and/or materials shall be submitted in accordance with Section 01300 of these Specifications.

06100.1.3 DEFINITIONS

Not used.

06100.2 MATERIALS

06100.2.1 LUMBER

Lumber materials shall be graded No. 2 or better, Douglas Fir, Pine, or Hemlock and shall be free of warping which will affect the alignment of the structural component in which it is installed. Lumber materials which contain signs of rot, fungus, or termite damage will be rejected. Wood materials installed in direct contact with soils, earth materials or concrete floors or footings shall be pressure treated or foundation grade Redwood.

06100.2.2 LAMINATED STRUCTURES

Laminated structural joists, beams and girders shall be of the size and strength capacity shown on the Drawings and shall be manufactured in accordance with the standards of the American Institute of Timber Construction.

06100.2.3 PLYWOOD

Plywood shall be not less than three ply and of the grade and thickness shown on the Drawings, and manufactured in accordance with the standards of the American Plywood Association.

06100.2.4 EXTERIOR FINISH

Wood materials used for exterior finishing shall be solid wood or exterior plywood or plywood siding of the type and grades shown on the Drawings.

06100.2.5 INTERIOR FINISH

Wood materials used for painted interior finishing shall be finger jointed grade ("Paint Grade") pine. Materials used for interior finishing when coated to show a natural wood grain shall be clear

grade solid wood or veneered plywood of the species, type and grade shown on the Drawings. Pressed wood or simulated wood materials will not be acceptable for wood cabinets or naturally finished wood trim.

06100.2.6 METAL FRAMING

Metal framing shall consist of galvanized steel sheet of the gage and dimensions shown on the Drawings and manufactured in accordance with the standards prescribed in the Uniform Building Code. Wood may be substituted for metal, or metal may be substituted for wood framing. However, all framing installed within a building must be either wood or metal, unless shown otherwise on the Drawings.

06100.2.7 WALLBOARD

All wallboard shall be of the size and configuration indicated on the Drawings and of a type consistent with good building practice. Wallboard shall conform to the applicable requirements of the most recent edition of the Uniform Building Code (UBC), Sections 2511, 2512, and 2513, as appropriate, together with associated tables therein.

06100.2.8 HARDWARE

All fasteners, hardware and fittings shall be of the size and configuration indicated on the Drawings and consistent with good building practice. Metal hardware and fittings shall be of a good quality, industrial grade, manufactured for heavy-duty service.

Fasteners shall be as required by the UBC as mentioned in 06100.2.7, above. All metal fasteners (nails, clips, etc.) used on members exposed to wet or exterior conditions shall be galvanized steel, stainless steel or aluminum. Screws for fastening gypsum wallboard shall be corrosion resistant steel.

06100.3 CONSTRUCTION REQUIREMENTS

06100.3.1 CARPENTRY STANDARDS

All carpentry work provided in this Contract shall be performed in accordance with the applicable requirements of the UBC, its current amendments, and any building requirement enforced by any local building authority.

In general, all carpentry shall be performed in a manner that exhibits good quality. All joints shall be cut to fit tight. All load bearing member joints shall be cut and fit to provide full bearing and load distributing capability.

06100.3.2 WALLBOARD

Installation of wallboard shall comply with the applicable requirements of UBC Sections 2511, 2512, and 2513. Fastener placement shall conform to Table 25G of the UBC as applicable.

Unless indicated otherwise in these Specifications, in addition to fastening with steel screws, all gypsum wallboard shall be glued at all contacts with framing.

06100.3.3 WOOD PLATES

Wood plates on concrete or masonry walls shall be installed to form a level plane. When necessary, cement grouting will be used to ensure full bedding of the plates.

06100.3.4 CABINETS

Cabinets shall be furnished and installed in conformity to the requirements for "custom" grade as defined by the Architectural Woodwork Institute standards. Shelving in cabinets shall be manufactured so as to be adjustable.

06100.3.5 EXPOSED PLYWOOD EDGES

Exposed edges of plywood paneling around door or vent openings, or at corners, shall be concealed with wood casing. Concealing shall be accomplished with 1/4-inch (minimum thickness) moldings unless shown otherwise on the Drawings.

06100.3.6 VINYL BASE

When not shown otherwise, 2-inch (minimum) width vinyl base shall be installed to close the joint between the floor and wall. Such base material shall be installed by securing with a waterproof adhesive to the wall.

06100.4 METHOD OF MEASUREMENT

Separate measurement will not be made for carpentry. When carpentry is required, its measurement shall be included with the measurement for the building or structure shown in the Bid Schedule.

06100.5 BASIS OF PAYMENT

Payment for carpentry shall be included in the payment for the building or structure as shown in the Bid Schedule.

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SUNRISE
ENGINEERING

07500.1 DESCRIPTION

Includes furnishing and installing lightweight fiberglass or foam insulation in buildings or enclosures as shown on the Drawings an in accordance with the requirements described herein.

07500.1.1 RELATED WORK

Not used.

07500.1.2 SUBMITTALS

The Contractor shall provide complete information which includes complete product description and manufacturer's installation instructions in accordance with the requirements of Section 01300.

07500.1.3 DEFINITIONS

Not used.

07500.2 MATERIALS

07500.2.1 FOAM

Foam insulation materials shall be Styrofoam brand insulation board, or approved equal, with a thermal resistance rating (R-Value) per inch of five (5) and a capability of being submerged in water and not absorbing more than 0.1% water by volume.

07500.2.2 FIBER

Fiber insulation materials shall consist of long, resilient glass fibers bonded with a thermosetting resin in batts faced with foil and kraft paper facing which enables the product to carry a fire hazard classification rating of 25/50 or less per ASTM E 84. Unless called for otherwise, the thermal resistance and material shall be Corning, 6”, R-19.

07500.3 CONSTRUCTION REQUIREMENTS

The type, application and installation of either insulation material will be as shown on the Drawings.

07500.3.1 PREPARATION AND INSTALLATION

The Contractor shall carefully prepare the supporting structure to provide a neat fit for the insulation material in accordance with its manufacturer’s recommendations. Appropriate anchor devices or procedures shall be provided to retain the insulation in proper position as recommended by the manufacturer.

07500.3.2 DUCT INSTALLATION

New supply ductwork shall be insulated with 1-pound density, 1-inch thick, fiberglass blanket insulation having aluminum foil reinforced facing complete with vapor barrier. Insulation shall be secured to the sheet metal with clips and adhesive as recommended by the insulation manufacturer. Insulation shall be fitted to the duct surfaces with all joints tightly butted together and against standing seams. All joints and/or holes shall be vapor sealed using an adhesive compound as recommended by the insulation manufacturer.

07500.4 METHOD OF MEASUREMENT

Separate measurement of thermal insulation will not be made when the material is installed as a component of a building or structure listed in the Bid Schedule. Measurement will be included with the building or structure which it serves.

07500.5 BASIS OF PAYMENT

Separate payment will not be made for thermal insulation included in the measurement of a building or structure in which it is installed.

07700.1 DESCRIPTION

This section covers furnishing and installing built-up or shingle roofing and metal roofing systems on buildings or enclosures as shown on the Drawings and in accordance with the requirements described herein.

07700.1.1 RELATED WORK

Not used.

07700.1.2 SUBMITTALS

The Contractor shall provide complete information which includes complete material description and manufacturer's installation instructions in accordance with the requirements of Section 01300.

07700.1.3 DEFINITIONS

Not used.

07700.2 MATERIALS

07700.2.1 ASPHALT CEMENT AND COATING

Asphalt cement and coating applied for bonding shall be Type I or II per ASTM D 312 with a flash point not less than 475^0 F. The material shall be heated just enough to achieve softening suitable for application while not producing an excess of fumes.

07700.2.2 FELT MEMBRANES

Shall be organic asphalt felt paper (#15 Plain 15 lb.) and heavyweight saturated organic felt paper (Heavy-duty 40 lb.).

07700.2.3 SHINGLES

Shall be organic asphalt, self-tabbing shingles with a 25 year limited warranty, Class “C” fire rating and a minimum weight of 225 pounds per square.

07700.2.4 FLASHING

Shall be 18 gage (min.) aluminum or galvanized steel sheet. Edging materials shall be aluminum or galvanized steel sheet and shall match the metal type used for the roof fascia covering, if any.

07700.2.5 NAILS

Shall be galvanized roofing nails with a minimum length of 1 1/2-inch.

07700.2.6 GRAVEL COVERING

Shall be 3/8-inch (max.) washed pea gravel.

07700.2.7 CAULKING

Shall be a good quality flexible roof sealant which can be applied under pressure with a standard hand operated caulking gun.

07700.2.8 METAL ROOFING AND RIDGE CAP

Consists of a 26-gauge spanline profile painted metal roofing and fastened with rubber washer galvanized roofing screws of sufficient length to penetrate the sheathing. Color shall be determined by the Engineer.

07700.3 CONSTRUCTION REQUIREMENTS

07700.3.1 PREPARATION

The Contractor shall carefully clean and prepare the roof surface in accordance with its manufacturer's recommendations. Roofing materials shall then be applied as follows:

07700.3.2 EDGING

Edging applied along the lower edge of the roof shall be set so that the base sheet extends over the upper edge of the edging strip to prevent any water from entering under the edging strip

07700.3.3 FLASHING

Flashing shall be installed with the upstream edges tucked under the asphalt shingles and the downstream edge always laid above the shingle layers. The upstream edge of all flashing and edges of overlapping shingles shall be caulked with a continuous strip of caulk. Flashing in valleys on the roof shall be extended at least 8-inches under the shingle layers on the sides.

07700.3.4 BUILT-UP ROOFING

Consists of a base sheet (40 LB felt membrane) laid directly on the roof sheathing and/or insulation. This sheet shall be fastened with roofing nails of sufficient length to fully penetrate the roof sheathing and placed at a spacing not to exceed 12-inches on center. Three layers of #15 plain felt paper will then be applied over the base sheet with hot asphalt cement. Following the application of the 15 lb. Felt paper, a heavy layer of asphalt coating shall then be applied and gravel shall be uniformly distributed over the surface at an application rate of 400 lbs. per 100 square feet.

07700.3.5 SHINGLED ROOFING

Consists of a 40 lb. base sheet applied directly on the roof sheathing and fastened along the edges with roofing nails of sufficient length to penetrate the sheathing. Edge nailing will be done at a spacing of not more than 8-inches on center. Following the application of the base sheet, shingles will be applied in accordance with the instructions of the manufacturer.

07700.3.6 METAL ROOFING AND RIDGE CAP

All installation and spacing of screws will be completed to manufacturer's specifications.

07700.4 METHOD OF MEASUREMENT

Separate measurement for roofing materials will not be made when the material is installed as a component of a building or structure listed in the Bid Schedule. Measurement will be included with the building or structure which it serves.

07700.5 BASIS OF PAYMENT

Separate payment will not be made for roofing materials included in the measurement of a building or structure on which it is installed.

DIVISION 8

DOORS AND WINDOWS

SUNRISE
ENGINEERING

08110.1 DESCRIPTION

This section of the specifications covers the furnishing and installing of all doors, transoms, center panels, windows, and associated finished hardware. In general, details, door and window types and sizes are indicated on the Plans.

08110.1.1 RELATED WORK

Not used.

08110.1.2 SUBMITTALS

08110.1.2.1 SHOP DRAWINGS - Shop drawings shall be submitted to the Engineer for his approval. Shop drawings shall show all details of doors, frames, windows, and accessory items, including all details or proper anchorage to the adjacent wall construction in each case.

08110.1.2.2 DESCRIPTIVE LITERATURE - Descriptive literature which identifies the manufacturer, model numbers, materials of fabrication and sizes shall be provided in accordance with Section 01300 of these Specifications.

08110.1.2.3 MANUFACTURER'S LITERATURE - Any manufacturer's literature provided for maintaining and operating their doors and hardware shall be furnished to the Owner prior to the time of final acceptance for payment.

08110.1.2.4 STAINED SAMPLES – See 08110.2.2.4 below.

08110.1.3 DEFINITIONS

Not used.

08110.2 MATERIALS

08110.2.1 STEEL DOORS

All steel doors indicated in the Door Schedule and their pressed steel frames shall be hollow steel doors as detailed on the Plans and specified herein.

Doors and frames shall be made of prime quality, cold-rolled, pickle annealed, stretcher leveled steel, free from scale, pitting, and surface defects.

Hollow metal doors shall be 1-3/4 inches thick flush type, constructed of 2 sheets of not less than 16-gauge steel sheets formed and welded for flush pan assembly, with internal 20-gauge vertical reinforcing channels spaced not over 8 inches on centers the full height of the door. Reinforcing channels shall be uniformly spot welded to mated pans. Continuous 18-gauge stiffener channels shall be welded to faceplates top and bottom of all doors. Filler channels shall be provided at the top of exterior doors and also at the bottom of doors with thresholds to provide flush closure. All interior void spaces shall be completely filled with not less than 3-pound density rock wool or polyurethane. There shall be no visible joints on the face of the doors.

Concealed sheet or bar steel reinforcing shall be provided for mortise type hardware. Reinforcing shall be not less than the following: 9-gauge for butts; 12-gauge for locksets; and 14-gauge for surface applied hardware. Reinforcing shall be drilled and tapped to template requirements. Concealed reinforcing shall be provided for closers.

08110.2.1.1 OPENINGS

Where indicated in the Door Schedules on the Plans, doors shall be provided with glazed openings. Moldings shall be integral with and welded into the door providing 2 recessed rebates at all openings. The top and bottom interior glazing stop shall be removable and shall be flush with face sheets of door. Doors with glazed openings shall be Overly door type, or approved equal.

08110.2.1.2 ASTRAGALS

Astragals shall be provided on the active leaf of all exterior double doors and shall be a 1-3/4 inches wide, 12-gauge steel strip extended the full height of the door.

08110.2.1.3 FRAMES

Frames for hollow metal doors shall be pressed steel as indicated on the Plans. Pressed steel frames shall be constructed of not less than 16-gauge steel and shall be of the shape indicated on the plans and as required to fit the various wall construction. Frames shall be of welded unit construction assembled and welded in the shop. Welding shall be to the hairline joint with all exposed beads ground smooth. Jamb rebates shall be provided for three gray rubber door silencers. Concealed forcing of the frames for mortise hardware shall be not less than the following: 3/16-inch for butts; 12-gauge for lock strike; 14-gauge for surface applied items; and 18-gauge plaster guards over mortised hardware reinforcement. Frames shall be mortised drilled, and tapped to template requirements. Lock reinforcing units shall be supplied by finish hardware supplier. Frames in concrete shall be held in place by grout poured in keyways provided at all heads and jambs. Anchors for doorframes in masonry shall be Overly No. 111, or approved equal.

After shop assembly, doors and frames shall be cleaned thoroughly, ground smooth, and all seams along the edges of the door shall be filled flush with mineral filler. All doors and frames shall be bonderized and given one shop coat of rust inhibitive primer.

Gray rubber mutes shall not be installed until after painting, and then installation shall be deferred until as late in the job as possible, to avoid loss or damage. Before installation of the rubber mutes, the space behind the holes which are to receive the mutes shall be thoroughly cleared of any mortar or other obstructions which might prevent the mutes snap-locking into place.

08110.2.2 WOOD WALK DOORS

08110.2.2.1 DOORS - Wood doors shall be furnished and installed where shown on the Plans and as specified herein. Doors shall be flush veneered, prefinished, with a clear thermoplastic film 3 mils thick, edges sealed, and individually carton packed. Doors shall be guaranteed by the manufacturer according to the N.W.M.S. Standard Door Guarantee.

08110.2.2.2 DOORFRAMES - Doorframes, except fire door, shall be extruded anodized aluminum as indicated on the Plans. Door frames and accessories shall be color anodized as indicated on the Drawings or required in these Specifications.

08110.2.2.3 FIRE-RATED WOOD DOOR - Door shall be 1-3/4-inch, “Label B”, one-hour mineral core fire door as manufactured by Weyerhaeuser Company; Paine Lumber Co., Inc.; or approved equal. Face veneer shall be Rotary Select White Birch and the door shall bear the “Label B” Underwriter’s Laboratory designation. The door shall be installed in a UL approved frame.

08110.2.2.4 SOLID CORE DOORS - Solid core doors shall be solid particleboard core as manufactured by Weyerhauser Company; Paine Lumber Company, Inc.; or approved equal. Face veneers and edges shall be stained. Stained samples shall be submitted to the Engineer for approval prior to staining of the actual door.

08110.2.2.5 HOLLOW CORE DOORS - Door face veneers and edges shall be Rotary White Birch, and shall be Paine Lumber Co. "Rezo Type", or approved equal.

08110.2.3 TRANSOMS AND CENTER REMOVABLE PANELS

Transoms shall be either glass or steel panel as indicated in the Door Schedule on the Plans. All transoms and center panels shall be easily removable with clips as indicated on the Plans. All center panels shall match the door in which the center panel is placed, in thickness, material, and finish unless otherwise noted in these Specifications or on the Plans.

Glass transoms shall have 1/4-inch tinted tempered plate glass and shall be shop glazed in 6063T5 extruded aluminum sashes.

Steel transoms shall match the door over which the transom is placed in thickness, material and finish. Each transom shall have a neoprene gasket between the steel back and the transom. The clip shall tighten the transom against the neoprene gasket.

08110.2.4 DOOR HARDWARE

Shall be as follows:

08110.2.4.1 PANIC BAR LATCH - All exterior doors shall be equipped with panic bar latching devices, Rim 80 Series by Sargent and Company, Apex 2000 Series by Precision or approved equal.

08110.2.4.2 DOOR CLOSURES - Doors shall be equipped with Series 351 closures as manufactured by Sargent and Company, QDC 100 Series by Stanley, or approved equal. All closures shall have hold-open features, and shall be ADA compliant.

08110.2.4.3 KNOB LATCH SET – Shall be as follows:

- Latch sets for exterior walk doors shall meet Fed. Spec. FFH-106a-161A. They shall be stainless steel unless specified otherwise on the door schedule. One latch set is required for each single door and one for the active-leaf on double doors on all exterior walk doors. Latch sets shall be locked/unlocked by key from the outside knob and pushbutton locked from the inside. Sargent 11 Line by Sargent Company, 9K Series by BEST, or approved equal.

- Latch sets for interior doors shall meet Fed. Spec. FFH-106a-161N. They shall have no locks. Knobs shall be Tulip type rasp.

08110.2.4.4 DEADLOCKING LATCH: Dead lock latches shall have a dead lock, double cylinder B252PD as manufactured by Schlage Locks, T Series by Stanley, or approved equal where shown on the door schedule.

08110.2.4.5 KEYING: Locks shall be keyed in conjunction with the existing system. Keying shall be submitted and is subject to Engineer's approval.

08110.2.5 LOCKS

Shall be Series 11 Line by Sargent, 9K Series by BEST, or approved equal, with L stainless steel levers. Five keys shall be provided for each lock set.

08110.2.6 HINGES

Shall be full mortise, five knuckle, with non-removable hinge pins. The hinges shall be 5 Knuckle Ball Bearing Hinges by Stanley, or approved equal. Each door shall be fitted with three hinges.

08110.2.7 THRESHOLDS

Shall be extruded aluminum, No. 171A, by Pemko, or approved equal.

08110.2.8 DOOR GASKETING

Shall be vinyl bubble, held in place with aluminum molding around the perimeter of the door.

08110.2.9 DOOR BOTTON PROTECTION

All Doors shall be provided with an aluminum molding with a neoprene gasket, No. 315 AN, by Pemko or approved equal.

08110.3 CONSTRUCTION REQUIREMENTS

08110.3.1 MANUFACTURE AND SHIPPING

All doors and doorframes shall be fabricated in a workmanlike manner. Hardware shall be installed by the door manufacturer. Hardware shall be installed so that the doors operate smoothly and with no binding

Doors shall be checked to assure that no damage has occurred during shipment to the Work site.

08110.3.2 INSTALLATION

08110.3.2.1 DOORS AND FRAMES - All doors and doorframes shall be installed in a workmanlike manner. All doors and frames shall be adjusted so that operation will be smooth, free, easy and with no binding in the hardware between doors and frames. Doors shall be set plumb, square and level at their proper elevation and location. All hardware shall be adjusted to operate smoothly, freely and properly. Door holders shall be installed on the outside of doors such that they will not cross the threshold when the door is opened.

Doors and frames shall be reinforced for hinges, locksets, strikes, flush bolts, etc., as required. Doorknobs are to be 40 inches above the floor to the centerline of the knob.

Wood doors shall be installed in accordance with the National Woodworkers Manufacturing Standards. After fitting at job site, all four edges shall receive two coats of clear compatible lacquer.

08110.3.2.2 STEEL TO ALUMINUM CONTACT - Wherever there is a steel to aluminum contact, the two metals shall be separated by butadyne tape or equal.

08110.3.2.3 GASKETING - Gasketing shall be installed in accordance with the manufacturer's recommendations. Installation of gasketing should be delayed until painting of the door and frame has been completed.

08110.3.2.4 PAINTING - Painting of the doors and frames shall be in accordance with the requirements of Section 09910 of these Specifications. Care shall be taken to assure door hardware is not painted.

08110.4 METHOD OF MEASUREMENT

No separate measurement will be made for doors and frames.

08110.5 BASIS OF PAYMENT

Payment for doors and frames shall be included in the contract unit price for the building on which the doors are installed and accepted.

DIVISION 9

FINISHES

SUNRISE
ENGINEERING

09500.1 DESCRIPTION

Work under this section of the Specifications shall include all labor, materials, equipment, and appliances required to furnish and install all lathing and stucco, as well as incidental and related items.

09500.1.1 RELATED WORK

Not used.

09500.1.2 SUBMITTALS

The Contractor shall submit finish coat color and texture samples to the Engineer/Owner for approval and selection.

09500.1.3 DEFINITIONS

Not used.

09500.2 MATERIALS

The materials used in the stucco shall be as follows:

09500.2.1 PORTLAND CEMENT

Portland Cement shall conform to ASTM C 150.

09500.2.2 LIME HYDRATE

Hydrated lime shall conform to Federal Specification No. SS-L-351.

09500.2.3 SAND

The sand used for scratch or brown coats shall be clean, free from organic matter and shall pass the soundness tests of ASTM C88. The loss in weight shall not exceed 10 percent for any sieve size.

SAND SEIVE SIZE

Sieve Size	Percent Passing
No. 89 Mesh	100
No. 14 Mesh	70 to 90
No. 28 Mesh	30 to 50
No. 48 Mesh	10 to 20
No. 100 Mesh	3

Not more than 3 percent of the sand by weight shall be allowed to pass the 100-mesh sieve. Sand shall be thoroughly dampened before using.

09500.2.4 REINFORCEMENT

Reinforcing shall be 3.4 galvanized wire mesh. Metal lath shall weigh not less than 3.4 pounds per square yard. Lath, furring and supporting material shall conform to ANSI A42.4.

09500.2.5 WATERPROOFING PAPER

Waterproofing paper shall be Morstop No. 2 or approved equal.

09500.2.6 WIRES, TIES, AND/OR STRING

Wire and ties shall be galvanized soft annealed No. 18 gauge.

09500.2.7 SCREENS

Screens shall be 26 gauge expanded wingtype, galvanized.

09500.2.8 CASING BEAD

Casing bead shall be Milcor" No. 66, 24 gauge zinc.

09500.2.9 CONTROL JOINT

Control Joint "Milcor" No. 15, 26 gauge zinc.

09500.2.10 FINISH COAT MATERIALS REQUIREMENTS

- Water proofing agent shall be a stearate compound, or approved equal.
- Colors and textures of finish coat shall be as per samples approved by the Engineer.
- Dry stucco mix shall be delivered to the job in the original package.
- Stucco waterproofed exterior float shall be as manufactured by California Stucco Products Company, San Francisco, California; Mission Stucco Company; or approved equal.

09500.3 CONSTRUCTION REQUIREMENTS

09500.3.1 INSTALLATION

All finished work shall be complete and ready for use. All lathing and stuccoing shall be done in accordance with the room finish schedule with details as indicated on the Plans, and as specifically specified within these Specifications. Details of lathing and stuccoing not specifically covered in these Specifications shall be done in accordance with ANSI A42.2 and ANSI A42.3 for Portland cement stucco insofar as they apply to this project, and insofar as they are not in contradiction with the specific requirements of these Specifications.

09500.3.2 WATERPROOF PAPER AND WIRE MESH

Use metal lath with waterproof back behind. Install casing beads, where shown, and wherever plaster abutts or adjoints any other material and at all exposed termination points plaster. Control joints shall be provided in the plaster at a maximum spacing of 15 feet, or as details.

09500.3.3 MORTAR

All mortar shall be mixed in a power mixer for at least 5 minutes before applying. Use only enough clean water to produce a plastic mortar mix. Mortar for both the scratch coat and the browning coat shall be mixed in the following proportions:

MORTAR PROPORTIONS

Ingredient	Amount
Portland cement	1 volume
Hydrated lime	1/10 volume to each volume of cement
Sand	3-1/2 volumes (minimum)

09500.3.4 SCRATCH COAT

After all reinforcement is in place, a scratch coat should be applied. The scratch coat shall be applied so that the reinforcement is entirely embedded to 1/2 inch in thickness. The scratch coat shall be scored in opposite directions with a metal scratching tool having teeth set 1 inch apart. Scratch coat should be wet down for at least two days after application and then be permitted to dry before applying browning coat.

09500.3.5 BROWNING COAT

The scratch coat shall be dampened evenly before applying browning coat. Browning coat shall be applied to a minimum thickness of 3/8 inch and shall be rodded straight and true in all directions. This coat shall be applied to an entire elevation without laps or joinings. Overnight joinings shall be made at natural breaking points, such as rises, angles, and window ledges. Browning coat should be wet down for two days after application and shall be permitted to cure and dry for a minimum of seven days before applying finish coat.

09500.3.6 FINISH COAT

Finish coat shall be waterproofed exterior float. Use only sufficient clean water to produce a plastic mortar.

The browning coat shall be dampened evenly with water before applying the finish coat. The finish coat shall be applied to an entire elevation without showing laps or joinings. Overnight joinings shall be made at natural breaking points, such as rises, angles, or window ledges. This coat shall be a minimum 1/8-inch in thickness. The day after application, this coat shall be fog sprayed lightly, but not to saturation, and maintained in a damp condition for not less than two days or until cured.

09500.4 METHOD OF MEASUREMENT

This work shall be included with that of other items on the Bid Schedule and no separate measurement will be made.

09500.5 BASIS OF PAYMENT

Payment for this work shall be included with that of other items on the Bid Schedule and no separate payment will be made.

DIVISION 10

BUILDING SPECIALTIES

SUNRISE
ENGINEERING

10210.1 DESCRIPTION

The Contractor shall furnish and install fans, louvers, dampers, and ventilators in designated buildings and equipment enclosures in accordance with the Drawings and these Specifications.

10210.1.1 RELATED WORK

Section 10125 - Electric Space Heaters
Section 16010 - Electrical System Requirements

10210.1.2 SUBMITTALS

The Contractor shall provide complete information, which includes cutaway drawings, parts lists, and capacity and manufacturer's installation instructions in accordance with the requirements of Section 01300.

10210.1.3 DEFINITIONS

Not used.

10210.2 MATERIALS

10210.2.1 QUALITY CONTROL

This specification is not intended to be exclusive or limit competition, but rather to set forth the minimum standards for quality and performance. The Owner reserves the right to reject substitutions if in his opinion, the proposed substitutions will not achieve comparable equipment installation and performance standards.

10210.2.2 FANS

10210.2.2.1 WALL FANS - Wall fans shall be new, wall mounted, direct drive fans, mounted in a screened aluminum or steel frame suitable for mounting in an exterior opening. The fan propeller shall be statically and dynamically balanced cast aluminum, rated in accordance with the Air Movement and Control Association (AMCA), Certified Ratings Program, and fitted with ball type bearings. The fan shall have a spun steel venturi/wall base, and a heavy-duty steel power assembly. The fan shall also include an all aluminum motor operated backdraft damper and a ¼ inch by ¼ inch mesh 16 gauge aluminum screen on the inlet, and corrosion resistant fasteners.

The screening shall be removable for maintenance of the motor, and the unit shall be fitted with flanges around the exterior perimeter, which can provide a weather tight fit without additional moldings. The fan motor shall be capable of operating at standard power supply voltages from 110 through 480 volt, single phase or three phase as specified. All wall fans shall be UL listed and shall be manufactured in compliance with NEC and OSHA standards. Noise levels shall not exceed the maximum limits of Section 11010 of these Specifications.

When the Drawings call for wall fans and louvers to be mounted in wall openings, the louvers will typically be installed on the wall exterior to protect the fan. Both the louvers and the fan units should be removable or coordinated for convenient maintenance. Power actuated louvers shall be connected such that they open automatically when the fan is energized.

10210.2.2.2 TUBE FANS - Tube fans shall be new, direct drive, tube type fan units capable of being mounted directly in a circular pipe duct. The fan motor and housing shall be fabricated from corrosion

resistant steel, aluminum, or plastic and shall be capable of operating in both a vertical or horizontal orientation. The fan propeller shall be rated in accordance with the AMCA Certified Ratings Program. The fan shall have straightening vanes, which are heliarc welded at the discharge side of the unit to eliminate turbulence. The fan shall have a pre-wired twist lock disconnect, and the motor shall be out of the air-stream. The fan wheel shall incorporate true airfoil blades, which are heliarc welded to the hub with non-overloading characteristics. The fan support bracket shall include an extruded rubber isolator. The fan motor shall use ball bearings and shall be capable of operating on a 110 through 480 volt, single phase or three phase standard power supply, as specified. All tube fans shall be UL listed and shall be manufactured in compliance with NEC and OSHA standards. Noise levels shall not exceed the maximum limits of Section 11010 of these Specifications.

10210.2.3 LOUVERS AND DAMPERS

10210.2.3.1 MECHANICALLY OPERATED LOUVERS - Mechanically operated louvers shall be the type and size shown on the Drawings, and shall be as manufactured by the Airolite Company, Penn Ventilator Company, Vent Products Company, Inc., or approved equal. The frame and blades shall be 0.080 6063T5 extruded aluminum, with a standard mill finish, and the frames shall be formed to fit the openings. Blades shall be accurately fitted and firmly secured to the frames. The edges of all louver blades shall be folded or beaded for rigidity. The louvers shall include blade edge seals, and a flange mounting system, unless otherwise shown on the Drawings. Axles shall be ½-inch minimum diameter x 2-inch long plated steel rods. Bearings shall be ½-inch minimum diameter nylon. All louvers and dampers shall be furnished with ¼-inch by ¼-inch mesh 16-gauge aluminum bird screens in a standard folded frame, installed on the inside face of fixed louvers, on outside face for adjustable or automatic louvers, unless shown otherwise on the Drawings. Unless specified otherwise, mechanically operated louvers shall close automatically when the fan is not operating. Louvers shall receive a Class I anodized coating.

10210.2.3.2 POWERED LOUVERS - Where powered operators are required, the louvers shall be fully equipped and set up with the powered operators installed. Powered operators shall be sized as shown on the drawings and shall be as manufactured by Barber Coleman, or approved equal.

10210.2.3.3 FIXED LOUVERS - Galvanized steel fixed louvers shall be a complete factory assembled unit with stationary blades welded securely to the frame and of the size and configuration shown on the Drawings. Louvers shall be fabricated from 10 gauge galvanized steel sheet and fit with a #10 copper alloy insect screen soldered to the inside surface of the louvered opening. Unless shown otherwise in the CONTRACT DOCUMENTS, painting of galvanized louvers will not be required.

10210.2.3.4 DOOR LOUVERS - Door louvers shall be complete factory assembled, adjustable steel (19 gauge min.) door louvers with manually operated shutters, which can be closed tight. The louvers shall be fit with mounting brackets, which form a tight fit around the opening in the door. The louver shall incorporate a factory installed coating system. The color shall be as selected and approved by the OWNER. The louver shall be the model, size and configuration shown on the Drawings. When no size is shown on the Drawings, door louvers shall be 12 inches by 24 inches.

10210.2.4 ROOF VENTILATORS

10210.2.4.1 POWERED ROOF VENTILATORS - Powered roof ventilators for attic ventilation shall operate automatically on a thermostat that can be adjusted between 60°F and 120°F. The ventilators shall be sized as shown on the Drawings. The units shall include built-in safety firestats in the thermostat housings that will automatically shut off power to the units if the temperature reaches or exceeds 170°F, to prevent the vent from drawing in more air in the event of a fire. The units shall be of all metal construction of either galvanized steel, aluminum, or both. No plastic domes or flashing plates shall be used. The units shall incorporate an integral screen of 1/8-inch mesh

maximum, to keep out birds and large insects. Appropriate flashing and lap cement shall be installed to ensure that the vents are fully weatherproof.

10210.2.4.2 WIND DRIVEN TURBINES - Wind driven turbine roof ventilators installed to remove hot attic air and to prevent condensation under winter conditions, shall be 12-inch internally braced turbine ventilators, as shown on the Drawings. Ventilators shall be constructed of 24-gauge galvanized steel with an aluminum painted finish, and shall have ribbed blades for added strength. Turbine ventilators shall use hard chrome plated DuPont Delrin bearing systems, or approved equal. The ventilator shall be supplied with an integral automatic damper, designed to fit inside the 12-inch turbine base and turbine with base units. The damper shall be fully open at 90°F and shall be fully closed at 50°F. When installed on pitched roofs the ventilator shall employ an angle adjustable base, which will allow the ventilator to be installed with the axis of ventilator rotation plumb. Appropriate flashing and lap cement shall be installed to ensure that the vents are fully weatherproof.

10210.2.5 TURBINE VENTILATORS FOR ROOM VENTILATION

Wind driven turbine roof ventilators installed to circulate and vent warm air out of building spaces shall be 12-inch internally braced turbine ventilators, as shown on the Drawings. Ventilators shall be constructed of 24-gauge galvanized steel with an aluminum painted finish, and shall have ribbed blades for added strength. Turbine ventilators shall use hard chrome plated DuPont Delrin bearing systems, or approved equal. The ventilator shall be supplied with an integral thermally actuated automatic damper, designed to fit inside the 12-inch turbine base and turbine with base units. The damper shall be fully open at 90°F and shall be fully closed at 50°F. When installed on pitched roofs the ventilator shall employ an angle adjustable base, which will allow the ventilator to be installed with the axis of ventilator rotation plumb. Turbine roof ventilators used for room ventilation shall incorporate ductwork through the roof, attic spaces and ceiling. A factory painted aluminum or vinyl louvered grille shall be fastened to the ceiling to cover the duct opening in the ceiling. The louver shall closely match the interior ceiling colors. The ductwork shall be 24 gauge galvanized steel, minimum. Appropriate flashing and lap cement shall be installed to ensure that the vents are fully weatherproof.

10210.3 CONSTRUCTION REQUIREMENTS

Fans, louvers, dampers and ventilators shall be installed at the locations shown on the Drawings. Installations shall be in strict accordance with the manufacturer's installation instructions, NEC, OSHA, applicable local codes and requirements, the Drawings, and these Specifications. Wall openings shall be as shown on the Drawings.

Equipment installed in a concrete or masonry opening shall be mounted with expansion anchors through the frame or flange, or as otherwise detailed on the Drawings. Equipment installed in a wood framed opening shall be installed using lag screws or bolts, or as otherwise detailed on the Drawings. Where a caulked seal is required, ventilation equipment shall be provided with caulking stops. After installation, all joints between the equipment and the opening shall be caulked.

10210.4 METHOD OF MEASUREMENT

10210.4.1 NO MEASUREMENT

Unless a separate bid item for furnishing and installing the work outlined in this Section is provided in the Bid Schedule, this work shall not be measured for separate payment, but shall be considered incidental to other items in the Bid Schedule.

10210.4.2 SEPARATE MEASUREMENT

Where items installed under this section are listed separately in the Bid Schedule, the items shall be measured by counting the completed and accepted units.

10210.5 BASIS OF PAYMENT

Complete compensation for the accepted work outlined in this Section shall be included in other bid items when no separate bid item is provided in the Bid Schedule for this work.

When a separate bid item is provided in the Bid Schedule, complete compensation for this accepted work shall be included in the contract unit price on the Bid Schedule.

PAY ITEM	UNIT
Install (*Size*) (*Type*) Louvers	Each
Replace (*Size*) (*Type*) Louvers	Each
Install (*Size*) (*Type*) Fan	Each
Replace (*Size*) (*Type*) Fan	Each
Install (*Size*) (*Type*) Damper	Each
Replace (*Size*) (*Type*) Damper	Each
Install (*Size*) (*Type*) Roof Ventilator	Each
Replace (*Size*) (*Type*) Roof Ventilator	Each
Install (*Size*) (*Type*) Room Ventilator	Each
Replace (*Size*) (*Type*) Room Ventilator	Each

DIVISION 11

PROCESS AND MECHANICAL EQUIPMENT

SUNRISE
ENGINEERING

11010.1 DESCRIPTION

This section is included for guidance in the selection and installation of mechanical equipment. The requirements contained herein apply to all items of mechanical equipment the same as if these provisions were contained in the individual part of the Specifications for the equipment.

11010.1.1 RELATED WORK

Not used.

11010.1.2 SUBMITTALS

11010.1.2.1 SHOP DRAWINGS – Shop drawings shall be submitted as follows:

- The Contractor shall submit Shop Drawings to the Engineer for approval on all mechanical equipment to be furnished under this Contract in accordance with Section 01300. The number of copies submitted shall be four, PLUS the number of copies the Contractor wishes to have returned.

- Prior to submitting the drawings, the Contractor shall review the information for completeness. Only complete information will be reviewed by the Engineer, and only after the Contractor has signified his approval of the information. Shop drawings will not be approved until cut-away or assembly drawings, with part and material specification lists, have been submitted.

- Shop drawings shall consist of a cover sheet which indicates intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the Specifications. In some special cases reproducible transparencies of Shop Drawings shall be furnished to the Engineer in addition to the above mentioned number of copies.

- Shop drawings for motors shall include published dimension sheets and shall include a motor data sheet which shows all the motor characteristics, i.e., horsepower, voltage, code letter, design letter, service factor, enclosure, insulation, etc. All characteristics of the motor shall be shown on the data sheet, which shall be approved by the Engineer prior to delivery of the motor.

- Shop drawings for pumps shall include make, style, speed, size, type, head-capacity, efficiency, materials used, design features, weights, etc. All characteristics of the pump shall be shown on the data sheet, which shall be approved by the Engineer prior to delivery.

- The Contractor shall assume the responsibility to ensure that approved guards for all drive units, pulleys, or rotating shafting are detailed on Shop Drawings and submitted with them to the Engineer for approval.

11010.1.2.2 PARTS CALCULATIONS AND DETAILS - The Contractor shall provide calculations and details on all parts individually and collectively to show that the equipment offered satisfies the performance, strength, vibration, and other requirements of these Specifications.

11010.1.2.3 GEAR REDUCTION UNITS - The Contractor shall submit complete engineering information, catalog data, design features, load capacities, and mechanical efficiency ratings for each gear reduction unit incorporated in the work. This information shall also be included in the equipment Operation and Maintenance Manuals, as described herein.

11010.1.2.4 OPERATION AND MAINTENANCE MANUALS - The Contractor shall furnish to the Owner four (4) copies of Operation and Maintenance (O & M) Manuals for each system or item in accordance with Section 01300 of these Specifications and as follows:

- O & M manuals shall be broken down into sections. The sections shall include Mechanical Equipment, Automatic and Special Valves, Control Systems, Electrical, and other additional sections as necessary. All sections shall be labeled and each item shall be sub-labeled. Each section shall include a description of the operation and maintenance of each item or component included in that section.
- There shall be included in the front of each manual an index laminated with plastic on both sides for protection against rough use.
- Each manual shall be bound in hard cover
- The manuals shall be delivered to the Owner prior to installation of any operating equipment.
- No acceptance of any equipment will be made until the complete manuals have been submitted, evaluated and approved.
- One copy of the complete manual shall be at the jobsite available for use by the Contractor's field personnel, the Owner, and the Engineer during installation, start-up and testing of the equipment.

11010.1.3 DEFINITIONS

Not used.

11010.2 EQUIPMENT

11010.2.1 QUALITY CONTROL

All equipment shall be the product of a manufacturer experienced in the design, construction, and operation of equipment for the purpose required. The manufacturer shall have furnished such equipment long enough to be able to show a record of successful operation for a period of not less than two years. When two or more units of equipment for the same purpose are required, they shall be products of the same manufacturer.

11010.2.2 MANUFACTURER'S GUARANTEE

Manufacturers or suppliers of all equipment furnished under this contract shall guarantee said equipment for a period of 1 full year from the date of Substantial Completion or Final Acceptance of the work in accordance with Section 00700.29 of these Specifications. Equipment shall be made up of parts which are designed to act as a unit; and the manufacturer shall guarantee that when the component parts are assembled into the final unit, these parts will fit and operate satisfactorily.

11010.2.3 ACCOMMODATION TO SEA LEVEL

The elevation of this project above sea level is shown on Drawings. Design and performance of all mechanical equipment shall conform thereto.

11010.2.4 GENERAL REQUIREMENTS

11010.2.4.1 HEAVY DUTY RATING - The manufacturer shall rate all mechanical items heavy duty. All parts of equipment shall be amply proportioned for all stresses, which may occur during operation and for any additional stresses, which may occur during fabrication and erection. Unless specified otherwise, all bearings shall be sized as a minimum for 100,000-hour service at maximum loading under AFMBA B-10 conditions.

11010.2.4.2 STEEL AND IRON - Structural steel shall conform to ASTM A 36. Iron castings shall be tough close-grained gray iron castings in accordance with ASTM A 48.

11010.2.4.3 FASTENERS - All fasteners for aluminum shall be stainless steel. All steel other than stainless steel shall be isolated from aluminum with stainless steel, neoprene, or other approved material.

11010.2.4.4 MODIFICATIONS TO PRODUCTION LINE EQUIPMENT - Modifications shall be made in manufacturer's equipment to make it conform to the specific requirements of the Drawings and Specifications, if the standard product does not fulfill all requirements.

11010.2.4.5 PRODUCTION LINE IMPROVEMENTS - All equipment shall include all production line improvements made prior to the contract or delivery date.

11010.2.5 MOTORS

11010.2.5.1 GENERAL - The purpose of this subsection is to identify and define premium quality electric motors having high electrical and mechanical integrity and energy efficient operation under adverse operating conditions to give maximum life and minimum life cycle costs.

11010.2.5.2 COMPLIANCE – Standards for motors are as follows:

- Motors shall be totally enclosed, either fan-cooled or non-ventilated, squirrel-cage induction motors, NEMA frame size 182T through 449T, as indicated on the Drawings or prescribed in the Special Provisions. Motors shall be Reliance XE or approved equal.
- All motors covered by this specification shall conform to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards, including IEEE Std. 841.
- Motors shall be designed for continuous duty for 3-phase, 60 HZ, 200, 230, 230/460 or 575 volt operation, NEMA design B.
- Ratings shall be based on a 40°C ambient temperature and on operation at the given project altitude. Ratings shall provide for a maximum resistance temperature rise of 80°C at a service factor of 1.0, and a 90°C rise at a service factor of 1.15, through 150HP.
- Motors shall be furnished with Class F insulation, 1.15 service factor but shall be selected for operation within their full load rating without applying the service factor.
- Motors shall be of a premium efficient design and shall be different from the manufacturer's standard efficient product.
- Motors shall be evaluated on conformance to this specification and total costs including initial cost and operating life-cycle cost. Life-cycle cost to be based on motor efficiency evaluation at a stated dollar penalty per kilowatt of motor losses based on specific operating conditions.

11010.2.5.3 CONSTRUCTION - Motor rotor construction shall be die cast aluminum or fabricated copper or their respective alloys. Rotors on frames 213T and above shall be keyed to shaft and rotating assembly dynamically balanced to and .0005 inches peak to peak 182T-326T frames, and .00075 inches peak to peak 364T-449T frames. Balance weights, if required, shall be secured to the rotor resistance ring or fan blades by rivets. Machine screws and nuts are prohibited. The entire rotating assembly between bearing inner caps shall be coated with a corrosion-resistant epoxy.

11010.2.5.4 MECHANICAL – Mechanical requirements shall be as follows:

- Bearings shall be ball, open, single row deep groove, Conrad type, and shall have a Class 3 internal fit conforming to AFBMA Std. 20. For belted duty applications, drive end bearing may be cylindrical roller type.

- Bearings shall be selected to provide L10 rating life of 17,500 hours minimum for belted applications, 100,000 hours minimum for flexible direct coupled applications. Calculations shall be based on external loads using NEMA belted applications limits per MG1-14.07 and typical sheave weights and internal loads defined by the manufacturer including magnetic pull and rotating assembly weight.

- Bearing temperature rise at rated load shall not exceed 60°C 3600 RPM or 50°C 1800 RPM and slower. Temperature rise is to be measured by RTD or thermocouple at bearing outer race.

- Bearing AFBMA identification number shall be stamped on motor nameplate.

- Motor lubrication system shall consist of a grease inlet on motor bracket with capped grease fitting on inlet, grease relief plug 180 degree from inlet, grease reservoir in bracket and grease reservoir in cast inner cap.

- Motor to be greased by manufacturer with a premium moisture resistant polyurea thickened grease containing rust inhibitors and suitable for operation over temperature from -25°C to 120°C.

- Bearings shall be protected by INPRO/SEAL bearing isolators on both ends of the motor unless otherwise approved by the Engineer.

11010.2.5.5 ENCLOSURE – Motor enclosure including frame with integrally cast feet, end brackets, locking bearing inner caps, fan guards, and conduit box and cover shall be cast iron, ASTM Type A-48, Class 25 or better.

11010.2.5.6 CONDUIT BOX - Motor conduit box shall be cast iron construction; rotatable in 90-degree increments, diagonally split with tapped NPT threaded conduit entrance hole. Neoprene conduit box cover gasket and neoprene lead seal gasket between box and motor frame shall be furnished. The conduit box shall incorporate a mounted, clamp-type ground lug.

11010.2.5.7 COOLING FAN – The external cooling fan shall be corrosion-resistant, non-sparking, bi-directional, keyed, clamped and shouldered on the motor shaft.

11010.2.5.8 BREATHER DRAINS - Stainless steel automatic breather drains shall be provided in the lowest part of both front and back end brackets to allow drainage of condensation.

11010.2.5.9 MOUNTING HARDWARE - All mounting hardware shall be hex head, high strength, SAE Grade 5, plated for corrosion protection. Screwdriver slot fasteners are prohibited. A forged, steel, shouldered eyebolt shall be provided on all frames. Eyebolt receptacle shall be threaded and designed to prevent moisture or foreign material from entering motor when eyebolt is removed.

11010.2.5.10 NAMEPLATE - Corrosion resistant stainless steel nameplate shall be affixed to motor frame with stainless steel or brass drive pins. Nameplate(s) shall include all required NEMA data and AFBMA bearing numbers, and connection diagram for dual voltage motors.

11010.2.5.11 SHAFT SLINGER - An external V-ring shaft slinger shall be provided on both shaft extensions 254T and larger and on the drive end shaft only 182T-215T to minimize entrance of moisture or foreign material into bearing cavity.

11010.2.5.12 CORROSION PROTECTION - Frame to end bracket assembly of machined parts shall be protected and sealed by application of thick corrosion-resistant material to the machine surfaces prior to assembly.

11010.2.5.13 ELECTRICAL – Electrical requirements shall be as follows:

- All motors shall successfully operate under power supply variations per NEMA MG1-14.30.
- All motors shall be NEMA Design B with torque and starting currents in accordance with NEMA MG1-12.35 and 12.38 except in special applications requiring higher starting torques where NEMA Design C is permitted.
- Motors shall have copper windings.
- Motor insulation system shall be Class F minimum, utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests.
- Motor leads shall be nonwicking type, Class F temperature rating or better and permanently numbered for identification.
- The entire wound and insulated stator shall receive an additional coating of epoxy paint on all air gap surfaces, to protect against moisture and corrosion.

11010.2.5.14 FACTORY TESTING - Each completed and assembled motor shall receive a routine factory test per NEMA standards.

11010.2.5.15 NOISE - The no-load sound pressure level, based on the A-weighted scale at 3 feet when measured in accordance with IEEE Std. 85 should not exceed 85 DBA.

11010.2.5.16 EFFICIENCY - All motors shall be of an energy-efficient design, different from manufacturer's standard product through the use of premium materials, design and improved manufacturing process, that reduces motor losses approximately 40% from standard efficient designs, and whose minimum efficiencies exceed NEMA Table MG1-12.6C. Motor efficiency shall be determined in accordance with NEMA Standard MG1-12.54 and full load efficiency labeled on motor nameplate in accordance with NEMA Standard MG1-12.55.

11010.2.5.17 FINISH - All motor parts including frame, brackets, fan cover, and terminal box shall receive a minimum of two coats of high grade USDA accepted epoxy paint. Motor assembly must satisfactorily withstand salt spray tests for corrosion per ASTM B-117 for 96 hours.

11010.2.6 PUMPS

11010.2.6.1 GENERAL - The Contractor shall furnish, install, and test all pumps. Pumps shall be of heavy-duty construction for heavy-duty continuous service or for intermittent service, whichever imposes the most severe service on the pump. Pumps of inferior design or make will not be accepted.

11010.2.6.2 MECHANICAL DEFECTS - Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive motor heating, defective materials, improper fitting of parts, and any other defect which will in time damage the pump or pumps or unreasonably impair the efficiency of the pumps.

11010.2.6.3 CAUSE FOR REJECTION – Rejection of pumps for cause will be as follows:

- Pumps that have mechanical defects or do not meet the range of head-capacity characteristics, efficiency, and vibration requirements will be rejected and shall be replaced at the Contractor's full expense for furnishing, installing, removal, and replacement.

- If it is found upon delivery that the pump materials do not agree with the requirements of the Specifications as to size, type, quality, or metallurgy, they will be rejected as unfit for use on this project. Bronze or brass parts of any pump in contact with the pumped liquid shall contain no aluminum nor greater than six percent zinc.

11010.2.6.4 FRICTION LOSSES - Pump friction losses, including entrance, column, shaft, and discharge losses shall be added to the total dynamic heads that are specified under each pump in order to get the head that the impeller must pump against. Pump head-capacity curves shall indicate that these losses have been included.

11010.2.6.5 PRESSURE GAUGES - Pumps shall be tapped at the suction and discharge for pressure gauges. In general, all pumps that can be tested by pressure gauges shall be provided with suitable taps on both suction and discharge. Taps may be in pumps or in adjacent pipes within three inches of the pump flange.

11010.2.6.6 TESTING - Each and every pump, with its motor, drive, gearing, etc., shall be checked run, and tested at the place of manufacture. In addition, all pumps shall be volumetrically tested as to head-capacity requirements and for the purpose of cross checking the calibration of meters as required by the Engineer, after installation. Four certified laboratory performance curves for each pump shall be submitted to the Engineer for approval before shipment of the pump.

11010.2.7 MECHANICAL POWER TRANSMISSION EQUIPMENT

All mechanical power transmission equipment including V-belts, sheaves, chains, sprockets, mechanical variable speed drives, gear reducers, open and enclosed gearing, clutches, brakes shall be rated for 24-hour a day service and sized with a minimum service factor of 1.5. The 1.5 service factor shall be related to the nameplated HP and torque of the prime source of power and not the equipment actual loading. Should the manufacturer recommend a service factor larger than 50%, the manufacturer's recommendation shall take precedence.

11010.2.8 GEAR REDUCTION UNITS

11010.2.8.1 CONSTRUCTION - Unless otherwise specified, all gear reduction units shall be helical or herringbone type. No planetary gear units shall be used for any purpose, and worm gear type units may be used only where specified. Gears of gear reduction units shall be made of highest quality alloys treated for hardness and severe service. The complete reduction unit shall be fully enclosed

in a heavy cast iron housing with gears running in oil. All bearings shall be of the anti-friction type.

11010.2.8.2 CLASS OF SERVICE - Gear reduction units shall be selected for the class of service specified. The class of service must be determined by the manufacturer of the gear reduction units after being informed by the Contractor as to what equipment the units are to be used for and to what type of duty the equipment will be subjected. Where no class of service is specified, gear reduction unit class of service shall be Class II or heavier, as required, as classified by the American Gear Manufacturers Association.

11010.2.8.3 CAPACITY AND PERFORMANCE - The actual and rated horsepower capacity, torque, overhung capacity, and bearing capacity of each reduction unit shall be not less than the horsepower rating of the drive motor nor less than that which will be encountered under full load and under the most severe operating conditions which the equipment will be called upon to operate. The Engineer may reject any gear reduction unit that does not meet the above requirements. Only gear reduction units of long established manufacture and reputation may be used.

11010.2.9 SPECIAL TOOLS

All special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment shall be furnished with the equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation instructions describing the use of each marked tool.

11010.2.10 LUBRICATION FITTINGS

All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housing, or guards. Fittings shall be accessible from safe, permanent walk or walk areas without ladders, scaffolds, etc. Fittings shall be Lincoln “Bullneck” Hydraulic Surface Check Fittings (Lincoln Engineering Co., St. Louis, Missouri), or approved equivalent. Lubrication fittings shall be mounted together wherever possible. They shall not be individual fittings field mounted together, but use shall be made of factory-mounted multiple fitting assemblies located in convenient area. Connection from multiple fitting assemblies to point of use shall be minimum 3/16” stainless steel tubing, securely mounted parallel with equipment lines and protected where exposed to damage.

11010.2.11 MACHINERY AND EQUIPMENT GUARDS

11010.2.11.1 CONSTRUCTION AND INSTALLATION - All machinery drive units, pulleys, or rotating shafting shall be furnished with approved guards, shields, or barriers. Such guards, shields, or barriers shall be neatly and substantially constructed, adequately supported from adjacent framing,. Guards shall be constructed of 6061-T6 aluminum unless otherwise indicated. The frame shall be covered with expanded aluminum for heat dissipation. All guards shall be isolated so no dissimilar metals come into contact.

All guards shall be sized to allow installation of pulleys up to and including 15 percent over size. The width of the guard shall be such as to allow one additional belt to be added in the future.

11010.2.11.2 COMPLIANCE - Guards shall be provided in all cases where required by state or OSHA or local codes. While all such guards may not be shown in detail on the Drawings, the Contractor is

expected to be familiar with the requirements of local, state, and federal regulations regarding machinery guards and safety devices.

11010.2.12 PAINTING

All equipment furnished for the project shall be painted in accordance with the requirements of Division 9 of these Specifications.

11010.3 EQUIPMENT CONSTRUCTION, INSTALLATION, AND TESTING

11010.3.1 GENERAL

The furnishing and installation of equipment shall include testing, painting, checking levels and alignment, furnishing and placing of lubricants of whatever type, and furnishing of factory-trained service mechanics or engineers where called for. All equipment when finally installed shall be complete and ready for operation without binding or overloading of critical components or motors. The Contractor shall furnish at no extra cost to the Owner all appurtenances, piping, valves, fittings, wiring, supports, hangers, etc., as are required to place the equipment in first-class operating condition and in a near and workmanlike manner.

11010.3.2 INSTALLATION

11010.3.2.1 GENERAL - Equipment shall be installed complete and ready to operate by skilled craftsmen. Each craftsman employed to install a specific type of equipment shall be thoroughly trained in the particular trade required to install that equipment.

All moving parts of equipment and machinery shall be carefully installed, tested for operation, and adjusted so that all parts move freely and function to secure satisfactory operation.

11010.3.2.2 WELDING - Qualified welders in accordance with applicable welding codes and procedures shall perform all welding. Welding shall be by electric arc, unless otherwise shown on the Drawings or required by these Specifications.

11010.3.2.3 ANCHOR BOLTS - Anchor bolts for heavy equipment shall be encased in metal tubing having an inside diameter not less than two times that of the bolt, unless otherwise detailed on the Drawings. Foundations for pumps, motors and other equipment shall be left one inch below the grade of machine base unless otherwise required on the Drawings. After the proper setting of machine for alignment and grade, the recess below the equipment base, together with recess between the anchor bolt and the metal tube, shall be grouted and carefully finished with non shrink grout.

11010.3.2.4 PIPING - All piping required for proper operation of equipment shall be installed. Piping layouts may require modification from that shown on the Drawings depending on equipment furnished. All costs for piping or piping modifications required to suit the particular equipment furnished shall be borne by the Contractor.

11010.3.2.5 ELECTRICAL - Unless otherwise specified herein all electrical work, materials and equipment shall conform to the provisions of Division 16, Electrical of these Specifications. It shall be the responsibility of the Contractor to provide complete electrical systems sized to suit the equipment furnished and installed.

11010.3.2.6 ALIGNMENT OF MOTORS AND EQUIPMENT – Alignment of motors and equipment shall be as follows:

- In general, checking and correcting the alignment shall follow the procedures established in Section B (1X) of the Standards of the Hydraulic Institute, Instructions for Installation, Operation, and Maintenance of Centrifugal Pumps, as applicable.

- In all cases, the equipment shall be properly leveled and brought into angular and parallel alignment.

- Equipment bases shall not be grouted nor foundation bolts finally tightened until all piping connections are complete and in satisfactory alignment, such that no strain is transmitted to the equipment.

- In every case where a drive unit is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and the alignment between the motor and the equipment checked and corrected after the complete unit has been leveled on its foundation. The alignment shall then be checked and corrected again after the grout has cured and the foundation bolts have been tightened.

11010.3.2.7 GROUTING – Grouting shall be performed as follows:

- Machinery shall first be perfectly aligned and leveled by means of steel wedges and shims near the anchor bolts. Anchor bolts shall be tightened against the shims on wedges before placing grout.

- Before grout placement, equipment foundations shall be prepared by chipping, hammering or sand blasting the entire concrete surface which will be grouted to remove any dirt or grease and to expose the concrete aggregate, unless approved otherwise by the Engineer.

- The equipment shall again be checked for level and alignment.

- The roughened foundation shall then be thoroughly cleaned, and the grout shall be thoroughly packed into place, filling all voids under the base of equipment.

- Special non-shrink grout shall be used in the placement of all heavy equipment and equipment bases. Non-shrink grout shall be as specified in Division 3 of these Specifications.

- Grout around all machinery bases shall be neatly pointed. All sandblast residue, grease, and debris shall be removed before any grout placement is started.

11010.3.3 TESTING

11010.3.3.1 GENERAL - Before testing, all equipment and mechanisms shall be filled by the Contractor with the proper amounts and types of oil and grease as recommended by the equipment manufacturer. The Contractor shall furnish all personnel, chemicals, and other necessary items as are required for the initial testing of equipment.

11010.3.3.2 DURATION OF TEST - Generally each piece of equipment, which in its normal use will operate for prolonged periods, shall be operated by the Contractor for at least 24 hours after installation, unless the Engineer is satisfied that a shorter test period is adequate. Satisfactory completion of this test does not relieve the Contractor of his responsibility in the event of binding, overloading, over-heating, or other equipment failure or malfunction after initial testing is performed.

11010.3.3.3 VIBRATION - The prime supplier shall make field tests for acceptable vibration in the on all pumps or other equipment with rotating shafts and/or a drive unit. Units shall be field tested for vibration after installation using the following process:

- All vibration testing shall be performed in the presence of and be witnessed by the Engineer. Testing shall be as required by the Engineer at various speeds between maximum and minimum. The Engineer shall be furnished a complete copy of vibration test data for each test performed.
- Each unit shall be tested separately with no other unit running.
- Drive systems, complete with motors, in place at the jobsite shall not vibrate more than 0.012 amplitude inch. Amplitude as used in this Section shall mean total peak-to-peak displacement, and it shall be measured by an IRD Vibration Meter, Model 306, or approved equal.
- All field tests shall be running tests with the drive unit driving the equipment.
- The equipment shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the drive system; shall have the torsional critical speed 20 percent above the maximum speed of the pump and drive system.
- Vibration that occurs at the rotational critical speed shall not be greater than 0.012 amplitude inch; and shall be free of apparent unbalance caused by defective bearings, by close-fitting parts which may rub on the rotating parts intermittently, by loose discs or rotor parts, unbalanced loads, or by oil whip.
- Unless directed otherwise by the Engineer, vibration shall be measured at the top of the motor.

11010.3.3.4 NOISE LEVELS – Noise levels for the equipment and motors shall be measured in the field in accordance with AGMA 295.03. The combination equipment and motor, shall be designed to emit not more than 85 dBA when the measurements of the “C” network of the sound level meter are converted to “A” network readings or read directly on “A” network, unless otherwise specified. The manufacturer shall guarantee the sound levels specified. Enclosures built over the units are not acceptable as a means to meet specified sound levels. Each piece of equipment and its driver shall be tested through the range of possible operating speeds.

11010.4 METHOD OF MEASUREMENT

Not used.

11010.5 BASIS OF PAYMENT

Not used.

DIVISION 15

MECHANICAL

SUNRISE
ENGINEERING

15010.1 DESCRIPTION

15010.1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 15 and other Divisions and Sections of the Specification where referenced.

B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 15.

C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

D. Inspection: Inspect work preceding or interfacing with work of Division 15 and report any known or observed defects that affect the Work to the Construction Manager/General CONTRACTOR. Do not proceed with the work until defects are corrected.

E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This CONTRACTOR shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect division 15000 work.

15010.1.2 RELATED WORK

Requirements: Provide Basic Requirements in accordance with the Contract Documents.

15010.1.3 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

A. Provide all building services extensions and connections to off-site and on-site utilities.

B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 15 CONTRACTOR.

C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Site Utilities CONTRACTOR.

D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities CONTRACTOR.

E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities CONTRACTOR.

F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 15 CONTRACTOR. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 15 CONTRACTOR.

G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.

H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection CONTRACTOR, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.

1. CONTRACTOR shall coordinate with other trades all interface piping and types of connections to be provided for interface.
2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

15010.1.4 REFERENCES

General:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.

3. When required by individual Specifications section, obtain copy of standard. Maintain copy at job site during work until substantial completion.

15010.1.5 DEFINITIONS

A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words of phrases such as "the CONTRACTOR shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

E. Indicated: The term “Indicated” is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used in lieu of “indicated”, it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

F. General CONTRACTOR: The term “General CONTRACTOR” used in Division 15 and elsewhere in the Contract Documents means the party with whom the OWNER has executed the OWNER-CONTRACTOR Agreement.

G. Approved equal: Except as otherwise defined in greater detail, term “approved equal” means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

15010.1.6 QUALITY ASSURANCE

A. Quality Control

1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.

2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.

3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.

B. Proof of Performance

1. Division 15 CONTRACTOR shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or OWNER. A signed certificate from the piping, sheetmetal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 15000 CONTRACTOR for inclusion in the Operation and Maintenance Manual.

15010.1.7 REGULATORY REQUIREMENTS

A. Execute Work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
State Department of Health Requirements
Model Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards

C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the UBC, and listed by Underwriters Laboratories, Inc.

15010.1.8 SUBMITTALS

A. CONTRACTORs are required to submit Mechanical Cost Breakdown to Engineer when submitting shop drawings. Shop drawings will not be accepted without a complete Mechanical Cost Breakdown. See last page of this Section for requested breakdown. If your standard compilation of bids is different than our requested breakdown, please send it in your format. We need the data to keep our cost estimating files up to date. Just fill-in blanks with a pencil, typing is not required.

B. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 15 in accordance with The General Conditions of the Contract. The CONTRACTOR agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the CONTRACTOR is to demonstrate to the Engineer that the CONTRACTOR understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. CONTRACTOR further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.

C. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder.

D. Test Reports: Submit certified test reports as required by various Sections of Division 15 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.

E. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.

15010.1.9 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.

B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.

C. NOTE: When alternate or substitute materials and equipment are used Division 15 CONTRACTOR shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General CONTRACTOR and other affected subcontractors shall be the responsibility of the Division 15 CONTRACTOR.

15010.1.10 PROJECT RECORD DOCUMENTS

A. General: Comply with Division 1.

B. Job Site Documents: Maintain at the job site, one record copy of the following:

1. Drawings
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

C. Record Information: Label each document “Record Document”. Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.

2. Dimensioned location of internal utilities and appurtenances concealed in construction.

3. Field changes of dimension and detail.

4. Changes by change order or field order.

5. Details not on original contract drawings.

6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.

E. Record the following information on Specifications.

1. Changes by change order or field order.
2. Other matters not originally specified.

F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

G. Submittal: At completion of project, deliver record documents to OWNER's representative and transmit a copy of signed receipt from OWNER to the Engineer.

15010.1.11 OPERATING AND MAINTENANCE DATA

A. Division 15 CONTRACTOR shall submit three (3) typed and bound copies of the maintenance manual, 8-1/2" x 11" in size, to the Mechanical Consulting Engineer for approval. These approved copies will be returned to the CONTRACTOR and shall then be transmitted to the OWNER.

B. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.

C. The manual shall be enclosed in a stiff-back, three-ring binder and shall have:

1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.

2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/ shutdown and long-term shutdown.

3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.

4. All test reports and proof of performance certificates.

5. Manufacturer's data on each piece of equipment, including the following. Provide original printed material in each book, faxes and photocopies are NOT acceptable.

a. Installation instructions.
b. Drawings and specifications (final shop drawings).
c. Parts lists.
d. Complete "as-built" wiring and temperature control diagrams. (Shop drawings are not acceptable.)
e. Lubrication and other preventative maintenance data.
f. Equipment warranties.

D. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the “Maintenance Manual”.

2. Tag all manual operating valves per requirements in Section 15010.

3. Provide a typed tag list or schedule mounted under glass in the equipment room stating number, location, and function of each tagged item. Insert a copy of tag list in each “Maintenance Manual”.

E. Division 15000 CONTRACTOR shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the Architect, Construction Manager/General CONTRACTOR and far enough in advance so that all necessary personnel can be adequately notified.

15010.1.12 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

15010.1.13 PROJECT CONDITIONS

A. Accessibility:

1. Division 15 CONTRACTOR shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with CONTRACTORs of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General CONTRACTOR of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 15 CONTRACTOR shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this

purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General CONTRACTOR prior to making the change.

3. Division 15 CONTRACTOR shall provide the Construction Manager/General CONTRACTOR with the exact locations of access doors for each concealed valve, shock absorber control, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.

B. Fabrication: Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the CONTRACTOR shall assure himself that they can be run as contemplated in cooperation with CONTRACTORS of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

C. Freeze Protection: Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

D. Scaffolding, Rigging and Hoisting: Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

15010.1.14 COORDINATION

A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

B. Coordination with Electrical Work: Section 15010.

C. Utility Interruptions: Coordinate mechanical utility interruptions with the OWNER and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

D. Cutting and Patching: Section 15010.

E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.

F. Each Division 15 subcontractor shall coordinate with other contractors to make certain that any of his equipment; piping or ductwork which is mounted on isolators or flexibly connected does not become “grounded” by another contractors work (e.g. walls, ceiling, etc.).

G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General CONTRACTOR and obtain written instructions for any changes necessary.

H. Order of Precedence: The precedence of mechanical construction documents are as follows:

1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.

2. Should there be a conflict within the Specifications or within Drawings of the same scale, the more stringent or higher quality requirements shall apply.

3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.

4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

15010.1.15 START-UP PROCEDURES

A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.

B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.

C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.

D. Factory personnel shall be notified as appropriate to start systems requiring their services.

E. Notify Engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

15010.1.16 SCHEDULE OF TESTING

A. Provide testing in accordance with the General Conditions of the Contract.

B. A schedule of testing shall be drawn up by the Division 15 CONTRACTOR in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

C. All testing must be performed in the presence of the Architect's/Construction Manager's/General CONTRACTOR's representative; his signature for verification of the test must appear on the schedule.

D. All testing must be performed in accord with the procedures set forth in Division 15 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 15000 CONTRACTOR for inclusion in Operation and Maintenance Manual.

E. Make all specified tests on piping, ductwork and related systems as specified in this specification.

F. Make sure operational and performance tests are made on seasonal equipment.

G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

15010.1.17 CLEANING AND FINISHING

A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.

B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 15 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

15010.1.18 WARRANTIES

A. Warranty: Provide a written warranty to the OWNER covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance.

B. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General CONTRACTOR for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

C. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.

D. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

15010.1.19 PROJECT CLOSEOUT

Project Observation Reports: At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents. The Mechanical CONTRACTOR and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General CONTRACTOR. The Engineer will not recommend the payment of retainage until this compliance certification has been received. Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

15010.1.20 CERTIFICATES AND KEYS

A. Certificates: Upon completion of the work, deliver to the Construction Manager/General CONTRACTOR one copy of Certificate of Final Inspection.

B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General CONTRACTOR.

15110.1 DESCRIPTION

This section is a materials specification and is included for guidance in selecting materials for pipe and related fittings and appurtenances used in the construction of water and sewer systems.

15110.1.1 RELATED WORK

Section 02222 - Waterline Pipe Installation
Section 02224 - Sewer Line Pipe and Manhole Installation
Section 15230 - Waterline Valves and Hydrants
Section 15232 - Water System Control Valves

15110.1.2 SUBMITTALS

The Contractor shall submit for review complete information, showing all pipe, materials, fittings, gaskets, couplings, coatings, linings, supports, mechanical restraints, thrust blocks and configuration prior to the delivery of any components to the project. All information shall be provided in accordance with Section 01300 and written evidence of compliance from the manufacturer shall accompany each delivery of material.

15110.1.3 DEFINITIONS

Not used.

15110.2 MATERIALS

15110.2.1 NSF COMPLIANCE

All pipe and materials furnished and installed for culinary use shall comply with NSF International Standard 61. Also, all plastic pipe must be approved by the NSF for potable water use and shall carry the factory "NSF" stamped label on the pipe indicating such approval.

15110.2.2 POLYVINYL CHLORIDE PIPE (PVC)

15110.2.2.1 PVC PIPE FOR WATER LINE CONSTRUCTION – Shall be as follows:

- For sizes less than 4 inches OD, PVC pipe shall be Schedule Rated pressure pipe meeting the requirements of ASTM D1785 of the schedule and size shown on the Drawings.
- PVC pipe 4 inches and larger, shall be rigid, thermoplastic Class Rated pressure pipe meeting the requirements of ANSI/AWWA Standard C900 or C905 (latest revision). The pressure class or the dimensional ratio and the size shall be as shown on the Drawings.
- While Class Rated and Pressure Rated pipe materials are not interchangeable, when specifically allowed in the Contract Documents, for size 4" and larger, rigid thermoplastic Pressure Rated pressure pipe, meeting the requirements of ASTM D2241, may be furnished and installed. Operating pressure for this pipe shall be as shown on the Drawings.

15110.2.2.2 FITTINGS FOR PVC PIPE – Unless specifically authorized otherwise, fittings for 4 inch and larger size PVC pipe in underground service shall be ductile iron (DI) and shall meet the requirements of NSF 61 and ANSI/AWWA C-153. They shall have a standard coating of cement mortar on the interior surfaces in compliances with AWWA C-104. DI fittings meeting these requirements may be used with smaller PVC piping. PVC fittings meeting the requirements of ANSI/AWWA C-907 may be used with PVC pipe smaller than 4 inches, and, in some instances, where specifically authorized, with PVC pipe sizes 4 inches through 8-inches.

15110.2.3 DUCTILE IRON PIPE

15110.2.3.1 INTERIOR COATING - The interior surface of all DI pipe shall be coated with a standard coating of cement-mortar in accordance with ANSI/AWWA Standard C-104 unless required otherwise in the Contract Documents. Field coating of DI pipe will not be acceptable.

15110.2.3.2 BURIED PIPE – Unless shown otherwise on the Drawings, shall be as follows:

- Buried ductile iron pipe shall be Thickness Class 51.
- Shall meet requirements of ANSI/AWWA C-151.
- Joints shall be bell and spigot or mechanical, which meet the requirements of ANSI/AWWA C-111.

15110.2.3.3 EXPOSED PIPE – Shall meet these requirements, unless shown otherwise on the Drawings:

- Exposed ductile iron pipe shall be Thickness Class 53.
- Pipe shall comply with ANSI/AWWA Standard C-151.
- Pipe joints shall be flanged, meeting the requirements of ANSI/AWWA C-115, or mechanical type couplings (MTC), meeting the requirements of ANSI/AWWA C-606. MTC shall be Victaulic grooved couplings, as manufactured by Victaulic Company of America or approved equal), unless shown otherwise on the drawings.
- 3" to 12" compact flanged fittings shall be ductile iron and shall be produced in accordance with laying lengths specified in ANSI/AWWA C110/A21.10. Flange surface shall be faced and drilled in accordance with ANSI Class 125 B16.1. Nominal body thickness shall be Manufacturer's Standard, but shall not be less than those specified in ANSI/AWWA C153/A21.53 "Standards for Ductile Iron Compact Fittings". Flange thickness shall be in accordance with the Manufacturer's Standards. Working pressure rating shall be 250 psi for water. Fittings shall be made in the United States of America and shall not have been refurbished or reworked by anyone other than the manufacturer. When greater than 250 psi is called for on the Plans, then the Supplier shall furnish higher class rated flanges. Standard Class 125 template for drilling shall be used for all flanges. Drilling templates shall be in multiples of four, so that fittings may be made to face in any quarter. Boltholes shall straddle the centerline and shall be equally spaced. Misalignment of boltholes of two opposing flanges shall not exceed 0.12 inches. Blind flanges 12 inches and over shall be provided with lifting eyes. Insulated flanges shall be provided where required.
- Gaskets shall be full faced, 1/16-inch thick compressed sheets of Aramid fiber base, with nitrile binder and non stick coating, suitable for temperatures to 700°, pressures to 1000 psig and a pH range of 1 to 11. Blind flange gaskets shall cover the entire inside face of the flange and shall be cemented in place. Gaskets shall be as manufactured by John Crane, style 2160; Garlock, style 3000; or approved equal.

15110.2.4 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

15110.2.4.1 PIPE – Shall be as follows:

- PE pipe shall be classified as 445574C, according to ASTM D3350. All PE pipe shall be manufactured according to AWWA C906 and ASTM D3035, F714. For oil and gas piping, PE pipe shall be per API 15LE.

- Pipe shall be made of high density, high molecular weight resin. PE plastic shall have a cell classification of 445574C as defined by ASTM D3350/AWWA C906. It shall be rated as PE4710 according to the requirements of the Plastics Pipe Institute. Internal pressure rating shall be as specified elsewhere in the project documents.

15110.2.4.2 FITTINGS FOR HDPE – Molded fittings shall be made of pre-blended virgin resins in accordance with the materials specifications of ASTM D3350. PE plastic fittings shall have a cell classification of 445574C as defined by ASTM D3350/AWWA C906. Socket fusion fittings shall be manufactured in compliance with ASTM D2683 and butt fusion fittings with ASTM D3261. Measurements of fittings shall be as required by ASTM D2122. All fittings shall be compatible for heat fusion with any pipe manufactured for like or similar resins.

Heat welded Flange Adapter Couplings shall be used for transition to other type piping material. The Contractor shall follow the manufacturer's recommendations, as well as specified procedures herein in fusing fittings to the polyethylene pipe.

15110.2.5 GALVANIZED IRON PIPE AND FITTINGS

Shall be of the schedule rating shown on the Drawings and shall be used only in exposed, non-corrosive atmospheres where piping diameters are less than 4 inches.

15110.2.6 PIPE AND FITTINGS FOR WATER SERVICE LINES

Shall meet the requirements provided in Section 15234 for water service connections.

15110.2.7 PIPE FOR GRAVITY SEWER SYSTEMS

Gravity sewer pipelines may be constructed with PVC or polyethylene (PE) plastic sewer pipe and fittings. Such materials shall be of the type, configuration and size shown on the Drawings and/or on the Bid Schedule.

15110.2.7.1 PVC PIPE - All PVC sewer pipe and fittings shall meet the standards of ASTM D3034 and F679. Such pipe shall be manufactured with a rubber gasketed joining system which meets ASTM D3212 and shall be furnished with a standard dimensional ratio of 35 (SDR 35) for wall thickness, unless shown otherwise on the Drawings.

15110.2.7.2 PE PIPE - All PE sewer pipe shall be smooth, solid wall, high density polyethylene pipe manufactured from PE 4710 material conforming to ASTM D3350 cell classification 445574C rating from the Plastic Pipe Institute. Fittings for this pipe shall be molded from a polyethylene compound equal to or exceeding the properties of the pipe being supplied.

15110.2.8 PIPE FOR PRESSURE SEWER SYSTEMS

Pressure sewer pipelines shall be constructed with DI, PVC, or PE plastic sewer pipe. Fittings and materials shall be of the type, SDR rating, (or pressure class) and size shown on the Drawings and/or on the Bid Schedule.

15110.2.8.1 PVC PIPE - All PVC pipe for pressure sewer lines shall be rigid, pressure rated, thermoplastic pipe which meets the standards of ASTM D2241. Fittings for PVC pipelines shall be Class 50, cement mortar lined, rubber gasketed, DI which meet the requirements of ANSI/AWWA C-153 and C-104.

15110.2.8.2 PE PIPE - PE pipe for pressure sewer lines shall be smooth, solid wall, high density polyethylene pipe manufactured from PE 4710 material conforming to ASTM D3350 cell classification 445574C

rating from the Plastic Pipe Institute. Fittings for this pipe shall be molded from a polyethylene compound equal to or exceeding the properties of the pipe being supplied.

15110.2.9 PIPE AND FITTINGS FOR IRRIGATION SYSTEMS

Pipe and fitting for irrigation systems shall be either DI or Pressure Rated PVC, of the type and class shown on the Drawings, for line diameters 4-inches and greater. Buried lines smaller than 4 inches in diameter shall be Schedule Rated PVC as shown on the Drawings.

15110.2.10 PIPE FOR DRAIN SYSTEMS

Piping for sub-drainage may be constructed with polyvinyl chloride (PVC) or polyethylene (PE) plastic non-pressure drainage or sewer pipe and fittings. Such materials shall be of the type, configuration and size shown on the Drawings and/or on the Bid Schedule.

15110.2.10.1 PVC PIPE - All PVC drainage pipe and fittings shall meet the standards of ASTM F794. Such pipe shall be manufactured with a rubber gasketed joining system which meets ASTM D3212 and may be furnished with ribbed, corrugated or smooth exterior walls with smooth interior wall surfaces, unless shown otherwise on the Drawings. Rubber gasketed joints will not be required for collection pipe applications with perforated or slotted pipe sections.

15110.2.10.2 PE PIPE - All PE drainage pipe shall be solid, corrugated or ribbed wall high-density polyethylene pipe with smooth interior wall surfaces. Material shall be PE 4710 material conforming to ASTM D3350 cell classification 445574C rating from the Plastic Pipe Institute. Fittings for this pipe shall be molded from a polyethylene compound and with equivalent properties and configurations specifically designed to fit the pipe being supplied.

15110.2.11 MISCELLANEOUS FITTINGS AND MATERIALS

15110.2.11.1 PIPE SUPPORTS - Floor mounted pipe supports for suspended, exposed piping systems shall be adjustable stanchion type supports designed to cradle the pipe diameter by 170 degrees. The support shall fit ductile iron or steel diameters snugly, without excessive gaps between the support and the pipe. Support saddle width shall be a minimum of 2 inches wide. The support must offer a minimum of 3 inches of final adjustment, after installation. Supports shall be supplied with independent base and adjustment collar designed to accept standard sized Schedule 40 galvanized steel pipe for coarse adjustment. Supports shall be fabricated from A36 mild steel, and shall have an electro-galvanized finish. Floor mounted pipe supports shall be the Standon Model S92 or C92 as manufactured by Material Resources, Inc., 22700 N. W. Quatama Street, Hillsboro, Oregon 97124, or approved equal. The standard required model shall be the S92. Non standard materials or model numbers shall be as specified on the Drawings.

15110.2.11.2 "Y" STRAINERS - shall be constructed of high-tensile ASTM A126 Class B Cast Iron with blow-off connections and self-aligning cylindrical screens and shall be equal to Watts Regulator Series 77F or better quality.

15110.2.11.3 FASTENERS – Fastener requirements are as follows:

- Unless otherwise required in these Specifications or shown on the Drawings, all bolting hardware for buried pipe, fittings, valves, and components shall be of manufacturer's standard materials.

- Unless otherwise required in these Specifications or shown on the Drawings, all bolting materials for exposed pipe, fittings, valves, and components shall be Type 316 stainless steel. Where space restrictions preclude the use of regular bolts, stainless steel threaded studs may be used on all valve flange connections.

- In all instances where stainless steel threaded fasteners are used, a coating of an approved, permanent anti-seize compound shall be applied to the fastener to prevent galling and to assist in disassembly.

- All bolts and/or studs shall extend through the nuts at least 1/4 inch.

15110.2.11.4 COUPLINGS – Couplings shall meet the following requirements:

- Unless prescribed otherwise on the Drawings or in these Specifications, couplings shall meet the requirements of ANSI/AWWA C-219. All flexible couplings shall meet the minimum requirements of Smith Blair 400 series.

- Sleeves shall have a smooth inside taper and there shall be no surface irregularities on any sealing surface. Gaskets shall be suitable for the project application.

- Flexible couplings for buried DI and PVC pipe sizes 2 through 16 inches in diameter shall be fabricated of steel or ductile iron. For pipe sizes larger than 16 inches, flexible couplings shall be of steel. Coupling components for use in potable water systems shall be factory coated with an FDA approved, bonded epoxy coating, applied to an average 12 mil thickness.

- Flexible couplings for exposed pipe shall be manufactured of steel, unless shown otherwise on the Drawings, or approved by the Engineer. Coupling components for use in potable water systems shall be factory coated with an FDA approved, fusion-bonded epoxy coating, applied to an average 12 mil thickness.

15110.2.11.5 RESTRAINT HARNESS – Where required, restraint harness for bell and spigot pipe joints shall be as manufactured by EBAA Iron Co. or an approved equal. The restraint shall consist of a split bell ring to go behind the bell and a split, serrated ring to grip the pipe on the other side of the joint. The harness shall be held together with clamping bolts and tie bolts. The rings shall be fabricated of 60-42-10 DI conforming to ASTM A-536. Clamping bolts shall be grade 5 zinc coated machine bolts. Tie bolts are of low alloy steel. The harness shall have a minimum working pressure of 150 psi. Harness size shall be as shown in the schedule on the Drawings or as specified in the Special Provisions.

15110.2.11.6 VALVES AND FITTINGS - Shall be as specified in their respective sections in these Specifications.

15110.2.11.7 BOXES AND ENCLOSURES – Shall be of the size, type, and configuration indicated on the Drawings and Contract Documents.

15110.3 CONSTRUCTION REQUIREMENTS

See Sections 02222 and 02224 for construction requirements for applicable piping systems.

15110.4 METHOD OF MEASUREMENT

In general, fittings for pipe and piping systems are, and will be, considered appurtenant to the pipeline being installed unless specifically called out for separate payment on the Bid Schedule.

15110.5 BASIS OF PAYMENT

Not used.

15238.1 DESCRIPTION

Includes furnishing and installing pressure gauges and their support piping and fittings in buildings and other structures at locations shown on the Drawings.

15238.1.1 RELATED WORK

Section 02222 – Waterline Pipe Installation
Section 15110 – Pipe and Piping Systems

15238.1.2 SUBMITTALS

The Contractor shall provide descriptive information which indicates the model number, manufacturer's name, dimensions, measuring range and manufacturer's certification of performance in accordance with the requirements of Section 01300.

15238.1.3 DEFINITIONS

Not used.

15238.2 MATERIALS

15238.2.1 PRESSURE GAUGES

Shall be US Gauge, Model 656, stem mounted and oil filled, as manufactured by AMETEK or an approved equal. Gauges have a 2 1/2-inch (minimum) stainless steel case with a pressure relief plug. The window shall be polycarbonate plastic with neoprene sealing gasket. The pressure reading range shall be as shown on the Drawings or as prescribed in the Special Provisions.

15238.2.2 SUPPORTING PIPE AND FITTINGS

Shall be 1/4-inch threaded Schedule 40 galvanized pipe.

15238.3 CONSTRUCTION REQUIREMENTS

Pressure gauges shall be installed in accordance with the manufacturer's recommendations and at the locations shown on the Drawings. The Contractor shall provide sufficient supporting pipe to mount pressure gauges vertically and oriented to be read easily. When possible, pressure gauges should be installed at least three pipe diameters downstream from any valve in the pipeline.

15238.4 METHOD OF MEASUREMENT

Separate measurement of pressure gauges and their supporting piping will not be made. Measurement will be included with the building or structure that it serves.

15238.5 BASIS OF PAYMENT

Separate payment for pressure gauges will not be made.

15300.1 DESCRIPTION

The Contractor shall furnish and install floor drains in structures of the size and type, and at the locations shown on the Drawings.

15300.1.1 RELATED WORK

Section 02222 – Waterline Pipe Installation
Section 02105 - Earthwork Materials

15300.1.2 SUBMITTALS

Not used.

15300.1.3 DEFINITIONS

Not used.

15300.2 MATERIALS

15300.2.1 DRAIN

Floor Drains shall be cast iron body, 6-inch (minimum) diameter heavy-duty grated type with a removable stainless steel cover.

15300.2.2 PIPING

Drain piping shall be drain waste and vent (DWV) schedule 40 PVC pipe and fittings sized to fit the floor drain in accordance with the Drawings.

15300.2.3 P-TRAPS

P-traps, when required on the Drawings, shall meet the requirements of Schedule 40 PVC pipefittings sized to fit the drainpipe.

15300.2.4 DRAIN GRAVEL

Drain gravel for floor drain sumps, where applicable, shall meet requirements of Section 02105 and shall be installed as shown on the Drawings.

15300.2.5 CHECK VALVES

Floor drain check valve, when required by the Drawings, shall be a rubber slip-on check valve capable of draining drainpipe under low flows and low pressures. The valves shall require no maintenance or repair. The check valves shall be attached to the drainpipe by stainless steel clamps.

15300.3 CONSTRUCTION REQUIREMENTS

15300.3.1 SETTING DRAINS

Where floor drains are required, the floor will have been designed with a slope to a low point where the drain is to be placed. Typically, the floor drain will be cast in the low point in the floor at the time of installation of the floor. The Contractor shall take care to coordinate the setting of

the drain and the pouring of the concrete so that the top surface of the drain cover is flush with the floor surface to allow complete drainage of any water which accumulates on the floor.

15300.3.2 PIPE WORK

Piping shall be connected and run on a 1% minimum slope away from the drain as shown on the Drawings. Where termination of the piping is in drain gravel, care shall be taken to locate the pipe end in the top one-third of the gravel sump. Where termination of the piping is at daylight, the Contractor shall provide a 5-foot section of cast iron or ductile iron pipe, sized to match the drain pipe, at the daylight end of the pipeline so that the thermoplastic pipe will not be exposed to daylight.

15300.4 METHOD OF MEASUREMENT

15300.4.1 NO MEASUREMENT

Unless provided for as a separate bid item in the Bid Schedule, no separate measurement of the floor drain, its connecting piping, gravel sump, etc., will be made. Measurement of the drain will be included with the building or structure identified in the Bid Schedule.

15300.4.2 SEPARATE MEASUREMENT

When provided for in the Bid Schedule, the cost of all material and labor required of the floor drain assembly will be measured by counting the number of floor drain assemblies installed and accepted.

15300.5 BASIS OF PAYMENT

When a separate bid item is provided, complete compensation for this accepted work shall be included in the contract unit price on the Bid Schedule.

PAY ITEM	UNIT
Floor Drain Assembly	Lump Sum
Floor Drain Assembly	Each

DIVISION 16

ELECTRICAL

SUNRISE
ENGINEERING

16010.1 DESCRIPTION

The General Conditions, Supplementary General Conditions, Alternates and Addenda, applicable drawings and the Technical Specifications herein shall apply to the providing and construction of a complete electrical system under the requirements of this Division 16.

16010.1.1 RELATED WORK AND REFERENCED SECTIONS

Section 01300 - Submittals
Section 02200 - Trench Excavation and Backfill
Section 16150 - Electrical Control Devices
Section 16210 - Electrical Fixtures
Section 16400 - Service and Distribution System

16010.1.2 SCOPE

A. The Work required under this Section consists of the Electrical General Requirements and related items necessary to complete the Work indicated within the Contract Documents.

B. This Section describes procedures and incidental items of Work relating to Electrical Division 16.

C. The drawings are diagrammatic, intended to indicate the general scope and location of the Work to be installed and are not to be considered as complete in every detail. The Contractor shall install all Work indicated and/or specified herein, complete in every way to perform the function (s) intended without additional cost.

D. Plans and Specifications are complementary; whatever is called for in either shall be as called for in both. In the event Work is called for in more than one place and is of conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.

16010.1.3 CONTRACT DOCUMENTS

A. Contract documents consist of drawings, specifications, and other documents issued by the Engineer. Each is complementary and requirements shown, written or reasonably inferable therefrom on one is considered as written, shown and implied in all.

B. Electrical drawings are diagrammatic, but shall be followed as closely as actual construction and Work of other Contractors will permit. Runs to panels from outlets referred to as “home runs” are indicated, by pointing in the general direction of panels. Contractor shall continue such circuits to the panels as though the routes were completely indicated.

C. Deviations from the Drawings required to make Work of this Contract conform to Building as constructed, or as to Work of other contractors or subcontractors, shall be made by the Contractor at his expense. The Engineer reserves the right to make minor changes in the location of equipment and outlets without additional charges.

D. The Contractor shall familiarize himself with the architectural and mechanical plans. The Contractor shall perform all Work and provide all material required by the electrical Contractor shown under these and all other sections of the plans and specifications.

16010.1.4 SUBMITTALS

All submittals shall meet the requirements of Section 01300 of these Specifications.

16010.1.4.1 SHOP DRAWINGS – Submittal of shop drawings shall be as follows:

A. Submittal of shop drawings shall meet the requirements of Section 01300 of these Specifications.

B. Shop drawings shall be submitted within fifteen (15) days after the award of contract.

C. Shop drawing shall include functional and descriptive literature of the particular item furnished complete with dimensional drawings, rough-in and installation instructions, knock-out locations, hangers or mounting devices, etc., as required for the proper checking and installation of the equipment. Catalog sheets without any reference made to the particular item will not be acceptable. All special features called for in the Contract Documents shall be noted. Where performance test results of a product design are called for in the technical sections of these specifications, test data sheets shall be provided with the shop drawing submittal.

D. Shop drawings shall be submitted for all switch gear, motor control centers, motor starters, control panels, telemonitoring panels, alarms, electrical controls, electrical instrumentation, communication devices and circuitry, lighting fixtures, and equipment anchors and supports for seismically supported components.

E. In connection with seismic restraint requirements, shop drawings are required for all equipment anchors, supports, and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, centers of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment so that the final design can be properly reviewed.

F. Three preliminary sets shall be submitted to the Architect/Engineer for their review. Following review, two sets will be returned to the Contractor for correction. After corrections have been made, the formal six sets of the corrected shop drawings shall be submitted for final review and distribution.

G. Each shop drawing required under this or other sections of Division 16 shall be bound together in sets in one hard back three ring binder per set, properly indexed for the formal submittal. Binders shall be properly sized to adequately contain all of the materials to be placed therein and shall be labeled to identity the Owner, the name of the job, the name of the Contractor and/or any sub-contractor (s), and any other pertinent information.

16010.1.4.2 MATERIALS LIST - A materials list including manufacturer, type, size, model number and other properties shall be submitted for all raceway, conduit, fittings, support materials, wire, cable, junction boxes, and wiring devices, including boxes for weather proof devices.

16010.1.4.3 EQUIPMENT/INSTRUMENT LIST - Equipment/Instrument list(s) including manufacturer, type, size, model number and other properties shall be submitted for all equipment and instruments.

16010.1.4.4 OPERATION AND MAINTENANCE MANUAL – The Contractor, or electrical subcontractor, shall assemble and deliver to the Owner an operation and maintenance (O&M) manual for the electrical systems furnished and installed in connection with the Work. O&M manuals shall be as follows:

A. Number of copies shall be as specified in Section 01300 or as required in the Special

Provisions or by the Engineer or the Owner. The O&M manual shall be reviewed and approved prior to the final inspection.

B. Each copy of the O&M manual shall be bound in a hard-backed binder. The front of each binder shall have the following information printed on it by silk screen process:

OPERATION AND MAINTENANCE MANUAL
FOR
(*PROJECT NAME*)
(*SPECIFIC SYSTEM NAME AND/OR LOCATION*, as appropriate)
(*OWNER'S NAME*)

C. Each copy shall contain a master index at the beginning of the manual showing all items included.

D. A separate section for each different type of item of equipment or information furnished shall be provided. Use plastic tab indexes for all sections of the book.

E. The first section of the manual shall consist of the names, addresses and telephone numbers of the Mechanical Engineer, Electrical Engineer, General Contractor, Electrical Contractor.

F. Descriptive literature (manufacturer's catalog cuts and other data) of each manufactured item shall be included. Literature shall show capacities and size of equipment used and shall be marked indicating each specific item with all applicable data underlined.

G. Operating instructions shall, at a minimum, include:

1. General description of the electrical system.
2. Where applicable, a step-by-step procedure to follow in putting each piece of electrical equipment in operation.
3. Provide diagram for the electrical control system showing the wiring of all related electrical control items, such as fuses, interlocks, electrical switches and relays.
4. Test results of all items requiring testing as called for in the technical section of specifications.

H. Maintenance instructions shall, at a minimum, include:

1. Manufacturer's maintenance instructions for each piece of electrical equipment installed in the project. Instructions should include installation instructions, parts numbers and lists, operation instructions of equipment, name of vendor, and maintenance and lubrication instructions.
2. A summary list of each piece of electrical equipment requiring lubrication, showing the name of the equipment, location, type and frequency of lubrication.
3. A complete list of all electrical equipment used indicating name, model, serial number and nameplate data of each item, together with number and name of each system with which the item is associated.

I. An approved copy of the manual shall be used during final inspection and shall be left with the Owner for its use and disposition.

16010.1.4.5 OTHER INFORMATION - Other information shall be provided as required by the Engineer.

16010.2 MATERIALS

All equipment and materials shall be as specified, new, of the best quality and free from defects. Each type of equipment or material shall be the same make and quality.

16010.2.1 UNDERWRITERS LABORATORIES

All equipment, materials, and devices shall be approved by Underwriters Laboratories, Inc. (UL). Custom designed items shall be fabricated using UL approved materials. All custom panels shall bear the UL label certifying UL-508 standards.

16010.2.2 MATERIALS AND EQUIPMENT TO BE SUPPLIED

The Contractor or electrical Subcontractor shall provide all materials, equipment, and any other fittings or devices required for a complete and finished installation. Materials and equipment shall be as shown on the Drawings and/or as called for in these Specifications, including the Special Provisions if any, unless otherwise approved, in writing, by the Engineer.

16010.2.3 APPROVAL OF SUBSTITUTIONS

Equipment and materials are designated by one or more manufacturer's name brands or numbers. It is not the intent of the Specifications to exclude other equipment or materials that equal the standard of those specified. If the Bidder, in its bid, desires to use equipment or materials other than those specified, the Bidder must obtain written approval from the Engineer in this regard at least seven (7) calendar days prior to bidding. Submit complete data, including detailed specifications and drawings with written request in duplicate. Samples may be requested if deemed necessary. Certificates of compliance with specifications or a list of all exceptions to the specifications shall be included with request.

16010.2.4 STORAGE OF EQUIPMENT AND MATERIALS

A. The Contractor shall be responsible for the proper transportation, unloading, storage, and holding of all electrical systems, materials, and equipment until they are installed in the Work, and accepted by the Owner. This shall include responsibility for damage, loss, theft, and pilferage.

B. Materials and equipment shall be handled and stored in accordance with the manufacturer’s and/or supplier’s instructions. Packaged items shall be stored in original, undamaged condition with manufacturer’s seals and labels intact. Materials and equipment shall be stored in a neat and orderly condition at all times and allowing for easy access for inspection.

16010.2.5 RACEWAYS AND FITTINGS

The manufacturer shall be Republic Steel, Triangle, National, Carlon, Allied or approved equal. All conduits shall be in accordance with the requirements of the National Electric Code (NEC) and applicable local codes. Steel conduit shall be in accordance with recommendations of the latest edition of American Iron and Steel Institute “Design Manual on Steel Electric Raceways.”

A. RIGID GALVANIZED STEEL CONDUIT (RGS)

1. Shall be USAS C80.1, zinc-coated by hot-dip galvanizing or sheradizing with additional enamel or lacquer coating.
2. Fittings shall be threaded type and of the same material as the conduit.
3. Unless otherwise noted, rigid metallic conduit shall be used for underground runs, under slab runs, and where runs are placed in concrete. It shall also be used

for exposed runs in mechanical rooms and for other exposed runs where the conduit is exposed to moisture, weather or mechanical injury.

4. Where rigid metallic conduit is used for underground installations, including elbows required to make sweeps in PVC conduit runs, the conduit shall be wrapped with 3m-50 10 mil pipe wrap or approved equal.

B. INTERMEDIATE METAL CONDUIT (IMC)

1. Shall be UL Standard 1242, hot-dip galvanized steel.
2. Fittings shall be threaded type and of the same material as the conduit.
3. It can be used for exposed runs in mechanical rooms and for other exposed runs where the conduit is exposed to moisture, weather or mechanical injury.
4. **This conduit shall not be used in hazardous areas.**

C. ELECTRICAL METALLIC TUBING (EMT)

1. Shall be in accordance with UL "Standard for Electrical Metallic Tubing" No. 797, galvanized mild steel with interior coat of enamel.
2. Fittings shall be steel compression type.
3. **Cast type, indenter, or set-screw type fittings shall not be used**.
4. EMT shall be used for exposed and concealed runs to lighting fixtures above 10 feet or above ceilings.
5. **Not approved for any exposed conduit runs or drops**.

D. NON-METALLIC CONDUIT (PVC)

1. Shall be PVC Schedule 40 heavy wall suitable for direct burial.
2. Fittings shall be threaded or solvent welded type of the same material as the conduit.
3. **Shall not be used above grade or embedded in concrete, except as noted specified for runs above 600 volts. PVC shall not be used where exposed or concealed in walls or floors**.
4. PVC may be used for all underground runs, except for bends exceeding 22 degrees where jacketed or wrapped rigid galvanized steel is required, and runs under concrete slabs. Runs under concrete slabs shall be embedded in earth a minimum of 4 inches below the bottom of the slab. Risers through concrete slabs shall be rigid steel or intermediate metal conduit.
5. Provide PVC to steel adapters as required.

E. FLEXIBLE LIQUID-TIGHT CONDUIT

1. Shall be galvanized steel, liquid-tight, with moisture and oil- proof extruded PVC cover.
2. Fittings shall be liquid-tight, compression type.
3. Approved for flexible connections to equipment, items or instruments subject to vibration such as motors, fans, pumps, dry transformers, etc.
4. **Flexible Liquid-tight conduit shall not be less than 18 inches in length and not more than 3 feet in length**.

F. FLEXIBLE STEEL CONDUIT

1. Shall be galvanized steel.
2. Fittings shall be compression type of the same material as the conduit.
3. Shall be used for lighting fixture runs above drop ceiling grid systems or other devices required or approved by NEC or as requested or approved by the Engineer. (Install ground conductor per NEC in runs over 6 feet in length.)

G. PVC COATED CONDUIT

1. Rigid Steel conduit coated with a minimum of 40 mil of PVC coating shall be used in all corrosive areas or where required by NEC or the Engineer.
2. **All fittings, boxes, support materials, clamps, etc., used with PVC coated conduit shall be PVC coated in a like manner**.
3. Wiring devices shall be corrosion resistant UL rated in corrosive areas requiring PVC coated conduit.

H. WALL AND FLOOR SLEEVES

Shall be galvanized sheet steel or pipe.

I. CLAMPS

1. Shall be galvanized malleable iron one-hole straps, beam clamps or other approved device with necessary bolts and expansion shields.
2. **Perforated metal straps shall not be used**.

J. CONDUIT SIZES

1. Shall be as indicated on the drawings.
2. **Shall not be smaller than ¾ inch exposed or 1 inch buried conduit unless otherwise specifically approved by the Engineer**.

K. CONDUIT BUSHINGS

1. For conduit 1-1/4 inch and larger use OZ type BLG or SBLG with Lay-in-Lug.
2. Use Lay-in-Lug bushings on multiple conduit entrances to enclosures or gutters.
3. Bonding bushings shall be used on conduits containing service entrance conductors.

L. ENTRANCE SEALS

Provide and install OZ entrance seals on all conduits entering building below grade.

M. RACKS AND SUPPORTS

1. Conduit support racks, Unistrut supports and fittings, etc., shall be hot-dipped galvanized, except in corrosive areas where the supports and fittings must be PVC coated.
2. **Painted metal supports are not allowed**.

N. PULL BOXES

1. Pull boxes, which are required for proper conduit installation, shall be sized according to the requirements of Article 314 of the NEC.
2. Conduit bodies shall be cast type with threaded hubs.
3. Outdoor, buried pull boxes shall be Oldcastle H-Series or equal.
   a) Pull boxes shall be sized per NEC 314.28 but shall not be smaller than 24" x 24" x 24".
   b) If fully enclosed pull boxes are used, they shall be coated with coal tar epoxy per specification 9900.3.2.4.

O. OUTLET/JUNCTION BOXES

1. Boxes shall be provided in the wiring or raceway systems wherever required for routing/pulling of wires, making connections and mounting of devices or fixtures.
2. Boxes in exposed conduit runs shall be cast metal condulets with threaded hubs installed exposed. **Non-metallic boxes are not allowed**.
3. Each box shall be metal and shall have the volume required by the National Electrical Code for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall not be less that 4 inch octagonal or 4 inch square except that smaller boxes may be installed as required by fixture configuration, as approved. Boxes in the raceway system shall not be less than 1-1/2 inches deep, except where shallower boxes required by structural conditions are approved.
4. Boxes for other than lighting fixture outlets shall not be less than 4 inches square.
5. Boxes in concealed conduit runs shall be equipped with tile extension rings, device mounting straps and accessories required for the purpose of the outlet.

16010.2.6 A. CONDUCTORS

1. Shall be of the type, size, and locations as shown on the Drawings and meet the requirements of the latest addition of the National Electric Code (NEC).
2. Shall be soft-annealed coated copper in accordance with ASTM B33 or B189.
3. All conductors shall be stranded copper.
4. All conductors shall be THHN/THWN copper rated at 600 volts, unless otherwise noted.
5. **Aluminum conductors will not be allowed**.

B. GROUNDING CABLE

Shall be as called out on the drawings and per NEC. (Grounding lugs shall be the clamp type made of high conductivity copper alloy and shall be provided for all equipment to be grounded.)

C. VFD CABLE

Conductor size shall be as shown in Plans and shall meet the requirements of the latest addition of the National Electric Code (NEC). Cable shall meet the requirements below:

6. Cable shall be designed for VFD applications and shall be rated 600V/2kV, NEC Type TC with a 90°C rating.
7. Three Copper circuit conductors with XLPE insulation.
8. Three symmetrical copper ground wires.

9. Spiral copper tape shield with 100% coverage.
10. Outer PVC jacket.
11. Suitable for Indoor, Outdoor, Burial and Oil Resistance

Acceptable manufacturers:

1. Belden
2. Southwire
3. Approved Equal

16010.2.7 SPLICES, TAPS AND TERMINATIONS

A. Splices, taps and terminations made in interior damp or wet locations, corrosive atmosphere locations or exterior boxes above or below grade shall be covered with 3M heat shrinkable ITCSN series sleeves or end caps or Raychem equal as approved by the Engineer.

B. All splices shall require approval by the Engineer.

16010.2.8 SAFETY SWITCH DISCONNECTS

A. Provide disconnect switches where shown and required by NEC as specified herein.

B. Type: Heavy duty, manual, single throw, fusible or non-fusible as indicated.

C. Rating: 600 volt, ampere size as noted or as required for load served.

D. Enclosure: Nema 4, Gasketed stainless steel or as called out in equipment schedule on drawings. Stainless steel 316 shall be used in hazardous/corrosive areas. Stainless steel 304 shall be used in all other locations.

E. Fuses: Switches shall be equipped with Type "R" fuse clips factory installed. Fuses shall be dual element type RK5 of size as noted.

F. Non-Fusible Switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

16010.2.9 JUNCTION BOXES

A. Junction or pull boxes, which are required but not shown, shall be sized according to requirement of Articles 370 and 373 of NEC.

B. Shall be cast type condulets with threaded hubs.

16010.2.10 WIRE DEVICES

A. Switches: 20 ampere, 120/277 volt, toggle type. Single pole used as designation for entire series - double pole, 3-way, 4-way or lock type. Hubbell #1221, Bryant #1221, Leviton #1221. Switch and pilot shall be Hubbell #1221-PL or Leviton #1221-PL. Double pole toggle switch shall be Hubbell #1222-2.

B. Ground Fault Interrupter Receptacles: 20 ampere, 125 volt, NEMA 5-20R, gray color. Leviton #6398.

C. Receptacles: 20 ampere, 125 volt, NEMA 5-20R, gray color for locations where indicated. Hubbell #5352, Bryant #5352, or Leviton #5352.

D. All devices shall be gray in color.

E. Special receptacles other than those listed above shall be as designated on the drawings.

F. Device Plates:

1. For surface mounted boxes plates shall be stainless steel suitable for use on cast metal device boxes, condulet FS and FD types. Shall be complete with gaskets and approved for wet locations.

2. For flush boxes in finished areas, plates shall be stainless steel. Gang plates shall be one-piece.

16010.3 CONSTRUCTION REQUIREMENTS

Unless notified otherwise, the Contractor responsible for the electrical Work shall perform all electrical work in accordance with the Drawings and with these Specifications.

16010.3.1 CODES, PERMITS, LICENSES AND STANDARDS

A. PERMITS AND LICENSES – The Contractor shall secure all permits and licenses required in connection with this work.

B. CODES AND STANDARDS - All work, labor, and equipment shall conform to applicable State and Local Codes and Standards and the applicable sections of the latest revisions of the following:

- American Society for Testing and Materials (ASTM)
- National Fire Protection Association, National Electrical Code (NEC)
- Insulated Power Cable Engineers Association (IPCEA)
- Underwriters Laboratories Inc. (UL)
- American Steel and Iron Institute, “Design Manual on Steel Electrical Raceways”
- National Electrical Manufacturer’s Association (NEMA)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronic Engineers (IEEE)
- Uniform Building Code (UBC)
- Uniform Fire Code (UFC)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

Conflicts between any of the above referenced codes and standards and between any of them and these Specifications and/or the Project Drawings shall be resolved by complying with the more stringent requirements.

16010.3.2 SAFETY

A. REGULATIONS - The Contractor’s work shall conform to the Associated General Contractors of America, Inc. *Manual of Accident Prevention in Construction* and shall comply with all current regulations of the Occupational Safety and Health Act (OSHA) as required for work identified on the Drawings or in these Specifications.

B. SAFETY GUARDS - All equipment, which the Contractor furnishes and installs, shall be provided with appropriate safety guards for prevention of accidents. The Contractor shall provide and maintain any other necessary construction required to secure safety of life or property, including the maintenance of sufficient lights to secure such protection.

16010.3.3 DIAGRAMMATIC DRAWINGS

A. The electrical drawings are diagrammatic, intended to indicate the general scope and locations of the work to be installed and are not to be considered as complete in every detail. The Contractor shall install all work indicated and/or specified herein, complete to perform the function intended without additional cost.

B. The electrical drawings are diagrammatic, however, they shall be followed as closely as actual construction and work of other contractors will permit. Runs to panels from outlets, referred to as "home runs", are indicated on the drawings by arrows pointing in the general direction of panels. Contractor shall continue such circuits to the panels as though the routes were completely indicated. Deviations from drawings required to make the work of this Contract conform to building as constructed, or as to work of other contractors, shall be made at the Contractor's expense. The Engineer reserves the right to make minor changes in the location of equipment and outlets without additional charges.

16010.3.4 SITE EXAMINATION

Examination of the site shall be made by the Contractor, who shall compare it with the drawings and specifications and satisfy himself as to the conditions under which the work is to be performed. The Contractor shall, at such time, ascertain and check all conditions which may affect its work. No allowance shall subsequently be made in the Contractor's behalf for any extra expenses to which the Contractor may be put due to failure or neglect on its part to make such examination and determination of the condition.

16010.3.5 SUPERVISION

A. A competent foreman or superintendent, approved by the Owner's Representative, shall be at the site at all times to receive instructions and shall have the proper authority to act on behalf of the Contractor. The Contractor shall verify dimensions given on the electrical drawings and report any errors or inconsistencies to the Engineer before commencing the work. The Engineer or its representative will interpret the meaning of the Drawings and Specifications where questions arise.

B. Contractor shall assign persons to be in direct charge of work who are thoroughly experienced in the types of construction work specified herein. All labor shall be performed in a workmanlike manner by skilled workmen under the supervision of competent foremen.

16010.3.6 WORKMANSHIP

Workmanship shall be in accordance with the best present-day construction methods and shall be neat and orderly throughout the project.

16010.3.7 COORDINATION OF CONSTRUCTION

A. The Contractor shall coordinate work with other contractors, subcontractors, the Owner, and the Engineer to assure orderly and expeditious progress of work. The Contractor shall select order/sequence of work and establish schedule of working hours for construction, all subject to review and direction by the Owner.

B. This Contractor shall be held solely responsible for the proper installation of its work. The Contractor shall arrange with the proper contractors for the installation of anchors and other embedded devices, and for the leaving of required chases, openings, etc., and shall do all cutting and patching made necessary by its failure or neglect to make such arrangements with others. Any cutting or patching done by this Contractor shall be subject to the directions of the Engineer and shall not be started until approval has been obtained.

C. All cutting, welding or drilling of concrete or structural members shall be properly reinforced and patched to match as nearly as possible the surrounding work. Before cutting, welding or drilling any concrete or structural member, the Contractor shall secure the approval of the Engineer. Where deemed appropriate by the Engineer, in the case of gross negligence pertaining to this issue, the Engineer reserves the right to back-charge the Contractor for the Engineers associated costs.

16010.3.8 **INSTALLATION**

RACEWAY AND FITTINGS

A. STANDARDS

1. All conduit to be installed in accordance with the requirements of the National Electrical Code, latest addition.
2. Steel conduit to be installed in accordance with recommendations of American Iron and Steel Institute “Design Manual on Steel Electrical Raceways”, latest addition.
3. PVC coated conduit installed in accordance with manufacturer instructions.

B. ELECTRICAL CONTINUITY

All metallic conduit systems shall be electrically continuous throughout.

C. MOISTURE

1. All conduit raceway systems shall be essentially moisture tight.
2. Conduit drainage shall be accomplished by sloping conduits towards manholes or boxes.
3. Where pockets cannot be avoided in exposed conduits, provide drainage fittings or weep holes. Weep holes drilled through the walls of any conduit or fitting shall not produce burrs on the inside or outside surface.

D. ALIGNMENT OF EXPOSED CONDUIT

Install conduit runs parallel or at right angles to lines of structure.

E. FIELD CUTS AND THREADS

1. Field cuts shall be made square, threads clean and sharp.
2. Remove burrs, sharp or rough edges by reaming.
3. Before couplings or fittings are attached, apply a coat of red lead or zinc chromate to male threads of RGS or IMC conduit, also apply these coatings or other special compound recommended by the manufacturer of the conduit where the conduit protective coating is damaged.

4. PVC coated conduit system requires male threads on conduit, elbows and nipples and all female threads on fittings or conduit couplings to be protected by application of a urethane coating.
5. **Care must be taken to assure that concrete surfaces are protected from cutting oil, any/all damage will be the responsibility of the Contractor**.

F. BENDS

1. Uniform, whether job-fabricated or made with standard fittings or boxes.
2. Do not dent or flatten conduit
3. Conduit installation should be installed symmetrically insofar as practicable.
4. Unless approved otherwise, bends larger than 1-1/4 inch shall be factory made.
5. Bends in exposed conduit shall be symmetrical insofar as practicable.
6. Do not expose bends at floor or ceiling.

G. LOCATION

1. Conduit routing is generally shown in schematic fashion, unless dimensioned or noted to the contrary.
2. Contractor is responsible to route conduits as required to connect equipment or devices.
3. Vertical risers, equipment and device locations are approximately as indicated on the drawings. Contractor shall coordinate installation of conduit with structure and equipment.
4. Contractor is responsible to coordinate conduit installation with other contractors installations, in the event of conflict, field routed conduit shall be moved at the Contractors expense.
5. Conduit shall be located a minimum 6 inches away from steam, hot water, or other hot surface. Protect from heat, as Engineer approved, if the 6 inch separation is impracticable.
6. Diagonal installation is not permitted.

H. BURIED/EMBEDDED CONDUIT

1. RGS conduit installed underground, or used in PVC runs for sweeps larger than 22 degrees, must be wrapped with 3M-50 10 mil pipe wrap, approved asphalt compound or approved equal.
2. Mid-run weep holes and gravel drainage pockets will not be permitted.
3. Conduits embedded in concrete or masonry shall be securely held in place during concrete placement and construction operations.
4. In concrete floors, conduit shall be set before pouring of concrete begins. Conduit shall be routed in a direct line, with bends as long as possible, with 2 inches minimum from conduit to bottom of slab and maximum conduit size of 2 inch, unless otherwise approved.
5. Non-metallic conduits above 600 Volts shall be encased in red concrete covered by a minimum of 2 inches on all sides.
6. Buried conduit shall be placed 18” below grade, then filled to grade with flowable fill concrete.
7. If minimum of 18” cannot be reached, 3000 psi concrete shall fill the trench to grade .

I. WALL PENETRATIONS

1. Penetrations through exterior building walls to be by core drilling and providing appropriate conduit entrance seals.

2. Openings through existing partitions shall be provided at Contractor's expense. Holes through masonry construction shall be drilled with suitable core drilling machine.
3. All work is to be performed neatly.
4. Patches shall match original material in composition and appearance.
5. Provide fire seals as detailed or required by NEC where a fire rated wall or partition is penetrated.
6. A template shall be provided by the Contractor to hold conduit groups terminating together or passing through fire walls or floors.
7. In walls and partitions, conduit shall be installed vertically. If vertical installation is impracticable, the Engineer shall approve horizontal installation for each location.

J. EXPANSION FITTINGS

Install expansion fittings in all conduit runs crossing structural expansion joints and in all straight conduit runs exceeding 75 feet in length.

K. CONDUIT ENDS

1. Insulating bushings shall be installed at open conduit ends, terminating in panels, control centers, consoles or other similar locations.
2. Plug space around cables with oakum and/or an approved sealing compound where conduits enter switchboards, cabinets or similar locations.
3. Cap or plug all spare conduit ends to prevent the entrance of foreign material.

L. CONDUIT CONNECTIONS

1. At cabinets and boxes use double locknuts and insulating bushings for rigid conduit.
2. At cable tray securely clamp conduit to tray and install insulating bushings.
3. Install insulated grounding bushings with lay-in ground lugs where metallic conduit terminates in non-metallic manholes or pullboxes.
4. Flexible conduit for connection to movable/vibrating equipment shall be liquid-tight, Sealtite as manufactured by Anaconda Metal Hose Company, or approved equal, utilizing approved liquid-tight fittings.

M. SUPPORTS

1. Hangers and supports shall be galvanized or PVC coated.
2. Hangars generally are not detailed, but must be adequate to support combined weight of conduit. Rigid fastenings are to spaced at a maximum of 6 feet.
3. Clamps will be galvanized malleable iron one-hole straps, beam clamps or other approved device with necessary bolts, washers and expansion shields.
4. **Perforated metal straps shall not be used**.
5. Adjustable hangers shall be used to support horizontal runs only, use trapeze hangers for parallel runs of conduit. Install u-bolts or other approved clamping device at each end and at each elbow. Install clamp every third intermediate hanger for each conduit.

N. CONDUIT CLEANING

Contractor is to clean and swab the inside of conduits, by mechanical means, to remove foreign materials and moisture before conductors are installed.

O. SPARE CONDUITS

1. Spare conduits shall have a nylon pulling line installed for future installation of cables.
2. Recessed panels shall have three 1 inch spare conduits in the wall space stubbed-out above ceiling and three 1 inch spare conduits stubbed under the floor.
3. Spare conduits shall be capped.

CONDUCTOR INSTALLATION

A. BENDING RADII

Not to be less than permitted by ICEA and/or NEC.

B. SUPPORTS IN VERTICAL RUNS

To be in accordance with NEC requirements.

C. SPLICING

1. Will be permitted only with Engineers approval, and will be held to an absolute minimum.
2. Permitted only in junction boxes or similar accessible locations.
3. Cover with heat shrinkable sleeves to make moisture proof and corrosive resistant.
4. No splicing of instrument or control wiring shall be allowed without specific approval, by the Engineer.

D. CONNECTORS

1. Solderless compression or mechanical type will be utilized where screw does not bear directly on the wire.
2. Apparatus lugs, conductor, and coat shall be thoroughly cleaned with suitable oxidation inhibiting compound prior to connection.
3. Retaining cup washers shall be used where solid wire is used at terminal blocks.
4. Compression type connectors shall be installed using ratchet type crimping tools that will not release until full compression has been achieved.
5. Dies for the crimping tools shall be matched to the connector and approved for use by the Engineer and the connector manufacturer.
6. Twist on type, Scotch-lok or approved equal, connectors shall be restricted to the connection of lighting fixture wires only.

E. POWER CABLES

All power cables will be installed in strict accordance with the manufacturers instruction, and in conformance with NEC.

F. CONNECTIONS

All apparatus lugs shall be tandem single or multi-barrel lugs as detailed/required.

G. CONDUCTOR PULLING

1. Use pulling grips or eyes.

2. Firmly mount pulling reels on portable stand and secure against displacement
3. Use an approved by the Engineer commercial pulling compound for lubrication.
4. Monitor and do not exceed cable-pulling tension as specified by the cable manufacturer.

H. COLOR CODING

1. Single phase service - use white for neutral conductor, and black for ungrounded conductors.
2. Three phase service - feeder and branch conductors shall be color coded as follows:

	120/208 Volt	277/480 Volt
a.	Phase A – Black	Brown
b.	Phase B – Red	Orange
c.	Phase C – Blue	Yellow
d.	Neutral – White	Grey
e.	Ground – Green or Bare	Green or Bare

3. Coding shall be by insulation color or minimum 1 inch band of colored tape.
4. Green covering of conductors shall be solely for grounding.

I. PHASING

1. Where common neutral is run for two or three circuits, phase conductors shall be connected to breakers in the panel, which are connected to different phase legs.
2. Home runs may be combined at the option of the Contractor, providing not more than three circuits are installed in one conduit, unless otherwise approved by the Engineer.

J. SERVICE SYSTEMS

1. Incoming service systems shall be grounded at two points with the UFER (ground wire tied to the rebar of the footings) and to driven ground rods as indicated on the Standard Detail Drawing.
2. Jumpers shall be provided around water meters and any dialectric sections of pipe.
3. Size shall be as indicated on the Drawings and/or as required by NEC.
4. Connections shall be accessible for inspection.
5. Neutral conductor connection to grounding electrode conductor shall be at the main service enclosure only.
6. Type of equipment and details of installation shall be verified with Power Company representatives.
7. Metering equipment shall be provided as indicated on the Drawings or as required by these Specifications.

16010.3.9 INSTALLATION OF POWER AND CONTROLS TO EQUIPMENT

Contractor shall provide all power and control wiring required for the work of other trades as described on the drawings and in the specifications, except where the furnishing and installing of such wiring is specified elsewhere. Connect cord sets to Owner furnished equipment and make connections to all electric power consuming equipment whether furnished under contract or by Owner.

16010.3.10 TEMPORARY ELECTRIC SERVICE DURING CONSTRUCTION

A. The Project Contractor is responsible for all project electrical work unless otherwise noted. The Contractor shall be aware, however, that some or all of the project electrical work may be performed by the Owner and/or an independent electrical contractor. The division of work to be performed by others may be indicated on the drawings, or may be as called for by the Engineer. But, the Contractor shall be responsible to review the Drawings and consult with the Engineer, to determine if its scope is less than one hundred percent of all project electrical work. The Contractor shall also be responsible to coordinate and schedule its work with that of the Owner or independent electrical contractor, and to leave its installations ready, with the connecting wires coiled, for the Owner or independent contractor to connect to or to terminate as necessary, thereby ensuring the most efficient completion of the project by all parties.

B. The Contractor or electrical subcontractor doing the work shall provide temporary power, complete with metering and wiring, for lighting and power outlets for construction tools and equipment. This contractor will make arrangements with the local power company for temporary electrical service connections for construction power.

C. No attempt shall be made herein to specify construction power requirements for equipment in detail. However, all temporary wiring shall meet NEC, Article 305, requirements. The service shall be provided with a main disconnect, and all power receptacles shall be, or be protected by, appropriately rated GFI single-pole devices.

D. At completion of the Project, or sooner if directed, the temporary power supply shall be disconnected and removed from the construction site.

E. During construction, if it becomes necessary to shut down power to a critical item of equipment or process, the Contractor or electrical subcontractor shall provide the necessary wiring and a portable generator or other source of electric power to keep such critical equipment or process in operation.

16010.3.11 SEISMIC RESTRAINT

A. The appropriate Seismic Zone Classification will be provided on the Drawings or in the Special Provisions. All electrical equipment shall be securely anchored and seismically braced in accordance with the regulations contained in the most recently adopted edition of the UBC and with the SMACNA *Guidelines for Seismic Restraints of Electrical Systems* as they pertain to the Seismic Zone Classification given.

B. Units mounted and secured directly to structures shall be provided with connectors of sufficient strength to meet the restraining criteria.

C. All electrical equipment which is to be securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than UBC requirements and SMACNA guidelines for the given seismic zone.

16010.3.12 LABELING OF J-BOX COVERS

All J-Box covers shall be labeled with information showing the voltage and the circuit number in reference to each home run pulled through that J-Box and a particular run of conduit. The Contractor shall continue such circuits to the panels as though the routes were completely indicated.

16010.3.13 REPAIR OF WORK

A. The work shall be carefully laid out in advance and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support, or anchorage of the conduit raceways or other electrical work, this work shall be carefully done. Any damage to building, piping or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Owner.

B. Penetrations within fire rated wall assemblies shall be appropriately repaired and replaced to full integrity of the designed fire resistance of the wall.

16010.3.14 TESTING

On completion of the work, the installation shall be tested free from all grounds and short circuits. Normal feeders, circuits, and service entrance conductors with wire size #2 and larger shall be tested for leakage phase-to-ground and phase-to-phase prior to energizing the electrical system. The Contractor shall submit a written report to the Engineer showing methods used and readings taken. Voltage applied for testing shall not exceed two times normal operating voltage.

16010.3.15 GUARANTEE/WARRANTY

A. The following guarantee is a part of the specification and shall be binding on the part of the Contractor:

"The Contractor guarantees that this installation is free from defects. The Contractor agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance."

B. Electrical systems and equipment shall not be considered acceptable for substantial completion until they have performed in service continuously without malfunction for at least ten (10) days.

16010.3.16 DEFECTIVE EQUIPMENT

If equipment fails to conform to the Specifications or to operate satisfactorily, the Owner will have the right to operate said equipment until defects are corrected. The Owner will have the right to operate rejected equipment until it is replaced, without cost for depreciation use or wear. The Contractor shall remove defective equipment from operation for examination, adjustment, alteration, or change only at times approved by Owner.

16010.3.17 CLEAN-UP

A. As the work progresses, and on a daily basis, the Contractor shall remove from the premises and surrounding streets, alleys, etc., all rubbish and debris resulting from its operations and shall leave all equipment and material furnished by the Contractor absolutely clean and ready for use.

B. In addition, the Contractor shall periodically remove all debris and waste in order to maintain safe working and operating conditions, and shall dispose of the same in an approved manner. At the completion of work, The Contractor shall remove all its rubbish, tools, scaffolds and surplus materials from and about the site, leaving its work clean and the areas ready for occupancy.

16010.3.18 AS-BUILT DRAWINGS

Blue line white prints of drawings will be furnished by the Engineer, on which the Contractor shall accurately and neatly mark, in colored pencil, all changes or deviations from the drawings as such changes are made in the work. These drawings shall be reviewed with the Engineer on a timely basis, not to exceed at least once each month. Failure to keep as-built drawings up to date shall be cause for withholding monthly or final payment.

16010.3.19 FINAL INSPECTION AND ACCEPTANCE

The Contractor shall notify the Engineer when work is considered to be complete, in full operating condition, and ready for final inspection. The Engineer, after determining that the installation is ready for final inspection, will conduct the final inspection and tests as are deemed necessary to determine that the provisions of the specifications are satisfied. The Owner will not accept work nor make final payment to the Contractor until Engineer has certified that the work of the Contractor is complete and in conformance with the specifications and guarantees.

16010.4 METHOD OF MEASUREMENT

16010.4.1 NO SEPARATE MEASUREMENT

Separate measurement shall NOT be made for furnishing or installing electrical systems, components, materials required to be installed within the pay limits for a building or enclosure identified in the Bid schedule to be furnished by the Contractor.

16010.4.2 SEPARATE MEASUREMENT

A. NEW BUILDINGS - Separate measurement shall be made for installation of electrical systems, components, and materials, required for a building or enclosure shown on the Drawings and as called for in these Specifications and identified in the Bid Schedule, when such electrical systems, components, and materials are identified and listed in the Bid Schedule.

B. EXISTING BUILDINGS - Separate measurement will be made for installation of electrical systems, components, and materials, required to be installed or replaced in an existing building or enclosure, as shown on the Drawings and as called for in these Specifications, when such electrical systems, components, and materials are identified and listed in the Bid Schedule.

16010.5 BASIS OF PAYMENT

16010.5.1 No separate payment shall be made for furnishing or installing electrical systems, components, or materials required to be installed within the pay limits for a building or enclosure identified in the BID schedule to be furnished by the Contractor.

PAY ITEM	UNIT
Electrical System *(Indicate Building)*	Lump Sum
Install Electrical *(Describe Component)*	Lump Sum
Install Electrical *(Describe Component)*	Each
Install Electrical *(Describe material)*	Lump Sum
Install Electrical *(Describe material)*	Lineal Foot
Replace Electrical *(Describe Component)*	Lump Sum
Replace Electrical *(Describe Component)*	Lump Sum
Replace Electrical *(Describe material)*	Lump Sum
Replace Electrical *(Describe material)*	Lineal Foot

16150. 1 GENERAL

16150.1.1 QUALITY ASSURANCE

A. Comply with NFPA 70 requirements for electrical materials and installation.

B. Provide products and components which have been UL listed and labeled, including UL marks indicating special type usage whenever applicable.

16150.2 PRODUCTS

16150.2.1 MOTOR STARTERS

A. Acceptable Manufacturers:

1. Allen-Bradley Co.
2. Eaton Corp/Power Distribution Div.
3. Cutler Hammer
4. General Electric Co. (GE Supply)
5. Square D Co.

B. Provide factory fabricated starters complying with NEMA Standards Publication ICS 2 with NEMA Type enclosures as specified in Section 16010.

C. Provide starters with thermal overload protection on each phase utilizing interchangeable melting alloy, Class 20 (trip in 20 seconds or less when carrying a current equal to 600 percent of its current rating) overload heaters, sized in field for full load current rating indicated on each motor nameplate.

D. Manual Motor Starter: Quick-make, quick-break trip free toggle or pushbutton operating mechanism; provisions for positive padlocking in OFF position.

E. Magnetic Motor Starter: Non-reversing or reversing, as indicated; manual reset overload relay with reset button on face of enclosure; full voltage starting; control transformer of sufficient capacity to handle operating coil and associated controls, integral with each starter; 120 volts control circuit, fuse protected; equipped with pilot light.

16150.2.2 CONTACTORS

A. Acceptable Manufacturers:

1. Allen-Bradley Co.
2. Eaton Corp/Power Distribution Div.
3. Culter Hammer
4. General Electric Co. (GE Supply)
5. Square D Co.

B. Provide contactors complying with NEMA Standards Publication ICS 2 with NEMA Type enclosures as specified in Section 16010, unless otherwise indicated.

16150.2.3 RELAYS

A. Acceptable Manufacturers:

1. Control Relays:

2. Allen-Bradley Co.
3. IDEC Systems & Controls Corp.
4. Omron Electronics, Inc./Control Components Div.
5. Potter & Brumfield
6. Square D Co.

B. Provide relays complying with NEMA Standards Publication ICS 2 with NEMA Type enclosures as specified in Section 16010, unless otherwise indicated.

16150.2.4 CONTROL PANELS

A. Acceptable Manufacturers:

1. Allen-Bradley Co.
2. Eaton Corp/Power Distribution Div.
3. Cutler Hammer
4. Square D Co.

B. Provide factory fabricated oiltight pushbuttons, selector switches, pilot (indicating) lights, and pushbutton stations complying with NEMA Standards Publication ICS 2, heavy duty, with NEMA Type enclosures as specified in Section 16010.

1. Fabricate pushbutton stations for vertical or horizontal mounting, as indicated, and with button and light arrangements, as indicated on drawings.

C. Pushbuttons: Momentary or maintained contacts, as indicated; contacts rated 10 amps continuous carrying current, 600 volts AC; quick-make, quick-break, snap action operating mechanism.

D. Selector Switches: Rotary type; two or three position control, as indicated; legend plate with markings as indicated.

E. Pilot Lights: Transformer type, 120 volts AC; glass or acrylic plastic prismatic lens, color as indicated; legend plate with markings as indicated.

16150.2.5 CIRCUIT AND MOTOR DISCONNECTS

A. Acceptable Manufacturers:

1. Cutler Hammer
2. Allen-Bradley Co.
3. Siemens Corp/Electrical Apparatus Div.
4. Square D Co.
5. General Electric Co. (GE Supply)

B. Provide factory fabricated switches complying with NEMA Standards Publication KS 1 with NEMA Type enclosures as specified in Section 16010.

C. Safety Switches: 3 pole, heavy-duty, horsepower rated disconnect; rated at 600 volts; quick-make, quick-break operating mechanism; integral operating handle provided with means for positive padlocking in OFF position; current carrying parts constructed of high conductivity copper, with silver-tungsten type switch contacts; fusible or non-fusible as indicated; positive pressure type reinforced fuse clips for fusible switches.

D. Fuses: Dual element type, with time delay; non-renewable; current limiting where indicated.

16150.2.6 TRANSFER SWITCHES – MANUAL

A. Acceptable Manufacturers:

1. Cutler Hammer
2. Square D Co.
3. General Electric Co. (GE Supply)

B. Provide manual transfer switches complying with NEMA Standards Publication KS 1, specifically designed to transfer power from one load to another load, with NEMA Type enclosures as specified in Section 16010.

C. Manual Transfer Switches: Double throw, 3 pole, heavy-duty, safety switch; rated at appropriate amperes, 600 volts; quick-make, quick-break operating mechanism; blades visible from front of unit for positive indication that switch is OFF; integral three position operating handle provided with means for positive padlocking in OFF position; current carrying parts constructed of high conductivity copper, with silver-tungsten type switch contacts; non-fusible.

16150.3 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

16150.3.1 These control devices shall be considered pertinent to the equipment which they are associated with. They will not be measured or paid for separately, but shall be included in other appropriate bid items.

16210.1 DESCRIPTION

The Contractor shall provide and install all lighting systems for the Project, complete with lamps, brackets, hangers, mounting devices and all other miscellaneous components required to complete the lighting system as shown on the Drawings and in accordance with these Specifications.

16210.1.1 RELATED WORK

Section 16010 - Electrical General Requirements

16210.1.2 SUBMITTALS

Shop drawings shall be submitted for all light fixtures in accordance with Section 1300 of these Specifications.

16210.1.3 DEFINITIONS

Not used.

16210.2 MATERIALS

16210.2.1 LIGHTING FIXTURE TYPES AND SIZES

Shall be as designated on the Drawings or as otherwise required by the Special Provisions. All work, equipment, and materials shall be in accordance with UL "Standards for Electric Lighting Fixtures", No. 57, and the NEC (National Electric Code).

16210.2.2 INCANDESCENT FIXTURES

Shall be complete with medium base socket, all hardware required for installation, and lamps. Lamps shall be medium base, inside frosted, general purpose, or the project type as referenced in the electrical schedule.

16210.2.3 FLUORESCENT FIXTURES

Shall be provided complete with Class "P" high power factor, electronic type ballast with a -20°F temperature rating, together with all miscellaneous hardware and lamps. Ballast shall be CBM certified, ETL rated, with maximum sound level equivalent to General Electric Company Sound Rating "A". Lamps shall be cool white unless otherwise required on the Drawings.

16210.2.4 HIGH INTENSITY DISCHARGE FIXTURES

Shall be ballast type, complete with all miscellaneous hardware and lamps. Photocells shall be used as required on the Drawings. Ballast shall be constant wattage, high power factor type. Lamps shall be inside frosted and of the wattage indicated.

16210.2.5 HIGH PRESSURE SODIUM FIXTURES

High-pressure sodium and metal halide fixtures shall be suitable for all burning positions as specified for each type of luminaire.

16210.3 CONSTRUCTION REQUIREMENTS

16210.3.1 Fixtures and related materials shall be installed as nearly as possible in the locations shown on the Drawings. The Contractor shall coordinate the exact locations with structure, equipment, and other devices as approved by the Engineer and/or the Owner. Mounting heights shall be as indicated on the Drawings.

16210.3.2 Conductors serving grid ceiling fixtures shall be enclosed in 1/2 inch flex conduit from a junction box attached to the building structure. Fixture locations shall be coordinated with ceiling system. Fixtures shall be securely fastened to the ceiling framing members.

16210.4 METHOD OF MEASUREMENT

Measurement for the lighting fixtures will not be made separately but will be included in the measurement for the building listed in the Bid Schedule.

16210.5 BASIS OF PAYMENT

Separate payment will not be made for light fixtures. Payment will be included in the contract unit price for the building in which the fixtures are installed and listed in the Bid Schedule.

16315.1 DESCRIPTION

The Contractor shall furnish, test, install, and place into satisfactory operation the liquid level switches with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

16315.1.1 RELATED WORK

Section 16010 – Electrical General Requirements

16315.1.2 SUBMITTALS

The Contractor shall provide descriptive information which indicates the model number, manufacturer's name, dimensions, measuring range and manufacturer's certification of performance in accordance with the requirements of Section 01300.

16315.2 MATERIALS

16315.2.1 LIQUID LEVEL SWITCHES

1. Float actuated switch shall be a dry contact type switch in a hermetically sealed polypropylene casing, suspended on a PVC coated cable.
2. The number of floats per level system shall be as shown.
3. Switch set points shall be as shown on the JVWCD drawings.
4. Mercury switch type capsules are not allowed.
5. As manufactured by:
    a) Gems 43765, LS-270 Series

16315.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide all materials needed to install equipment in accordance with the manufacturer's recommendations and at the locations shown on the Drawings.

16315.4 METHOD OF MEASUREMENT

Separate measurement of this equipment will not be made. Measurement will be included as per Electrical Work and Equipment.

16315.5 BASIS OF PAYMENT

Separate payment for this equipment will not be made.

16400.1 GENERAL

16400.1.1 APPLICABLE SECTIONS

The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 16.

16400.1.2 SCOPE

Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the drawings.

16400.1.3 WORK INCLUDED

A. Electrical work required for this work is shown on the drawings and includes, but is not necessarily limited to:

1. Complete new electrical distribution system for power and lighting as shown.
2. Complete system of raceways and outlets for Control and all other auxiliary systems of this Division 16. Unless noted otherwise, the equipment and wiring of these auxiliary systems will be furnished and installed under their respective sections; however, the conduit raceway systems will be furnished and installed under this Section 16400.
3. All excavating, backfilling, compacting, and grading required for the installation of all work covered under this Division 16.

B. Shall furnish and install all component parts of all the systems required for their safe and proper operation, whether or not specifically mentioned or noted on the drawings, except those items or articles which are specifically noted hereinafter as being supplied otherwise.

C. Perform all trenching and backfilling required in connection with the work of this section in strict accordance with the provisions of Division 02000 of these specifications.

D. Provide all required electrical connections and service to items described in all other sections of these specifications. Provide all those services outlined in other divisions of the specifications as being done by the electrical sub-contractor.

16400.1.4 RELATED WORK SPECIFIED ELSEWHERE:

Section 16010 – Electrical General Requirements
Section 16410 – Fuses
Section 16210 – Electrical Fixtures

16400.2 PRODUCTS

16400.2.1 DISTRIBUTION PANELBOARDS

A. Distribution panelboards shall be factory assembled dead front, wall mounted as scheduled and braced for the indicated ampere rms symmetrical with equipment, bussing connections, circuit breakers and all similar components indicated on the drawings or required for proper completion. Each breaker shall have an etched micarta nameplate secured by two cadmium plated screws. Nameplates shall indicate equipment served as shown in schedule. Busses shall be copper of a maximum current density of 1000 amperes per inch and shall be equipped with uninsulated equipment ground bus. Three phase, 4-wire panels shall have full capacity neutral bus.

B. All floor mounted panels shall be mounted on a **4" housekeeping pad** and therefore to comply with NEC, the operating handles of switches and breakers shall be no more than 6'-2" above the bottom of the panel.

C. Distribution panel boards shall be wall mounted as indicated in schedules. For access to wiring gutters, panel shall be door within door construction. Shall be Square D, I-Line or equal of Siemens I.T.E., Cutler Hammer/Westinghouse or General Electric.

16400.2.2 BRANCH CIRCUIT PANELBOARDS

A. Branch circuit panelboards shall be Square D for the scheduled voltage, 3 phase, 4 wire operation or equal of Siemens, or General Electric. Shall be equipped with bolt-on breakers. Minimum width shall be 20 inches. Minimum depth shall be 5.75 inches. Panel trims shall be of the door within door construction.

B. Busses shall be copper.

C. Branch circuit breakers shall be provided per schedules on drawings. All multi-pole breakers shall be common trip.

D. Doors shall be complete with corrected circuit schedule on inside. Panels shall be NEMA 3R type construction.

16400.2.3 DRY TYPE TRANSFORMERS

A. General Purpose Dry-Type Transformers: (Under 600 volts)

1. General: Furnish and install at locations shown on the drawings dry-type two winding power transformers for general power and lighting applications indicated. Transformers shall be UL listed and bear the required Listing Mark.
2. Electrical Rating: Shall be 60 hertz of sizes, phases, high voltage and low voltage as scheduled on the drawings. Each transformer, unless specifically noted otherwise, shall have six (6) 2-1/2% full capacity taps, two above and four below nominal voltage in the high voltage winding.Temperature Classification: Each transformer shall utilize an insulation system that has been properly temperature classified and approved by Underwriters' Laboratories. Unless specifically noted otherwise, the insulation classification shall be 220 C with 150 C winding temperature rise in accordance with Underwriters' Laboratories specification UL506.

3. Load Rating:

   a. Each transformer supplied to this specification shall be capable of operating at 100% of nameplate rating (NPR) continuously while in an ambient temperature not exceeding 40°C and shall be capable of meeting the daily overload requirements of ANSI Standard C57.96 as stated in the following chart:

PERMISSIBLE ONCE DAILY OVERLOADS WITH NORMAL LIFE MAINTAINED			
Peak Load Following and Followed by a Constant Load of			
Peak Load Time (Hours)	90% NPR	70% NPR	50% NPR
1/2	162% NPR	185% NPR	200% NPR
1	138% NPR	148% NPR	152% NPR
2	123% NPR	128% NPR	133% NPR
4	113% NPR	115% NPR	118% NPR
8	106% NPR	107% NPR	108% NPR
NPR = Nameplate Rating			

   b. Transformer loaded in accordance with this paragraph shall be capable of long service life under the thermal conditions specified. There shall be no need for derating.

4. Sound Rating: Each transformer shall have sound levels equal or lower than those established in the latest revision of ANSI Standard C89 as shown in the following chart:

Transformer Rating KVA	Maximum Sound Level Decibels
10-50	45
51-150	50
150-300	55

5. Other Requirements: The following requirements shall be in accordance with Underwriters' Laboratories specification UL506:
   a. Enclosure:
      (i) Ventilation openings
      (ii) Corrosion resistance
      (iii) Cable bending space
      (iv) Grounding provisions
      (v) Surface temperature rise
      (vi) Wiring compartment temperature rise
      (vii) Terminations

6. Test Requirements:
   a. Each transformer furnished to this specification shall be subjected to the following production tests:
      (i) Applied potential
      (ii) Induced potential
      (iii) No load losses
      (iv) Voltage ratio
      (v) Polarity
      (vi) Continuity
   b. The manufacturer shall have performed the following additional tests on units identical to the design type being furnished to this specification. Proof of performance of these lists in the form of test data sheets shall be provided as part of the shop drawing submittal.
      (i) Sound levels
      (ii) Temperature rise tests
      (iii) Full-load losses
      (iv) Regulation
      (v) Impedance

7. Shop Drawings: Submit shop drawing for review prior to delivery to job site.

16400.3 EXECUTION

16400.3.1 INSTALLATION OF GROUNDING SYSTEM

A. The conduit system and neutral conductor of the wiring system shall be grounded to the cold water pipe having a continuous path to earth in compliance with grounding provisions as outlined in the NEC. Point of connection to the water system shall be as near as practicable to the service entrance. Provide bonding jumper same size as system ground to provide ground continuity from customer's side of metallic lines service entrance and street side of metallic mains. The neutral and ground shall be connected together at the main service switch only.

B. Where the water main is not metallic, delete water pipe ground requirements and provide a concrete encased electrode consisting of a 20-foot length of #3/0 bare copper conductor tied to the steel reinforcing bars and encased within a concrete footing. This footing shall be in direct contact with earth and located near the main panel.

C. The Contractor shall also install a made electrode ground system consisting of copperclad rods spaced not closer than six feet apart. Grounding conductors and connections to ground rods shall be protected from damage and shall be placed to avoid disconnect by unauthorized personnel. Interconnect with water pipe ground system.

D. The equipment grounding system shall be such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with the electrical circuits operate continuously at ground potential and provide a low impedance path for the possible ground fault currents. The system shall comply with the National Electrical Code, modified as indicated on the drawings or specifications and as hereinafter specified to incorporate a maximum 25 ohms ground resistance. Grounding connections shall be accessible for inspection.

E. The distributions system shall be provided with a separate equipment grounding conductor for each single or three-phase feeder, each branch circuit with a multi-pole protective device and each single phase receptacle and motor circuit as indicated. The required grounding conductor shall be installed in the common raceway with the related phase and/or neutral conductors. Single-phase branch circuits required for lighting, shall consist of phase and neutral conductors installed in common metallic conduit which shall serve as the grounding conductor. Conduit equipment connections utilized in conjunction with the above single-phase branch circuits shall be provided with suitable bonding jumpers connected to approved grounding type bushings. Single-phase branch circuits and all branch circuits installed in flexible conduits shall be provided with a separate grounding conductors as hereinbefore specified for the multi-pole branch circuits.

16400.3.2 INSTALLATION OF PANELS

A. Installation: Unless otherwise indicated on the drawings, install wall panels with the top of the trim 6'-0" above the finished floor. Panels located in equipment rooms and wire closets shall be surface mounted. Floor mounted panels shall be provided with a 4" concrete housekeeping pad. Floor mounted panels shall be anchored to floor at all four corners and to wall or structural member at top for seismic restraint.

B. Directories: Mount a typewritten directory behind glass or plastic on the inside of each panel door. On the directory, show the circuit number and complete description of all outlets with specific locations on each circuit. In addition, provide a typewritten label inside door showing source of power to panel both as to feeder switch, panel designation and location within buildings.

16400.3.3 GENERAL PURPOSE DRY TYPE TRANSFORMERS

General purpose dry transformers shall be mounted on floor at locations shown on drawings. Each shall be anchored to floor by means of a minimum of four 1/2" x 6" anchor bolts grouted in existing concrete floor.

16400.3.4 TESTING

A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the Engineer Owner's Representative.

B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the National Electrical Code.

16400.3.5 FINAL INSPECTION

A. This Division 16 contractor's job foreman shall be present at the final inspection of the work by the Owner.

B. Electrical job foreman shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.

C. See Section 16010 for other requirements for final inspection.

16400.4 METHOD OF MEASUREMENT

16400.4.1 SERVICE ENTRANCE. Provide all conduit, sweeps, support members, concrete transformer pads & pad vaults, grounding equipment, breakers, disconnects, enclosures, conductors, and appurtenances as required by the local utility, and as shown on the drawings and as defined in the applicable sections of the specifications required for a complete and fully functioning system.

16400.4.2 GROUNDING SYSTEM. Provide all grounding conductors, connections, ground rods, ground wells, and associated appurtenances and as shown on the drawings, and as defined in the applicable sections of the specifications.

16400.4.3 POWER PANEL (PP) OR MOTOR CONTROL CENTER (MCC). Provide all conduit, sweeps, pull boxes, power panels, motor starters, motor savers, receiving and installation of motor control center, transient voltage surge suppressor (TVSS), support members, grounding equipment, breakers, disconnects, enclosures, conductors and connections, and appurtenances as shown on the drawings and as defined in the applicable sections of the specifications required for a complete and functioning system.

16400.4.4 DRY TYPE TRANSFORMERS. Provide dry type transformer and appurtenances as shown on the drawings and as defined in the applicable sections of the specifications required for a complete and functioning system.

16400.4.5 LIGHTING PANEL (LP). Provide all conduit, sweeps, support members, grounding equipment, breakers, disconnects, enclosures, conductors and connections, switches, receptacles, and appurtenances as shown on the drawings and as defined in the applicable sections the specifications required for a complete and functioning system. Where lighting fixtures are not called out in the pay item, they are included in the LIGHTING PANEL (LP).

16400.4.6 LIGHTING FIXTURES. Material cost for lighting fixtures and all appurtenances. Note: conduit, wire and switches and included in LIGHTING PANEL (LP) section(s).

16400.4.7 HEATING VENTILLATION AIR CONDITIONING (HVAC). Provide all conduit, sweeps, support members, grounding equipment, breakers, disconnects, enclosures, conductors, switches, receptacles, and appurtenances as shown on the drawings and as defined in the applicable sections the specifications required for a complete and functioning system. Note: conduit, wire and switches and included in LIGHTING PANEL (LP) section(s).

16400.4.8 CONTROL PANELS. Provide all conduit, signal and power conductors and connections, and appurtenances for all control panels as shown on the drawings and as defined in the applicable sections of the specifications required to provide a complete and functioning system.

16400.5 BASIS OF PAYMENT

16400.5.1 No separate payment shall be made for furnishing or installing electrical systems, components, or materials required to be installed within the pay limits for a building or enclosure identified in the BID schedule to be furnished by the Contractor.

16400.5.2 When electrical systems, components, or materials are measured for a new building or enclosure as shown on the Bid Schedule, separate payment will be made as listed below.

16400.5.3 When initial installation or replacement of electrical systems, components, or materials is made in an existing building as shown on the Bid Schedule, the accepted quantity will be paid for at the contract price listed below:

PAY ITEM	UNIT
Service Entrance	Lump Sum
Grounding System	Lump Sum
Lighting Panel LP1 & Control Panel	Lump Sum
Lighting Fixtures	Lump Sum
HVAC	Lump Sum
Control Panels	Lump Sum

16960.1 DESCRIPTION

The Contractor shall furnish, test, install, and place into satisfactory operation the magnetic intrusion switches with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

16960.1.1 SUBMITTALS

The Contractor shall provide descriptive information which indicates the model number, manufacturer's name, dimensions, measuring range and manufacturer's certification of performance in accordance with the requirements of Section 01300.

16960.2 MATERIALS

16960.2.1 MAGNETIC INTRUSION SWITCH

1. Device identification: See Plans.
2. Magnetic industrial contact type with stainless steel armored cable.
3. Sealed unit.
4. UL Listed
5. Form A Contact or Form C Contact.
6. Supports gaps up to 3"
7. Manufacturers:
    a) Interlogix 2507A
    b) Interlogix 2505A
    c) or approved equal.

16960.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide all materials needed to install equipment in accordance with the manufacturer's recommendations and at the locations shown on the Drawings. Contractor shall provide all mounting brackets, fasteners and other appurtenances required for a complete installation and to accommodate required offsets based on site conditions.

16960.4 METHOD OF MEASUREMENT

Separate measurement of this equipment will not be made.

16960.5 BASIS OF PAYMENT

Separate payment for this equipment will not be made.

CHLORINATION EQUIPMENT — SECTION SP 11232

11232SP DESCRIPTION

This section covers the provision and installation of chlorination equipment at two sites, one in Sandy and one at the Rosecrest site as seen in plans.

11232.1.1 RELATED WORK

Section SP 13210 – Chlorination Building

11232.1.2 SUBMITTALS

11232.1.2.1 DESCRIPTIVE LITERATURE - The Contractor shall furnish descriptive literature, which identifies the manufacturer, model numbers, materials of fabrication, and sizes of all components in the chlorination system, as described, in accordance with Section 01300 of these Specifications.

11232.1.2.2 OPERATION AND MAINTENANCE MANUALS - The Contractor shall furnish to the Owner manufacturer's operation and maintenance manuals for all chlorination equipment it provides prior to the time of final acceptance for payment.

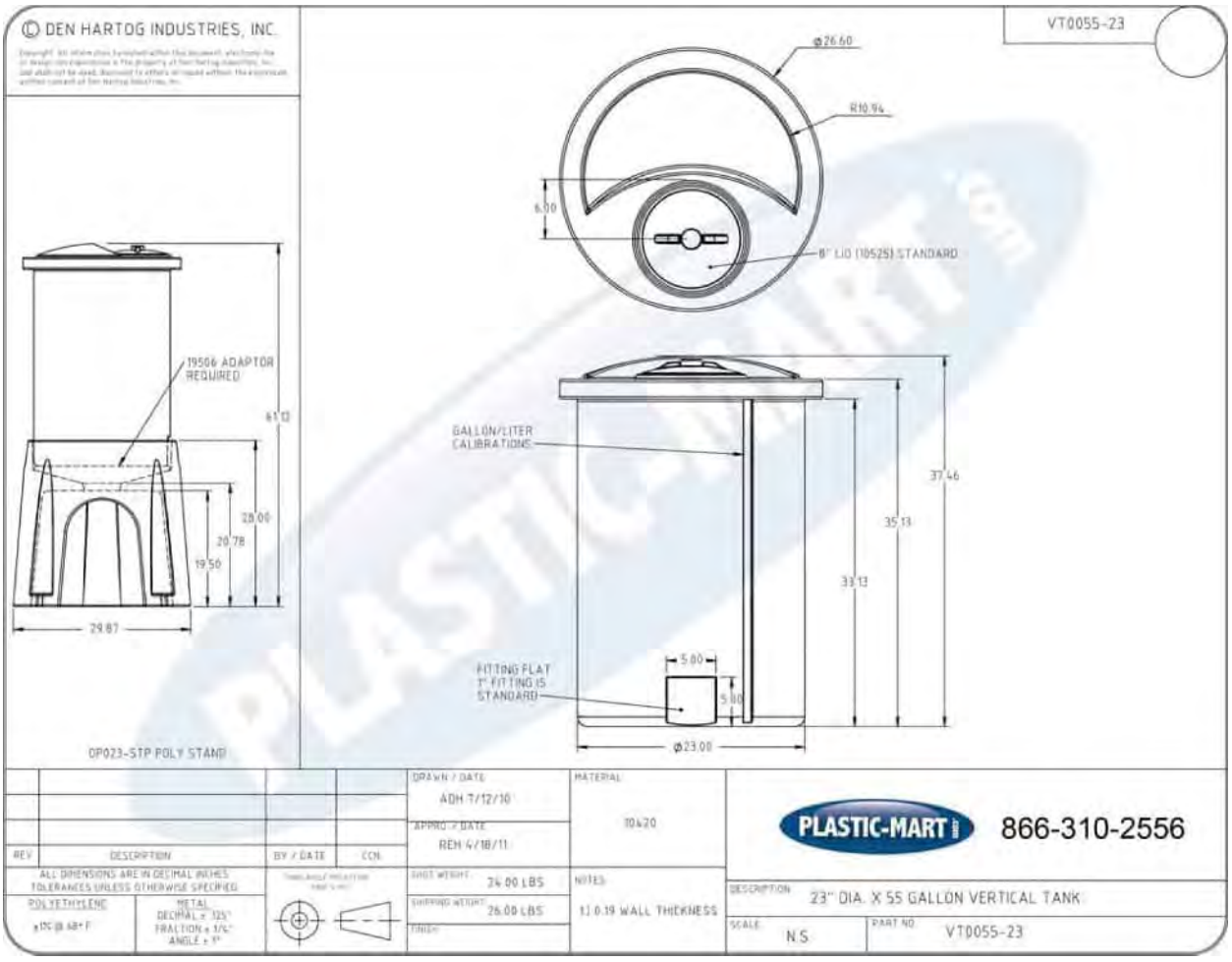
11232.1.3 DEFINITIONS

Not used.

11232.2 EQUIPMENT AND MATERIALS

11232.2.1 DAY TANK

Day Tank shall be Ace Storage Tank 23" x 38" Part No A-VT0055-23 or Equivalent with OPO23-STP Poly Stand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VT0055-23
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8" LID (10525) STANDARD
19506 ADAPTOR REQUIRED
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28.00
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DRAWN / DATE
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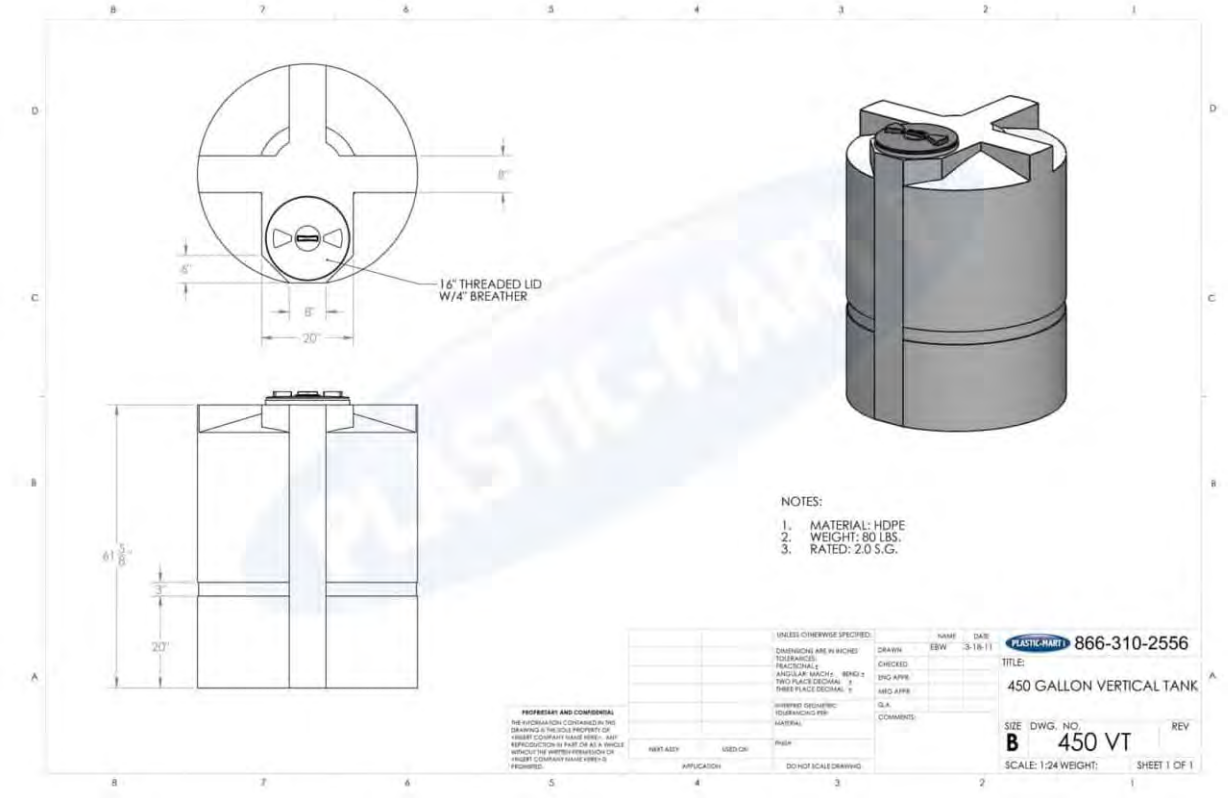
APPRO. / DATE
REH 4/18/11
MATERIAL
10420
PLASTIC-MART
866-310-2556
REV
DESCRIPTION
BY / DATE
CON.
ALL DIMENSIONS ARE IN DECIMAL INCHES
TOLERANCES UNLESS OTHERWISE SPECIFIED
POLYETHYLENE
METAL
DECIMAL ± .125"
FRACTION ± 1/16"
ANGLE ± 1°
SHOT WEIGHT
24.00 LBS
SHIPPING WEIGHT
26.00 LBS
FINISH
NOTES
1) 0.19 WALL THICKNESS
DESCRIPTION
23" DIA. X 55 GALLON VERTICAL TANK
SCALE
N.S.
PART NO.
VT0055-23

11232.2.2 Storage Tank

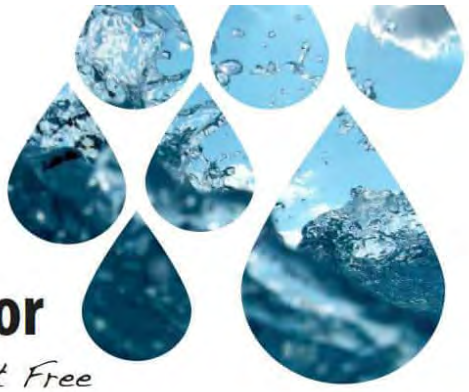
Storage Tank shall be Custom Roto Vertical Tank 48” x 62” Part No CRMI-450VT or Equivalent



11232.2.3 CHLORINE RESIDUAL ANALYZER

Chlorine Residual Analyzer shall be ATI Q46H/62-63 Residual Chlorine Monitor or Equivalent

Call **800.959.0299** to speak with a sales representative
or visit us on the web at **www.analyticaltechnology.com**



ResidualChlorineMonitor

MONITOR YOUR CHLORINE ...*Reagent Free*

Q46H Flowcell Style Sensor

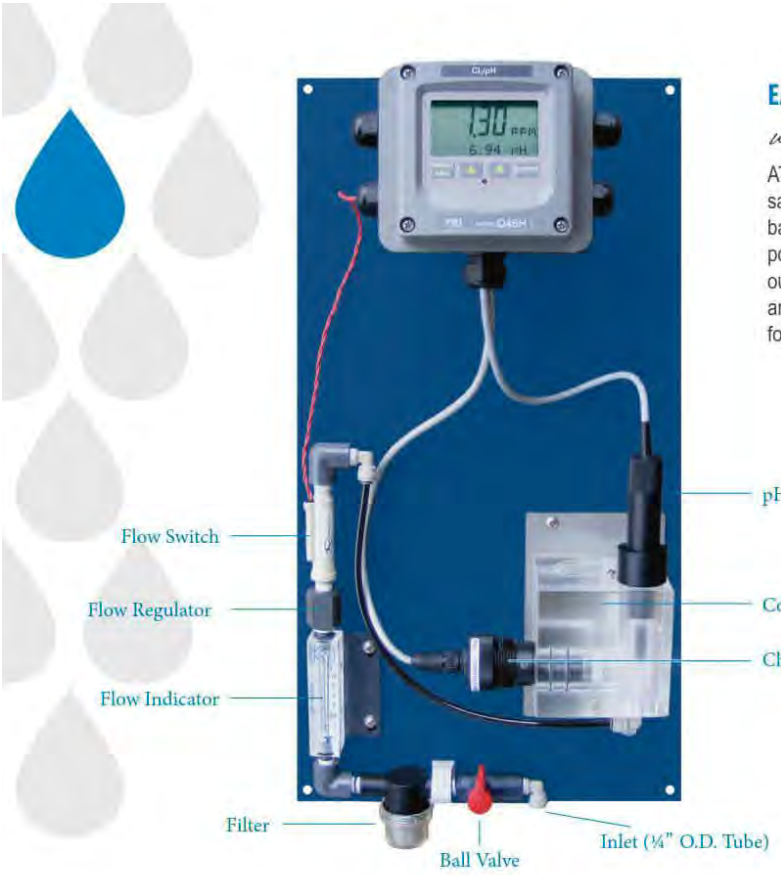
ATI's Model Q46H Chlorine Monitor is the latest version of our proven Q Series monitoring instruments for free or combined chlorine. Monitor capabilities have been expanded to include options for a 3rd analog output or for adding additional low power relay outputs. Digital communication options for Profibus DP, Modbus RTU, Modbus TCP/IP or Ethernet IP have been added, as well.

The Q46H system uses a polarographic membraned sensor to measure chlorine directly, without the need for chemical reagents. When needed, automatic pH compensation may be added for highest free chlorine measurement accuracy. Systems are available to provide 4-20 mA outputs for chlorine, pH, and temperature to allow easy CT calculations.

Q46H systems are economical to purchase, economical to maintain, and provide long term accuracy and reliability for your chlorine monitoring needs.

EPA Method 334 Compliant

ATI ANALYTICAL TECHNOLOGY, INC.



EASY INSTALL.

Want to simplify installation?

ATI can supply the Q46H complete with sample flow controls mounted to a PVC back plate ready to mount. Connect power, water sample, and analog/relay outputs and you're ready to go. Systems are available with or without a flow switch for remote indication of loss of sample.

FEATURES.

Free or Combined Chlorine. Q46H Monitors are factory set for either Free or Combined Chlorine measurement, but can easily be converted from one to the other in the field.

Economical Operation. Reagent-less operation and low parts cost makes the Q46H your best choice for chlorine monitoring applications in potable water, wastewater, cooling water, or high purity water systems.

Automatic pH Compensation. For free chlorine monitoring under widely varying pH conditions, automatic pH compensation may be added to maintain the highest measurement accuracy at pH levels up to 9.5.

Dual Chlorine/pH Monitoring. Even when pH correction is not required, adding a pH sensor to the system converts the monitor to a dual analyzer, providing 4-20 mA outputs for both chlorine and pH.

Flexibility. Programmable range options from 0-200 PPB up to 0-200 PPM provide maximum application flexibility.

AC or DC Power Options. Power options include universal 90-260 VAC or 12-24 VDC.

Analog Output Options. Two isolated 4-20 mA outputs are standard, with an option for a third output if required. Default setting provides analog outputs for chlorine and pH.

PID Output. Standard PID control function assignable to one analog output.

Digital Communications. Available in either Profibus DP, Modbus RTU, Modbus TCP/IP or Ethernet IP.

Relay Outputs. Three SPDT relays are standard, with relay functions programmable for alarm, control, or trouble indication. Three additional low power relays available as an option.

Flexible Mounting. NEMA 4X (IP-66) enclosure is suitable for wall, pipe, or panel mounting.

Clear Display. Back-lit large LCD display provides clear visibility in any lighting conditions. A scrolling second line on the display provides additional information and programming prompts.

SENSOR & FLOWCELL OPTIONS.

Two types of chlorine sensors are available. One is designed for flowcell installation, and the other is for submersion applications. Free chlorine monitoring should always be done using a flowcell system. Good control of sample flow and pressure is important for accurate measurement. The standard constant-head flowcell should be used for most applications. A sealed flowcell and a low-volume flowcell are also available for special applications. Consult your ATI representative for application assistance.

Submersible combined chlorine sensors can sometimes be used for measuring total chlorine in wastewater effluent. Wastewater effluents containing more than 1 PPM of ammonia, often result in a chlorine residual that is more than 90% monochloramine. Direct measurement with a submersible sensor can provide a dependable monitor without all the sampling and chemicals associated with total chlorine measurement.

Submersion and Flowcell Sensors

Constant Head Flowcell

Sealed Flowcell

Say *Goodbye* to Buffers & DPD Reagents ...*Forever!*

SENSOR STABILIZATION.

Chlorine sensors, especially free chlorine, require up to 8 hours of stabilization time when first installed or after membrane change. ATI offers a battery powered "polarizer" that can be used to stabilize a spare sensor so it is ready to run within a few minutes of installation. Polarizers simply plug into the sensor connector and require no adjustments.

Sensor Polarizer

SYSTEM OPTIONS.

Standard Q46H Systems are AC powered (100-240 VAC, 50/60 Hz), or a DC powered (12-24 VDC) version is also available. The basic system includes two isolated 4-20 mA outputs and 3 SPDT alarm relays.

If pH correction is required, or if pH measurement is also desired, an optional pH sensor is available. With this sensor connected, the second analog output may be configured for pH instead of temperature to provide a dual chlorine/pH monitor system.

Q46H systems may also be supplied with an additional output board. This output board may contain **either** a third 4-20 mA output **or** three additional low power relays. Adding the third analog output is the most common as the system then provides isolated outputs for chlorine, pH, and temperature.

In addition to the analog output options, Q46H monitors may be supplied with digital communications. Communication options currently include Profibus DP, Modbus RTU, Modbus TCP/IP and Ethernet IP.

Q46H/62-63 SPECIFICATIONS

ELECTRONIC MONITOR

Display Range	0-2.000, 0-20.00, or 0-200.0 PPM
Accuracy	0.5% of selected range or 0.02 PPM
Repeatability	0.3% of selected range or 0.01 PPM
Non-Linearity	0.1% of selected range
Temperature Drift	0.01% of span/°C
Power	90-260 VAC, 50/60 Hz, 10 VA max.; 12-24 VDC, 500 mA max.
Analog Outputs	Two isolated 4-20 mA, 500 Ω load max. (3rd output optional)
Relays	Three SPDT, 6A @250 VAC, 5A @24 VDC (3 additional SPST non-isolated, 1A @30 VDC optional)
Display	4 digit, 0.75" numeric LCD with 12 character second line, LED back light.
Enclosure	NEMA 4X (IP-66) Polycarbonate, V-0 flammability
Operating Temperature	-20 to 60°C (-4 to 140°F)
Weight	6 lbs (2.7 kg) with sensor, flowcell & accessories 15 lbs (6.8 kg) assembled into panel
Zero Drift	< 0.01 PPM/month
Operating Conditions	0 to 50°C

SENSOR & FLOWCELL

Sensor	Membrane-Covered Amperometric (Polarographic)
Optional pH Sensor	Combination pH sensor, with or without preamplifier
Materials	PVC & 316SS
Response Time	90% in 60 sec
Temperature Limits	-5 to 55°C
Pressure Limit	0-50 PSIG
Sensor Cable	25 ft (7.5 m) standard
Sensor Flowcell	Clear Acrylic Constant-Head Overflow standard Sealed Acrylic Flowcell optional
Sample Flowrate	7-15 GPH (0.5-1.0 LPM)

NOTES:

1 - All systems are supplied w/one package of membranes, one 120 cc bottle of electrolyte, & one spare parts kit containing 3 each of all o-rings & special screws.
2 - Suffix D, 2, 3, or 4 allow Q46H to supply outputs for both chlorine & pH.
3 - Flowcell for Cl_2 / pH combo systems should be kept within 25 ft of monitor.
4 - Buffer packet for pH 4 & 7 supplied with opt. 2, 3 or 4, suffix D.
5 - Pipe mount requires two 2" U-bolts (47-0005).

ORDERING INFORMATION

Model Q46H/62-63 A-B-C-D-E-F-G Chlorine Monitor

Suffix A - Measurement Type
62 - Free Chlorine
63 - Combined Chlorine

Suffix B - Power
1 - 100-240 VAC, +/-10%, 50/60 Hz
2 - 12-24 VDC

Suffix C - Sensor Style
1 - Sensor with constant head flowcell and 25 ft cable
2 - Submersible sensor with 25 ft cable (Combined Chlorine only)
3 - Sensor with sealed low-volume flowcell
4 - Sensor with 1-1/2" Flow "T" (Combined Chlorine only)
5 - Sensor with sealed flowcell
6 - Flow sensor only, no flowcell (use with extreme caution)

Suffix D - pH Sensor Input
1 - None
2 - Q22 pH Sensor with battery preamp, 25 ft cable
3 - Standard pH sensor with 25 ft cable & adapter for overflow cell
4 - Standard pH sensor with 25 ft cable & sealed flowcell

Suffix E - Digital Output
1 - None
2 - Profibus DP
3 - Modbus RTU
4 - Ethernet IP
5 - Modbus TCP/IP

Suffix F - Optional output (select only one)
1 - None
2 - One additional 4-20 mA output
3 - Three additional low power relays (SPST, 0.5 A max.)

Suffix G - System Assembly
1 - None
2 - Panel with flow controls, without flow switch
3 - Panel with flow controls, with flow switch

ACCESSORIES

07-0100 NEMA 4X junction box
31-0038 Sensor interconnect cable (max. 100 ft)
00-0628 Mounting bracket kit for submersible sensor
00-0259 CO_2 buffer injection system (for precipitation control)
55-0003 Rotameter for CO_2 buffer system
00-0570 Free Chlorine sensor polarizer (flow)
00-0572 Combined Chlorine sensor polarizer (flow)
00-0573 Combined Chlorine sensor polarizer (submersion)
47-0005 2" U-bolt, 304SS
05-0094 Panel Mount Bracket Kit

ATi ANALYTICAL TECHNOLOGY, INC. CE C SP US

Visit Us on the Web: www.analyticaltechnology.com

B / Q46H/62-63 (07/17)

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Fax 01457 874 468
Email sales@atluk.com

Represented by:

11232.2.4 CHLORINE PUMP

Chlorine Pump shall be Grundfos DDA 7.5-16 FC-PV/V/V-F-31U7U7B or Equivalent

GRUNDFOS **DATA BOOKLET**

SMART Digital

DDA, DDC, DDE

DIGITAL DOSING
pumps and accessories

be
think
innovate

GRUNDFOS

Table of contents

1. General data

Performance range

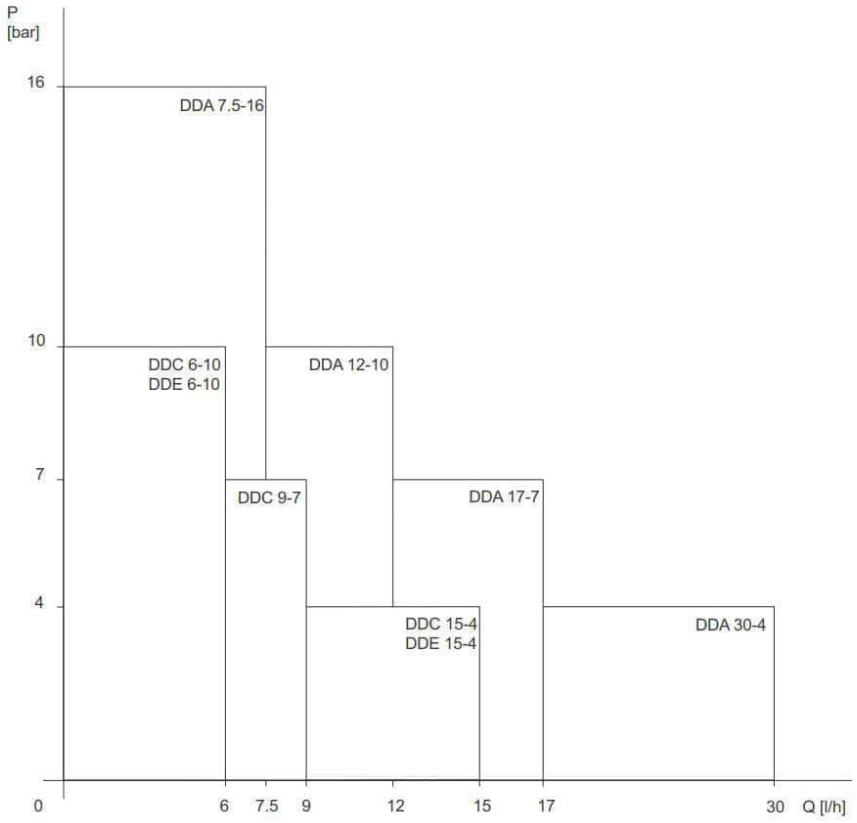

Fig. 1 Performance range

Features at a glance

TM04 8240 0312

Fig. 2 DDA, DDC, DDE

Digital Dosing™

The SMART Digital generation DDA, DDC and DDE with powerful variable-speed stepper motor brings state-of-the-art technology to perfection. Combined expert knowledge and the new patented solutions set future standards. Traditional technologies such as stroke length / stroke frequency adjustment with synchronous motor or solenoid drive become a thing of the past.

Unique flexibility with only a few variants

The included click-stop mounting plate makes the new pump more flexible. Three different positions are possible without using any additional accessories, such as wall brackets. Service and pump exchange can now be done easily and fast just by clicking the pump in and out of the mounting plate.

The control cube on the DDA and DDC pump can be lifted and turned easily into three different positions: front, left or right.

TM04 1662 2610

Fig. 3 Modularity of the control cube

A turn-down ratio of up to 1:3000, a wide supply voltage range (100-240 V; 50/60 Hz), combined connection sets and other features reduce the models and variants to a minimum.

Precise and easy setting / usability and interaction

The operator can easily install the pump and set it to discharge exactly the quantity of dosing liquid required for the application. In the display, the setting of the pump is read out directly, the flow is shown in ml/h, l/h, or gph.

The click wheel (turn-and-push knob) and the graphical LC display with plain-text menu in more than 20 languages make commissioning and operation intuitive. As the LCD is backlit in different colors, the pump status can be seen from a distance (traffic-light concept).

TM04 1661 2610

Fig. 4 Display DDA, DDC

Thanks to a variety of operation modes, signal inputs and outputs, the pump can easily be integrated into every process.

Advanced process reliability

An intelligent drive and microprocessor control ensures that dosing is performed precisely and with low pulsation, even if the pump is dosing high-viscosity or degassing liquids. Malfunctions, caused e.g. by air bubbles, are detected quickly by the maintenance-free FlowControl system and then displayed in the alarm menu. The AutoFlowAdapt function automatically adjusts the pump according to the process conditions, e.g. varying backpressure. The integrated flow measurement makes additional monitoring and control equipment redundant.

Designed to save costs

In general, the investment for a dosing pump installation is low compared to its life cycle costs including the cost of the chemicals. The following features make the SMART Digital DDA, DDC and DDE pumps contribute to low life cycle costs:

- No underdosing or overdosing due to high dosing accuracy and FlowControl
- Longer maintenance intervals thanks to the universal chemical resistance of the full-PTFE diaphragm
- Reduced energy consumption thanks to state-of-the-art drive technology.

Three application-oriented type ranges

DDA: High-end pump range for extended flow and pressure ranges with sensor-based FlowControl and measurement functions for challenging industrial applications, e.g.

- Process water
- Food and beverage
- Ultrafiltration and reverse osmosis
- Pulp and paper
- Boiler feed water
- CIP (Cleaning-In-Place).

DDC: User-friendly pump range with standard inputs and outputs for common applications, e.g.

- Drinking water
- Waste water
- Swimming pool water
- Cooling tower
- Chemical industry.

DDE: Low-budget pump range with basic functions including manual operation or control via PLC for OEM applications, e.g.

- Car wash
- Irrigation.

2. Identification

Type key

Example:	DDA	7.5-	16	AR-	PP	/V	/C	-F	-3	1	U7U7	F	G

Type range

DDA
DDC
DDE

Maximum flow [l/h]

Maximum pressure [bar]

Control variant

B	Basic (DDE)
P	B with pulse mode (DDE)
PR	P with relay output (DDE)
A	Standard (DDC)
AR	A with alarm relay and analog input (DDA, DDC)
FC	AR with FlowControl (DDA)
FCM	FC with flow measurement (DDA)

Dosing head variant

PP	Polypropylene
PVC	Polyvinyl chloride**
PV	PVDF (polyvinylidene fluoride)
SS	Stainless steel 1.4401

Gasket material

E	EPDM
V	FKM
T	PTFE

Valve ball material

C	Ceramic
SS	Stainless steel 1.4401

Control cube position

F	Front-mounted (change to left and right possible)
X	No control cube (DDE)

Supply voltage

3	1 x 100-240 V, 50/60 Hz
I	24-48 VDC (DDC)***

Valve type

1	Standard
2	Spring-loaded

0.1 bar suction opening pressure
0.1 bar discharge opening pressure

Installation set*

I001	Tubing 4/6 mm (up to 7.5 l/h, 13 bar)
I002	Tubing 9/12 mm (up to 60 l/h, 9 bar)
I003	Tubing 0.17" x 1/4" (up to 7.5 l/h, 13 bar)
I004	Tubing 3/8" x 1/2" (up to 60 l/h, 10 bar)

Connection, suction/discharge

U2U2	Tubing 4/6 mm, 6/9 mm, 6/12 mm, 9/12 mm
U7U7	Tubing 0.17" x 1/4"; 1/4" x 3/8"; 3/8" x 1/2"
AA	Threaded, Rp 1/4", female (SS)
VV	Threaded, NPT 1/4", female (SS)
XX	No connection

Mains plug

F	EU
B	USA, Canada
G	UK
I	Australia, New Zealand, Taiwan
E	Switzerland
J	Japan
L	Argentina
X	No plug (only 24-48 VDC)***

Design

G	Grundfos

Special variant

C3	Inspection Certificate 3.1 (EN 10204)

* Including 2 pump connections, foot valve, injection unit, 6 m PE discharge tubing, 2 m PVC suction tubing, 2 m PVC deaeration tubing (4/6 mm)

** PVC dosing heads only up to 10 bar

*** Planned for 2013

3. Functions

Overview of functions


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TM04 1637 2110


TM04 8241 0312

Control variant:	FCM	FC	AR	AR	A	PR	P	B
General								
Digital Dosing: Internal stroke speed and frequency control	•	•	•	•	•	•	•	•
Mounting plate (basic/wall mounting)	•	•	•	•	•	•	•	•
Control panel, see page 9								
Control cube mountable in three positions: front, left, right	•	•	•	•	•			
Control panel position: front-fitted						•	•	•
Transparent protective cover for control elements	•	•	•	•	•			
Capacity setting in milliliters, liters or US-gallons	•	•	•	•	•			
Graphical display with background light in four colors for status indication: white, green, yellow, red	•	•	•	•	•			
Plain-text menu in different languages	•	•	•	•	•			
Turn-and-push knob (click wheel) for easy navigation	•	•	•	•	•			
Capacity adjustment knob (0.1 - 100 %)						•	•	•
Start/Stop key	•	•	•	•	•			
100 % key (deaeration)	•	•	•	•	•	•	•	
Operation mode switch (manual/pulse)						•	•	
Operation modes, see page 11								
Manual speed control	•	•	•	•	•	•	•	•
Pulse control in ml/pulse	•	•	•	•	•			
Pulse control (1:n)						•	•	
Analog control 0/4-20 mA	•	•	•	•				
Batch control (pulse-based)	•	•	•					
Dosing timer cycle	•	•	•					
Dosing timer week	•	•	•					
Fieldbus control	•	•	•					
Functions, see page 13								
Auto deaeration also during pump standby	•	•	•					
FlowControl system with selective fault diagnosis	•	•						
Pressure monitoring (min/max)	•	•						
Flow measurement	•							
AutoFlowAdapt	•							
SlowMode (anti-cavitation)	•	•	•	•	•			
Calibration mode	•	•	•	•	•			
Scaling of analog input	•	•	•					
Service information display	•	•	•	•	•			
Relay setting: alarm, warning, stroke signal, pump dosing, pulse input*	•	•	•	•		•		
Relay setting (additionally): timer cycle, timer week	•	•	•					
Inputs/outputs, see page 14								
Input for external stop	•	•	•	•	•	•	•	
Input for pulse control	•	•	•	•	•	•	•	
Input for analog 0/4-20 mA control	•	•	•	•				
Input for low-level signal	•	•	•	•	•	•	•	
Input for empty tank signal	•	•	•	•	•	•	•	
Output relay (2 relays)	•	•	•	•		•		
Output analog 0/4-20 mA	•	•	•					
Input/Output for GENIbus	•	•	•					
Input/Output for E-box (e.g. E-box 150 with Profibus DP)	•	•	•					

* DDE-PR: relay 1: alarm; relay 2: low-level signal, stroke signal, pulse input

Functional description

The electronically controlled variable-speed motor (stepper motor) of the DDA, DDC and DDE pumps provides optimum control of the stroke speed. The duration of each discharge stroke varies according to the capacity set, resulting in optimum discharge flow in any operating situation, while the duration of each suction stroke is constant (see figure below).

The advantages are as follows:

- The pump always operates at full stroke length, irrespective of the capacity set; this ensures optimum accuracy, priming and suction.
- A capacity range of up to 1:3000 (turndown ratio) reduces variants and spare parts.
- Smooth and continuous dosing ensuring an optimum mixing ratio at the injection point without needing static mixers.
- Significant reduction of pressure peaks, preventing mechanical stress on wearing parts such as diaphragm, tubes, connections, resulting in extended maintenance intervals.
- The installation is less affected by long suction and discharge lines.
- Easier dosing of high-viscosity and degassing liquids (SlowMode).

The optimum dosing control shown below takes place in any operation mode.

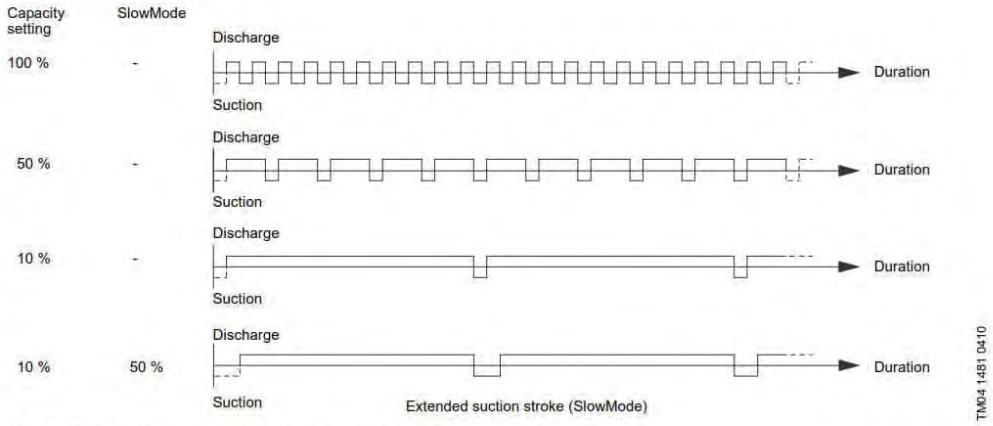

Fig. 5 Relation between stroke-frequency adjustment and capacity

Control cube DDA and DDC

DDA and DDC pumps are supplied with front-mounted control cube. The position of the control cube can easily be changed by unfastening 2 screws, lifting the cube, turning it to the left or to the right and fastening both screws again.

TM04 1639 2110

Fig. 6 Two of three possible control cube positions: at the front or at the left or at the right of the pump

Operating elements DDA and DDC

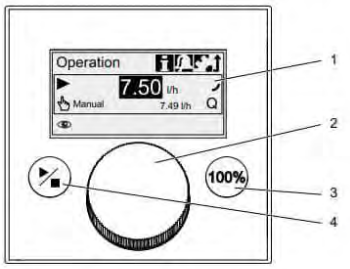

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Fig. 7 Operating elements DDA and DDC

Pos.	Description
1	Graphical LC display
2	Click wheel
3	100 % key (deaeration)
4	Start/Stop key

The click wheel guides the user quickly and easily through the plain-text menu.

If the maximum capacity is required over a short period of time, for example during start-up, press the 100 % key. To set the pump to run for a specific number of seconds at maximum capacity, press the 100 % key and turn the click wheel clockwise simultaneously.

Operating elements DDE

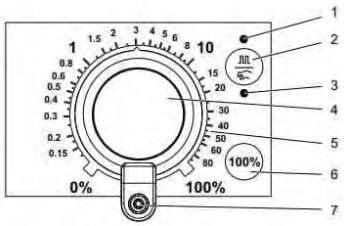

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Fig. 8 Operating elements DDE

Pos.	Description
1	Status LED pulse (DDE-PR and DDE-P)
2	Operation mode switch (DDE-PR and DDE-P)
3	Status LED manual
4	Capacity adjustment knob
5	Logarithmic scale
6	100 % key (DDE-PR and DDE-P)
7	Mechanical lock

With the capacity adjustment knob the capacity of the pump can easily be adjusted in % of the maximum flow.

Applies to DDE-PR, DDE-P

When holding down the operation mode switch, the pump changes from manual operation to pulse mode or vice versa.

If the maximum capacity is required over a short period of time, for example during start-up, press the 100 % key.

Depending on the selected operation mode, the respective status LED (pulse or manual) is activated according to the following table:

LED color	Pump status
Green (flashing)	Stopped
Green	Running
Red-green (flashing)	External stop
Yellow	Low level (warning)
Red	Empty tank (alarm)
Red (flashing)	Motor blocked (alarm)

Menu

The DDA and DDC dosing pumps feature a user-friendly plain-text menu. The menu consists of 4 tabs: Operation; Info; Alarm; Setup. During initial start-up, all menu text appears in the English language. The menu can be set to display other languages.

This example applies to DDA pumps:

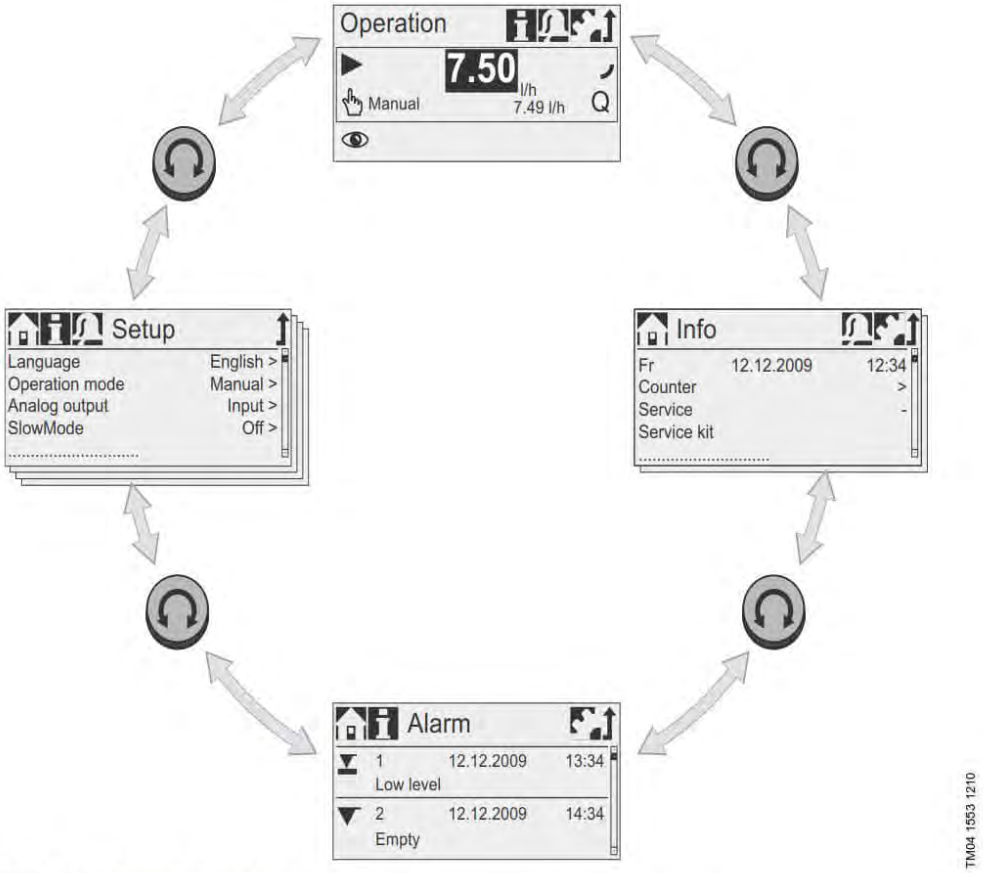

Fig. 9 Menu overview (example of main menus)

The menu text appears in up to 29 languages on a big graphical display, backlit in four different colours according to the traffic light concept.

Display	Fault	Pump status		
White	-	Stop ■	Standby ❙❙	
Green	-			Running ▶
Yellow	Warning	Stop ■	Standby ❙❙	Running ▶
Red	Alarm	Stop ■	Standby ❙❙	

Operation modes

Manual control

The pump ensures constant dosing according to the quantity set in l/h or ml/h or gph by means of the click wheel. The pump automatically changes between the measuring units.

Setting range

Pump type	Setting range*	
	From [l/h]	To [l/h]
DDA 7.5-16	0.0025	7.5
DDA 12-10	0.0120	12.0
DDA 17-7	0.0170	17.0
DDA 30-4	0.0300	30.0
DDC 6-10	0.0060	6.0
DDC 9-7	0.0090	9.0
DDC 15-4	0.0150	15.0
DDE 6-10	0.0060	6.0
DDE 15-4	0.0150	15.0

* When the SlowMode function is enabled the max. flow is reduced (see page 13)

Pulse control

The pump doses in proportion to an external potential-free pulse signal, for example from a water meter. There is no direct relation between pulses and dosing strokes. The pump automatically calculates its optimal speed to ensure the required quantity is dosed for each incoming pulse.

Applies to DDA and DDC

The quantity to be dosed is set in ml/pulse. The pump adjusts its speed according to two factors:

- the frequency of external pulses
- the set quantity per pulse.

Setting range

Pump type	Setting range [ml/pulse]
DDA 7.5-16	0.0015 - 14.8
DDA 12-10	0.0029 - 29.0
DDA 17-7	0.0031 - 31.0
DDA 30-4	0.0062 - 62.0
DDC 6-10	0.0016 - 16.2
DDC 9-7	0.0017 - 16.8
DDC 15-4	0.0032 - 31.6

The frequency of external pulses is multiplied by the set quantity. If the product exceeds the maximum flow of the pump, a maximum of 65,000 pulses can be stored for later processing with the Memory pulse function, when activated.

Applies to DDE-PR, DDE-P control variant

The dosing quantity per pulse is adjusted with the adjustment knob according to the scale from 0.1 to 100 % of the stroke volume. The pump adjusts its speed according to two factors:

- the frequency of external pulses
- the set percentage of stroke volume.

Setting range, DDE-PR, DDE-P

Pump type	Setting range [ml/pulse]
DDE 6-10	0.0008 - 0.81
DDE 15-4	0.0016 - 1.58

Analog 0/4-20 mA control

Applies to DDA and DDC-AR control variant

The pump ensures dosing according to an external analog signal. The dosed capacity is proportional to the input value in mA.

Operation mode	Input signal	Dosing capacity
4-20	≤ 4.1 mA	0 %
	≥ 19.8 mA	100 %
0-20	≤ 0.1 mA	0 %
	≥ 19.8 mA	100 %

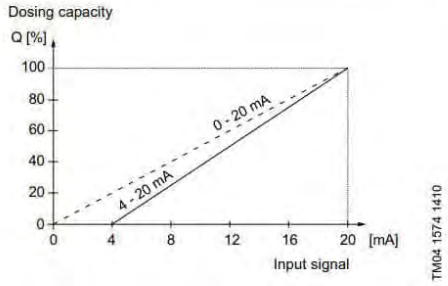

Fig. 10 0/4-20 mA control

Applies to DDA

With the analog scaling function, the curve can be individually drawn between two arbitrary points: I_1/Q_1 and I_2/Q_2.

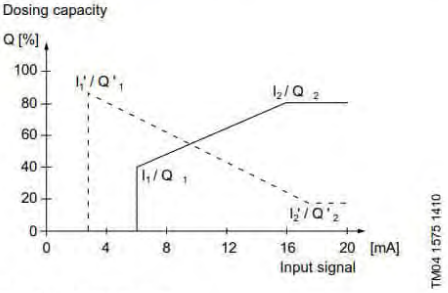

Fig. 11 Analog scaling

Pulse-based batch control

Applies to DDA

The set quantity is dosed in batches within the set dosing time (t_1). A batch is dosed every time the pump receives an external pulse. If the pump receives new pulses before a batch is completed, these pulses will be ignored. In the event of interrupts such as external stop or alarm, incoming pulses will also be ignored. After ending of the interrupts, a new batch will be dosed with the next incoming pulse.

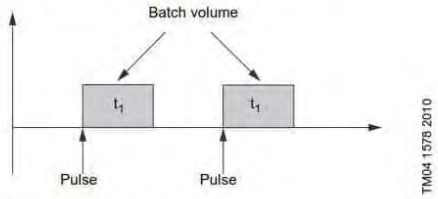

Fig. 12 Pulse-based batch control

Setting range

Pump type	Setting range		
	From [ml/batch]	To [l/batch]	Resolution* [ml]
DDA 7.5-16	0.74	999	0.09
DDA 12-10	1.45	999	0.18
DDA 17-7	1.55	999	0.19
DDA 30-4	3.10	999	0.39

* Due to the digital motor control, down to 1/8 of the dosing volume can be dosed.

Dosing timer cycle

Applies to DDA

After a start delay (t_2) the set batch volume is repeatedly dosed in the set cycle time (t_3). The dosing time (t_1) can be adjusted. Batch dosing is stopped during any interrupt, e.g. power supply failure or external stop while the time continues running in the background (real-time clock). After ending of the interrupt, batch dosing proceeds according to the current status in the timeline.

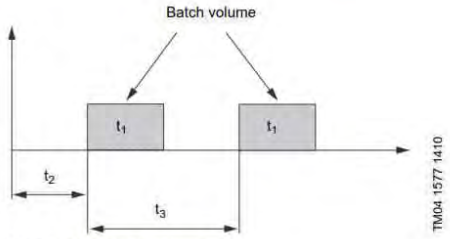

Fig. 13 Dosing timer cycle

Setting range

The batch volume setting range corresponds to the pulse-based batch control setting range.

Dosing timer week

Applies to DDA

The integrated real-time clock features also batch dosing based on a weekly period. There is a maximum of 16 procedures per week. Each dosing procedure consists of:

- Batch volume
- Dosing time
- Start time
- 1 to 7 weekdays (Monday to Sunday).

In case several procedures are overlapping, the procedure with the highest flow rate has the highest priority. Batch dosing is stopped during any interrupt, e.g. power supply failure or external stop, while the time continues running in the background (real-time clock). After ending of the interrupt, batch dosing proceeds according to the current status in the timeline.

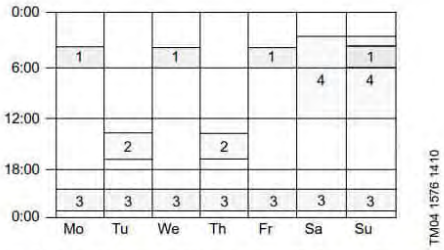

Fig. 14 Dosing timer week (example with 4 procedures)

Setting range

The batch volume setting range corresponds to the pulse-based batch control setting range.

Functions

SlowMode

Applies to DDA, DDC

When the SlowMode function (anti-cavitation) is selected, the pump extends and smooths its suction stroke. This results in a softer suction stroke.

The SlowMode function is used in these situations:

- when pumping high-viscosity liquids
- when pumping degassing liquids
- when the suction line is long
- when the suction lift is high.

Depending on the application, the motor speed during the suction stroke can be reduced individually to approximately 50 % or 25 % of the normal motor speed.

The maximum pump capacity is reduced accordingly. See pages 25 and 26 for further details.

Auto deaeration

Applies to DDA

The auto deaeration function avoids breakdown of the dosing process due to air-locking, when dosing degassing liquids such as sodium hypochlorite. During long dosing breaks, e.g. at the weekend or overnight, air-bubbles can form in the suction line and get into the dosing head. If too much air is in the dosing head, and the dosing process is started again, no liquid will be dosed (air-lock). Software-controlled diaphragm movements at regular intervals encourage the air bubbles to rise and finally to be displaced out of the dosing head.

These movements are executed

- when the pump is not stopped and
- during dosing breaks (e.g. external stop or no incoming pulses).

Calibration

Applies to DDA and DDC

The pump is calibrated in the factory at the nominal pressure of the respective pump type (see maximum pressure Technical data page 25, 26). After start-up, the dosing pump can be calibrated for the actual installation to ensure that the displayed value (ml, l or gph) is correct. A calibration program in the setup menu facilitates this process. The AutoFlowAdapt function keeps the dosing precision (DDA-FCM control variant), even if the backpressure changes.
For the description of the AutoFlowAdapt function, see page 18.

External stop

Applies to DDA, DDC, DDE-PR, DDE-P control variant

With the external stop function, the pump can be stopped from a remote place by an external contact signal. It is not recommended to switch on and off the power supply as it was usual when working with a conventional dosing pump. When working with microprocessor-controlled digital dosing pumps, the external stop signal has to be used, in order to keep the optimal dosing precision and to prevent damages to the electronics.

When activating the external stop contact, the pump changes from running ▶ to standby ❚❚. The operation display shows an activated external stop ▶❚❚.
The signal input can be set to normally open (default) or normally closed contact.

Counters

Applies to DDA and DDC

The pump displays resettable and non-resettable counters in the info menu tab.

Counter	Description	Resettable
Volume	Accumulated dosed quantity in liters or US gallons	Yes
Operating hours	Accumulated number of operating hours (power-on)	No
Motor runtime	Accumulated number of motor runtime hours	No
Strokes	Accumulated number of dosing strokes	No
Power on/off	Accumulated number of times the mains supply has been switched on	No

Service display

Applies to DDA, DDC

Due to the optimized construction and the smooth digital dosing principle, the service periods are more than twice as long, if compared to conventional pumps. However, the wear parts have to be exchanged in regular intervals in order to keep the dosing precision and the process reliability at a high level. The service display in the pump shows when service of the wear parts is required. The displayed service kit product number makes service more convenient. The following information is displayed in the Info display:

Display		Description
Service	- Soon Now	No service required Order parts for service soon Service must be performed now
Service kit	8-digit Grundfos material number	The service kit contains all parts needed for standard maintenance: diaphragm + valves
Reset service system		After performing the service, reset the system

The following service messages appear, depending on what happens first:

Display	Motor runtime [h]	Regular intervals [months]*
Service soon	7,500	23
Service now	8,000	24

* Applies to DDA only

In case of difficult liquids, e.g. with abrasive particles, the service intervals can be shorter and service has to be performed earlier.

Level control

Applies to DDA, DDC, DDE-PR and DDE-P

The pump can be connected to a dual level control unit for monitoring of the chemical level in the tank. The pump can react to two level signals:

Level sensors	Pump reaction*	
	DDA, DDC	DDE-PR, DDE-P
Low-level signal	• Display is yellow (Warning) • is flashing • Pump continues running	• LED lights up in yellow • Pump continues running
Empty tank signal	• Display is red (Alarm) • ▼ is flashing • Pump stops	• LED lights up in red • Pump stops

* Depending on the pump model and settings, the relay outputs can be activated (see *Relay output*, page 14)

Relay output

Applies to DDA, DDC-AR and DDE-PR control variant

The pump can activate 2 external signals by means of built-in relays switched via internal potential-free contacts. Depending on the process control requirements, the following relay output settings can be chosen:

Applies to DDA and DDC-AR control variant

Signal		Description
Relay 1	Relay 2	
Alarm*	Alarm	Display red, pump stopped (e.g. empty tank signal, etc.)
Warning*	Warning	Display yellow, pump running (low level signal, etc.)
Stroke signal	Stroke signal	Every completed stroke
Pump dosing	Pump dosing*	Pump is running and dosing
Pulse input	Pulse input	Every pulse coming in from pulse input
Bus control	Bus control	Set by a command in the Bus communication function (page 15) (only DDA)
	Timer cycle	Timer can be set in menu: on-time, cycle-time, start delay (only DDA)
	Timer week	Timer can be set in menu: procedure, on-time, start time and weekdays (only DDA)
Contact type		
NO*	NO*	Normally Open Contact
NC	NC	Normally Closed Contact

* default setting

Applies to DDE-PR control variant

Signal		Description
Relay 1	Relay 2	
Alarm*		Empty tank, motor blocked
	Low level*	Low level tank
	Stroke signal	Every completed stroke
	Pulse input	Every pulse coming in from pulse input
Contact type		
NO*	NO*	Normally Open Contact
NC	NC	Normally Closed Contact

* default setting

Analog output

Applies to DDA

In addition to the analog input (operation mode: analog 0/4-20 mA) the pump is also equipped with an analog 0/4-20 mA output signal. Depending on the process control requirements, the following analog output settings are available:

Setting	Description of analog output signal	Control variant		
		FCM	FC	AR
Output = Input	Mapped 1:1 to the analog input, e.g. used in master-slave applications	X	X	X
Actual flow	Flow measured in the dosing head (Flow Measurement page 18)	X	X*	X*
Backpressure	Backpressure measured in the dosing head (Pressure monitoring page 18)	X	X	
Bus control	Set by a command in the bus communication (see below)	X	X	X

* Output signal is calculated based on motor speed and pump status (target flow rate)

Bus communication

BUS

Applies to DDA

The pump is equipped with a built-in module for GENIbus communication. With the additional E-Box 150 module (see page 36) the pump can be integrated into a Profibus DP network.

The bus communication possibilities enable remote monitoring and setting via the fieldbus system.

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Fig. 15 DDA with E-box

Key lock and mechanical lock

Applies to DDA, DDC

To protect the pump from maloperation, a key lock can be set by entering a 4-digit PIN-code. When the pump is locked, it is still possible to navigate through the menus Alarm and Info and to acknowledge alarms. Two levels of protection are available:

- Settings: the keys and are still available.
- Settings + keys: the keys and are also locked.

For temporary (2 minutes) or final deactivation the preset 4-digit pin-code has to be entered again.

Applies to DDE

The adjustment knob can be locked with a locking screw to fix the current setting.

Basic settings

Applies to DDA, DDC

With load factory settings, the pump can be reset to the default settings. In addition, with save customer settings, the current configuration of the pump is stored and can be activated later by load customer settings. The latest saved configuration is stored in the memory.

Units

Applies to DDA, DDC

It is possible to select metric units (liter/milliliter/bar) or US units (US gallons/psi). Depending on the operation mode and menu, the following units are displayed:

Operation mode/Function	Metric units	US units
Manual control	ml/h or l/h	gph
Pulse control	ml/⊓	ml/⊓
Analog 0/4-20 mA control	ml/h or l/h	gph
Batch control (pulse- or timer-based)	ml or l	gal
Calibration	ml	ml
Volume counter	l	gal
Pressure monitoring	bar	psi

Additional display

Applies to DDA, DDC

The additional display function provides further useful status information, e.g. the target flow rate as well as the actual flow rate. The value is shown in the operation display together with the corresponding symbol.

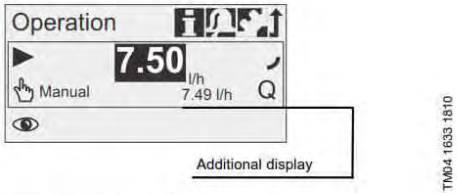


Fig. 16 Additional display

The following additional information can be selected:

Settings		Description
Default display		Depending on the operation mode:
	Q	Actual flow (manual, pulse)[1]
	Q	Target flow (pulse)
		Input current (analog)[4]
		Remaining batch volume (batch, timer)[3]
		Time until next batch (timer)[3]
Dosed volume	V	Total dosed volume (Counters see page 13)
Actual flow	Q	Actually measured flow[1]
Backpressure	P	Current backpressure in the dosing head[2]

1) Only DDA-FCM control variant
2) Only DDA-FCM/FC control variant
3) Only DDA pumps
4) Only DDA pumps and DDC-AR control variant

FlowControl

Applies to DDA-FC/FCM control variant

Fig. 17 DDA FlowControl

The pump monitors the dosing process of liquids when the FlowControl function is activated. Although the pump is still operating, some influences such as air bubbles may cause reduced flow rates or even stop the dosing process. For optimal process safety and reliability, the activated FlowControl function immediately detects and displays the following malfunctions:

- Overpressure
- Discharge line burst
- Air bubbles in the dosing head
- Cavitation at the suction side
- Suction valve leakage
- Discharge valve leakage.

The unique FlowControl is based on an intelligent and maintenance-free sensor integrated in the dosing head. During the dosing process, the sensor measures the actual pressure and sends the measured value to the microprocessor in the pump. An internal indicator diagram is generated combining the actual pressure value with the diaphragm position (stroke length). With it, the dosing process is monitored, as the different malfunctions can immediately be detected due to their specific deviations in the curve. Compressible air bubbles, for instance, will reduce the discharge phase and the stroke volume (see fig. 18).

The sensitivity and the delay of the FlowControl function can be adjusted individually.

FlowControl requires a minimum backpressure of 2 bar. Grundfos recommend an additional spring-loaded valve (approx. 3 bar) on the discharge side for dosing low capacities (< 1 l/h) (see page 44).

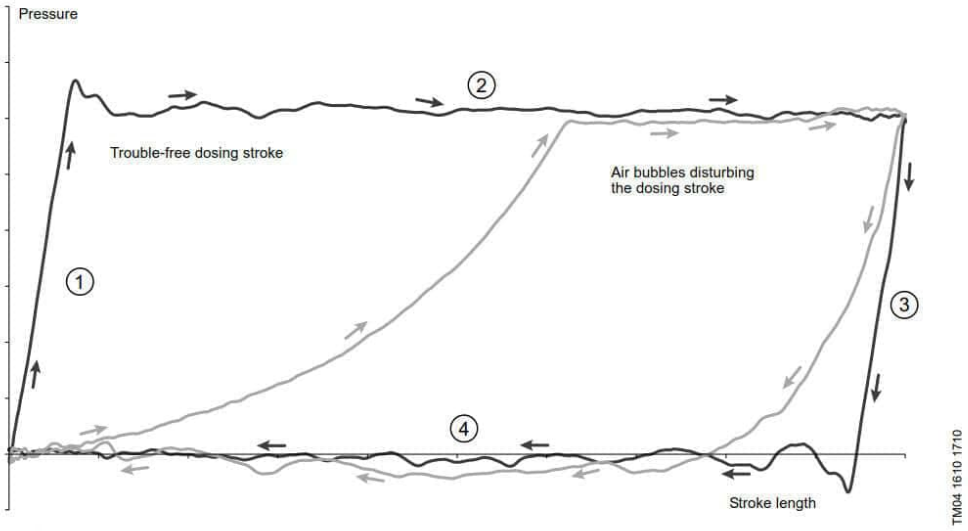


Fig. 18 Indicator diagram

1	Compression phase
2	Discharge phase
3	Expansion phase
4	Suction phase

Pressure monitoring

Applies to DDA-FC/FCM control variant

The integrated pressure sensor measures the actual pressure of the system, which is shown in the display. A maximum pressure can be set. If the pressure in the system exceeds the set maximum (e.g. caused by a closed valve), the pressure monitoring function stops the dosing process immediately. As soon as the backpressure falls below the set maximum, the dosing process is continued. In case the pressure drops below the minimum limit (e.g. caused by a burst discharge line) the pump stops and major chemical spills are prevented.

Pressure setting range

Pump type	Fixed min. pressure* [bar]	Adjustable max. pressure [bar]**
DDA 7.5-16	< 2	3 ... 17 (default)
DDA 12-10	< 2	3 ... 11 (default)
DDA 17-7	< 2	3 ... 8 (default)
DDA 30-4	< 2	3 ... 5 (default)

* Can be either set as a warning (pump keeps running) or as an alarm (pump stops).

** The adjustable max. pressure is equivalent to the max. operating pressure plus 1 bar

Flow measurement

Applies to DDA-FCM control variant

The pump can precisely measure and display the actual dosing flow. Via the analog 0/4-20 mA output, the actual flow signal can easily be integrated in any process control system, without needing any additional measurement equipment.

The Flow measurement function is based on an indicator diagram as described in FlowControl (page 16). Accumulating the length of each discharge stroke phase and multiplying it with the stroke frequency results in the displayed actual flow.
Any malfunctions, such as air bubbles or lower backpressure, will result in a reduced or increased actual flow rate. When the AutoFlowAdapt function (page 18) is activated, the pump compensates these influences by correcting the stroke speed.

AutoFlowAdapt

Applies to DDA-FCM control variant

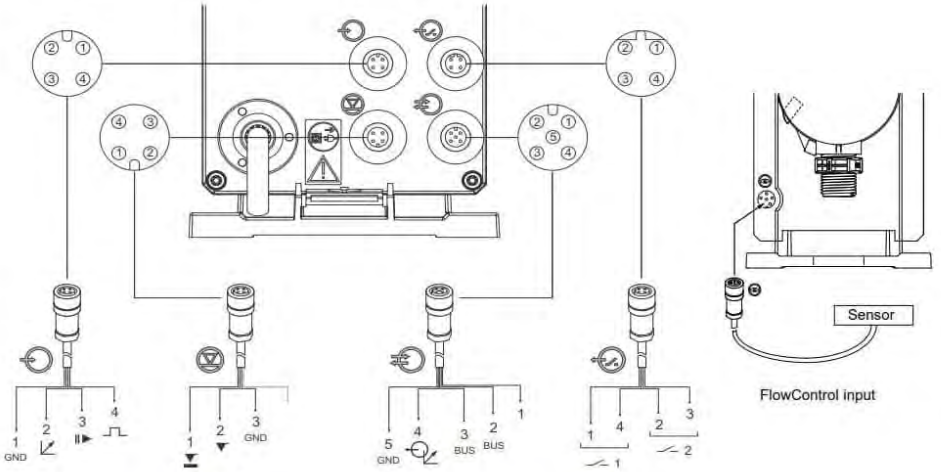
When activating the AutoFlowAdapt function even environmental changes will be compensated, so that the required target flow rate will be achieved.
The integrated AutoFlowAdapt makes additional monitoring and control devices redundant. The AutoFlowAdapt function is based on:

- FlowControl: malfunctions are detected
- Pressure monitoring: system pressure changes are detected
- Flow measurement: deviations in the target flow are detected.

Examples:

- FlowControl detects air bubbles in the system. Due to a special motor drive strategy and a certain speed increase, the pump will try to keep the flow rate constant. This is especially important when dosing degassing liquids.
- In general, increasing system pressure reduces the stroke volume whereas falling system pressure increases the stroke volume. The AutoFlowAdapt function compensates this by automatically and continuously adapting the motor speed. Despite fluctuating system pressure, dosing accuracy is maintained.

Wiring diagram, DDA



Cable 1
Analog/external stop/pulse
Material No.
2 m cable: 96609014
5 m cable: 96609016

Cable 2
Level input
see page 38xx, suction lances

Cable 3
GENIbus, analog output
Material No.
2 m cable: 96632921
5 m cable: 96632922

Cable 4
Relay output
Material No.
2 m cable: 96609017
5 m cable: 96609019

Cable 1: Analog, external stop and pulse input

Function	Pin holes 1/brown	2/white	3/blue	4/black	Plug type
Analog	GND/ (-) mA	(+) mA			mA signal
External stop	GND		X		Contact
Pulse	GND			X	Contact

Cable 2: Level input

Function	Pin holes 1	2	3	4	Plug type
Low level	X		GND		Contact
Empty tank		X	GND		Contact

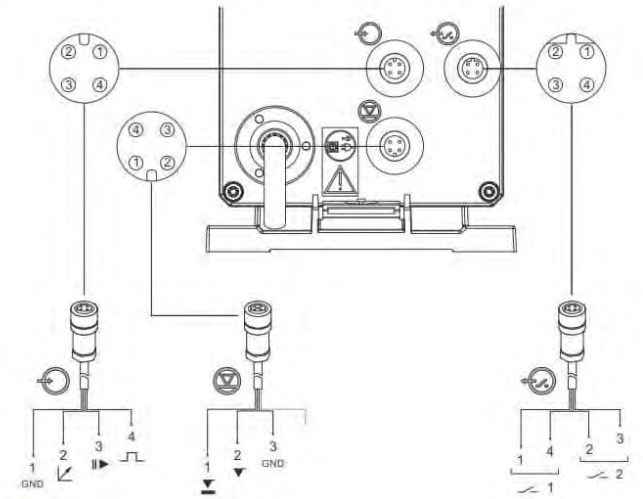
Cable 3: GENIbus, analog output

Function	Pin holes 1/brown	2/white	3/blue	4/black	5/yellow-green	Plug type
GENIbus	+30 V	GENI bus TXD	GENI bus RXD		GND	Bus
Analog output				(+) mA	GND/ (-) mA	mA signal

Cable 4: Relay output

Function	Pin holes 1/brown	2/white	3/blue	4/black	Plug type
Relay 1	X			X	Contact
Relay 2		X	X		Contact

Wiring diagram, DDC



Cable 1
Analog/external stop/pulse
Material No.
2 m cable: 96609014
5 m cable: 96609016

Cable 2
Level input
see page 38xx, suction lances

Cable 4
Relay output
Material No.
2 m cable: 96609017
5 m cable: 96609019

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Cable 1: Analog, external stop and pulse input

Function	Pin holes				Plug type
	1/brown	2/white	3/blue	4/black	
Analog*	GND/ (-) mA	(+) mA			mA signal
External stop	GND		X		Contact
Pulse	GND			X	Contact

Cable 2: Level input

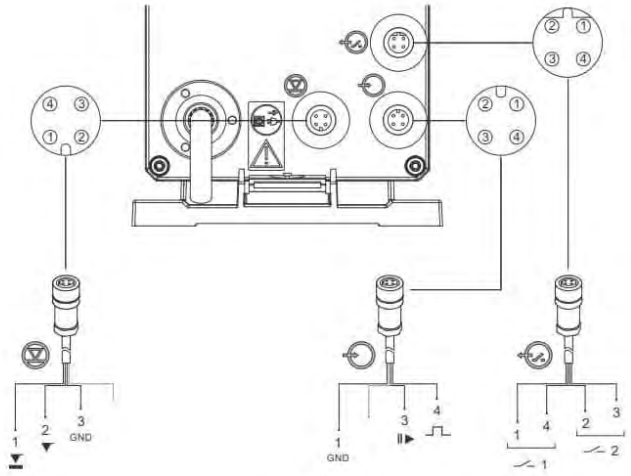
Function	Pin holes				Plug type
	1	2	3	4	
Low level	X		GND		Contact
Empty tank		X	GND		Contact

Cable 4: Relay output*

Function	Pin holes				Plug type
	1/brown	2/white	3/blue	4/black	
Relay 1	X			X	Contact
Relay 2		X	X		Contact

* applies to DDC-AR control variant

Wiring diagram, DDE-PR, -P



Cable 2
Level input
see page 38xx, suction lances

Cable 1
External stop/pulse
Material No.
2 m cable: 96609014
5 m cable: 96609016

Cable 4
Relay output
Material No.
2 m cable: 96609017
5 m cable: 96609019

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Cable 1: External stop and pulse input

Function	Pin holes				Plug type
	1/brown	2/white	3/blue	4/black	
External stop	GND		X		Contact
Pulse	GND			X	Contact

Cable 2: Level input

Function	Pin holes				Plug type
	1	2	3	4	
Low level	X		GND		Contact
Empty tank		X	GND		Contact

Cable 4: Relay output*

Function	Pin holes				Plug type
	1/brown	2/white	3/blue	4/black	
Relay 1 (Alarm)	X			X	Contact
Relay 2 (see page 14)		X	X		Contact

* applies to DDE-PR control variant

4. Construction

DDA and DDC

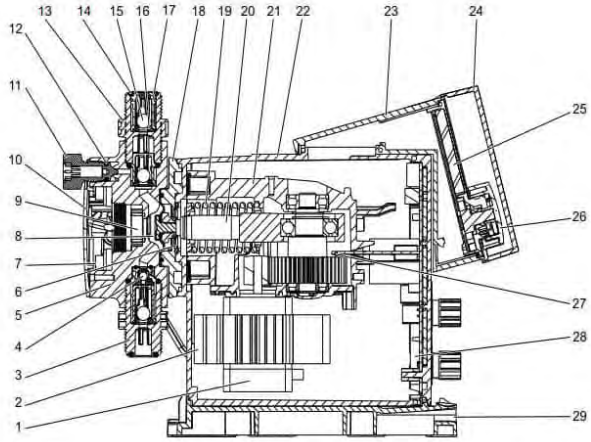


Fig. 19 Sectional drawing, DDA

Construction

The DDA and DDC pumps are motor-driven diaphragm dosing pumps consisting of the following main parts:

Dosing head: Patented design with a minimum of clearance space optimized for degassing liquids. With integrated deaeration valve for priming and venting complete with connection for a 4/6 mm or 0.17" x 1/4" tubing. DDA-FCM/FC pumps have an integrated pressure sensor in the dosing head.

Valves: Double-ball discharge and suction valve* design for less clearance space - optimized for degassing liquids. Spring-loaded valves for higher viscosities are available as an option.

Connections: Robust and easy-to-use connection packages for various sizes of tubing or pipes.

Diaphragm: Full PTFE diaphragm designed for long life and universal chemical resistance.

Flange: With separation chamber, safety diaphragm and drain hole.

Drive unit: Positive return crank with patented noiseless spur gear drive, energy recovery spring for high efficiency (only DDA), stepper motor, all mounted in a robust gear housing.

Control cube: Containing operation electronics with display, keys, click-wheel and protective cover.

Housing: Containing drive unit and power electronics with robust signal sockets. The housing can be clicked on the mounting plate.

Material specification

Pos.	Description	Material options
1	Stepper motor	-
2	Cooling element**	Aluminium
3	Suction valve, complete***	-
4	Valve ball, DN 4*	Ceramic Al_2O_3 99.5 %, SS 1.4401
5	Dosing head	PP, PVC, PVDF, SS 1.4435
6	Safety diaphragm	EPDM
7	Dosing head screw	SS 1.4301
8	Diaphragm	full PTFE
9	Pressure sensor	-
10	Dosing head cover	PP, SS 1.4301
11	Deaeration valve	PP, PVC, PVDF
12	Deaeration valve O-ring	EPDM/FKM
13	Discharge valve, complete***	-
14	Discharge valve O-ring	EPDM, FKM, PTFE
15	Discharge valve ball, DN 8	Ceramic Al_2O_3 99.5 %, SS 1.4401
16	Discharge valve seat	EPDM, FKM, PTFE
17	Discharge valve ball cage	PP, PVC, PVDF, SS 1.4435
18	Flange	PPO/PS 20 % gf
19	Energy recovery spring**	EN 10270-2/VD SiCr
20	Connecting rod	PA 6.6 30 % gf
21	Gear box	PPO/PS 20 % gf
22	Housing	PPO/PS 20 % gf
23	Control cube	PPO/PS 20 % gf
24	Display cover	PC
25	Operation PCB	-
26	Click wheel	PPO/PS 20 % gf
27	Hall sensor	-
28	Power PCB	-
29	Mounting plate	PPO/PS 20 % gf

* Only for pumps up to 7.5 l/h with standard valves
** Only for DDA
*** Pump can be supplied with spring-loaded valves (Material: Tantal)

DDE

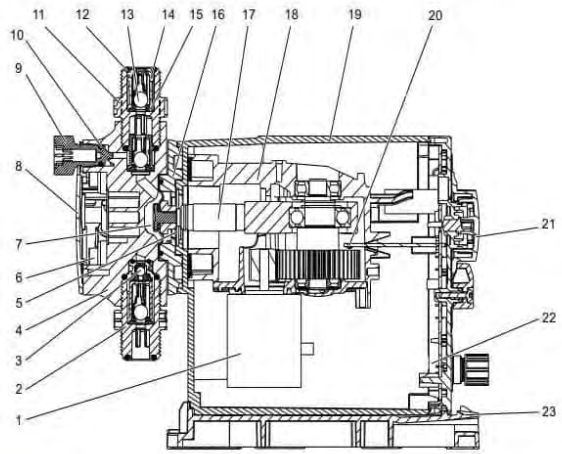


Fig. 20 Sectional drawing, DDE

Construction

The DDE pump is a motor-driven diaphragm dosing pump consisting of the following main parts:

Dosing head: Patented design with a minimum of clearance space optimized for degassing liquids. With integrated deaeration valve for priming and venting complete with connection for a 4/6 mm or 0.17" x 1/4" tubing.

Valves: Double-ball discharge and suction valve* design for less clearance space - optimized for degassing liquids. Spring-loaded valves for higher viscosities are available as an option.

Connections: Robust and easy-to-use connection packages for various sizes of tubing or pipes.

Diaphragm: Full PTFE diaphragm designed for long life and universal chemical resistance.

Flange: With separation chamber, safety diaphragm and drain hole.

Drive unit: Positive return crank with patented noiseless spur gear drive, stepper motor, all mounted in a robust gear housing.

Housing: Containing drive unit, control panel and electronics with robust signal sockets. The housing can be clicked on the mounting plate.

Material specification

Pos.	Description	Material options
1	Stepper motor	-
2	Suction valve, complete**	-
3	Valve ball, DN 4*	Ceramic Al_2O_3 99.5 %, SS 1.4401
4	Dosing head	PP, PVC, PVDF, SS 1.4435
5	Safety diaphragm	EPDM
6	Dosing head screw	SS 1.4301
7	Diaphragm	full PTFE
8	Dosing head cover	PP, SS 1.4301
9	Deaeration valve	PP, PVC, PVDF
10	Deaeration valve O-ring	EPDM/FKM
11	Discharge valve, complete**	-
12	Discharge valve O-ring	EPDM, FKM, PTFE
13	Discharge valve ball, DN 8	Ceramic Al_2O_3 99.5 %, SS 1.4401
14	Discharge valve ball cage	PP, PVC, PVDF, SS 1.4435
15	Discharge valve seat	EPDM, FKM, PTFE
16	Flange	PPO/PS 20 % gf
17	Connecting rod	PA 6.6 30 % gf
18	Gear box	PPO/PS 20 % gf
19	Housing	PPO/PS 20 % gf
20	Hall sensor	-
21	Capacity adjustment knob	PPO/PS 20 % gf
22	Power PCB	-
23	Mounting plate	PPO/PS 20 % gf

* Only for pumps up to 6 l/h with standard valves

** Pump can be supplied with spring-loaded valves (Material: Tantal)

5. Dimensions

DDA and DDC

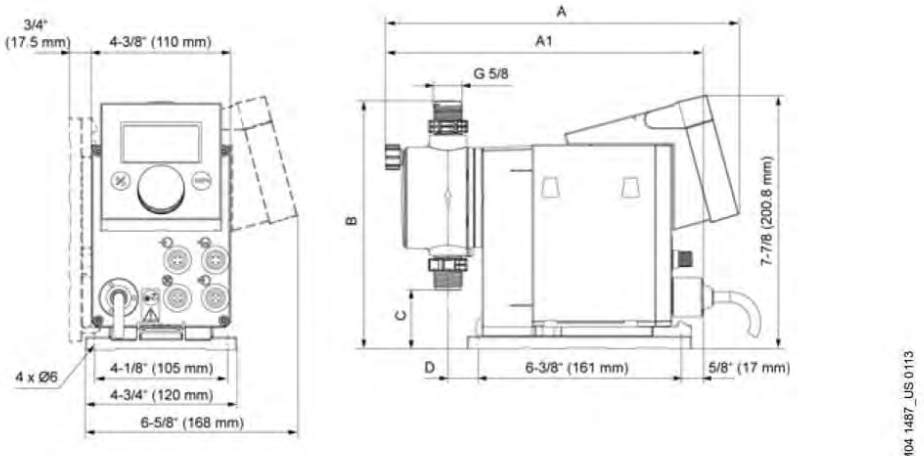


Fig. 21 DDA and DDC with front-fitted or side-fitted control cube

DDE

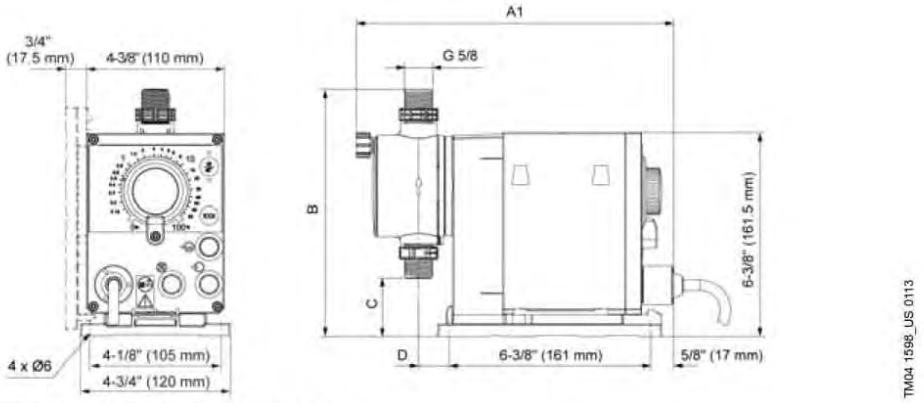


Fig. 22 DDE-PR with front-fitted control elements

Pump type	A [In.]	A1 [In.]	B [In.]	C [In.]	D [In.]
DDA 7.5-16 DDC 6-10 DDC 9-7 DDE 6-10	11 (280 mm)	9-7/8 (251 mm)	7-3/4 (196 mm)	1-7/8 (46.5 mm)	7/8 (24 mm)
DDA 12-10 DDA 17-7 DDC 15-4 DDE 15-4	11 (280 mm)	9-7/8 (251 mm)	7-7/8 (200.5 mm)	1-1/2 (39.5 mm)	7/8 (24 mm)
DDA 30-4	11-5/8 (295 mm)	10-1/2 (267 mm)	8 (204.5 mm)	1-3/8 (35.5 mm)	1-1/2 (38.5 mm)

6. Technical data

DDA

Data			7.5-16	12-10	17-7	30-4
Mechanical data	Turndown ratio (setting range)	[1:X]	3000	1000	1000	1000
	Max. dosing capacity	[l/h]	7.5	12.0	17.0	30.0
		[gph]	2.0	3.1	4.5	8.0
	Max. dosing capacity with SlowMode 50 %	[l/h]	3.75	6.00	8.50	15.00
		[gph]	1.00	1.55	2.25	4.00
	Max. dosing capacity with SlowMode 25 %	[l/h]	1.88	3.00	4.25	7.50
		[gph]	0.50	0.78	1.13	2.00
	Min. dosing capacity	[l/h]	0.0025	0.0120	0.0170	0.0300
		[gph]	0.0007	0.0031	0.0045	0.0080
	Max. operating pressure	[bar]	16	10	7	4
		[psi]	230	150	100	60
	Max. stroke frequency [1]	[strokes/min]	190	155	205	180
	Stroke volume	[ml]	0.74	1.45	1.55	3.10
	Accuracy of repeatability	[%]	± 1			
	Max. suction lift during operation [2]	[m]	6			
	Max. suction lift when priming with wet valves [2]	[m]	2	3	3	2
	Min. pressure difference between suction and discharge side	[bar]	1 (FC and FCM: 2)			
	Max. inlet pressure, suction side	[bar]	2			
	Max. viscosity in SlowMode 25 % with spring-loaded valves [3]	[mPas] (= cP)	2500	2500	2000	1500
	Max. viscosity in SlowMode 50 % with spring-loaded valves [3]	[mPas] (= cP)	1800	1300	1300	600
	Max. viscosity without SlowMode with spring-loaded valves [3]	[mPas] (= cP)	600	500	500	200
	Max. viscosity without spring-loaded valves [3]	[mPas] (= cP)	50	300	300	150
	Min. internal tubing/pipe diameter suction/discharge side [4], [2]	[mm]	4	6	6	9
	Min. internal tubing/pipe diameter suction/discharge side (high viscosity) [4]	[mm]	9			
	Min./Max. liquid temperature	[°C]	-10/45			
	Min./Max. ambient temperature	[°C]	0/45			
Electrical data	Voltage	[V]	100-240 V, 50/60 Hz			
	Length of mains cable	[m]	1.5			
	Max. inrush current for 2 ms at 100 V	[A]	8			
	Max. inrush current for 2 ms at 230 V	[A]	25			
	Max. power consumption P_1	[W]	24 [5]			
	Enclosure class		IP 65, Nema 4X			
	Electrical safety class		II			
Signal input	Max. load low-level / empty tank / pulse / external stop input		12 V, 5 mA			
	Min. pulse length	[ms]	5			
	Max. pulse frequency	[Hz]	100			
	Impedance at analog 0/4-20 mA input	[Ω]	15			
	Max. resistance in level/pulse circuit	[Ω]	1000			
Signal output	Max. ohmic load on relay output	[A]	0.5			
	Max. voltage on relay/analog output	[V]	30 VDC/30 VAC			
	Impedance at 0/4-20 mA analog output	[Ω]	500			
Weight/size	Weight (PVC, PP, PVDF)	[kg]	2.4	2.4		2.6
	Weight (stainless steel)	[kg]	3.2	3.2		4.0
	Diaphragm diameter	[mm]	44	50		74
Sound pressure	Max. sound pressure level	[dB(A)]	60			
Approvals			CE, CB, CSA-US, NSF61, GOST, C-Tick			

1) The maximum stroke frequency varies depending on calibration
2) Data is based on measurements with water
3) Maximum suction lift: 1 m, dosing capacity reduced (approx. 30 %)
4) Length of suction line: 1.5 m, length of discharge line: 10 m (at max. viscosity)
5) With E-box

DDC

Data			6-10	9-7	15-4
Mechanical data	Turndown ratio (setting range)	[1:X]	1000	1000	1000
	Max. dosing capacity	[l/h]	6.0	9.0	15.0
		[gph]	1.5	2.4	4.0
	Max. dosing capacity with SlowMode 50 %	[l/h]	3.00	4.50	7.50
		[gph]	0.75	1.20	2.00
	Max. dosing capacity with SlowMode 25 %	[l/h]	1.50	2.25	3.75
		[gph]	0.38	0.60	1.00
	Min. dosing capacity	[l/h]	0.0060	0.0090	0.0150
		[gph]	0.0015	0.0024	0.0040
	Max. operating pressure	[bar]	10	7	4
		[psi]	150	100	60
	Max. stroke frequency [1]	[strokes/min]	140	200	180
	Stroke volume	[ml]	0.81	0.84	1.58
	Accuracy of repeatability	[%]		± 1	
	Max. suction lift during operation [2]	[m]		6	
	Max. suction lift when priming with wet valves [2]	[m]	2	2	3
	Min. pressure difference between suction and discharge side	[bar]		1	
	Max. inlet pressure, suction side	[bar]		2	
	Max. viscosity in SlowMode 25 % with spring-loaded valves [3]	[mPas] (= cP)	2500	2000	2000
	Max. viscosity in SlowMode 50 % with spring-loaded valves [3]	[mPas] (= cP)	1800	1300	1300
	Max. viscosity without SlowMode with spring-loaded valves [3]	[mPas] (= cP)	600	500	500
	Max. viscosity without spring-loaded valves [3]	[mPas] (= cP)	50	50	300
	Min. internal tubing/pipe diameter suction/discharge side [4], [2]	[mm]	4	6	6
	Min. internal tubing/pipe diameter suction/discharge side (high viscosity) [4]	[mm]		9	
	Min./Max. liquid temperature	[°C]		-10/45	
	Min./Max. ambient temperature	[°C]		0/45	
Electrical data	Voltage AC	[V]		100-240 V, 50/60 Hz	
	Voltage DC (option)	[V]		24-48 VDC	
	Length of mains cable	[m]		1.5	
	Max. inrush current for 2 ms at 100 V	[A]		8	
	Max. inrush current for 2 ms at 230 V	[A]		25	
	Max. power consumption P_1	[W]		22	
	Enclosure class			IP65, Nema 4X	
	Electrical safety class			II	
Signal input	Max. load low-level / empty tank / pulse / external stop input			12 V, 5 mA	
	Min. pulse length	[ms]		5	
	Max. pulse frequency	[Hz]		100	
	Impedance at analog 0/4-20 mA input	[Ω]		15	
	Max. resistance in level/pulse circuit	[Ω]		1000	
Signal output	Max. ohmic load on relay output	[A]		0.5	
	Max. voltage on relay output	[V]		30 VDC/30 VAC	
Weight/size	Weight (PVC, PP, PVDF)	[kg]		2.4	2.4
	Weight (stainless steel)	[kg]		3.2	3.2
	Diaphragm diameter	[mm]		44	50
Sound pressure	Max. sound pressure level	[dB(A)]		60	
Approvals				CE, CB, CSA-US, NSF61, GOST, C-Tick	

1) The maximum stroke frequency varies depending on calibration
2) Data is based on measurements with water
3) Maximum suction lift: 1 m, dosing capacity reduced (approx. 30 %)
4) Length of suction line: 1.5 m, length of discharge line: 10 m (at max. viscosity)

DDE

Data			6-10	15-4
Mechanical data	Turndown ratio (setting range)	[1:X]	1000	1000
	Max. dosing capacity	[l/h]	6.0	15.0
		[gph]	1.5	4.0
	Min. dosing capacity	[l/h]	0.0060	0.0150
		[gph]	0.0015	0.0040
	Max. pressure	[bar]	10	4
		[psi]	150	60
	Max. stroke frequency	[strokes/min]	140	180
	Stroke volume	[ml]	0.81	1.58
	Accuracy of repeatability	[%]	± 5	
	Max. suction lift during operation [1]	[m]	6	
	Max. suction lift when priming with wet valves [1]	[m]	2	3
	Min. pressure difference between suction and discharge side	[bar]	1	
	Max. inlet pressure, suction side	[bar]	2	
	Max. viscosity with spring-loaded valves [2]	[mPas] (= cP)	600	500
	Max. viscosity without spring-loaded valves [2]	[mPas] (= cP)	50	50
	Min. internal tubing/pipe diameter suction/discharge side [1, 3]	[mm]	4	6
	Min. internal tubing/pipe diameter suction/discharge side (HV) [3]	[mm]	9	
	Min./Max. liquid temperature	[°C]	-10/45	
	Min./Max. ambient temperature	[°C]	0/45	
Electrical data	Voltage	[V]	100-240 V, 50/60 Hz	
	Length of mains cable	[m]	1.5	
	Max. inrush current for 2 ms at 100 V	[A]	8	
	Max. inrush current for 2 ms at 230 V	[A]	25	
	Max. power consumption P_1	[W]	19	
	Enclosure class		IP65, Nema 4X	
	Electrical safety class		II	
Signal input	Max. load low-level / empty tank / pulse / external stop input		12 V, 5 mA	
	Min. pulse length	[ms]	5	
	Max. pulse frequency	[Hz]	100	
	Max. resistance in level/pulse circuit	[Ω]	1000	
Signal output	Max. ohmic load on relay output	[A]	0.5	
	Max. voltage on relay output	[V]	30 VDC/30 VAC	
Weight/size	Weight (PVC, PP, PVDF)	[kg]	2.4	2.4
	Weight (stainless steel)	[kg]	3.2	3.2
	Diaphragm diameter	[mm]	44	50
Sound pressure	Max. sound pressure level	[dB(A)]	60	
Approvals	CE, CB, CSA-US, NSF61, GOST, C-Tick			

1) Data is based on measurements with water
2) Maximum suction lift: 1 m, dosing capacity reduced (approx. 30 %)
3) Length of suction line: 1.5 m, length of discharge line: 10 m (at max. viscosity)

7. Pump selection

DDA, standard range

Power supply: 1 x 100-240 V, 50/60 Hz (switch mode)
Mains plug: USA, Canada
Connection set: Tube, 0.17" x 1/4", 1/4" x 3/8", 3/8" x 1/2"
Connection SS: Threaded, NPT 1/4", female

Max. flow [l/h]	Max. pressure [bar]	Materials			Installation set*	Type key**	Material number		
		Dosing head	Gaskets	Valve balls			AR	FC	FCM
7.5	16	PP	EPDM	Ceramic	No	DDA 7.5-16 AR-PP/E/C-F-31U7U7BG	97722357	97722391	97722425
					Yes	DDA 7.5-16 AR-PP/E/C-F-31I003BG	97722358	97722392	97722426
			FKM	Ceramic	No	DDA 7.5-16 AR-PP/V/C-F-31U7U7BG	97722361	97722395	97722429
					Yes	DDA 7.5-16 AR-PP/V/C-F-31I003BG	97722362	97722396	97722430
		PVC Only up to 150 psi	EPDM	Ceramic	No	DDA 7.5-16 AR-PVC/E/C-F-31U7U7BG	97722365	97722399	97722433
					Yes	DDA 7.5-16 AR-PVC/E/C-F-31I003BG	97722366	97722400	97722434
			FKM	Ceramic	No	DDA 7.5-16 AR-PVC/V/C-F-31U7U7BG	97722369	97722403	97722437
					Yes	DDA 7.5-16 AR-PVC/V/C-F-31I003BG	97722370	97722404	97722438
		PVDF	PTFE	Ceramic	No	DDA 7.5-16 AR-PV/T/C-F-31U7U7BG	97722385	97722419	97722453
					Yes	DDA 7.5-16 AR-PV/T/C-F-31I003BG	97722386	97722420	97722454
		SS	PTFE	SS 1.4401	No	DDA 7.5-16 AR-SS/T/SS-F-31VVBG	97722389	97722423	97722457
12	10	PVC Only up to 150 psi	EPDM	Ceramic	No	DDA 12-10 AR-PVC/E/C-F-31U7U7BG	97722467	97722501	97722535
					Yes	DDA 12-10 AR-PVC/E/C-F-31I004BG	97722468	97722502	97722536
			FKM	Ceramic	No	DDA 12-10 AR-PVC/V/C-F-31U7U7BG	97722471	97722505	97722539
					Yes	DDA 12-10 AR-PVC/V/C-F-31I004BG	97722472	97722506	97722540
			PTFE	Ceramic	No	DDA 12-10 AR-PVC/T/C-F-31U7U7BG	97722475	97722509	97722543
					Yes	DDA 12-10 AR-PVC/T/C-F-31I004BG	97722476	97722510	97722544
		PVDF	EPDM	Ceramic	No	DDA 12-10 AR-PV/E/C-F-31U7U7BG	97722479	97722513	97722547
					Yes	DDA 12-10 AR-PV/E/C-F-31I004BG	97722480	97722514	97722548
			FKM	Ceramic	No	DDA 12-10 AR-PV/V/C-F-31U7U7BG	97722483	97722517	97722551
					Yes	DDA 12-10 AR-PV/V/C-F-31I004BG	97722484	97722518	97722552
			PTFE	Ceramic	No	DDA 12-10 AR-PV/T/C-F-31U7U7BG	97722487	97722521	97722555
					Yes	DDA 12-10 AR-PV/T/C-F-31I004BG	97722488	97722522	97722556
		SS	PTFE	SS 1.4401	No	DDA 12-10 AR-SS/T/SS-F-31VVBG	97722491	97722525	97722559
17	7	PVC Only up to 150 psi	EPDM	Ceramic	No	DDA 17-7 AR-PVC/E/C-F-31U7U7BG	97722569	97722604	97722638
					Yes	DDA 17-7 AR-PVC/E/C-F-31I004BG	97722570	97722605	97722639
			FKM	Ceramic	No	DDA 17-7 AR-PVC/V/C-F-31U7U7BG	97722574	97722608	97722642
					Yes	DDA 17-7 AR-PVC/V/C-F-31I004BG	97722575	97722609	97722643
			PTFE	Ceramic	No	DDA 17-7 AR-PVC/T/C-F-31U7U7BG	97722578	97722612	97722646
					Yes	DDA 17-7 AR-PVC/T/C-F-31I004BG	97722579	97722613	97722647
		PVDF	EPDM	Ceramic	No	DDA 17-7 AR-PV/E/C-F-31U7U7BG	97722582	97722616	97722650
					Yes	DDA 17-7 AR-PV/E/C-F-31I004BG	97722583	97722617	97722651
			FKM	Ceramic	No	DDA 17-7 AR-PV/V/C-F-31U7U7BG	97722586	97722620	97722654
					Yes	DDA 17-7 AR-PV/V/C-F-31I004BG	97722587	97722621	97722655
			PTFE	Ceramic	No	DDA 17-7 AR-PV/T/C-F-31U7U7BG	97722590	97722624	97722658
					Yes	DDA 17-7 AR-PV/T/C-F-31I004BG	97722591	97722625	97722659
		SS	PTFE	SS 1.4401	No	DDA 17-7 AR-SS/T/SS-F-31VVBG	97722594	97722628	97722662
30	4	PVC Only up to 150 psi	EPDM	Ceramic	No	DDA 30-4 AR-PVC/E/C-F-31U7U7BG	97722672	97722706	97722740
					Yes	DDA 30-4 AR-PVC/E/C-F-31I004BG	97722673	97722707	97722741
			FKM	Ceramic	No	DDA 30-4 AR-PVC/V/C-F-31U7U7BG	97722676	97722710	97722744
					Yes	DDA 30-4 AR-PVC/V/C-F-31I004BG	97722677	97722711	97722745
			PTFE	Ceramic	No	DDA 30-4 AR-PVC/T/C-F-31U7U7BG	97722680	97722714	97722748
					Yes	DDA 30-4 AR-PVC/T/C-F-31I004BG	97722681	97722715	97722749
		PVDF	EPDM	Ceramic	No	DDA 30-4 AR-PV/E/C-F-31U7U7BG	97722684	97722718	97722752
					Yes	DDA 30-4 AR-PV/E/C-F-31I004BG	97722685	97722719	97722753
			FKM	Ceramic	No	DDA 30-4 AR-PV/V/C-F-31U7U7BG	97722688	97722722	97722756
					Yes	DDA 30-4 AR-PV/V/C-F-31I004BG	97722689	97722723	97722757
			PTFE	Ceramic	No	DDA 30-4 AR-PV/T/C-F-31U7U7BG	97722692	97722726	97722760
					Yes	DDA 30-4 AR-PV/T/C-F-31I004BG	97722693	97722727	97722761
		SS	PTFE	SS.1.4401	No	DDA 30-4 AR-SS/T/SS-F-31VVBG	97722696	97722730	97722764

* Installation set includes: 2 pump connections, foot valve, injection unit, 6 m PE discharge tube, 2 m PVC suction tube, 2 m PVC vent tube (4/6 mm)
** Also available in **FC**- and **FCM**-control version

DDC, standard range

Power supply: 1 x 100-240 V, 50/60 Hz (switch mode)
Mains plug: USA, Canada
Connection set: Tube, 0.17" x 1/4", 1/4" x 3/8", 3/8" x 1/2"
Connection SS: Threaded, NPT 1/4", female

Max. flow [l/h]	Max. pressure [bar]	Materials			Installation set*	Type key**	Material number	
		Dosing head	Gaskets	Valve balls			A	AR
6	10	PVC Only up to 150 psi	EPDM	Ceramic	No	DDC 6-10 A-PVC/E/C-F-31U7U7BG	97721537	97721571
					Yes	DDC 6-10 A-PVC/E/C-F-31I003BG	97721538	97721572
			FKM	Ceramic	No	DDC 6-10 A-PVC/V/C-F-31U7U7BG	97721541	97721575
					Yes	DDC 6-10 A-PVC/V/C-F-31I003BG	97721542	97721576
			PTFE	Ceramic	No	DDC 6-10 A-PVC/T/C-F-31U7U7BG	97721545	97721579
					Yes	DDC 6-10 A-PVC/T/C-F-31I003BG	97721546	97721580
		PVDF	EPDM	Ceramic	No	DDC 6-10 A-PV/E/C-F-31U7U7BG	97721549	97721583
					Yes	DDC 6-10 A-PV/E/C-F-31I003BG	97721550	97721584
			FKM	Ceramic	No	DDC 6-10 A-PV/V/C-F-31U7U7BG	97721553	97721587
					Yes	DDC 6-10 A-PV/V/C-F-31I003BG	97721554	97721588
			PTFE	Ceramic	No	DDC 6-10 A-PV/T/C-F-31U7U7BG	97721557	97721591
					Yes	DDC 6-10 A-PV/T/C-F-31I003BG	97721558	97721592
		SS	PTFE	SS 1.4401	No	DDC 6-10 A-SS/T/SS-F-31VVBG	97721561	97721595
9	7	PVC Only up to 150 psi	EPDM	Ceramic	No	DDC 9-7 A-PVC/E/C-F-31U7U7BG	97721605	97721639
					Yes	DDC 9-7 A-PVC/E/C-F-31I004BG	97721606	97721640
			FKM	Ceramic	No	DDC 9-7 A-PVC/V/C-F-31U7U7BG	97721609	97721643
					Yes	DDC 9-7 A-PVC/V/C-F-31I004BG	97721610	97721644
			PTFE	Ceramic	No	DDC 9-7 A-PVC/T/C-F-31U7U7BG	97721613	97721647
					Yes	DDC 9-7 A-PVC/T/C-F-31I004BG	97721614	97721648
		PVDF	EPDM	Ceramic	No	DDC 9-7 A-PV/E/C-F-31U7U7BG	97721617	97721651
					Yes	DDC 9-7 A-PV/E/C-F-31I004BG	97721618	97721652
			FKM	Ceramic	No	DDC 9-7 A-PV/V/C-F-31U7U7BG	97721621	97721655
					Yes	DDC 9-7 A-PV/V/C-F-31I004BG	97721622	97721656
			PTFE	Ceramic	No	DDC 9-7 A-PV/T/C-F-31U7U7BG	97721625	97721659
					Yes	DDC 9-7 A-PV/T/C-F-31I004BG	97721626	97721660
		SS	PTFE	SS 1.4401	No	DDC 9-7 A-SS/T/SS-F-31VVBG	97721629	97721663
15	4	PVC Only up to 150 psi	EPDM	Ceramic	No	DDC 15-4 A-PVC/E/C-F-31U7U7BG	97721673	97721707
					Yes	DDC 15-4 A-PVC/E/C-F-31I004BG	97721674	97721708
			FKM	Ceramic	No	DDC 15-4 A-PVC/V/C-F-31U7U7BG	97721677	97721711
					Yes	DDC 15-4 A-PVC/V/C-F-31I004BG	97721678	97721712
			PTFE	Ceramic	No	DDC 15-4 A-PVC/T/C-F-31U7U7BG	97721681	97721715
					Yes	DDC 15-4 A-PVC/T/C-F-31I004BG	97721682	97721716
		PVDF	EPDM	Ceramic	No	DDC 15-4 A-PV/E/C-F-31U7U7BG	97721685	97721719
					Yes	DDC 15-4 A-PV/E/C-F-31I004BG	97721686	97721720
			FKM	Ceramic	No	DDC 15-4 A-PV/V/C-F-31U7U7BG	97721689	97721723
					Yes	DDC 15-4 A-PV/V/C-F-31I004BG	97721690	97721724
			PTFE	Ceramic	No	DDC 15-4 A-PV/T/C-F-31U7U7BG	97721693	97721727
					Yes	DDC 15-4 A-PV/T/C-F-31I004BG	97721694	97721728
		SS	PTFE	SS.1.4401	No	DDC 15-4 A-SS/T/SS-F-31VVBG	97721697	97721731

* Installation set includes: 2 pump connections, foot valve, injection unit, 6 m PE discharge tube, 2 m PVC suction tube, 2 m PVC vent tube (4/6 mm)
** Also available in **AR**-control version

DDE, standard range

Power supply: 1 x 100-240 V, 50/60 Hz (switch mode)
Mains plug: USA, Canada
Connection set: Tube, 0.17" x 1/4", 1/4" x 3/8", 3/8" x 1/2"
Connection SS: Threaded, NPT 1/4", female

Max. flow [l/h]	Max. pressure [bar]	Materials			Installation set*	Type key**	Material number		
		Dosing head	Gaskets	Valve balls			B	P	PR
6	10	PVC Only up to 150 psi	EPDM	Ceramic	No	DE 6-10 B-PVC/E/C-X-31U7U7BG	97721059	97721093	98147336
					Yes	DDE 6-10 B-PVC/E/C-X-31I003BG	97721060	97721094	98147337
			FKM	Ceramic	No	DDE 6-10 B-PVC/V/C-X-31U7U7BG	97721063	97721097	98147340
					Yes	DDE 6-10 B-PVC/V/C-X-31I003BG	97721064	97721098	98147341
			PTFE	Ceramic	No	DDE 6-10 B-PVC/T/C-X-31U7U7BG	97721067	97721101	98147346
					Yes	DDE 6-10 B-PVC/T/C-X-31I003BG	97721068	97721102	98147347
		PVDF	EPDM	Ceramic	No	DDE 6-10 B-PV/E/C-X-31U7U7BG	97721071	97721105	98147348
					Yes	DDE 6-10 B-PV/E/C-X-31I003BG	97721072	97721106	98147349
			FKM	Ceramic	No	DDE 6-10 B-PV/V/C-X-31U7U7BG	97721075	97721109	98147332
					Yes	DDE 6-10 B-PV/V/C-X-31I003BG	97721076	97721110	98147333
			PTFE	Ceramic	No	DDE 6-10 B-PV/T/C-X-31U7U7BG	97721079	97721113	98147356
					Yes	DDE 6-10 B-PV/T/C-X-31I003BG	97721080	97721114	98147357
		SS	PTFE	SS 1.4401	No	DDE 6-10 B-SS/T/SS-X-31VVBG	97721083	97721117	98147360
15	4	PVC Only up to 150 psi	EPDM	Ceramic	No	DDE 15-4 B-PVC/E/C-X-31U7U7BG	97721127	97721161	98147370
					Yes	DDE 15-4 B-PVC/E/C-X-31I004BG	97721128	97721162	98147371
			FKM	Ceramic	No	DDE 15-4 B-PVC/V/C-X-31U7U7BG	97721131	97721165	98147374
					Yes	DDE 15-4 B-PVC/V/C-X-31I004BG	97721132	97721166	98147375
			PTFE	Ceramic	No	DDE 15-4 B-PVC/T/C-X-31U7U7BG	97721135	97721169	98147378
					Yes	DDE 15-4 B-PVC/T/C-X-31I004BG	97721136	97721170	98147379
		PVDF	EPDM	Ceramic	No	DDE 15-4 B-PV/E/C-X-31U7U7BG	97721139	97721173	98147382
					Yes	DDE 15-4 B-PV/E/C-X-31I004BG	97721140	97721174	98147383
			FKM	Ceramic	No	DDE 15-4 B-PV/V/C-X-31U7U7BG	97721143	97721177	98147386
					Yes	DDE 15-4 B-PV/V/C-X-31I004BG	97721144	97721178	98147387
			PTFE	Ceramic	No	DDE 15-4 B-PV/T/C-X-31U7U7BG	97721147	97721181	98147390
					Yes	DDE 15-4 B-PV/T/C-X-31I004BG	97721148	97721182	98147391
		SS	PTFE	SS 1.4401	No	DDE 15-4 B-SS/T/SS-X-31VVBG	97721151	97721186	98147394

* Installation set includes: 2 pump connections, foot valve, injection unit, 6 m PE discharge tube, 2 m PVC suction tube, 2 m PVC vent tube (4/6 mm)
** Also available in **P-** and **PR-**control version

DDA, DDC, DDE, non-standard range

Key to the designations of the three following tables:

Max. flow, press.	Control variant	Materials of dosing head, gaskets and valve balls	Control cube position	Supply voltage	Valve type	Connection / Installation set	Mains plug	Design	Special variant
[l/h] - [bar]	See page 6	*Head:* PP: Polypropylene PVC: Polyvinyl chloride** PV: PVDF SS: Stainless steel 1.4401 *Gaskets:* E: EPDM V: FKM T: PTFE C: Valve balls: SS: Ceramic Stainless steel 1.4401	F: Front-mounted (change to left and right possible) X: No control cube (only DDE)	3: 1 x 100-240 V, 50/60 Hz I: 24-48 VDC (DDC)	1: Standard 2: Spring-loaded (HV version)	*Suction/discharge connection:* U2U2: Tubing, 4/6 mm, 6/9 mm, 6/12 mm, 9/12 mm U7U7: Tubing, 0.17" x 1/4", 1/4" x 3/8", 3/8" x 1/2" AA: Threaded, Rp 1/4", female (SS) VV: Threaded, NPT1/4", female (SS) XX: Without connection *Installation set** I001: 4/6 mm up to 7.5 l/h, 13 bar I002: 9/12 mm up to 60 l/h, 9 bar I003: 0.17" x 1/4" up to 7.5 l/h, 13 bar I004: 3/8" x 1/2" up to 60 l/h, 10 bar	F: EU B: USA, Canada G: UK I: Australia, New Zealand, Taiwan E: Switzerland Japan J: Argentina L: No plug X: (only 24-48 VDC)	G: Grundfos	C3: Inspection Certificate 3.1 (EN 10204)

* Installation set includes 2 pump connections, foot valve, injection unit, 6 m PE discharge tubing, 2 m PVC suction tubing, 2 m PVC deaeration tubing (4/6 mm)

** PVC dosing heads only up to 10 bar

DDA

Max. flow, press.	Control variant	Materials: Head	Materials: Gaskets	Materials: Balls	Control cube position	Supply voltage	Valve type	Connection / Installation set	Mains plug	Design	Special variant
7.5-16	AR FC FCM	PP	E V	C	F	3	1 2	U2U2 U7U7 XX I001 I003	F B G I E J L	G	C3
		PVC PV	E V T	C							
		SS	T	SS	F	3	1 2	AA VV XX			
12-10 17-7 30-4	AR FC FCM	PP	E V	C	F	3	1 2	U2U2 U7U7 XX I002 I004			
		PVC PV	E V T	C							
		SS	T	SS	F	3	1 2	AA VV XX			

DDC

Max. flow, press.	Control variant	Materials: Head	Materials: Gaskets	Materials: Balls	Control cube position	Supply voltage	Valve type	Connection / Installation set	Mains plug	Design	Special variant
6-10	A AR	PP	E V	C	F	3 I	1 2	U2U2 U7U7 XX I001 I003	F B G I E J L	G	C3
		PVC PV	E V T	C							
		SS	T	SS	F	3 I	1 2	AA VV XX			
9-7 15-4	A AR	PP	E V	C	F	3 I	1 2	U2U2 U7U7 XX I002 I004			
		PVC PV	E V T	C							
		SS	T	SS	F	3 I	1 2	AA VV XX			

DDE

Max. flow, press.	Control variant	Materials			Control cube position	Supply voltage	Valve type	Connection / Installation set	Mains plug	Design	Special variant
		Head	Gaskets	Balls							
6-10	B P PR	PP	E V	C	X	3	1 2	U2U2 U7U7 XX I001 I003	F B G I E J L	G	C3
		PVC	E V T	C							
		PV									
		SS	T	SS	X	3	1 2	AA VV XX			
15-4	B P PR	PP	E V	C	X	3	1 2	U2U2 U7U7 XX I002 I004			
		PVC	E V T	C							
		PV									
		SS	T	SS	X	3	1 2	AA VV XX			

8. Accessories

Accessories overview

Grundfos offers a comprehensive range of accessories covering every need when dosing with Grundfos pumps.

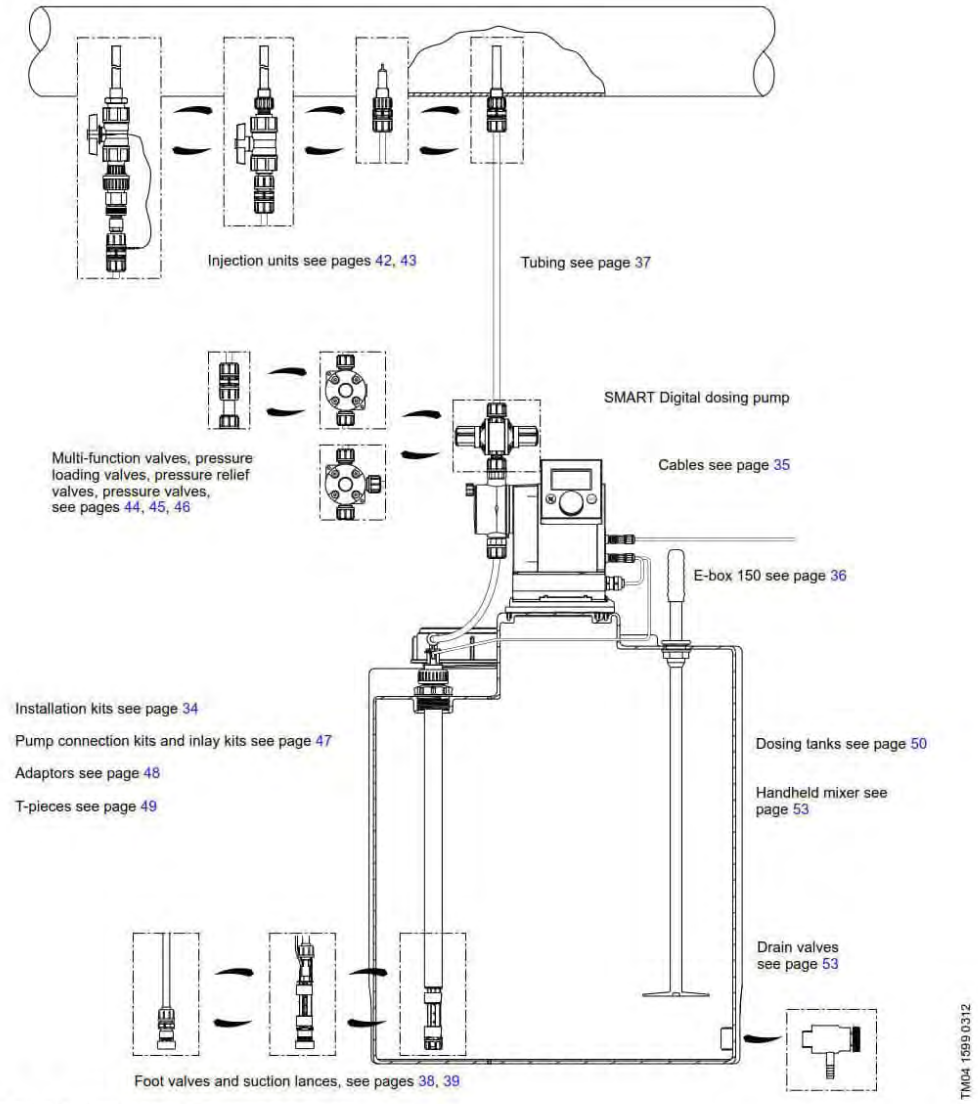


Fig. 23 SMART Digital pump with accessories

Installation kits for dosing pumps

An installation kit includes the following parts:

- Injection unit with spring-loaded non-return valve (see page 42)
- PE discharge tubing, 19.7 ft.
- PVC suction tubing, 6.5 ft.
- PVC deaeration tubing, 6.5 ft.
- Foot valve with strainer and weight, without or with level indication (see page 38).

Fig. 24 Installation kit with foot valve without level indication

Fig. 25 Installation kit with foot valve with level indication

Technical data

Size			Material of foot valve / injection unit			Material number	
Max. flow rate* [gph]	Suction / discharge tubing [in.]	Deaeration tubing [in.]	Housing	Gasket	Ball	Foot valve without level indication	Foot valve with level indication
2	0.17x1/4	0.17x1/4	PP	FKM	Ceramic	95730488	95730512
				EPDM	Ceramic	95730489	95730513
			PVC	FKM	Ceramic	95730490	95730514
				EPDM	Ceramic	95730491	95730515
				PTFE	Ceramic	95730492	95730516
			PVDF	FKM	Ceramic	95730493	95730517
				EPDM	Ceramic	95730494	95730518
				PTFE	Ceramic	95730495	95730519
8	1/4x3/8	0.17x1/4	PP	FKM	Ceramic	95730496	95730520
				EPDM	Ceramic	95730497	95730521
			PVC	FKM	Ceramic	95730498	95730522
				EPDM	Ceramic	95760499	95730523
				PTFE	Ceramic	95730500	95730524
			PVDF	FKM	Ceramic	95730501	95730525
				EPDM	Ceramic	95730502	95730526
				PTFE	Ceramic	95730503	95730527
15.85	3/8x1/2	0.17x1/4	PP	FKM	Ceramic	95730504	95730528
				EPDM	Ceramic	95730505	95730529
			PVC	FKM	Ceramic	95730506	95730530
				EPDM	Ceramic	95730507	95730531
				PTFE	Ceramic	95730508	95730532
			PVDF	FKM	Ceramic	95730509	95730533
				EPDM	Ceramic	95730510	95730534
				PTFE	Ceramic	95730511	95730535

* Viscosity similar to water

Cables and plugs

Cables and plugs are used for the connection of the dosing pump to external control devices, such as process controllers, flow meters, level control units, etc.

- Cable material: PVC, 0.34 mm^2
- Plug type: M 12.

Fig. 26 Cable and plug

Technical data

Socket	Application		Pins	Plug type	Cable length [ft. (m)]	Material number
	Input	Analog pulse External stop	4	Straight	6.5 (2)	96609014
					16.4 (5)	96609016
					No cable	96698715
				Angled	6.5 (2)	96693246
	Input	Low level Empty tank	4	Straight	No cable	96698715
	Output	Analog GENIbus	5	Straight	6.5 (2)	96632921
					16.4 (5)	96632922
					No cable	96609031
				Angled	6.5 (2)	96699697
	Output	Relay 1 Relay 2	4	Straight	6.5 (2)	96609017
					16.4 (5)	96609019
					No cable	96696198
				Angled	6.5 (2)	96698716

E-box 150 Profibus

The Grundfos E-box 150 (E-box = Extension Box) is a Plug & Play Profibus fieldbus communication interface for the integration of SMART Digital DDA dosing pumps into a Profibus DP network. Fieldbus communication allows to use the DDA dosing pump in industrial automation systems (PLC; SCADA), where advanced remote control and monitoring functions are required:

- Remote control of all settings, e.g. operation mode, flow rate, etc.
- Remote monitoring of all parameters, e.g. measured flow, pressure, faults with cause, etc.

The E-box 150 contains a standard Grundfos CIM 150 communication interface module for data transmission between a Profibus DP network and a Grundfos pump. System integration is straightforward with the standard GSD file (www.grundfosalldos.com).

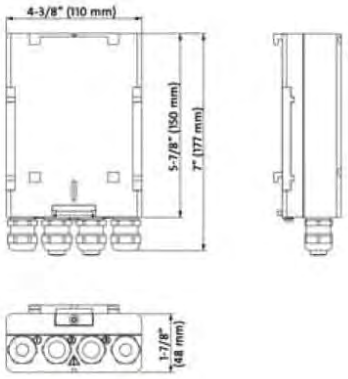
DDA dosing pumps can be retrofitted easily with the E-box 150: it is simply placed between the pump and the mounting plate (DDA software version V2.10 or higher required). The E-box 150 has a connecting cable to plug into the pump directly.

Description	Material number
E-box 150	97513994

TM04 8455 0312

Fig. 27 E-box

Dimensions



TM04 8454_US 0113

Fig. 28 E-box, dimensions

Technical data

E-box data	Supply voltage	30 VDC, ± 10 % (via M 12 plug of DDA)
	Max. power consumption	5 W
	Cable length	6.29" [160 mm]
	Max. relative humidity	96 %
	Pollution degree	2
	Enclosure class	IP 65 according to IEC 60529 NEMA 4X
	Electrical safety class	3
	Min. / max. ambient temperature	0/45 °C
	Approvals	CE, CB, CSA-US, GOST, C-Tick
GENIbus connection	Data protocol	GENIbus
	GENIbus connection type	Three-wire RS-485
	Transmission speed	9.6 kbits/s
Profibus specifications	Data protocol	Profibus DP
	Profibus implementation class	DP-V0
	Profibus connection type	Two-wire RS-485 (lines: A, B)
	Recommended cable type	Screened, double-twisted pair conductor cross-section: 0.25 - 1 mm^2 AWG: 24-18
	Maximum cable length	100 m at 12000 kbits/s 1200 m at 9.6 kbits/s
	Slave address (set in DDA display)	1-126
	Line termination (set via DIP switches)	On/off
	Supported data rates	9.6 kbits/s to 12000 kbits/s

Tubing

Tubing is available in various materials, sizes and lengths.

TM04 8268 0411

Fig. 29 Tubing

Technical data

Inner/outer diameter [in]	Material	Maximum pressure [psi]	Length [ft.]	Material Number
0.125 x 1/4	PVC	85	20	91127749
0.125 x 1/4	PVC	85	100	98257648
1/4 x 3/8	PVC	73	100	91127750
	PE	192	20	91127825
			100	91127751
	ETFE	290	100	91127753
3/8 x 1/2	PE	123	20	91127826
			100	91127752

Foot valves

Foot valves are installed at the lower end of the suction tubing. They are available either without level indication or with low-level and empty-tank indication.

Foot valves include:

- Weight
- Strainer (mesh size approx. 0.8 mm)
- Non-return valve
- Tubing connection set: 0.17"x1/4", 1/4"x3/8" and 3/8"x1/2"
- Pipe connection set: threaded, 1/4" NPT, female (stainless steel).

Foot valves with low-level and empty-tank indication include additionally:

- Reed-switch unit with two floaters
- 5 meters of cable with PE jacket
- M 12 plug to connect DDA, DDC, DDE or DDI dosing pump
- PE cap, ∅58 mm, for assembly in Grundfos cylindrical tanks, or for use with tank adaptors.

The switch mode of the low-level and empty-tank indication is factory-set to NO. The switch mode can be set to NC by turning the floaters upside down.

Electrical data of the level indication:

- Max. voltage: 48 V
- Max. current: 0.5 A
- Max. load: 10 VA.

Fig. 30 Left: foot valve without level indication; right: foot valve with level indication

Dimensions

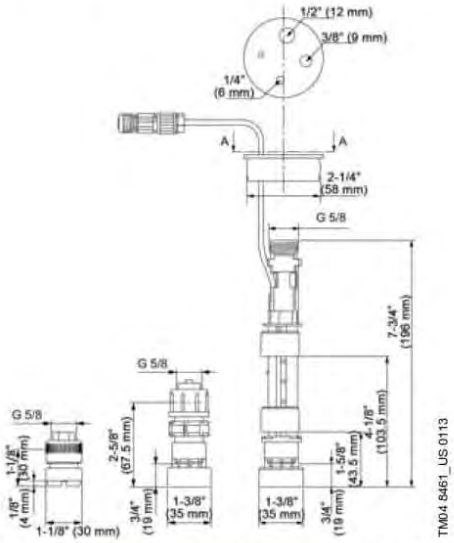


Fig. 31 Left: stainless-steel foot valve; center and right: PE or PVDF foot valve, dimensions

Technical data

Max. flow rate [gph]	Material			Material number	
	Housing	Gasket	Ball	without level indication	with level indication
15.85	PE	FKM, EPDM	Ceramic	98070955	98070970
		PTFE	Ceramic	98070956	98070971
	PVDF	FKM, EPDM	Ceramic	98070957	98070972
		PTFE	Ceramic	98070958	98070973
	SS	PTFE	SS	98070964	-

Suction lances

Suction lances are installed at the lower end of the suction tubing. They are available either without level indication or with low-level and empty-tank indication. Their immersion depth is adjustable.

Suction lances include:

- Strainer (mesh size approx. 0.8 mm)
- Non-return valve
- Tubing connection set: 0.17"x1/4", 1/4"x3/8" and 3/8"x1/2"
- Adjustable tank connection with holes for e.g. relief line.

Suction lances with low-level and empty-tank indication include additionally:

- Reed-switch unit with 2 floaters
- 5 meters of cable with PE jacket
- M 12 plug to connect DDA, DDC, DDE or DDI dosing pump.

The switch mode of the low-level and empty-tank indication is factory-set to NO. The switch mode can be set to NC by turning the floaters upside down.

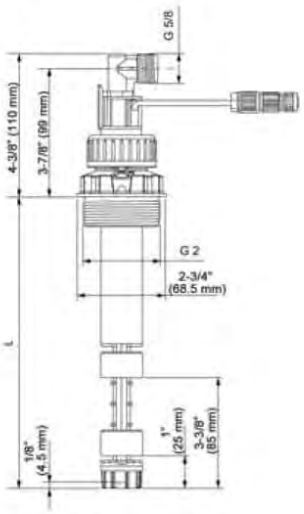
Electrical data of the level indication:

- Max. voltage: 48 V
- Max. current: 0.5 A
- Max. load: 10 VA.

TM04 8458 0312

Fig. 32 Suction lance

Dimensions



TM04 8460_US 0113

Fig. 33 Suction lance, dimensions

Dimensions / Selection

For dosing tank type	Tank volume Gal. [l]	Recommended immersion depth (L) [in. (mm)]
Grundfos cylindrical tank (see page 51)	60	19-1/2 [500]
	100	27-1/8 [690]
	200	27-1/8 [690]
	300	38-1/2 [980]
	500	43-1/4 [1100]
	1000	47-1/4 [1200]
Grundfos square tank (see page 50)*	100	27-1/8 [690]
L-ring drum*	32 [120]	32-1/4 [820]
	58 [220]	38-1/2 [980]
Steel drum*	57 [216]	38-1/2 [980]
Standard jerricans according to EN 12712*	3, 9 [12, 33 large cap]	15-3/4 [400]
	7, 8, 9 [25, 30, 33]	19-1/2 [500]
	16 [60]	27-1/8 [690]
IBC*	all sizes	47-1/4 [1200]

* suitable adaptors see page 41

Technical data

Max. flow rate [gph]	Max. immersion depth* [in. (mm)]	Material: Housing	Material: Gasket	Material: Ball	Material number: without level indication	Material number: with level indication
15.85	15-3/4 (400)	PE	FKM, EPDM	Ceramic	98070982	98071078
			PTFE	Ceramic	98070983	98071079
		PVDF	FKM, EPDM	Ceramic	98070984	98071080
			PTFE	Ceramic	98070985	98071081
	19-1/2 (500)	PE	FKM, EPDM	Ceramic	98070994	98071090
			PTFE	Ceramic	98070995	98071091
		PVDF	FKM, EPDM	Ceramic	98070996	98071092
			PTFE	Ceramic	98070997	98071093
	22-3/8 (570)	PE	FKM, EPDM	Ceramic	98071006	98071102
			PTFE	Ceramic	98071007	98071103
		PVDF	FKM, EPDM	Ceramic	98071008	98071104
			PTFE	Ceramic	98071009	98071105
	27-1/8 (690)	PE	FKM, EPDM	Ceramic	98071018	98071114
			PTFE	Ceramic	98071019	98071115
		PVDF	FKM, EPDM	Ceramic	98071020	98071116
			PTFE	Ceramic	98071021	98071117
	32-1/4 (820)	PE	FKM, EPDM	Ceramic	98071030	98071126
			PTFE	Ceramic	98071031	98071127
		PVDF	FKM, EPDM	Ceramic	98071032	98071128
			PTFE	Ceramic	98071033	98071129
	38-1/2 (980)	PE	FKM, EPDM	Ceramic	98071042	98071138
			PTFE	Ceramic	98071043	98071139
		PVDF	FKM, EPDM	Ceramic	98071044	98071140
			PTFE	Ceramic	98071045	98071141
	43-1/4 (1100)	PE	FKM, EPDM	Ceramic	98071054	98071150
			PTFE	Ceramic	98071055	98071151
		PVDF	FKM, EPDM	Ceramic	98071056	98071152
			PTFE	Ceramic	98071057	98071153
	47-1/4 (1200)	PE	FKM, EPDM	Ceramic	98071066	98071162
			PTFE	Ceramic	98071067	98071163
		PVDF	FKM, EPDM	Ceramic	98071068	98071164
			PTFE	Ceramic	98071069	98071165

* minimum immersion depth for all sizes: approx. 5-1/2" (140 mm)

Accessories for suction lances and foot valves with level indication

Adaptors for containers

These adaptors allow the installation of standard suction lances (G 2 thread) and foot valves with level indication (PE cap) on different types of containers.

TM04 8506 0712

Technical data

Adaptor type		For container type	Remark	Material No.
	TM04 8470 0512	counter nut for tanks without threaded opening, e.g. 100-liter square tank or 1000-liter cylindrical tank	PVC, grey	98071170
	TM04 8471 0512	containers with 2" NPT threaded opening	PVC, grey	98156690
		drums with S 70 x 6 coarse thread (MAUSER 2")	PE, blue	98071171
		drums with S 56 x 4 coarse thread (TriSure®)	PE, orange	98071172
	TM04 8473 0512	jerricans with small opening (approx. ∅36), according to EN 12713	PE, green	98071173
		jerricans with medium-sized opening (approx. ∅45), according to EN 12713	PE, yellow	98071174
		jerricans with large opening (approx. ∅57), according to EN 12713	PE, brown	98071175
		US containers with bung hole of 63 mm (ASTM International)	PE, white	98071176
	TM04 8472 0512	IBC (Intermediate Bulk Container) with opening of ∅150 mm, S 160 x 7	PE, black	98071177

Emission protection kits

Gas emitted by liquid in a container can cause bad odor and corrosion. Emission protection kits help avoid such problems. Suction lances can be retrofitted with emission protection kits.

Two variants are available:

- Emission protection kit with snifting valve: no gas can escape from the container, but air can be drawn in.
- Emission protection kit for use with filter: gas can escape from the container and air can be drawn in. The kit can be connected to a filter by means of a 4/6 mm tubing.

They include:

- gasket for the tank adaptor
- snifting valve or tubing nipple 4/6 mm (tubing is not included)
- gasket for the cable outlet.

Order data

Variant	Remark	Material number
Emission protection kit with snifting valve	can be retrofitted	98071178
Emission protection kit for use with filter	can be retrofitted	98071179

M-12-plug-to-flat-plug adaptor

The adaptor allows to connect suction lances or foot valves with level indication to pumps with a level input designed for flat plugs (e.g. DMX and DMH with AR control unit).

Order data

Description	Material number
M-12-plug-to-flat-plug adaptor	96635010

Injection units

Injection units connect the dosing line with the process line. They ensure a minimum backpressure of 0.7 bar, and avoid backflow of the dosing liquid.

In general, they include:

- Injection pipe. PP, PVC and PVDF versions can be shortened.
- Spring-loaded non-return valve with Tantal spring.
- Tubing connection set: 0.17" x 1/4", 1/4" x 3/8" and 3/8" x 1/2".
- Stainless steel inlet pipe connection: 1/4" female NPT.

Standard injection units

Dimensions

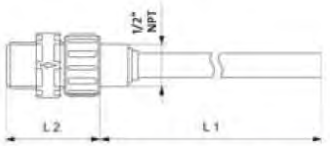


Fig. 34 Standard injection unit, PP, PVC, and PVDF version

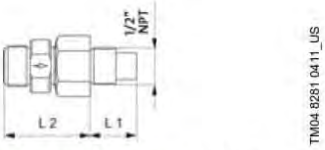


Fig. 35 Standard injection unit, stainless-steel version

Technical data

Max. flow rate [gph]	Max. pressure [psi]	Material			Dimensions		Material number
		Housing	Gasket	Ball	L 1 In. [mm]	L 2 In. [mm]	
15.85	232	PP	FKM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730906
			EPDM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730910
		PVC	FKM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730914
			EPDM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730918
			PTFE	Ceramic	3-7/8 [100]	1-7/8 [47]	95730922
		PVDF	FKM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730926
			EPDM	Ceramic	3-7/8 [100]	1-7/8 [47]	95730930
			PTFE	Ceramic	3-7/8 [100]	1-7/8 [47]	95730934
	1450	Stainless steel	PTFE	Stainless steel	1-1/8 [27]	2 [50]	95730938
	232	PVC	FKM	Ceramic	11-3/4 [300]	1-7/8 [47]	95730942
			EPDM	Ceramic	11-3/4 [300]	1-7/8 [47]	95730946
			PTFE	Ceramic	11-3/4 [300]	1-7/8 [47]	95730950

Injection units with lip valve

Injection units with lip valve are typically used to add sodium hypochlorite solution to water with a high carbonate content. The FKM lip prevents crystallization and blocking caused by alkali carbonate reactions at the point of injection.

Dimensions

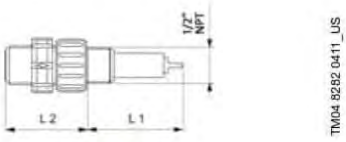


Fig. 36 Injection unit with lip valve

Technical data

Max. flow rate [gph]	Max. pressure [psi]	Material			Dimensions		Material number
		Housing	Gasket	Ball	L 1 [in.(mm)]	L 2 [in. (mm)]	
15.85	232	PVC	FKM	Ceramic	2 1/8 [55]	2 3/8 [59]	95730966

Injection units with ball valve

Injection units with ball valve are used for applications where the injection point must be closable. The ball valve is placed between the injection pipe and the spring-loaded non-return valve. Thus, the dosing line can be completely disconnected from the process. The non-return valve can be disassembled and cleaned without stopping the process and emptying the process line.

Dimensions

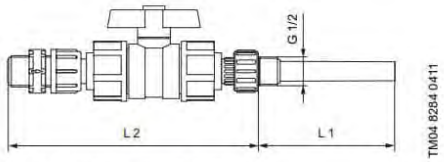


Fig. 37 Injection unit with ball valve

Technical data

Max. flow rate [gph]	Max. pressure [psi]	Material			Dimensions		Material number
		Housing	Gasket	Ball	L 1 [in. (mm)]	L 2 [in. (mm)]	
15.85	232	PVC	FKM	Ceramic	3-7/8 (100)	7-1/4 (183)	95730954
			EPDM	Ceramic	3-7/8 (100)	7-1/4 (183)	95730958
	928	Stainless steel	PTFE	Stainless steel	1-1/8 (27)	5-1/2 (138)	95730962

Injection units, withdrawable for cleaning

These injection units are used where regular cleaning of the injection pipe is required. The construction allows the withdrawal of the injection unit from the process line and the cleaning of it, without stopping the water flow. The injection point can be closed with the integrated ball valve. The immersion depth of the injection pipe can be adjusted.

Dimensions

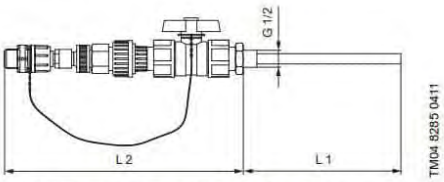


Fig. 38 Injection unit, withdrawable for cleaning

Technical data

Max. flow rate [gph]	Max. pressure [psi]	Material			Dimensions		Material number
		Housing	Gasket	Ball	L 1 [in. (mm)]	L 2 [in. (mm)]	
15.85	145	PVC	FKM	Ceramic	7-1/4 (185)	11 (280)	95730970
			EPDM	Ceramic	7-1/4 (185)	11 (280)	95730974

Hot-injection units with ball valve

Hot-injection units with ball valve can be used for direct injection of dosing liquid into processes with a temperature of up to 248 °F.

In addition, these injection units include:

- Injection pipe, stainless steel.
- Ball valve installed between the injection pipe and the cooling pipe, stainless steel.
- Bendable cooling pipe, stainless steel, length 1 m.

Dimensions

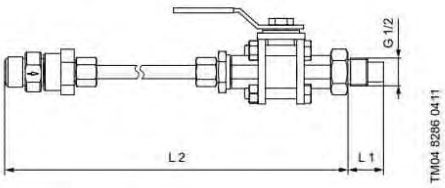


Fig. 39 Hot-injection unit with ball valve

Technical data

Max. flow rate [gph]	Max. pressure [psi]	Material			Dimensions		Material number
		Housing	Gasket	Ball	L 1 [in. (mm)]	L 2 [in. (mm)]	
15.85	232	PVDF	PTFE	Ceramic	1-1/8 (27)	45-1/2 (1158)	95730978
	928	Stainless steel	PTFE	Stainless steel	1-1/8 (27)	45-1/2 (1158)	95730982

Multi-function valves, pressure relief valves, pressure loading valves

Multi-function valves combine the functions of pressure relief valves and pressure loading valves. In addition, they allow deaeration of the pump and emptying of the discharge line for maintenance.

Pressure relief valves, or safety valves, protect the pump and the discharge installations against excessive pressure. All pressurized dosing installations should include a pressure relief valve.

Pressure loading valves maintain a certain backpressure for the pump. They are used in applications with too low backpressure or no backpressure at all. Pressure loading valves are also used to prevent siphoning, when the admission pressure is higher than the backpressure. They provide a constant backpressure for the dosing pump when the system pressure is fluctuating.

TM04 8267 0411

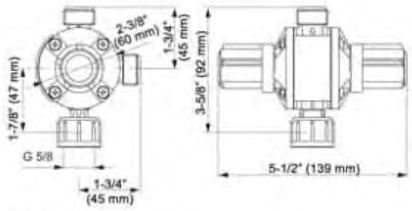
Fig. 40 Multi-function valve, pressure relief valve, pressure loading valve

Multi-function valves

A multi-function valve is mounted directly on the pump discharge side. The top connection is for the discharge line, the side connection leads the relief liquid back into the tank.

- Loading pressure, adjustable from 14.5 to 58 psi, is factory-set to 43.5 psi.
- Relief pressure, adjustable from 101 to 232 psi, is factory-set to145 psi.
- Maximum system pressure 232 psi.
- Tubing connection set: 0.17"x1/4", 1/4"x3/8" and 3/8"x1/2".

Dimensions



TM04 8288_US 0113

Fig. 41 Multi-function valve

Technical data

Max. flow rate [gph]	Housing	Material			Material number
		Connections	Gasket	Diaphragm	Relief pressure 10 bar
15.85	PVDF	PP	FKM	PTFE	95730813
			EPDM	PTFE	95730814
		PVC	FKM	PTFE	95730815
			EPDM	PTFE	95730816
			PTFE	PTFE	95730817
		PVDF	FKM	PTFE	95730818
			EPDM	PTFE	95730819
			PTFE	PTFE	95730820

Pressure relief valves

Pressure relief valves are installed in the discharge line near the pump, using the 2 in-line connections. The side connection leads the relief liquid back into the tank.

- Relief pressure, adjustable from 72.5 to 145 psi, is factory-set to 145 psi, or
- Maximum system pressure 232 psi.
- Tubing connection set: 0.17"x1/4", 1/4"x3/8" and 3/8"x1/2".
- Pipe connection set: threaded, 1/4" NPT, female (stainless steel).

Dimensions

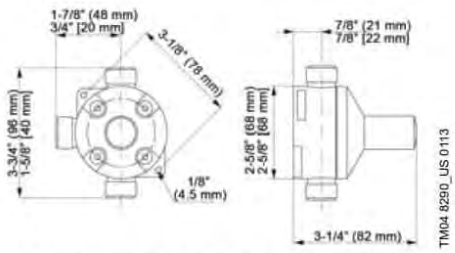


Fig. 42 Pressure relief valve. Dimensions in brackets apply to stainless-steel version.

Technical data

Max. flow rate [gph]	Material			Material number
	Diaphragm	Housing and connections	Gasket	Relief pressure 10 bar
15.85	PTFE	PP	FKM / EPDM	95730762
		PVC	FKM / EPDM	95730763
			PTFE	95730764
		PVDF	FKM / EPDM	95730765
			PTFE	95730766
		Stainless steel	No gaskets	95730772

Pressure loading valves

Pressure loading valves are installed in the discharge line after the pressure relief valve, and after the pulsation damper, if fitted.

- Loading pressure, adjustable from 14.5 to 72.5 psi, is factory-set to 43.5 psi.
- Maximum system pressure: 232 psi.
- Tubing connection set: 0.17"x1/4", 1/4"x3/8" and 3/8"x1/2"
- Pipe connection set: threaded, 1/4" NPT, female (stainless steel).

Dimensions

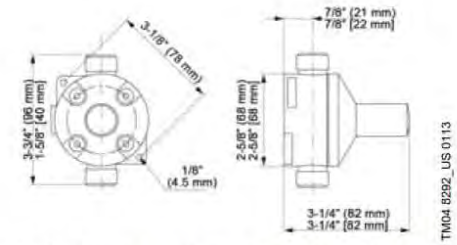


Fig. 43 Pressure loading valve. Dimensions in brackets apply to stainless-steel version.

Technical data

Max. flow rate [gph]	Material			Material number
	Diaphragm	Housing and connections	Gasket	
15.85	PTFE	PP	FKM / EPDM	95730746
		PVC	FKM / EPDM	95730747
			PTFE	95730748
		PVDF	FKM / EPDM	95730749
			PTFE	95730750
		Stainless steel	No gaskets	95730752

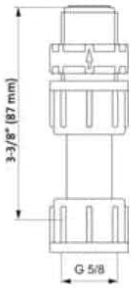
Pressure valves

Pressure valves provide a constant backpressure of 3 bar. They are particularly required for DDA-FC or DDA-FCM pumps at very small flow rates.

Pressure valves are installed either directly on the pump discharge side, or on the pressure relief valve.

- Loading pressure, 43.5 psi, is not adjustable.
- Maximum system pressure: 232 psi.
- Spring material: Alloy C-4 (NiMo16CrTi, material number 2.4610).
- No connections included.

Dimensions



TM04 8293_US 0113

Fig. 44 Pressure valve

Technical data

Max. flow rate [gph]	Material			Material number
	Ball	Housing	Gaskets	
15.85	Ceramic	PP	FKM	95730325
			EPDM	95730326
		PVC	FKM	95730327
			EPDM	95730328
			PTFE	95730329
		PVDF	FKM	95730330
			EPDM	95730331
			PTFE	95730332
	Stainless steel	Stainless steel	PTFE	95730333

Pump connection kits and inlay kits

Retrofit pump connection kits and inlay kits for the integration of Grundfos standard pumps into installations with various sizes of tubing or pipes.

A pump connection kit includes:

- 1 set of inlays
- 1 union nut.

An inlay kit includes:

- 2 sets of inlays.

Fig. 45 Left: pump connection kit; right: inlay kit

Technical data

Connection type	Size	Material	Material number	
			Connection kit	Inlay kit
Tubing (cone and ring)	4/6 mm, 6/9 mm, 6/12 mm, 9/12 mm	PP	97691902	-
		PVC	97691903	-
		PVDF	97691904	-
	0.17" x 1/4", 1/4" x 3/8", 3/8" x 1/2"	PP	97691905	-
		PVC	97691906	-
		PVDF	97691907	-
	4/6 mm, or 0.17" x 1/4"	PP	97702474	95730984
		PVC	97702485	95730720
		PVDF	97702495	95730729
	4/9 mm	PP	98153922	98153977
		PVC	98153944	98154006
		PVDF	98153949	98154029
	5/8 mm	PP	97702475	95730711
		PVC	97702486	95730721
		PVDF	97702496	95730730
	6/8 mm	PP	97702476	95730712
		PVC	97702487	95730722
		PVDF	97702497	95730731
	6/9 mm	PP	97702477	95730713
		PVC	97702488	95730723
		PVDF	97702498	95730732
	6/12 mm	PP	97702478	95730714
		PVC	97702489	95730724
		PVDF	97702499	95730733
	9/12 mm	PP	97702479	95730715
		PVC	97702490	95730725
		PVDF	97702500	95730734
	1/4" x 3/8"	PP	97702482	95730718
		PVC	97702492	95730727
		PVDF	97702503	95730737
	3/8" x 1/2"	PP	97702483	95730719
		PVC	97702493	95730728
		PVDF	97702504	95730738
Tubing (cutting ring type)	1/8" x 1/4"	PP	97702481	95730717
		PVDF	97702502	95730736
Pipe welding	External diameter 16 mm	PP	97702480	95730716
		PVDF	97702501	95730735
Pipe cementing	Internal diameter 12 mm	PVC	97702491	95730726
Pipe, threaded, male	1/2" NPT	PP	97702484	-
		PVC	97702494	-
		PVDF	97702505	-
		Stainless steel	97702508	-
Pipe, threaded, female	Rp 1/4"	Stainless steel	97702472	95730739
	1/4" NPT	Stainless steel	97702473	95730740
Pipe (cutting ring type)	4/6 mm	Stainless steel	97702506	-
	8/10 mm	Stainless steel	97702507	-

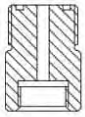
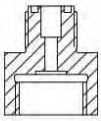
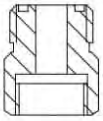
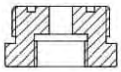
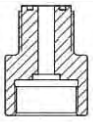
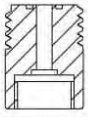
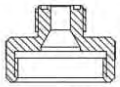
Adaptors

Threaded adaptors

Threaded adaptors are used to convert between different threaded connection sizes.

A threaded adaptor kit includes:
- 1 adaptor
- 1 O-ring.

Technical data

Type		Threaded connection size		Material		Material number
		Female	Male	Housing	Gaskets	
	TM04 8296 0411	G 3/8	G 5/8	PP	FKM / EPDM	95730407
				PVC	FKM / EPDM	95730408
					PTFE	95730409
				PVDF	FKM / EPDM	95730410
					PTFE	95730411
	TM04 8297 0411	G 5/8	G 3/8	PP	FKM / EPDM	95730412
				PVC	FKM / EPDM	95730413
					PTFE	95730414
				PVDF	FKM / EPDM	95730415
					PTFE	95730416
	TM04 8298 0411	G 5/8	G 3/4	PP	FKM / EPDM	95730417
				PVC	FKM / EPDM	95730418
					PTFE	95730419
				PVDF	FKM / EPDM	95730420
					PTFE	95730421
	TM04 8299 0411	G 5/8	G 1 1/4	PP	FKM / EPDM	95730422
				PVC	FKM / EPDM	95730423
					PTFE	95730424
				PVDF	FKM / EPDM	95730425
					PTFE	95730426
	TM04 8300 0411	G 5/8	M 20 x 1.5	PP	FKM / EPDM	95730427
				PVC	FKM / EPDM	95730428
					PTFE	95730429
				PVDF	FKM / EPDM	95730430
					PTFE	95730431
	TM04 8475 0612	G 5/8	M 30 x 3.5	PVDF	FKM / EPDM	98154048
					PTFE	98154054
	TM04 8301 0411	G 1 1/4	G 5/8	PP	FKM / EPDM	95730432
				PVC	FKM / EPDM	95730433
					PTFE	95730434
				PVDF	FKM / EPDM	95730435
					PTFE	95730436

Union nut adaptors

Union nut adaptors consist of a rigid pipe with union nuts on both ends. They have neither gaskets nor glued or welded connections.

Technical data

Type		Threaded connection size		Material	Material number
		Female	Female	Housing	
	TM04 8306 0411	G 5/8	G 5/8	PVC	95730437
				PP	95730438
				PVDF	95730439

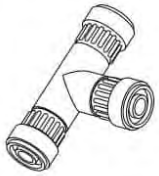
Tubing-to-tubing and tubing-to-pipe adaptors

Technical data

Type	Description	Connections		Material		Material number
		Side 1	Side 2	Housing and connections	Gaskets	
 TM04 8302 0411	Valve housing with two male threads G 5/8	For tubing 0.17"x1/4", 1/4"x3/8", 3/8"x1/2"		PP	FKM / EPDM	95730372
				PVC	FKM / EPDM	95730373
					PTFE	95730374
				PVDF	FKM / EPDM	95730375
					PTFE	95730376
		Without		PP	FKM / EPDM	95730356
				PVC	FKM / EPDM	95730357
					PTFE	95730358
				PVDF	FKM / EPDM	95730359
					PTFE	95730360
		Without	Threaded 1/4" NPT	Stainless steel	PTFE	95730710

T-pieces

Technical data

Type	Description	Connections			Material		Material number
		Bottom	Top	Side	Housing and connections	Gaskets	
 TM04 8304 0411	Three male threads G 5/8	For tubing 0.17"x1/4", 1/4"x3/8", 3/8"x1/2"			PP	FKM / EPDM	95730392
					PVC	FKM / EPDM	95730393
						PTFE	95730394
					PVDF	FKM / EPDM	95730395
						PTFE	95730396
		-	Without	-	PP	FKM / EPDM	95730346
					PVC	FKM / EPDM	95730347
						PTFE	95730348
					PVDF	FKM / EPDM	95730349
						PTFE	95730350
 TM04 8305 0411	Two male threads G 5/8, one female connection with union nut	Union nut G 5/8	Without	For tubing 0.17"x1/4", 1/4"x3/8", 3/8"x1/2"	PP	FKM / EPDM	95730402
					PVC	FKM / EPDM	95730403
						PTFE	95730404
					PVDF	FKM / EPDM	95730405
						PTFE	95730406
				Without	PP	FKM / EPDM	95730351
					PVC	FKM / EPDM	95730352
						PTFE	95730353
					PVDF	FKM / EPDM	95730354
						PTFE	95730355

Dosing tanks

Square tank, 100 liters

The closed, square tank has a screw cap and a mounting platform for one pump or two pumps in parallel.

The pump mounting platform is higher than the screw cap to protect pumps and connections when filling chemicals into the tank.

- Tank material: MDPE
- Weight: 15 kg
- Wall thickness: 4 mm
- Liquid temperature: -4 °F (-20 °C) to 113 °F (45 °C).

SMART Digital pumps can be fitted directly on the mounting platform by means of brass inserts moulded into the platform.

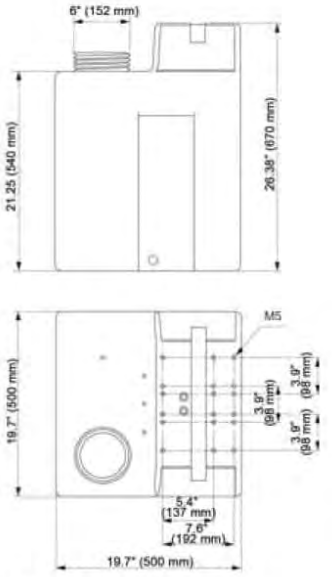
The square tank is prepared for a G 3/4 drain valve.

When using a rigid suction line in the tank, choose the counter nut for fixing (see page 41).

TM04 8307 0411

Fig. 46 Square tank

Dimensions



TM04 8308_US 0113

Fig. 47 Square tank, dimensions

Order data

Tank volume [l]	Material number
26 gal. (100L)	96489271

Cylindrical tanks

Cylindrical tanks are available transparent or black. They have a liter scale and a black screw cap.

- Tank material: LLDPE, UV-stabilized
- Liquid temperature: -4 °F (-20 °C) to 113 °F (45 °C).

All cylindrical tanks are prepared for a G 3/4 opening for a drain valve, and have a screw plug (PE/EPDM).

The cylindrical tanks with volumes of 60, 100, 200, 300 and 500 liters include additionally:

- Threaded M 6 inserts for the assembly of a SMART Digital, a DDI, or a DMX model 221 dosing pump
- A G 2 opening for a suction lance or a foot valve, closed with a screw plug
- A flange for an electric mixer with threaded inserts
- Threaded M 6 inserts at the bottom part for floor mounting with a set of floor-mounting brackets (see page 53).

TM04 8468 0412

Fig. 48 Cylindrical tank, 60L (16 gal.)

Technical data

Tank volume Gal. [L]	Type	Material	Weight [lbs.]	Material Number
15 [60L]	Cylindrical	PE	12.2	98148805
26 [100L]			16.5	98149057
53 [200L]			25.4	98149215
79 [300L]			28.7	98149245
132 [500L]			61.7	98149266
264 [1000L]			88.2	96688086

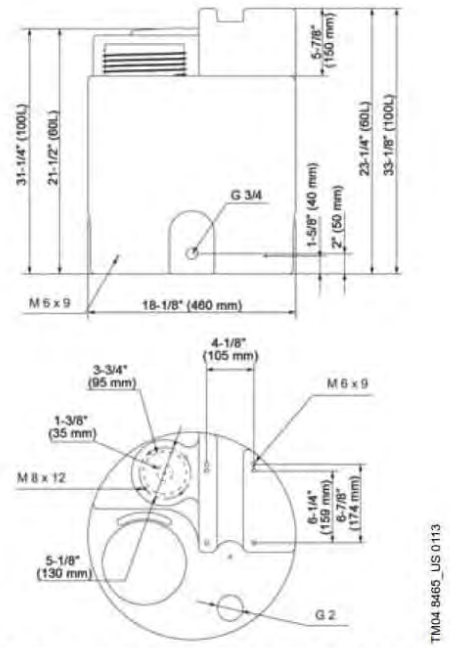


Fig. 49 Cylindrical tank, 15 gal. [60L] and 26 gal. [98L]

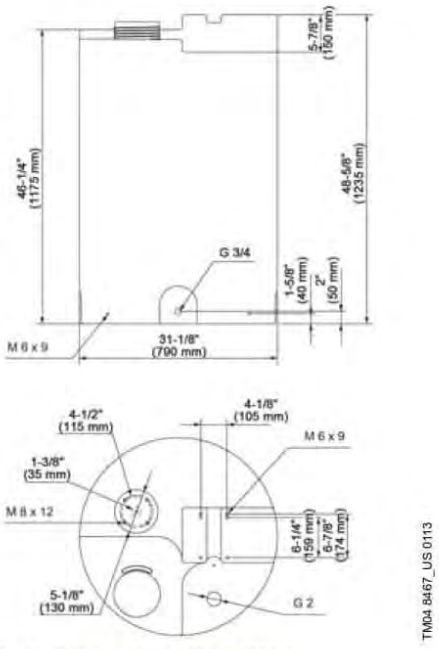


Fig. 51 Cylindrical tank, 132 gal. [500L]

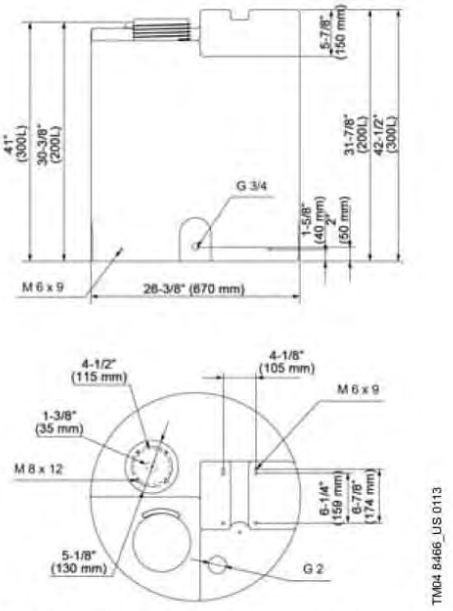


Fig. 50 Cylindrical tank, 53 gal. [200L] and 79 gal. [300L]

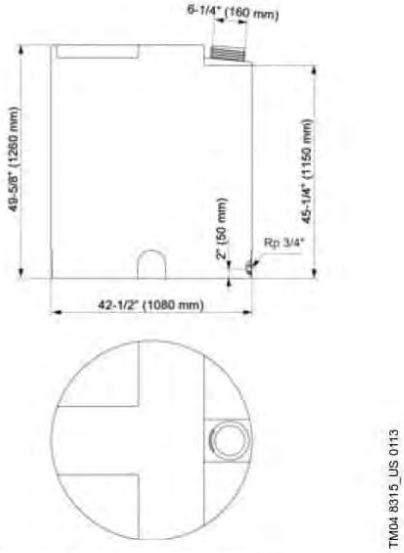
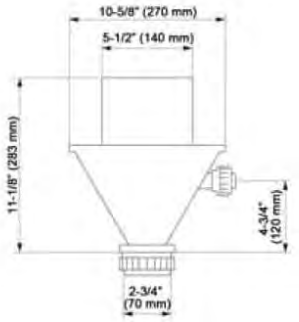


Fig. 52 Cylindrical tank, 264 gal. [1000L]

Accessories for dosing tanks



TM04 8318_US 0113

Fig. 53 Dissolving hopper, dimensions

TM04 8477 0512

Fig. 54 Handheld mixer

Technical data

Description	Specifications	Material	Material number
Drain valve for installation in the threaded sleeve of the dosing tank	Dosing tank connection G 3/4	PVC	96689132
Ventilation valve	Spring-loaded, opening pressure 0.05 bar	PVC / FKM / glass	96694401
Dissolving hopper for washing powders into the dosing tank	Dosing tank connection: DN 40 through-bolt; water connection: G 5/4, with union nut and inlay for PVC pipe (cementing diameter 25 mm)	PVC	96726979
Handheld mixer for use in dosing tanks	Shaft length 1200 mm, length can be adapted to the corresponding dosing tank, with DN-15 through bolt for connection at the dosing tank	PE	98133793
Set of floor-mounting brackets	4 floor-mounting brackets with fixing screws		98149921
Set of screws for mounting a pump on a 100-liter square tank	for pump types DDA, DDC, DDE	Stainless steel	95730862
Set of screws for mounting a pump on a 60-, 100-, 200-, 300-, or a 500-liter cylindrical tank	for pump types DDA, DDC, DDE, DDI, DMX model 221	Stainless steel	98159495
Set of screws for mounting a pump on a 40-liter or a 1000-liter cylindrical tank	for pump types DDA, DDC, DDE, DDI, DMX model 221	PP	95730864

9. Pumped liquids

The resistance table below is intended as a general guide for material resistance (at room temperature), and does not replace testing of the chemicals and pump materials under specific working conditions.

The data shown are based on information from various sources available, but many factors (purity, temperature, abrasive particles, etc.) may affect the chemical resistance of a given material.

Note: Some of the liquids in this table may be toxic, corrosive or hazardous.

Note: Please be careful when handling these liquids.

Pumped liquid (20 °C)			Material								
			Dosing head				Gasket			Ball	Acc.
Description	Chemical formula	Concentration %	PP	PVDF	SS 1.4401	PVC	FKM	EPDM	PTFE	Ceramic	PE
Acetic acid	CH_3COOH	25	•	•	•	•	–	•	•	•	•
		60	•	•	•	•	–	•	•	•	•
		85	•	•	❍	–	–	–	•	•	–
Aluminium chloride	$AlCl_3$	40	•	•	–	•	•	•	•	•	•
Aluminium sulphate	$Al_2(SO_4)_3$	60	•	•	•	•	•	•	•	•	•
Ammonia, aqueous	NH_4OH	28	•	•	•	•	–	•	•	•	•
Calcium hydroxide ★7	$Ca(OH)_2$		•	•	•	•	•	•	•	•	•
Calcium hypochlorite	$Ca(OCl)_2$	20	❍	•	–	•	•	•	•	•	•
Chromic acid	H_2CrO_4	10	•	•	•	•	•	•	•	•	•
		30	–	•	–	•	•	❍	•	•	•
		50	–	•	–	•	•	–	•	•	•
Copper sulphate	$CuSO_4$	30	•	•	•	•	•	•	•	•	•
Ferric chloride ★3	$FeCl_3$	100	•	•	–	•	•	•	•	•	•
Ferric sulphate ★3	$Fe_2(SO_4)_3$	100	•	•	❍	•	•	•	•	•	•
Ferrous chloride	$FeCl_2$	100	•	•	–	•	•	•	•	•	•
Ferrous sulphate	$FeSO_4$	50	•	•	•	•	•	•	•	•	•
Fluosilicic acid	H_2SiF_6	40	•	•	❍	•	–	❍	•	•	•
Hydrochloric acid	HCl	< 25	•	•	–	•	•	•	•	•	•
		25-37	•	•	–	•	•	❍	•	•	•
Hydrogen peroxide	H_2O_2	30	•	•	•	•	•	•	•	•	•
Nitric acid	HNO_3	30	•	•	•	•	•	•	•	•	•
		40	❍	•	•	•	•	–	•	•	•
		70	–	•	•	–	•	–	•	•	❍
Peracetic acid	CH_3COOOH	5-15	❍	•	❍	❍	–	❍	•	•	❍
Potassium hydroxide	KOH	50	•	–	•	•	–	•	•	•	•
Potassium permanganate	$KMnO_4$	10	•	•	•	•	❍	•	•	•	•
Sodium chlorate	$NaClO_3$	30	•	•	•	•	•	•	•	•	•
Sodium chloride	NaCl	30	•	•	–	•	•	•	•	•	•
Sodium chlorite	$NaClO_2$	20	•	•	–	❍	•	•	•	•	•
Sodium hydroxide	NaOH	30	•	•	•	•	❍	•	•	•	•
		50	•	•	•	•	–	•	•	•	•
Sodium hypochlorite	NaOCl	12-15	–	•	–	•	•	•	•	•	•
Sodium sulphide	Na_2S	30	•	•	•	•	•	•	•	•	•
Sodium sulphite	Na_2SO_3	20	•	•	•	•	•	•	•	•	•
Sodium thiosulfate	$Na_2S_2O_3$	10	•	•	•	•	•	•	•	•	•
Sulphurous acid	H_2SO_3	6	•	•	•	•	•	•	•	•	•
Sulphuric acid ★4	H_2SO_4	< 80	•	•	–	•	•	❍	•	•	•
		80-96	❍	•	–	•	•	–	•	•	–
		98	–	•	•	–	❍	–	•	•	–

• Resistant

❍ Limited resistance

– Not resistant

★3 Risk of crystallization.

★4 Reacts violently with water and generates much heat. (Pump should be absolutely dry before dosing sulfuric acid.)

★7 Once the pump is stopped, calcium hydroxide will sediment rapidly.

For further information, see "Pumped liquid guide".

10. Further product information

WebCAPS

WebCAPS is a **Web**-based **C**omputer **A**ided **P**roduct **S**election program available on www.grundfos.us.

WebCAPS contains detailed information on more than 220,000 Grundfos products in more than 30 languages.

Information in WebCAPS is divided into six sections:

- catalog
- literature
- service
- sizing
- replacement
- cad drawings.

Catalog

Based on fields of application and pump types, this section contains the following:

- technical data
- curves (QH, Eff, P1, P2, etc.) which can be adapted to the density and viscosity of the pumped liquid and show the number of pumps in operation
- product photos
- dimensional drawings
- wiring diagrams
- quotation texts, etc.

Literature

This section contains all the latest documents of a given pump, such as

- data booklets
- installation and operating instructions
- service documentation, such as service kit catalog and service kit instructions
- quick guides
- product brochures.

Service

This section contains an easy-to-use interactive service catalog. Here you can find and identify service parts of both existing and discontinued Grundfos pumps.
Furthermore, the section contains service videos showing you how to replace service parts.

Sizing

This section is based on different fields of application and installation examples and gives easy step-by-step instructions in how to size a product:

- Select the most suitable and efficient pump for your installation.
- Carry out advanced calculations based on energy, consumption, payback periods, load profiles, life cycle costs, etc.
- Analyze your selected pump via the built-in life cycle cost tool.
- Determine the flow velocity in wastewater applications, etc.

Replacement

In this section you find a guide to selecting and comparing replacement data of an installed pump in order to replace the pump with a more efficient Grundfos pump.
The section contains replacement data of a wide range of pumps produced by other manufacturers than Grundfos.

Based on an easy step-by-step guide, you can compare Grundfos pumps with the one you have installed on your site. When you have specified the installed pump, the guide will suggest a number of Grundfos pumps which can improve both comfort and efficiency.

CAD drawings

In this section, it is possible to download 2-dimensional (2D) and 3-dimensional (3D) CAD drawings of most Grundfos pumps.

These formats are available in WebCAPS:

2-dimensional drawings:

- .dxf, wireframe drawings
- .dwg, wireframe drawings.

3-dimensional drawings:

- .dwg, wireframe drawings (without surfaces)
- .stp, solid drawings (with surfaces)
- .eprt, E-drawings.

WinCAPS

Fig. 55 WinCAPS DVD

WinCAPS is a **Win**dows-based **C**omputer **A**ided **P**roduct **S**election program containing detailed information on more than 220,000 Grundfos products in more than 30 languages.

The program contains the same features and functions as WebCAPS, but is an ideal solution if no internet connection is available.

WinCAPS is available on DVD and updated once a year.

Grundfos GO

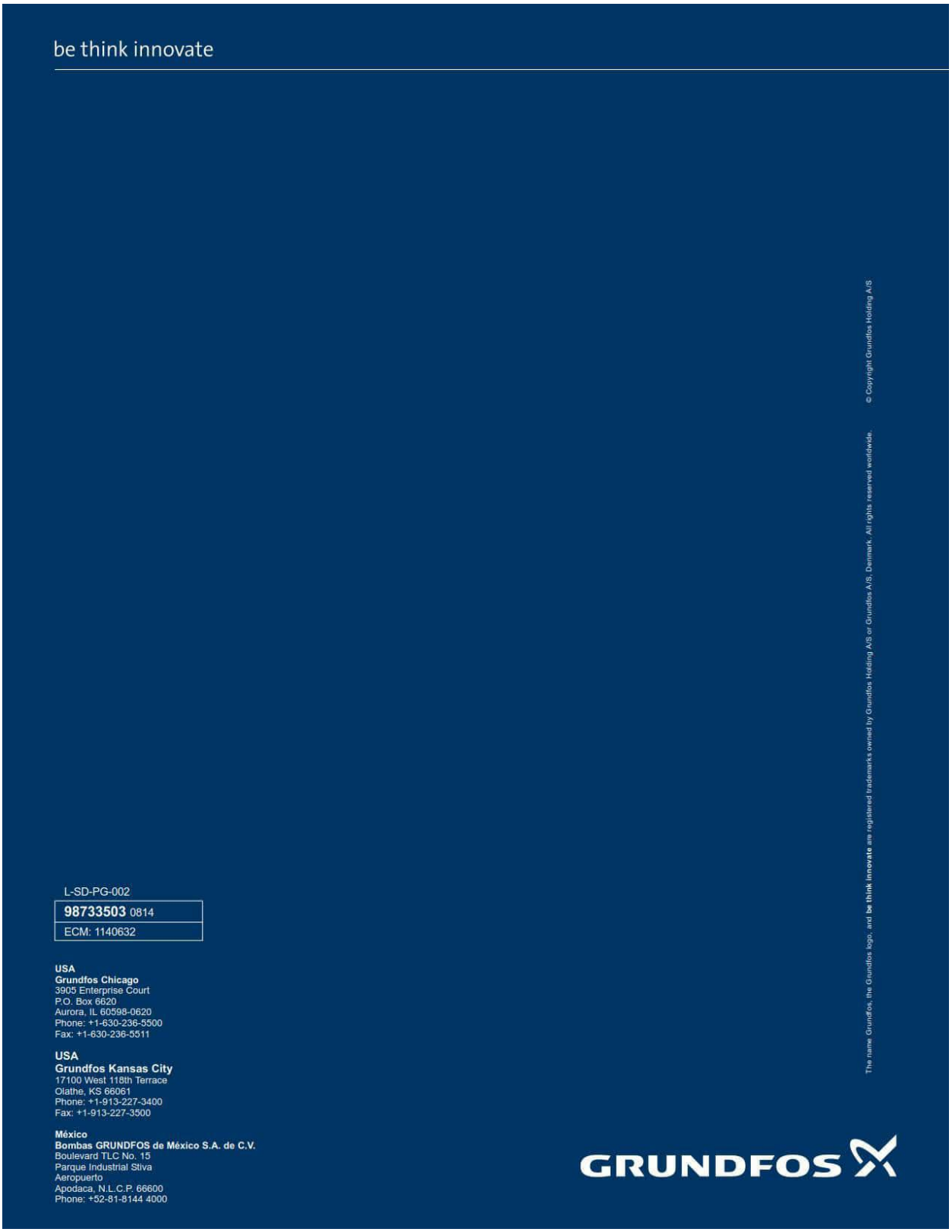
Mobile solution for professionals on the GO!

Grundfos GO is the mobile tool box for professional users on the go. It is the most comprehensive platform for mobile pump control and pump selection including sizing, replacement and documentation. It offers intuitive, handheld assistance and access to Grundfos online tools, and it saves valuable time for reporting and data collection.

GET IT ON Google play

Available on the App Store

Subject to alterations.


be think innovate
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GRUNDFOS

11232.2.5 TANK PUMP

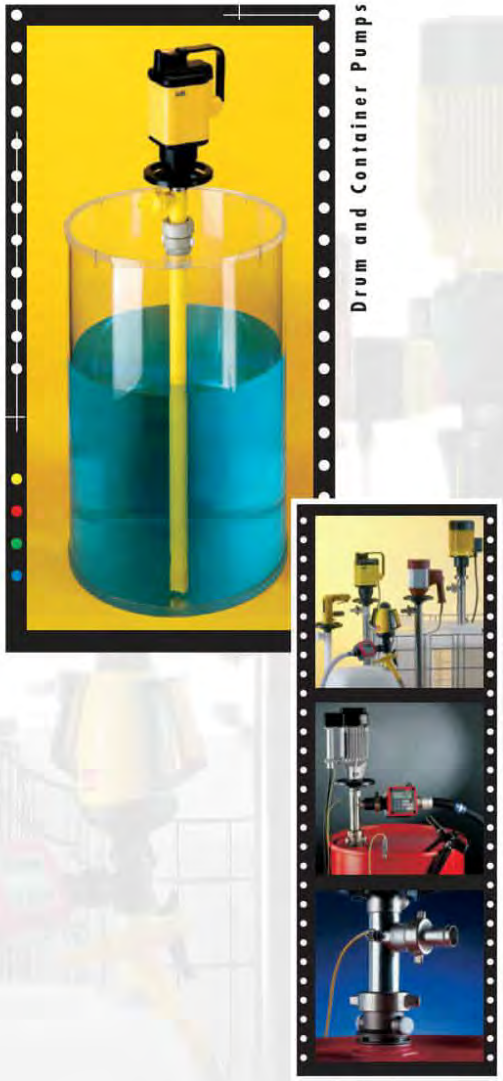
Tank Pump shall be Lutz Pump with Lutz Drum Part No. 0110-202 or Equivalent

Lutz®
The Fluid Managers

Electrical/Pneumatic

Drum and Container Pumps

The ultimate professional solution to all your transfer needs



With Lutz through thick and thin

From the bucket to the pump

Transferring corrosive, flammable or toxic liquids presents its own challenges to personal safety and the environment.
At Lutz, we believe you will be able to find your optimum solution among the range of products which have been developed specifically to overcome the dangers and disadvantages of decanting such liquids.

1954
The company is founded by Karl Lutz.

1963
Explosion-proof motor for drum pumps, approved by the PTB*, Braunschweig.

1972
The product innovation – a sealless pump unit introduced.

1986
First UL approved explosion proof motor B 40-UL, class I - groups C + D, Class II - groups F + G introduced for the US market

1988
The first drum pump worldwide for complete drainage.

1988
The new B 55-T generation of motors: TEFC standards that are state of the art even today.

1990
Fume barrier for enhanced safety and health protection at the work place.

1990
The first compressed air motor worldwide in a flameproof enclosure with an explosion-protection classification of Ex d IIC T6.

1993
Modular flow meter system for efficiency and accurate measurement.

1996
Lutz introduces IBC Pumps in lengths up to 78" for safe transfer.

1997
The new generation of explosion proof state of the art Silver Star ME I 6 motor introduced for the US and Canadian markets.

2001
Complete pump sets provide enhanced service and a high degree of customer-friendliness.

2004
Flow meter system HDO for thin bodied to highly viscous liquids.

2007
Lutz B2 Vario pump for the laboratory and research sector.

2011
Battery powered laboratory pump Lutz B1 for convenient and safe transfer of small liquid amounts.

(*The Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, is the National Institute of natural and engineering sciences and the highest technical authority for metrology and physical safety engineering in the Federal Republic of Germany)

Lutz Drum Pumps today

The Principle with so many useful Variations.

The wide variety of fluids and container types/ dimensions necessitates an extensive range of different drum pump models. Depending on the requirement, they are available in a variety of materials, equipped with motors adapted to the output requirement for differing voltages as well as pneumatically operated, with the required delivery rate and suitable sealing system. Added to this are pump tubes in varying lengths and a wide range of accessories permitting, for example, adaptation to problem containers or application conditions.

3

Lutz Drum Pump Motors

Power which is convincing.

B 28

Universal motor

Power:	800 watt/1.07 HP
Voltage:	120 volt
Frequency:	60 Hz
Enclosure:	open drip proof 16' cord and plug

B 36 / MI 4 or
B 36-SC/MI 4 E (speed control)

Universal motor

Power:	640 watt/0.85 HP
Voltage:	120 volt (230 V available)
Frequency:	60 Hz
Enclosure:	open drip proof 16' cord and plug

B 55-T-5/ MA II 5*)
B 55-T-7/MA II 7)**

Universal motor

Power:	*) 510 watt/0.68 HP **) 700 watt/0.93 HP
Voltage:	120 volt (230 V available)
Frequency:	60 Hz
Enclosure:	TEFC 16' cord and plug

MD-1 MD-2

MD-1 (Ex)/ MD-2 (Ex)

Compressed air motor
(EN 50 014)

Power:	400 watt/0.54 HP
Operating Pressure:	87 PSI
Air consumption:	32 CFM

4GT (Non-Ex)

Compressed air motor

Power:	220 watt/0.3 HP
Operating Pressure:	87 PSI
Air consumption:	14 CFM

SILVER STAR
ME I 6 (Ex)

Universal motor

Power:	0.5 HP
Voltage:	120 volt
Frequency:	60 Hz
Enclosure:	Explosion proof Class I Groups C + D Class II Groups F + G

Variable speed control, 16' cord

MA II 3-12 V

Universal motor

Power:	260 watt/0.35 HP
Voltage:	12 volt DC
Enclosure:	TEFC 10' cord with alligator clamps

B 4/GT
Continuous Duty

Three phase gear motor

Power:	750 watt/1.0 HP
Voltage:	230/440 volt
Frequency:	60 Hz
Enclosure:	TEFC

4

Lutz Pump Tubes

All Lutz Motors are interchangeable with all Lutz Pump Tubes.

Multi-purpose Pump Tubes – Mechanical Seal (MMS) or Sealless (MSL)

Motors and pump tubes are purchased separately

5

Technical Data

Lutz
The Fluid Managers




Pump tubes			MMS-PP MSL-PP 41-R SS/HC	MMS-PP MSL-PP 41-L SS/HC	MMS-PVDF MSL-PVDF 41-R HC	MMS-PVDF MSL-PVDF 41-L HC	MMS-ALU MSL-ALU 41-R	MMS-ALU MSL-ALU 41-L	MMS-SS MSL-SS 41-R	MMS-SS MSL-SS 41-L
Mechanical Seal (MS) Sealless (SL)			MS / SL	MS / SL	MS / SL	MS / SL	MS / SL	MS / SL	MS / SL	MS / SL
Max. Temperature			122 °F	122 °F	212 °F	212 °F	212 °F	212 °F	212 °F	212 °F
Type of impeller			Rotor	Impeller	Rotor	Impeller	Rotor	Impeller	Rotor	Impeller
Zone 0			No	No	No	No	No	No	Yes	Yes
 B 28	Quantity*	Up to GPM	48	24	48	24	48	24	54	28.5
	Delivery head*	Up to FT	33	69	33	69	33	69	40	66
	Viscosity**	Up to cps	400/600	1000/1200	400/600	1000/1200	400/600	1000/1200	600/1000	1000/1200
	Spec. gravity***	Up to	1.5	2.0	1.5	2.0	1.5	2.0	1.5	2.0
	Weight lbs.	Motor + pump tube	9.7	9.7	10.8	10.8	10.4	10.4	13.5	13.5
 B 36 / MI 4	Quantity*	Up to GPM	45	23	45	23	45	23	54.5	29
	Delivery head*	Up to FT	31	69	31	69	31	69	36	68.5
	Viscosity**	Up to cps	300/600	500/900	300/600	500/900	300/600	500/900	300/900	500/1100
	Spec. gravity***	Up to	1.1	1.4	1.1	1.4	1.1	1.4	1.1	1.4
	Weight lbs.	Motor + pump tube	7.4	7.4	9.9	9.9	9.5	9.5	12.6	12.6
 MA II 5-120 B 55-T-5	Quantity*	Up to GPM	42	21	42	21	42	21	48	25
	Delivery head*	Up to FT	26	56	26	56	26	56	31	52.5
	Viscosity**	Up to cps	100/500	600/1000	100/500	600/1000	100/500	600/1000	100/600	400/1000
	Spec. gravity***	Up to	1.2	1.6	1.2	1.6	1.2	1.6	1.2	1.6
	Weight lbs.	Motor + pump tube	14.5	14.5	15.6	15.6	15.2	15.2	18.3	18.3
 MD-1/MD-2	Quantity*	Up to GPM	48	23	48	23	48	23	53	26
	Delivery head*	Up to FT	33	69	33	69	33	69	33	42.5
	Viscosity**	Up to cps	850/850	1100/1100	850/850	1100/1100	850/850	1100/1100	850/850	1100/1100
	Spec. gravity***	Up to	1.2	1.6	1.2	1.6	1.2	1.6	1.2	1.6
	Weight lbs.	Motor + pump tube	5.9	5.9	7	7	6.6	6.6	9.7	9.7
 4 GT	Quantity*	Up to GPM	32	18	32	18	32	18	41.5	22.5
	Delivery head*	Up to FT	20	36	20	36	20	36	24.5	43
	Viscosity**	Up to cps	400/400	900/900	400/400	900/900	400/400	900/900	300/300	600/600
	Spec. gravity***	Up to	1.2	1.6	1.2	1.6	1.3	1.6	1.2	1.6
	Weight lbs.	Motor + pump tube	4.9	4.9	6	6	5.6	5.6	8.7	8.7
 ME I 6	Quantity*	Up to GPM	×	×	×	×	×	×	48.5	27
	Delivery head*	Up to FT	×	×	×	×	×	×	33	54
	Viscosity**	Up to cps	×	×	×	×	×	×	300/500	600/750
	Spec. gravity***	Up to	×	×	×	×	×	×	1.3	1.7
	Weight lbs.	Motor + pump tube	×	×	×	×	×	×	20.7	20.7
 MA 3-12V	Quantity*	Up to GPM	24	12	24	12	24	12	39.5	22
	Delivery head*	Up to FT	12	24	12	24	12	24	19.5	33
	Viscosity**	Up to cps	1/100	1/100	1/100	1/100	1/100	1/100	1/100	1/100
	Spec. gravity***	Up to	1.2	1.8	1.2	1.8	1.2	1.8	1.2	1.6
	Weight lbs.	Motor + pump tube	12.8	12.8	13.9	13.9	13.5	13.5	16.6	16.6

*Determined with water at 68 °F.

** Determined with oil. Continuous/ intermittent duty (10 min.)

***Determined with 10 feet 3/4" hose and open discharge. Higher densities possible for shorter operating periods.

× Not a suggested combination

6






Technical Data

Lutz The Fluid Managers

SL-HC 42-R	SL-HC 42-L	RE 88 PP 40-L	RE 88 SS MP SL-PP 41-L	MP MS-PP 50/41-L	MP MS-SS 41-R	B70V-SR 25.1 PTFE	B70V-SR 25.1 PTFE	Pump tubes	
SL	SL	MS	MS	MS	MS	Packed Gland	MS	**Mechanical Seal (MS) Sealless (SL)**	
248 °F	248 °F	122 °F	212 °F	122 °F	212 °F	284 °F	284 °F	**Max. Temperature**	
Rotor	Impeller	Impeller	Impeller	Impeller	Rotor	****	****	**Type of impeller**	
Yes	Yes	No	Yes	No	Yes	No	Yes	**Zone 0**	
54	28.5	17.5	20	24	49	▲	▲	Quantity*Up to GPM	 B 28
40	66	43	56	69	36	▲	▲	Delivery head* Up to FT	
600/1000	1000/1200	1300/1500	1000/1400	1000/1200	300/600	25,000	25,000	Viscosity** Up to cps	
1.5	2.0	2.1	2.0	2.0	1.5	*	*	Spec. gravity*** Up to	
16.7	16.7	10	15	10	14.3	26.0	26.0	Weight lbs.	
54.5	29	16	20	23	51	▲	▲	Quantity*Up to GPM	 B 36 / MI 4
36	68.5	42.5	62	69	29.5	▲	▲	Delivery head* Up to FT	
300/900	500/1100	1200/1400	500/1000	500/900	100/300	20,000	20,000	Viscosity** Up to cps	
1.1	1.4	1.9	1.4	1.4	1.1	*	*	Spec. gravity*** Up to	
15.9	15.9	9.1	14.1	9.1	13.5	23.5	23.5	Weight lbs.	
48	25	15	16	21	45	▲	▲	Quantity*Up to GPM	 MA II 5-120 B 55-T-5
31	52.5	36	46	56	28	▲	▲	Delivery head* Up to FT	
100/600	400/1000	1000/1200	400/800	600/1000	100/200	20,000	20,000	Viscosity** Up to cps	
1.2	1.6	1.7	1.6	1.6	1.2	*	*	Spec. gravity*** Up to	
21.6	21.6	14.8	19.8	14.8	19.2	29.0	29.0	Weight lbs.	
53	26	16	18	23	52	▲	▲	Quantity*Up to GPM	 MD-1/MD-2
33	42.5	36	43	69	33	▲	▲	Delivery head* Up to FT	
850/850	1100/1100	1600/1600	1200/1200	1100/1100	400/400	50,000	50,000	Viscosity** Up to cps	
1.2	1.6	1.7	1.5	1.6	1.2	*	*	Spec. gravity*** Up to	
13	13	6.2	11.2	6.2	10.6	20.5	20.5	Weight lbs.	
41.5	22.5	12	12	18	36	–	–	Quantity*Up to GPM	 4 GT
24.5	43	26	31.5	36	20.5	–	–	Delivery head* Up to FT	
300/300	600/600	500/500	500/500	900/900	300/300	–	–	Viscosity** Up to cps	
1.2	1.6	1.7	1.5	1.6	1.2	–	–	Spec. gravity*** Up to	
12	12	5.2	10.2	5.2	9.6	–	–	Weight lbs.	
48.5	27	×	18.5	×	47	▲	▲	Quantity*Up to GPM	 ME I 6
33	54	×	49	×	38	▲	▲	Delivery head* Up to FT	
300/500	600/750	×	600/800	×	100/300	20,000	20,000	Viscosity** Up to cps	
1.3	1.7	×	1.7	×	1.3	*	*	Spec. gravity*** Up to	
24	24	×	22.2	×	21.6	31.7	31.7	Weight lbs.	
39.5	39.5	12.5	14	12	37	–	–	Quantity*Up to GPM	 MA 3-12V
19.5	33	16.5	23	24	16.5	–	–	Delivery head* Up to FT	
1/100	1/100	1/100	1/100	1/100	1/100	–	–	Viscosity** Up to cps	
1.2	1.6	1.6	1.2	1.8	1.2	–	–	Spec. gravity*** Up to	
19.9	19.9	13.1	18.1	13.1	17.5	–	–	Weight lbs.	

**** SS Rotor with PTFE Stator ▲ Consult Lutz Pumps × Not a suggested combination

7

The Multipurpose Solution

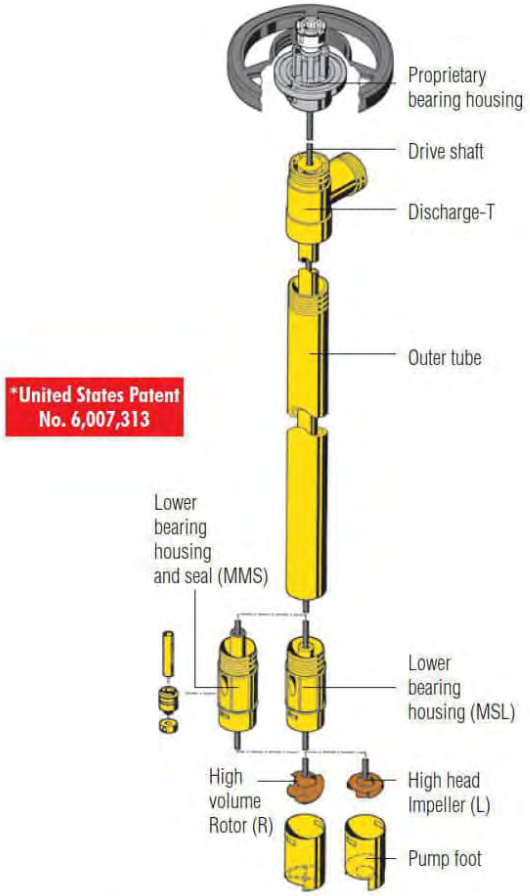
4 Options – One pump tube

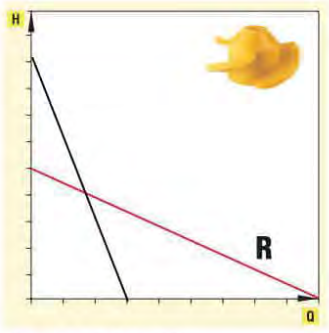
- Mech. Seal (MS)
- Seal Less (SL)
- High volume Rotor (R)
- High head Impeller (L)

50 Years of Experience ...
This brilliant design, from the top bearing housing to the discharge-T and pump tube will assure you the highest chemical resistance and minimal wear – extended service life.

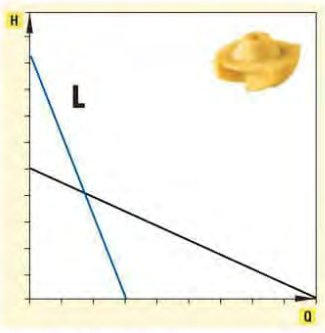
High Quality – For You
Our metal proprietary bearing housing enhances the heat dissipation of the bearing friction. The exceptionally corrosion-resistant coating ensure extended life. Due to wall thickness, the outer tube is extremely rigid. The drive shaft for PVDF and PP are in Hast. C with stainless as an option.

Maintenance made simple
Money and downtime reduced! The lower bearing housing with mech. seal (MS) or the sealless (SL) are easily replaced if repair or conversions are needed. That goes for changing the rotor or impeller too. The robust snap on/off pump foot is even easier to replace.





High volume Rotor (R)



High head Impeller (L)

Lutz Polypropylene Pump Tube

For a wide range of acids and alkalis

Sealless (MSL) or with Mechanical Seal (MMS)

Applications
The robust Lutz pump tube with mechanical seal or sealless is suitable for pumping clean and dirty, thin-bodied and slightly viscous, aggressive and non-aggressive liquids out of drums and small or large containers.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Structure and function (MMS-PP)
Lutz pump tubes are immersible centrifugal pumps. The drive shaft of this pump tube is sealed by a single-acting mechanical seal (MS). The patented mechanical seal is integral with the lower bearing housing. This position guarantees the best operating conditions and ensures the long service life of the mechanical seal.

The pump must not be allowed to run dry.

Structure and function (MSL-PP)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is not sealed. The bearing housing unit above the impeller is designed to prevent pumped liquid from rising between the shaft and the inner tube. This device guides the liquid which penetrates between the drive shaft and the shaft bearing back into the container being drained.

Length:
MMS/MSL: 27", 39", 47"
MSL only: 55", 59", 63", 67", 78"

Special length on request.

Warning:
The drum and container pump **must not** be used for flammable liquids.

Note:
Axial-flow rotor for high delivery rate and low delivery head. Radial-flow impeller for low delivery rate and high delivery head.

Type	MMS-PP (Mechanical Seal)	MSL-PP (Sealless)
Wetted parts		
Housing:	Polypropylene	Polypropylene
Mechanical seal:	Carbon, SiC, Viton®, HC-4 (2.4610)	None
Bearings:	ETFE/PTFE	ETFE/PTFE
Drive shaft:	Stainless Steel (316 Ti) HC-4 (2.4610) on request	HC-4 (2.4610) Stainless Steel (316 Ti)
Examples of liquids:	Acids, Alkalis, Vegetable Oils, Liquids, Phosphates, Sulphates, Nitrates, Chlorates, Paints and Inks, Water, Sulphites	Acids, Alkalis, Galvanic Fluids, Phosphates, Sulphates, Nitrates, Chlorates, Paints and Inks, Water, Oils, Sulphites
Type of impeller:	axial-flow rotor (R) or radial-flow impeller (L) Material: PP	axial-flow rotor (R) or radial-flow impeller (L) Material: PP

For performance information see page 6 & 7

Viton® is a registered Trademark of DuPont Dow Elastomers.

Picture shows:
Pump tube with motor B 36 / MI 4

Lutz PVDF Pump Tube

For concentrated liquids

Picture shows:
Pump tube with motor B 55 T / MA II 5

Sealless (MSL) or with Mechanical Seal (MMS)

Applications
The robust Lutz pump tube with mechanical seal or sealless is suitable for pumping clean and dirty, thin-bodied and slightly viscous, aggressive and non-aggressive liquids out of drums and small or large containers.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Structure and function (MMS-PVDF)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is sealed by a single-acting mechanical seal (MS). The patented mechanical seal is integral with the lower bearing housing. This position guarantees the best operating conditions and ensures the long service life of the mechanical seal.
The pump must not be allowed to run dry.

Structure and function (MSL-PVDF)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is not sealed. The bearing housing unit above the impeller is designed to prevent pumped liquid from rising between the shaft and the inner tube. This device guides the liquid which penetrates between the drive shaft and the shaft bearing back into the container being drained.

Length:
27", 39", 47"
Special length on request.

Warning:
The drum and container pump **must not** be used for flammable liquids.

Note:
Axial-flow rotor for high delivery rate and low delivery head. Radial-flow impeller for low delivery rate and high delivery head.

Type	MMS-PVDF (Mechanical Seal)	MSL-PVDF (Sealless)
Wetted parts		
Housing:	PVDF	PVDF
Mechanical seal:	Carbon, SiC, Viton®, HC-4 (2.4610)	None
Bearings:	PTFE	PTFE
Drive shaft:	HC-4 (2.4610)	HC-4 (2.4610)
Examples of liquids:	Highly concentrated Acids and Alkalis, Ethyl Chloride, Chloroform, Chromic Acid, Phosphoric Acid 95%, Perchloric Acid, Sulphuric Acid, Chlorine Water etc.	Highly concentrated Acids and Alkalis, Bromic Acid, Hydrobromic Acid, Chloroform, Dimethyl Phthalate, Hydrofluoric Acid, Potassium Bromate, Sodium Perchlorate, Phosphoric Acid 95%, Nitric Acid etc.
Type of impeller:	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE

Lutz Aluminum Pump Tube

For neutral liquids

Sealless (MSL) or with Mechanical Seal (MMS)

Applications
The robust Lutz pump tube with mechanical seal or sealless is so designed that it can run dry; it is suitable for pumping non-aggressive, clean, thin-bodied and slightly viscous liquids out of drums and small or large containers.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Structure and function (MMS-ALU)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is sealed by a single-acting mechanical seal (MS) and two shaft seals located behind it, making a robust sealing system.
The pump must not be allowed to run dry.

Structure and function (MSL-ALU)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is not sealed. The bearing housing unit above the impeller is designed to prevent pumped liquid from rising between the shaft and the inner tube. This device guides the liquid which penetrates between the drive shaft and the shaft bearing back into the container being drained.

Length:
27", 39", 47"
Special length on request.

Warning:
The drum and container pump **must not** be used for flammable liquids.

Note:
Axial-flow rotor for high delivery rate and low delivery head. Radial-flow impeller for low delivery rate and high delivery head.

Type	MMS-ALU (Mechanical Seal)	MSL-ALU (Sealless)
Wetted parts		
Housing:	ALU, PVDF	Alu, PVDF
Seals:	Viton®	None
Mechanical seal:	Carbon, SiC, Viton®, Stainless Steel	None
Bearings:	PTFE	PTFE
Drive shaft:	Stainless Steel (316 Ti)	Stainless Steel (316 Ti)
Examples of liquids:	Thin-bodied and slightly viscous Mineral Oils, contaminated Oils, Cooling Lubricants, Vegetable Oils, Butylene Glycol, Diesel Fuel, Chlorodiphenyl, Fuel Oil, Ethereal Oils etc.	Thin-bodied and medium viscous Mineral Oils, Butylene Glycol, Diesel Fuel, Fuel Oil, Crude Oil, Phenol, Glycerine, Fatty Acid, Ethereal Oils, Linseed Oil, Paraffin Oil etc.
Type of impeller:	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE

Picture shows:
Pump tube with motor B 55 T / MA II 5

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Lutz Stainless Steel Pump Tube

For flammable and aggressive liquids

Picture shows:
Pump tube with motor Silver Star ME I 6

Sealless (MSL) or with Mechanical Seal (MMS)

Applications
The robust Lutz pump tube with mechanical seal or sealless is suitable for pumping clean and dirty, thin-bodied and slightly viscous, aggressive and non-aggressive, flammable and non-flammable liquids out of drums and small or large containers.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Structure and function (MMS-SS)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump tube is sealed by a single-acting mechanical seal (MS) and two shaft seals located behind it, making a robust sealing system. The pump tube must not be allowed to run dry.

Structure and function (MSL-SS)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump is not sealed. The bearing housing insert above the impeller is designed to prevent the pumped liquid from rising between the shaft and the inner tube. This insert guides the liquid which penetrates between the drive shaft and the shaft bearing back into the container being drained.

Length:
MMS/MSL: 27", 39", 47"
MSL only: 55", 59", 63", 67", 78"
Special length on request.

Ex

The pump tube is "Zone 0" approved in combination with the original Lutz motors Silver Star / MD-1 / MD-2 in accordance with standards for use in hazardous locations.

Note:
Axial-flow rotor for high delivery rate and low delivery head. Radial-flow impeller for low delivery rate and high delivery head.

For correct bonding and grounding see page 13.

Type	MMS-SS (Mechanical Seal)	MSL-SS (Sealless)
Wetted parts		
Housing:	Stainless Steel (316 Ti)	Stainless Steel (316 Ti)
Seals:	Viton®	None
Mechanical seal:	Carbon, Ceramic, Viton®, Stainless Steel (316 Ti)	None
Bearings:	Carbon	Carbon
Drive shaft:	Stainless Steel (316 Ti)	Stainless Steel (316 Ti)
Examples of liquids:	Gasoline, thin-bodied Oils, Solvents, Chlorine Carbon Hydrogens, Alcohols, Amines, Benzoles, Phenoles, Toluol, Xylol, Fruit Juices, Paints and Inks, Vegetable Oils etc.	Alcohols, Aceton, Acetonitrile, Acetates, Ether, Diethanolamine, Freon, Frigen, Methylene Chloride, Dimethyl Phthalate, Dioxane, Diethylamine, Pyridine etc.
Type of impeller:	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE	axial-flow rotor (R) or radial-flow impeller (L) Material: ETFE

Lutz Hastelloy C Pump Tube

For extremely corrosive applications

SL-HC Sealless

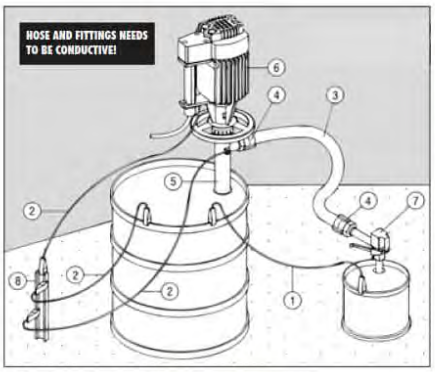
Applications
The robust Lutz pump tube is suitable for pumping nearly all kinds of liquids, whether extremely aggressive or flammable, clean or dirty, thin-bodied or slightly viscous out of drums and small or large containers

Structure and function (SL-HC)
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump is not sealed. The bearing housing insert above the impeller is designed to prevent the pumped liquid from rising between the shaft and the inner tube. This insert guides the liquid which penetrates between the drive shaft and the shaft bearing back into the container being drained.

Length:
39", 47", Special length on request.

Ex

The pump tube is "Zone 0" approved in combination with the original Lutz motors Silver Star / MD-1 / MD-2 in accordance with standards for use in hazardous locations.



*Zone "0": Defines a constant hazardous explosive atmosphere. Covers interior of drum/container used for storing or transporting of explosive liquids. Equipment approved for zone "0" must be specially tested and certified.

Required accessories when using explosion proof pumps in hazardous locations.

Explosion proof plug and socket outlets, bonding and grounding cable, conductive hoses and nozzles in Stainless Steel. Ex-Motor (ME I, MD-1, MD-2)

Bonding and Grounding Diagram

① Bonding wire
② Ground wire
③ Conductive hose, (10^6 Ohm)
④ Conductive fitting of the hose into hose connector
⑤ Metal pump tube for zone "0"* in Stainless Steel or Hastelloy "C"
⑥ Explosion proof motor ME I / MD-1 / MD-2
⑦ Nozzle in Stainless Steel
⑧ Grounding rod

Type	SL-HC (Sealless)
Wetted parts	
Housing:	HC-4 (2.4610)
Seals:	Viton®
Mechanical seal:	None
Bearings:	ETFE, Carbon
Drive shaft:	HC-4 (2.4610)
Examples of liquids:	Bromine, Chlorosulphonic Acid, Butylchloride, Chlorine Water and nearly all kinds of liquids
Type of impeller:	axial-flow rotor (R) or radial-flow impeller (L) , Material: ETFE

Picture shows:
Pump tube with air motor MD-2

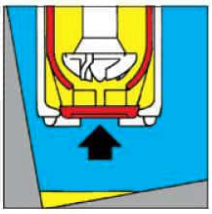
Lutz Pump Tubes RE for complete drum drainage

in stainless steel and polypropylene

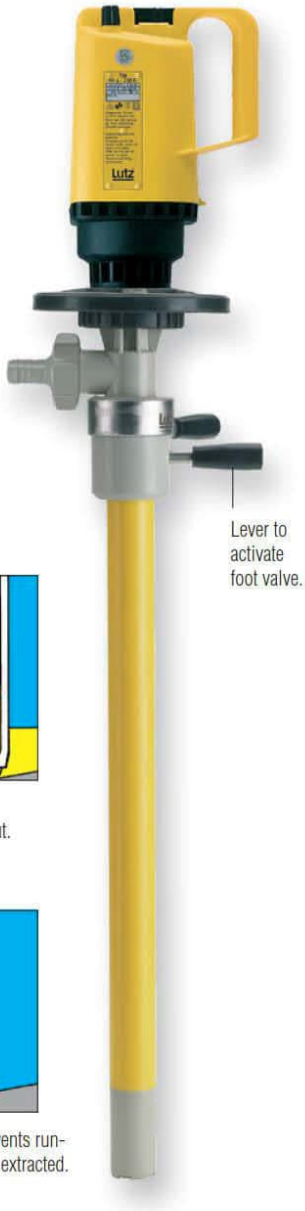
Head Start – Nothing Left Behind
Not only more money in your pocket, but a huge contribution to our environment.
Ignoring waste and costs are things of the past. The RE pump provides the solution for reducing waste and avoiding costs through product loss and waste disposal. Use the RE means almost no residue left in drum.

Patented solution
Simple to operate. When the impellller picks up air, the valve is closed by moving lever 90°. Then motor is shut down. With the liquid captured, the pump tube can be moved to next drum or liquid being disposed.

Sealing pot is open - the liquid is pumped out.



Closed sealing pot prevents run-back when the pump is extracted.



Lever to activate foot valve.

Picture shows:
RE pump tube with motor B 36 / MI 4

Lutz Pump Tube RE 88 in PP and Stainless Steel

For complete drainage of highly toxic, expensive and sensitive liquids

RE 88 PP / RE 88 SS Mechanical Seal

Applications
The pump tube RE-88 PP and RE-88 SS is designed to be used where drums or other containers have to be completely drained.
The relatively small pump tube diameter of 41 mm also makes the unit ideal for use in narrow-necked containers or in drums with a 2" bunghole.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Structure and function
Lutz pump tubes are immersible centrifugal pumps.
The drive shaft of this pump is sealed by a single-acting mechanical seal (MS) above the impeller, making a robust sealing system.
The pump tube must not be allowed to run dry.

Length:
27", 39", 47"
Special length on request.

Warning:
The RE 88 Polypropylene pump **must not** be used for flammable liquids.

Ex

The pump tube is "Zone 0" approved in combination with the original Lutz motors Silver Star / MD-1 /MD-2 in accordance with standards for use in hazardous locations.

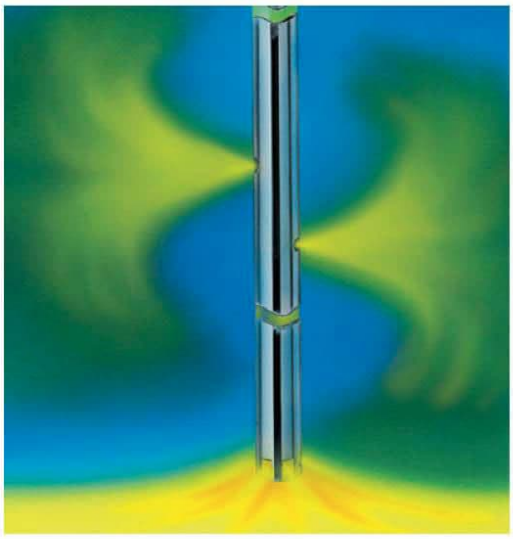
For correct bonding and grounding see page 13.

Type	RE-88 PP (Mechanical Seal)	RE-88 SS (Mechanical Seal)
Wetted parts		
Housing:	PP	Stainless Steel (316 Ti)
Seals:	Viton®	FEP coated
Mechanical seal:	Carbon, Ceramic, Viton®, HC-4 (2.4610)	Carbon, Ceramic, PTFE, HC-4 (2.4610)
Bearings:	Carbon	Carbon
Drive shaft:	Stainless Steel (316 Ti)	Stainless Steel (316 Ti)
Examples of liquids:	Water, Acids, Alkalis, Hydrazine, Oils, Fruit Juices, Galvanic Fluids, Phosphates, Sulphates, Nitrates etc.	Petrol, Fuel Oil, Diesel Oil, thin-bodied Oils, Solvents, Chlorine Carbon Hydrogens, Alcohols, Amines, Benzoles, Phenoles etc.
Type of impeller:	radial-flow impeller (L) Material: PP	radial-flow impeller (L) Material: ETFE

Picture shows:
RE Pump tube with motor MD-2

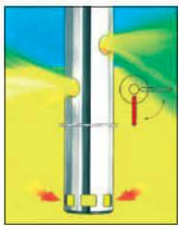
Two in One

Mixing pump tube for corrosive and neutral liquids

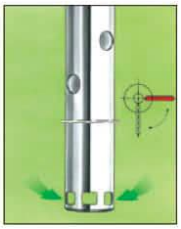


First mix then pump

When it comes to handling emulsions or suspensions which tend to settle out at the bottom of the containers, the MP, mix and pump tube, is an invaluable aid in ensuring that your liquids are gently re-mixed and homogenized.



Mix



Pump

Picture shows:
Mixing pump tube with motor B 55 T / MA II 5

Lutz MP Pump Tube in PP and Stainless Steel

For mixing and pumping of emulsions and suspensions

MP-PP / MP-SS Mechanical Seal

Applications
The Lutz mixing pump tube is designed to be used in any situation where it is necessary to mix and pump in a single operation.
The relatively small pump tube diameter of 50 mm (Polypropylene) and 41 mm (Stainless Steel) also makes the unit ideal for use in narrow-necked containers or in drums with a 2" bunghole.
The rate of flow, viscosity and density of the medium determine the mixing intensity and the delivery rate of the mixing pump tube. Experience has shown that the mixture quantity should preferably not exceed 55 Gallons if the medium is thin-bodied.

The drive shaft of this pump tube is sealed by a single-acting mechanical seal (MS) above the impeller, making a robust sealing system. The pump tube must not be allowed to run dry.
The pump tube is non-lubricated, thus preventing contamination of the liquids pumped.

Length:
39", 47"
Special length on request.

Warning:
The mixing pump tube in Polypropylene (PP) **must not** be used for flammable liquids.

Ex

The mixing pump tube in Stainless Steel is "Zone 0" approved in combination with the original Lutz motors Silver Star / MD-1 / MD-2 in accordance with standards for use in hazardous locations.

For correct bonding and grounding see page 13.

Type	MP MS-PP (Mechanical Seal)	MP SL-PP (Sealless)	MP MS-SS (Mechanical Seal)
Wetted parts			
Housing:	PP	PP	Stainless Steel (316 Ti)
Seals:	–	–	FEP coatet
Mechanical seal:	Carbon, SiC, Viton®, HC	–	Ceramic, PTFE, Stainless Steel (316 Ti)
Bearings:	ETFE/PTFE	ETFE/PTFE	Carbon
Drive shaft:	Stainless Steel (316 Ti)	Stainless Steel (316 Ti) optional HC-4 (2.4610)	Stainless Steel (316 Ti)
Examples of liquids:	Chemical, pharmaceutical and metalworking industries, in food production, in printing works, in car repair workshops and in painting/decorating firms.		
Type of impeller:	radial-flow impeller (L) Material: PP	radial-flow impeller (L) Material: PP	axial-flow rotor (R) Material: ETFE

Picture shows:
Mixing pump tube with motor Silver Star ME I 6

With Lutz through thick and thin

Latest edition for sanitary applications: New B70V-H-SR Sanitary

NEW **Lutz B70V-H-SR Sanitary**

Practical, reliable and ready for use

The design of the Lutz B70V-H-SR Sanitary pump emphasises practical use: only manually detachable, thread-free connections have been used in the areas in contact with the medium.
The Lutz B70V-H-SR Sanitary is easy and fast to dismantle for thorough mechanical cleaning and to reassembly.

An open type spring loaded mechanical seal is available or optionally, a closed version to avoid direct contact with the product.

All materials and the seal designs conform to 3-A Sanitary Standard.

Tube diameter: 54 mm (2.12")
Length: 1100 mm (43.3")
Connection: Tri-Clamp 2"

Thanks to the hand wheel connection, the drive motor can be quickly separated from the pump flange. This facilitates handling, cleaning and transferring the pump to a new container.

Operating Data

Quantity:	up to 13 GPM
Delivery head:	up to 200 FT (87 PSI)
Temperature of medium:	up to 284 °F
Viscosity:	up to 50,000 cps (with MD-2 air motor)

Accessories: Tri-Clamp fitting and spout 2"

02-10

Type	Lutz B70V Sanitary
Wetted parts	
Housing:	Stainless Steel (316 L)
Rotor:	Stainless Steel (316 Ti)
Seals:	EPDM (FDA compliant)
Mechanical seal:	SiC/hard carbon/EPDM (acc. to 3-A standard) opt. SiC/SiC/EPDM or closed version for stricter requirements
Drive shaft:	Stainless Steel (316 Ti)
Stator materials:	PTFE
Examples of liquids:	Cosmetics industry: creams, soaps, toothpaste, shampoos and raw materials for soaps Confectionery industry: honey, syrups and preserves Food industry: milk, whey, cheese, spread and ketchup

Lutz Progressive Cavity Pump B70V-SR

Smooth pumping of highly viscous liquids

B70V-SR (Portable, 32 lbs with motor)

Applications
For applications in the food, pharmaceutical and cosmetics industry, no special shaft joint protection is needed.

Pump Tubes
Pump tubes with different flow rates and length are available for the Lutz B70V-SR. The speed reducer is mounted directly on the pump tube. This reduces the relatively high speeds of the universal or compressed-air motors to a suitable speed for the pump tube of around 690 rpm. The pump tube, drive shaft and eccentric screw are made of Stainless Steel (316 Ti).

Do not run dry or against closed valve.

Tube diameter: 54 mm (2.12")
Length: 1000 mm (39.4") or 1100 mm (43.3")

Drive Motors
A variety of electric and compressed air motors are available. (see page 4)

Operating Data

Quantity:	up to 13 GPM
Delivery head:	up to 200 FT (87 PSI)
Temperature of medium:	up to 284 °F
Viscosity:	up to 50,000 cps (with MD-2 air motor)

Accessories
Bypass valves, hoses, hose clips, dosing devices, electronic flow meters, batch dosing appliance with time control and other accessories are available on request.

Type	B70V-SR
Wetted parts	
Housing and Rotor:	Stainless Steel (316 Ti)
Seals:	Viton® (FPM)
Mechanical seal:	Carbon/SS, Viton® or SiC/SiC , Viton®
Packing gland:	PTFE soft packing, safe for use with foodstuffs
Drive shaft:	Stainless Steel (316 Ti)
Stator materials:	NBR light, Viton®, PTFE
Examples of liquids:	Chemical industry: acids, lyes, sludge, viscous pastes, dispersions, adhesives, etc. Cosmetics industry: creams, soaps, toothpaste, shampoos and raw materials for soaps Confectionery industry: honey, syrups and preserves Paint and lacquer factories: paints, lacquers and pastes Food industry: milk, whey, cheese, spread and ketchup Mineral oil industry: high-viscosity oils and fluid greases.

Lutz Rechargeable Pump B1 for Laboratories

Mobile and user friendly

Top Performance in a compact design

Battery Pump Set B1 comprises:
Battery motor 9.6 V, pump tube polypropylene 1",
5' (1.5 m) PVC-hose 1/2", charger and hose nozzle

- ✓ Reliable and tested drum pump technique
- ✓ Modular design
- ✓ Infinitely variable speed controller for comfortable and safe filling applications
- ✓ Ergonomical design for easy handling
- ✓ Optimized complete drum drainage
- ✓ Sophisticated battery system
- ✓ Battery charger as wall bracket for safe storage
- ✓ Chemical-resistant
- ✓ Easy to service

Immediately ready for use:
Only few simple operations required

- Remove the motor from the charging station
- Connect the motor with the pump tube
- Open the nozzle and fill up the requested liquid amount infinitely variable

Model	Lutz Batterz Pump B1
Material:	PP
Pump shaft:	Hastelloy
Flow rate:	4 GPM
Delivery head:	25 ft
Viscosity:	200 cps
Spec. gravity	1.3
Temp. of medium:	32 °F up to 104 °F

Accessories:
Charger for battery motor,
curved spout PVC, 3/4" drum adapter

Lutz B2 Vario Drum and Laboratory Pump

B2 Vario (polypropylene or stainless steel)

Safety First
Personal safety and the environment are of vital importance when it comes to handling chemicals, acids, alkalis or other dangerous liquids, particularly when transferring small amounts of liquid. The new "Lutz B2 Vario" provides a complete solution. The infinitely variable speed controller with integrated on/off switch allows a controlled and comfortable filling of smaller and larger liquid amounts. The operator can gradually regulate the delivery rate from lowest up to requested speed by one movement of the hand.

From Pump only to complete system, for safe and accurate transfer.

- **Laboratory pump** with hose connection
- **Set:** pump, 5' (1,5 m) PVC-hose, Lutz nozzle, 2 hose clips, wall bracket.

Variable speed motor 110 V with safety cut-off to enable the transfer of liquids in small amounts

Set: Lutz B2 Vario with 110 V motor and pump tube PP-SL 32

- Easy and safe to operate by integrated ergonomically designed handles and nozzle
- Ultra quiet, long service life
- **Different lengths available** 19", 27" and 39" for the use in small vessels up to 55 gal. drums
- Wide range of applications possible due to sealless construction
- Service-friendly and simple to dismantle
- Available in **110 V** or **air motor**
- Available in **polypropylene** or **stainless steel 316**

Set: Lutz B2 Vario with air motor and pump tube SS-SL 28

Operating pressure: 87 psi
Air consumption: 13 CFM

Model	Lutz B2 Vario PP-SL 32	Lutz B2 Vario SS-SL 28
Wetted parts		
Housing:	PP	Stainless Steel (316 Ti)
Seals:	None	None
Mechanical seal:	None	None
Bearings:	ETFE/PTFE	ETFE/PTFE
Drive shaft:	Hastelloy C	Stainless Steel (316 Ti)
Examples of liquids:	Battery acid, ammonia solution, glycols, photographic developer/-fixer, phosphoric acid, hydrochloric acid and hydrogen peroxide, etc.	Oil-based lubricants, cleaner solvent plasticizer, etc.
Type of impeller:	axial-flow rotor (R) Material: PP	axial-flow rotor (R) Material: ETFE

For more details request literature Lutz B2 Vario (Ref. no. 9000-117)

Lutz Flow meter TR-Series

Quick, easy and precise

Features:

- ✓ Chemical resistance against corrosive and aggressive liquids
- ✓ Easy calibration
- ✓ Proven radial turbine technology
- ✓ Totalizer function
- ✓ Light weight, compact design with rotatable (90°) display
- ✓ For all drum and container pumps

PP for neutral and aggressive liquids
such as glycol, ferric (III) chloride, hydrochloric acid, phosphoric acid, etc.

PVDF for highly aggressive fluids
such as chlorine solution, nitric acid, sulphuric acid, etc.

For more details request literature:
Lutz Flow Control System (Ref. no. 9000-123)

The TR series flow meter can be combined with all drum and container pumps with the 1" or 1 1/4" connection. Simply attach the union fitting – and it is ready for use.

Model		TR90-PP	TR90-PVDF
Material	Housing top	PP	PVDF
(in contact with	Keypad	PES	PES
the medium)	Turbine	PP	PVDF
	Shaft	HC C-2000 (2.4675)	HC C-2000 (2.4675)
	Seal	FPM	FPM
Range of measurement	GPM	1.3-23.8	1.3-23.8
Range of viscosity	cps	0.8-40	0.8-40
Maximum pressure	PSI	58 (at 68 °F)	58 (at 68 °F)
Connection*		1 or 1 1/4	1 1/4
Temperature range	°F	14-122	14-122

*Inline fittings 1" available

Viton® is a registered Trademark of DuPont Dow Elastomers.

Lutz Modular Flow Control System

Totalizing and batch control at your fingertip

There are a lot of measuring devices for fluids. But the advantages of the new Lutz flow meters stand out from them all.
Their precision, flexibility and user-friendliness will win you over.

Discover the pluses of innovative Lutz technology:

- ✓ Touch screen display
- ✓ Multilingual menus
- ✓ Simple plain-text operation
- ✓ Integrated help function
- ✓ High precision through overrun correction and characteristic adjustment
- ✓ Safety and monitoring functions
- ✓ Simple system connection
- ✓ Plug & play modular design

For more details request literature:
Lutz Flow Control System (Ref. no. 9000-124)

You have got the choice:
Plastic or stainless steel design

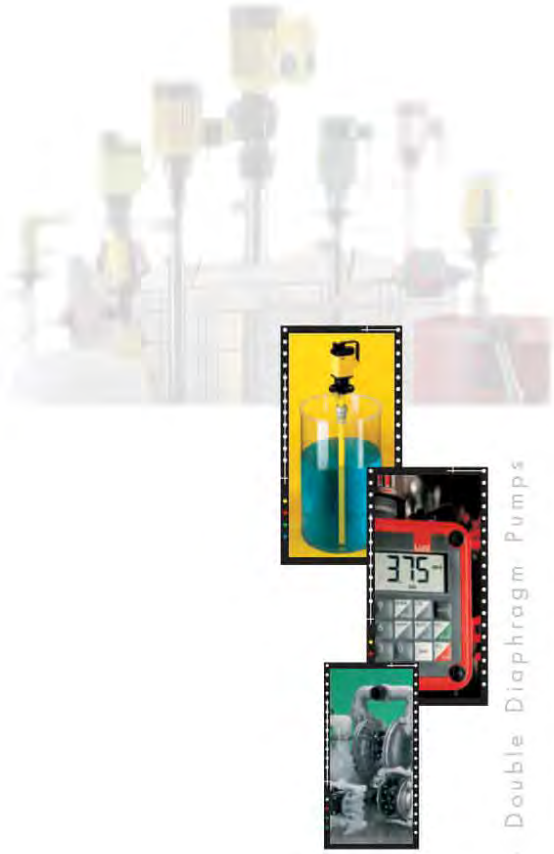
Type ST
for neutral liquids
such as water, heating oil, diesel and hydraulic fluid

Type SL
for aggressive acids and caustic solutions
such as hydrocloric acid, sulphuric acid and caustic

Type LM
for highly flammable solvents
such as ethanol, petrol, isopropanol, kerosene

Type UN
for highly flammable and aggressive media
such as formic acid, acetic acid, tetrahydrofuran

Type VA I
for highly flammable and aggressive media
such as ether, styrene, xylene, nitric acid, tetrahydrofuran



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0699.185

Ref. no. 9000-143 rev. Printed in Germany Bo. 5.000/02.12

11232.2.6 RADAR LEVEL METER

Radar Level Meter shall be Endress+Hauser Micropilot M (IP65/NEMA 4X) or Equivalent

Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Micropilot M FMR230/231/240/244/245

Level-Radar
Continuous and non-contact level measurement.
Cost-effective 4 to 20 mA 2-wire technology.
Suitable for hazardous locations.

Application

The Micropilot M is used for continuous, non-contact level measurement of liquids, pastes, slurries, and solids. The measurement is not affected by changing media, temperature changes, gas blankets or vapors.

- The FMR230 is especially suited for measurement in buffer and process tanks.
- The FMR231 has its strengths wherever high chemical compatibility is required.
- The FMR240 with the small 40 mm (1½") horn antenna is ideally suited for small vessels. Additionally, it provides an accuracy of ±3 mm (0.12 in).
- The FMR244 combines the advantages of the horn antenna with high chemical resistance. The 80 mm (3") horn antenna is used additionally in solids.
- The FMR245 - highly resistant up to 200 °C (392 °F) and easy to clean.

Your benefits

- 2-wire technology, low price:
  A real alternative to differential pressure, floats and displacers. 2-wire technology reduces wiring costs and allows easy implementation into existing systems.
- Non-contact measurement:
  Measurement is almost independent from product properties.
- Easy on-site operation via menu-driven alphanumeric display.
- Easy commissioning, documentation and diagnostics via Endress+Hauser operating software.
- 2 frequency ranges - FMR230/FMR231 in the C-band and FMR240/244/245 ind the K-band: No compromises, the right frequency for every application.
- HART or PROFIBUS PA respectively FOUNDATION Fieldbus protocol.
- High temperatures: Suitable for process temperatures up to 200 °C (392 °F), up to 400 °C (752 °F) with high-temperature antenna.
- Rod antenna with inactive length:
  Reliable measurement in narrow nozzles, with condensation and build-up in the nozzle.
- Used for level monitoring (MIN, MAX) up to SIL 2 as per IEC 61508 / IEC 61511.
- Gas-tight feedthrough to improve the process safety for FMR230 standard, for FMR231/240/245 optionally.

TI00345F/00/EN/15.12
71182793

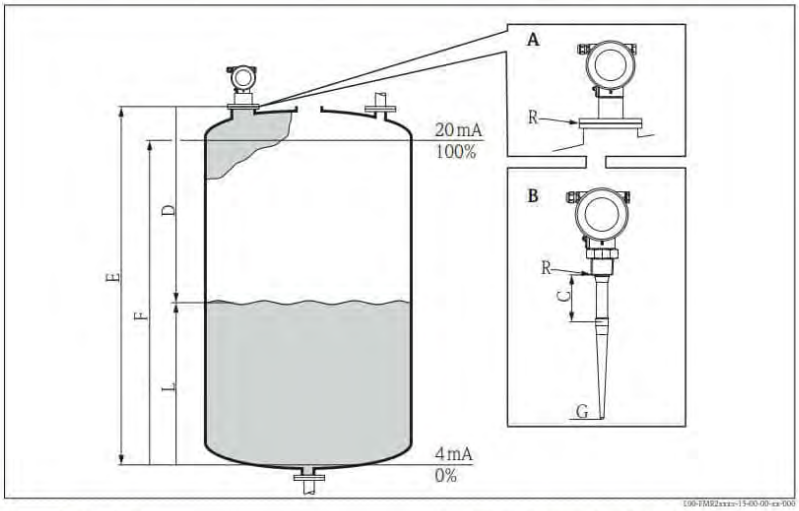
Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Measuring principle

The Micropilot is a "downward-looking" measuring system, operating based on the time-of-flight method. It measures the distance from the reference point (process connection) to the product surface. Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system.



A Flange version
B Threaded connection R1½", 1½" NPT
C Inactive length
G Max. level
R Reference point

Input

The reflected radar impulses are received by the antenna and transmitted into the electronics. A microprocessor evaluates the signal and identifies the level echo caused by the reflection of the radar impulse at the product surface. The unambiguous signal identification is accomplished by the PulseMaster® eXact software, based on many years of experience with time-of-flight technology.
The distance "D" to the product surface is proportional to the time of flight "t" of the impulse:

$D = c \cdot t/2$,
with "c" being the speed of light.

Based on the known empty distance "E", the level "L" is calculated:

$L = E - D$

Refer to the above figure for the reference point for "E".

The Micropilot is equipped with functions to suppress interference echoes. The user can activate these functions. They ensure that interference echoes (i.e. from edges and weld seams) are not interpreted as level echo.

Output

The Micropilot is commissioned by entering an empty distance "E" (=zero), a full distance "F" (=span) and an application parameter. The application parameter automatically adapts the device to the process conditions. For models with a current output, the factory adjustment for zero point "E" and span "F" is 4 mA and 20 mA. For digital outputs and the display module, the factory adjustment for zero point "E" and span "F" is 0% and 100%. A linearization with max. 32 points, based on a table entered either manually or semi-automatically, can be activated locally or remotely. This function provides a measurement in engineering units and a linear output signal for spheres, horizontal cylindrical tanks and vessels with conical outlet.

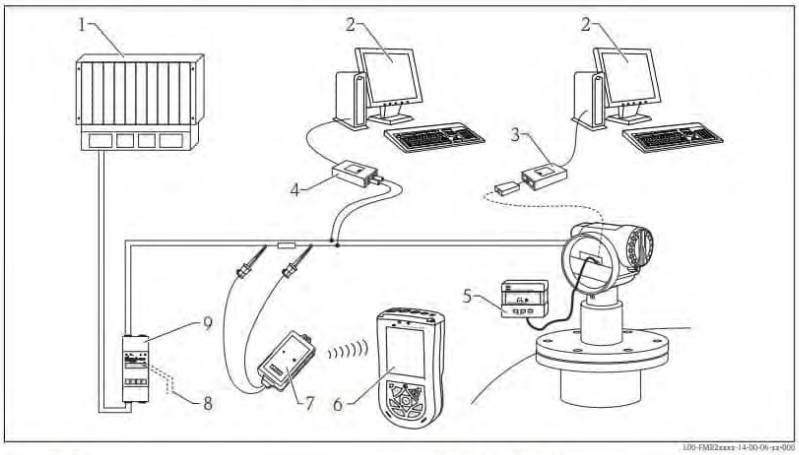
Equipment architecture

Stand-alone

The Micropilot M can be used for measurement in a stilling well / bypass as well as in free space.
The device provides a 4 to 20 mA output with HART protocol, or PROFIBUS PA respectively FOUNDATION Fieldbus communication.

4 to 20 mA output with HART protocol.

The complete measuring system consists of:



1	*PLC*	*6*	*Field Xpert SFX100*
2	*FieldCare*	*7*	*VIATOR Bluetooth modem with connecting cable*
3	*Commubox FXA195 with ToF Adapter FXA291*	*8*	*Connection for Commubox FXA195*
4	*Commubox FXA195*	*9*	*Transmitter power supply unit RMA422 or RN221N (communication resistor included)*
5	*Operating and display module*		

On-site operation

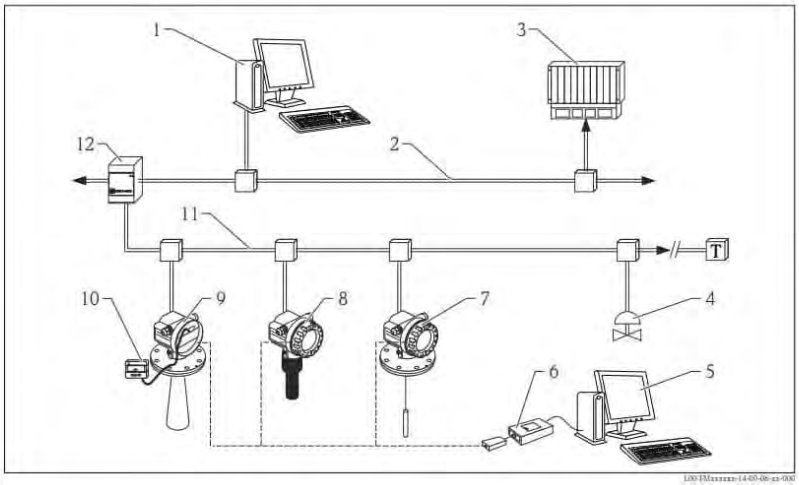
- With display and operating module,
- With a Personal Computer, FXA291 with ToF Adapter FXA291 (USB) and the operating software "FieldCare". FieldCare is a graphical operating software for devices from Endress+Hauser (radar, ultrasonic, guided microimpulse). It assists with commissioning, securing data, signal analysis and documentation of the measuring point.

Remote operation

- With Field Xpert SFX100
- With a Personal Computer, Commubox FXA195 and the operating software "FieldCare"

System integration via PROFIBUS PA

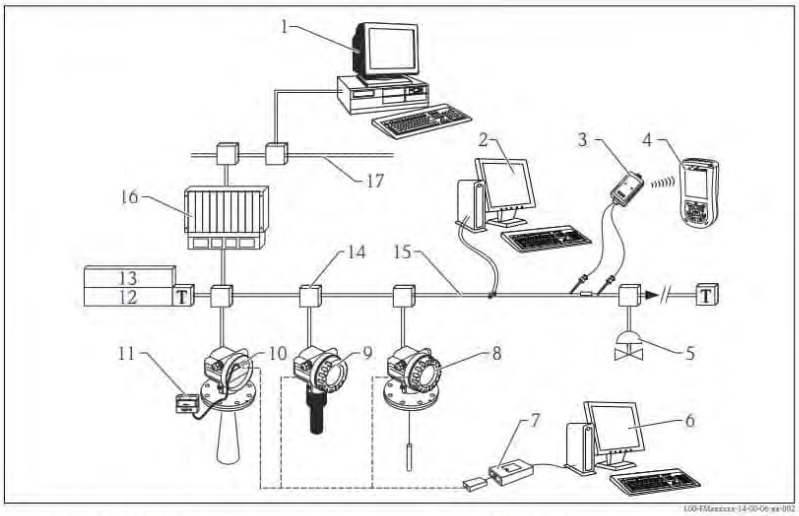
A maximum of 32 transmitters (8 if mounted in an explosion hazardous location Ex ia IIC according to FISCO-model) can be connected to the bus. The segment coupler provides the operating voltage to the bus.
Both on-site as well as remote operation are possible. The complete measuring system consists of:



1	*PC with FieldCare and Profiboard resp. Proficard*	*7*	*Levelflex M*
2	*PROFIBUS DP*	*8*	*Prosonic M*
3	*PLC*	*9*	*Micropilot M*
4	*More Functions (valves etc.)*	*10*	*Operating and display module*
5	*FieldCare*	*11*	*PROFIBUS PA*
6	*Commubox FXA291 with ToF Adapter FXA291*	*12*	*Segment coupler*

System integration via FOUNDATION Fieldbus

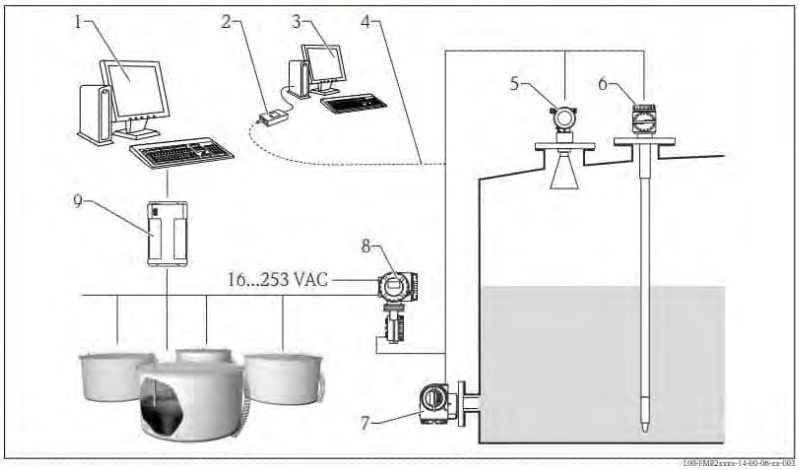
A maximum of 32 transmitters (standard, Ex em or Ex d) can be connected to the bus.
For protection class Ex ia IIC: the max. number of transmitters depends on the established rules and standards for intrinsically safe circuits (EN 60079-14, proof of intrinsically safety). Both on-site as well as remote operation are possible. The complete measuring system consists of:



1	*ControlCare Delta V...*	10	*Micropilot M*
2	*E.g. NI-FBUS configurator*	11	*Operating and display module*
3	*VIATOR Bluetooth modem with connecting cable*	12	*Power conditioner*
4	*Field Xpert SFX100*	13	*Power supply*
5	*More Functions (valves etc.)*	14	*FF Link*
6	*FieldCare*	15	*FOUNDATION Fieldbus*
7	*Commubox FXA291 with ToF Adapter FXA291*	16	*PLC*
8	*Levelflex M*	17	*Ethernet*
9	*Prosonic M*		

Integrated in tank gauging system

The Endress+Hauser Tank Side Monitor NRF590 provides integrated communications for sites with multiple tanks, each with one or more sensors on the tank, such as radar, spot or average temperature, capacitive probe for water detection and/or pressure sensors. Multiple protocols out of the Tank Side Monitor guarantee connectivity to nearly any of the existing industry standard tank gauging protocols. Optional connectivity of analog 4 to 20 mA sensors, digital I/O and analog output simplify full tank sensor integration. Use of the proven concept of the intrinsically safe HART bus for all on-tank sensors yields extremely low wiring costs, while at the same time providing maximum safety, reliability and data availability.



1 *Fuels Manager Software*
2 *Commubox FXA195*
3 *FieldCare*
4 *HART 2 wire*
5 *Micropilot M*
6 *Prothermo*
7 *Pressure*
8 *Tank Side Monitor*
9 *RTU8130 (remote terminal unit)*

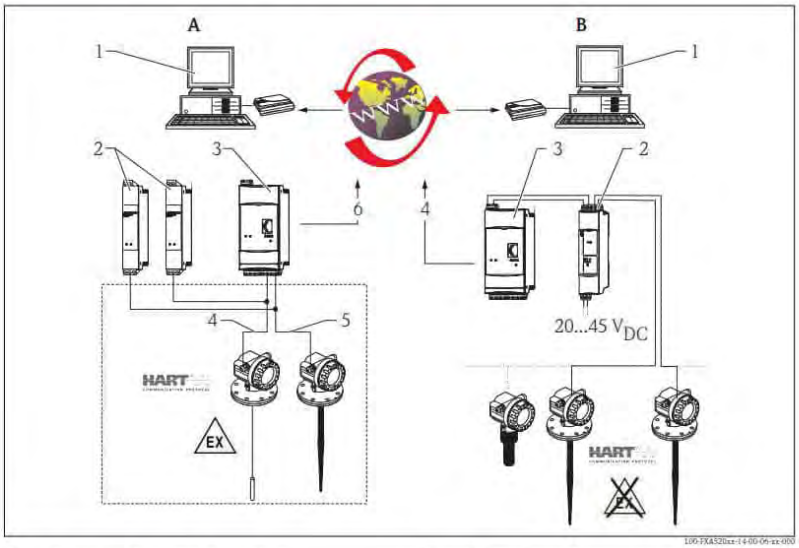
System integration via Fieldgate

Vendor Managed Inventory

By using Fieldgates to interrogate tank or silo levels remotely, suppliers of raw materials can provide their regular customers with information about the current supplies at any time and, for example, account for them in their own production planning. For their part, the Fieldgates monitor the configured level limits and, if required, automatically activate the next supply. The spectrum of options here ranges from a simple purchasing requisition via e-mail through to fully automatic order administration by coupling XML data into the planning systems on both sides.

Remote maintenance of measuring equipment

Fieldgates not only transfer the current measured values, they also alert the responsible standby personnel, if required, via e-mail or SMS. In the event of an alarm or also when performing routine checks, service technicians can diagnose and configure connected HART devices remotely. All that is required for this is the corresponding HART operating software (e.g. FieldCare) for the connected device. Fieldgate passes on the information transparently, so that all options for the respective operating software are available remotely. Some on-site service operations can be avoided by using remote diagnosis and remote configuration and all others can at least be better planned and prepared.



A *Remote configuration/diagnostics*
1 *Via HART Client: FieldCare*
2 *E.g. 2x RN221N-B...*
3 *Fieldgate FXA520*
4 *Channel 1*
5 *Channel 2*
6 *Analog; Ethernet; GSM*

B *Remote monitoring*
1 *HTTP script; Web browser*
2 *Multidrop-Connector FXN520*
3 *Fieldgate FXA520*
4 *Analog / Ethernet / GSM*

Note!
The number of devices which can be connected in mutidrop mode can be calculated by the "FieldNetCalc" program. A description of this program can be found in Technical Information TI00400F/00/EN (Multidrop Conncector FXN520). The program is available form your Endress+Hauser sales organisation or in the internet at: www.endress.com → Select your country → Download → Search: Fieldnetcalc.

Input

Measured variable

The measured variable is the distance between a reference point (→ 4) and a reflective surface (i.e. medium surface). The level is calculated based on the tank height entered.The level can be converted into other units (volume, mass) by means of a linearization (32 points).

Measuring range in liquids

The usable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location and eventual interference reflections.

The maximum configurable range is:
- 20 m (66 ft) for Micropilot M FMR23x,
- 40 m (131 ft) for Micropilot M FMR24x (basic version),
- 70 m (230 ft) for Micropilot M FMR24x (with additional option F (G), see "Ordering information")

The following tables describe the groups of media as well as the achievable measuring range as a function of application and media group. If the dielectric constant of a medium is unknown, it is recommended to assume media group B to ensure a reliable measurement.

Media group	DC (Er)	Examples
A	1.4 to 1.9	non-conducting liquids, e.g. liquefied gas[1)]
B	1.9 to 4	non-conducting liquids, e.g. benzene, oil, toluene, …
C	4 to 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, …
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

1) Treat Ammonia NH_3 as a medium of group A, i.e. use FMR230 in a stilling well.

Measuring range in solids

The FMR244 with 80 mm (3") antenna or FMR240 with 100 mm (4") horn antenna and additional option "F" (= advanced dynamics) is also suited for solid applications. The usable measuring range depends on the reflection properties of the medium, the mounting position and interference reflections which may be present. The maximum configurable measuring range for the FMR240 with 100 mm (4") horn antenna and additional option "F" (= advanced dynamics) is 30 m (98 ft) in solid applications. It is recommended to use the variable flange seal for alignment (→ 84).

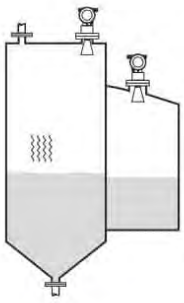
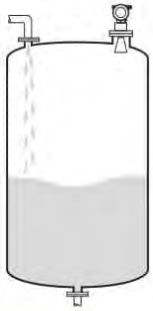
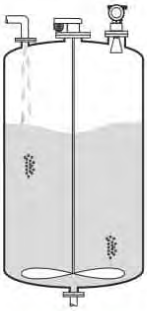
Reduction of the max. possible measuring range through:
- Media with poor reflection properties (= small DC). For examples refer to table below.
- Angle of repose.
- Extremely loose surfaces of bulk solids, e.g. bulk solids with low bulk weight for pneumatic filling.
- Build-up, above all of moist products.

The following table describes the media groups and the dielectric constant Er.

Media group	DC (Er)	Examples	Signal attenuation
A	1.6 to 1.9	– Plastic granulate – White lime, special cement – Sugar	19 to 16 dB
B	1.9 to 2.5	– Portland cement, plaster	16 to 13 dB
C	2.5 to 4	– Grain, seeds – Ground stones – Sand	13 to 10 dB
D	4 to 7	– Naturally moist (ground) stones, ores – Salt	10 to 7 dB
E	> 7	– Metallic powder – Carbon black – Coal	< 7 dB

The respective lower group applies for very loose or loosened bulk solids.

Measuring range depending on vessel type, conditions and product for FMR230, FMR231

	Storage tank [1]		Buffer tank [1]		Process tank with agitator [1]		Stilling well	Bypass
	 Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes).		 Moving surfaces (e.g. continuous filling, from above, mixing jets).		 Turbulent surface. Single stage agitator < 60 U/min.			
FMR230:	150 mm (6")	200 mm (8"), 250 mm (10")	150 mm (6")	200 mm (8"), 250 mm (10")	150 mm (6")	200 mm (8"), 250 mm (10")	80 to 250 mm (3 to 10")	80 to 250 mm (3 to 10") [2]
FMR231:	Rod antenna	—	Rod antenna	—	Rod antenna	—	—	—
	B: 10 (32); C: 15 (49); D: 20 (65)	B: 15 (49); C: 20 (65); D: 20 (65)	B: 5 (16); C: 7.5 (25); D: 10 (32)	B: 7.5 (25); C: 10 (32); D: 12.5 (41)	B: 4 (13); C: 6 (20); D: 8 (26)	B: 6 (20); C: 8 (26); D: 10 (32)	A, B, C, D: 20 (65)	C, D: 20 (65)
Measuring range [m (ft)]								

1) For media group A to use a stilling well (20 m (66 ft).

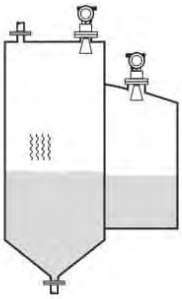
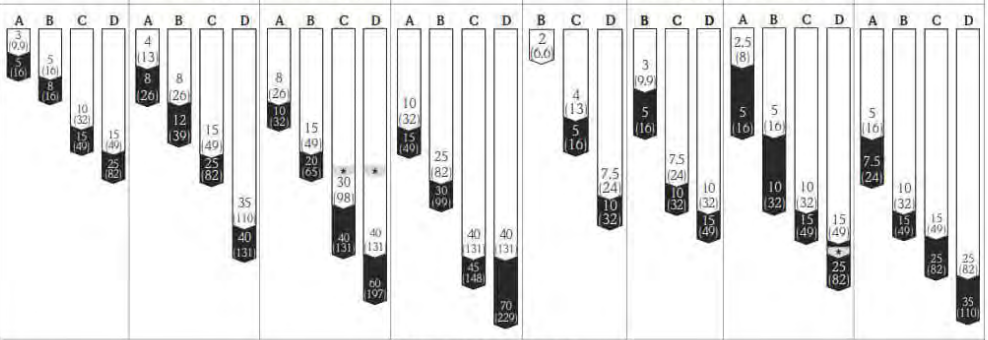
2) For media group A and B possible, i.e. with stilling well in bypass.

Measuring range depending on vessel type, conditions and product for FMR240, FMR244, FMR245

Standard: max. measuring range = 40 m (131 ft)	With additional option "F" ("G"): max. measuring range = 70 m (230 ft)
* Max. recommended measuring range = 20 m (66 ft) for FMR244 with 80 mm (3") antenna, in solids 15 m (49 ft).[1) 2)] The recommended measuring range for FMR240 with 100 mm (4") horn antenna in solids is 30 m (98 ft).	

1) Larger measuring range in solids available on request.

2) In solids with additional option "F" (= advanced dynamic), and variable flange seal (→ 84).

	Storage tank				Buffer tank			
	 Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes).				 Moving surfaces (e.g. continuous filling, from above, mixing jets).			
FMR240	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")
FMR244	40 mm (1½")	-	* 80 mm (3")	-	40 mm (1½")	-	* 80 mm (3")	-
FMR245	-	50 mm (2")	80 mm (3")	-	-	50 mm (2")	80 mm (3")	-
								
	Measuring range [m (ft)]							

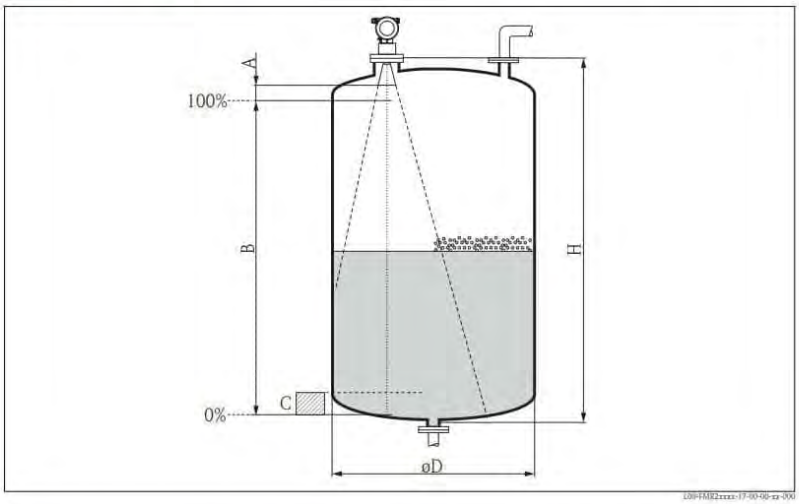
	Process tank with agitator				Stilling well[1]	Bypass[2]
	 Turbulent surface. Single stage agitator < 60 RPM.					
FMR240	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")	40 to 100 mm (1½" to 4")	40 to 100 mm (1½" to 4")
FMR244	40 mm (1½")	–	80 mm (3")	–	40 to 100 mm (1½" to 4"	–
FMR245	–	50 mm (2")	80 mm (3")	–	50 to 80 mm (2" to 3")	50 to 80 mm (2" to 3")
	B C D	B C D	B C D	B C D	A, B, C, D	C, D
	1 (3.2) 2 (6.6) 3 (9.8) 5 (16)	2 (6.6) 3 (9.8) 7.5 (25) 5 (16) 10 (32)	2.5 (8.2) 5 (16) 12 (39) 8 (26) 15 (49)	4 (13) 5 (16) 8 (26) 15 (49) 10 (32) 20 (65)	20 (65)	20 (65)
	Measuring range [m (ft)]					

1) Larger measuring range on request.
2) For media group A and B to use a Levelflex M with coax probe.

Measuring conditions in liquids

Note!

- In case of **boiling surfaces, bubbling** or tendency for **foaming,** use FMR230 or FMR231. Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions. For FMR240/244/245, the additional option "F" ("G") recommended (→ 67).
- In case of heavy **steam development** or **condensate** the max. measuring range of FMR240 may decrease depending on density, temperature and composition of the steam → use FMR230 or FMR231.
- For the measurement of absorbing gases such as **ammonia NH_3** or some **fluorocarbons** [1], please use FMR230 in a stilling well.



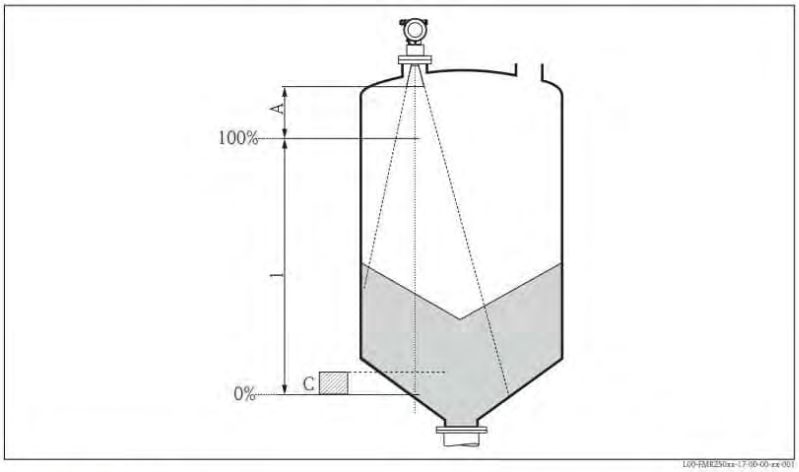
- The measuring range begins, where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets the level cannot be detected below this point.
- In case of media with a low dielectric constant (groups A and B), the tank bottom can be visible through the medium at low levels (low height **C**). Reduced accuracy has to be expected in this range. If this is not acceptable, we recommend positioning the zero point at a distance **C** (see Fig.) above the tank bottom in these applications.
- In principle it is possible to measure up to the tip of the antenna with FMR230/231/240. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than **A** (see Fig.) to the tip of the antenna.
  For FMR244/245, the end of measuring range should not be chosen closer than **A** (see Fig.) to the tip of the antenna, especially if there is development of condensate.
- The smallest possible measuring range **B** depends on the antenna version (see Fig.).
- The tank diameter should be greater than **D** (see Fig.), the tank height at least **H** (see Fig.).

	A [mm (in)]	B [m (ft)]	C [mm (in)]	D [m (ft)]	H [m (ft)]
FMR230/231	50 (1.97)	> 0,5 (1.6)	150 to 300 (5.91 to 11.8)	> 1 (3.3)	> 1,5 (4.9)
FMR240	50 (1.97)	> 0,2 (0.7)	50 to 250 (1.97 to 9.84)	> 0,2 (0.7)	> 0,3 (1)
FMR244	150 (5.91)	> 0,2 (0.7)	50 to 250 (1.97 to 9.84)	> 0,2 (0.7)	> 0,3 (1)
FMR245	200 (7.87)	> 0,2 (0.7)	50 to 250 (1.97 to 9.84)	> 0,2 (0.7)	> 0,3 (1)

1) Affected compounds are e.g. R134a, R227, Dymel 152a.

Measuring conditions in solids

- The measuring range begins, where the beam hits the bottom. Particularly with conical outlets the level cannot be detected below this point. The maximum measuring range can be increased in such applications by using a top target positioner (→ 82).
- In case of media with a low dielectric constant (groups A and B), the bottom can be visible through the medium at low levels. In order to guarantee the required accuracy in these cases, it is recommended to position the zero-point at a distance **C** above the bottom (see Fig.).
- In principle it is possible to measure up to the tip of the antenna with the Micropilot M. However, due to considerations regarding abrasion and build-up and depending on the orientation of the product surface (angel of repose), the end of the measuring range should be at a distance of **A** (see Fig.). If required, and if some conditions (high DC value, flat angle of repose) are met, shorter distances can be achieved.



1 Measuring range

A [mm (in)]	C [mm (in)]
approx. 400 (15.7)	50 to 150 (1.97 to 5.91)

Operating frequency

- FMR230/231: C-band
- FMR240/244/245: K-band

Up to 8 Micropilot M transmitters can be installed in the same tank because the transmitter pulses are statistically coded.

Transmitting power

Distance	Average energy density in beam direction	
	max. measuring range = 20 m (66 ft) / 40 m (131 ft)	measuring range = 70 m (230 ft)
1 m (3.3 ft)	< 12 nW/cm²	< 64 nW/cm²
5 m (16 ft)	< 0.4 nW/cm²	< 2.5 nW/cm²

Output

Output signal

HART

Signal coding	FSK ±0.5 mA over currency signal
Data transmission rate	1200 Baud
Galvanic isolation	Yes (IO-Module)

PROFIBUS PA

Signal coding	Manchester Bus Powered (MBP)
Data transmission rate	31.25 KBit/s, voltage mode
Galvanic isolation	Yes (IO-Module)

FOUNDATION Fieldbus

Signal coding	Manchester Bus Powered (MBP)
Data transmission rate	31.25 KBit/s, voltage mode
Galvanic isolation	Yes (IO-Module)

Signal on alarm

Error information can be accessed via the following interfaces:
- Local display:
  - Error symbol
  - Plain text display
- Current output, signal on error can be selected (e.g. according to NAMUR recommendation NE43).
- Digital interface

Linearization

The linearization function of the Micropilot M allows the conversion of the measured value into any unit of length or volume. Linearization tables for calculating the volume in cylindrical tanks are pre-programmed. Other tables of up to 32 value pairs can be entered manually or semi-automatically.

Protocol specific data

HART

Manufacturer ID	000011 hex	
Device Type Code	000F hex (for FMR230/231)	001E hex (for FMR240/244/245)
Transmitter specific revision	04 hex (for FMR230/231)	05 hex (for FMR240/244/245)
HART specification	5.0	
DD-Files	Information and files can be found: ▪ www.endress.com ▪ www.hartcomm.org	
Load HART	Min. 250 Ω	
Device variables	Primary value: level or volume [1]	
Features supported	▪ Burst mode ▪ Additional Transmitter Status	

1) according to configuration

PROFIBUS PA

Manufacturer ID	000011 hex
Ident number	1522 hex
Profile Version	3.0
GSD file	Information and files can be found: ▪ www.endress.com ▪ www.hartcom.com
GSD file version	
Output values	Primary value: measured value Secondary value: distance
Input values	Display value of PLC
Features supported	▪ I&M ▪ Identification & Maitenance (for FMR240/244/245 of software version 01.05.00)

FOUNDATION Fieldbus

	FMR230/231	FMR240/244/245
Manufacturer ID	452B48	
Device Type	100F hex	100F hex
Device Revision	04 hex	05 hex
DD Revision CFF Revision	Information and files can be found: ▪ www.endress.com ▪ www.feldbus.org	
Devise Tester Version (ITK Version)	4.61	5.00
ITK Test Campaign Number	IT035500	IT042000
Link Master (LAS) Capable	yes	
Link Master / Basic Device Selectable	yes, default: Basic Device	
Node Address	Default: 247	
Features supported	Following methods are supported: ▪ Basic setup ▪ Safety settings ▪ Acknowledge alarm ▪ Linearisation ▪ Extended calibration ▪ Output ▪ System parameters ▪ Lock TB Manufacturer parameters	

Virtual Communication Relationship (VCRs)	
Number of VCRs	24
Number of Link Objects in VFD	24
Permanent entries	1
Client VCRs	0
Server VCRs	24
Source VCRs	23
Sink VCRs	0
Subscriber VCRs	23
Publisher VCRs	23

Devise Link Capabilities	
Slot time	4
Min. inter PDU delay	4
Max. response delay	10

Transducer Blocks		
Block	**Content**	**Output values**
Sensor Block	Contains all parameters related to the mesurement	▪ Level or volume[1] (channel 1) ▪ Distance (channel 2)
Diagnsotic Block	Contains diagnostic information	No output values
Display Block	Contains parameters to configure the local display	No output values

1) depending on the configuration of the sensor-block

Function Blocks				
Block	**Content**	**Number of blocks**	**Execution time**	**Functionality**
Resource Block	The Resource Block contains all the data that uniquely identifies the field device. It is an electronic version of a nameplate of the device.	1	—	Enhanced
Analog Input 1	The AI block takes the manufacturer's input data, selected by channel number, and makes it available to other function blocks at its output.	2	30 ms	Standard
Analog Input 2			30 ms	
PID Block	The PID block serves as proportional-integral-derivative controller and is used almost universally to do closed-loop-control in the field including cascade and feedforward.	1	80 ms	Standard
Arithmetic Function Block	This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be done.	1	50 ms	Standard
Input Selector Block	The input selector block provides selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI blocks. The block performs maximum, minimum, middle, average and 'first good' signal selection.	1	30 ms	Standard
Signal Characterizer Block	The signal characterizer block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is determined by a single look-up table with 21 arbitrary x-y pairs.	1	40 ms	Standard
Integrator Block	The Integrator Function Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input block. The block may be used as a totalizer that counts up until reset or as a batch totalizer that has a setpoint, where the integrated or accumulated value is compared to pre-trip and trip settings, generating discrete signals when these settings are reached.	1	60 ms	Standard

Additional Function Block Information	
Instantiable Function Blocks	No
Number of instanciable blocks	—

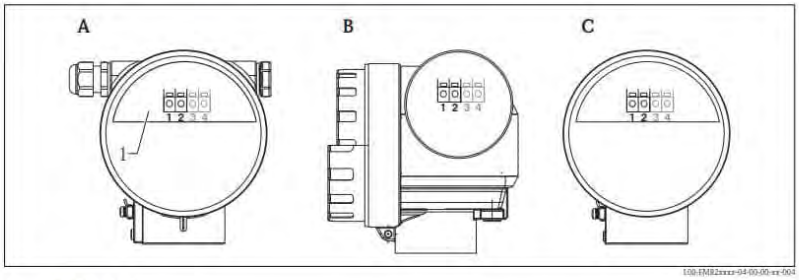
Auxiliary energy

Electrical connection

Terminal compartment

Three housings are available:
- Aluminium housing F12 with additionally sealed terminal compartment for:
  - Standard,
  - Ex ia.
- Aluminium housing T12 with separate terminal compartment for:
  - Standard,
  - Ex e,
  - Ex d,
  - Ex ia (with overvoltage protection, → 🖹 24)
- 316L housing F23 for:
  - Standard,
  - Ex ia.

The electronics and current output are galvanically isolated from the antenna circuit.



A *F12 housing*
B *T12 housing*
C *F23 housing*
1 *Sealed terminal compartment*

Cable gland

Type		Clamping area
Standard, Ex ia, IS	Plastic M20x1.5	5 to 10 mm (0.2 to 0.39 in)
Ex em, Ex nA	Metal M20x1.5	7 to 10.5 mm (0.28 to 0.41 in)

Terminals

For wire cross-sections of 0.5 to 2.5 mm² (20 to 14 AWG)

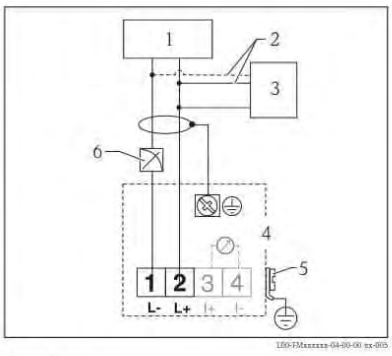
Terminal assignment

2-wire, 4 to 20 mA with HART

The 2-wire cable is connected to the screw terminals in the terminal compartment.

Cable specification:
A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

Note!
- Protective circuitry against reverse polarity, RFI, and over-voltage peaks is built into the device (refer to TI00241F/00/EN "basics for EMC-tests").
- See TI00402F/00/EN for connection to Tank Side Monitor NRF590.

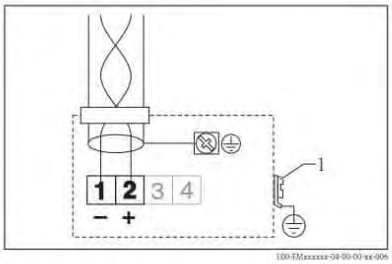


1 Power
2 Alternatively
3 Commubox FXA195, Field Xpert SFX100
4 Test socket for testing of the signal current
5 Plant ground
6 4 to 20 mA

PROFIBUS PA

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the auxiliary energy. For further information on the network structure and earthing and for further bus system components such as bus cables, see the relevant documentation, e.g. BA00034S/04/EN "Guidelines for planning and commissioning PROFIBUS DP/PA" and the PNO Guideline.

Cable specification:
Use a twisted, screened two-wire cable, preferably cable type A.



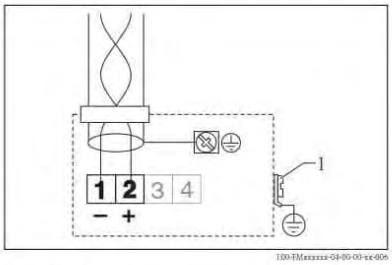
1 Plant ground

Note!
For further information on the cable specifications, see Operating Instructions BA00034S/04/EN "Guidelines for planning and commissioning PROFIBUS DP/PA", PNO Guideline 2.092 "PROFIBUS PA User and Installation Guideline" and IEC 61158-2 (MBP).

FOUNDATION Fieldbus

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the auxiliary energy. For further information on the network structure and earthing and for further bus system components such as bus cables, see the relevant documentation, e.g. BA00013S/04/EN "FOUNDATION Fieldbus Overview" and the FONDATION Fieldbus Guideline.

Cable specification:
Use a twisted, screened two-wire cable, preferably cable type A.



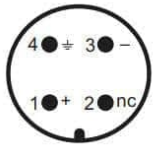
1 Plant ground

Note!
For further information on the cable specifications, see Operating Instructions BA00013S/04/EN "FOUNDATION Fieldbus Overview", FONDATION Fieldbus Guideline and IEC 61158-2 (MBP).

Fieldbus plug connectors

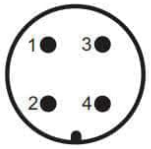
For the versions with a connector M12 or 7/8", the housing does not have to be opened for connecting the signal line.

Pin assignment of the M12 plug connector



Pin	Meaning
1	Signal +
2	Not assigned
3	Signal –
4	Earth

Pin assignment of the 7/8" plug connector



Pin	Meaning
1	Signal –
2	Signal +
3	Shield
4	Not assigned

Load HART

Minimum load for HART communication: 250 Ω

Supply voltage

HART

The following values are the voltages across the terminals directly at the device:

Communication		Current consumption	Terminal voltage
HART	standard	4 mA	16 to 36 V
		20 mA	7.5 to 36 V
	Ex ia	4 mA	16 to 30 V
		20 mA	7.5 to 30 V
	Ex d	4 mA	16 to 30 V
		20 mA	11 to 30 V
	dust Ex	4 mA	16 to 30 V
		20 mA	11 to 30 V
Fixed current, adjustable e.g. for solar power operation (measured value transferred at HART)	standard	11 mA	10[1] to 36 V
	Ex ia	11 mA	10[1] to 30 V
Fixed current for HART Multidrop mode	standard	4 mA [2]	16 to 36 V
	Ex ia	4 mA [2]	16 to 30 V

1) Short-term min. start-up voltage: 11.4 V

2) Start up current 11 mA.

PROFIBUS PA and FOUNDATION Fieldbus

The following values are the voltages across the terminals directly at the device:

Type	Terminal voltage
Supply voltage	9 to 30 V (Ex) [1] 9 to 32 V (non-Ex) max. voltage 35 V
Device (Lift off) minimum voltage	9 V
Polarity sensitive	No
FISCO/FNICO compliant in accordance to IEC 60079-27	Yes

1) There may be additional restrictions for devices with an explosion protection certificate. Refer to the notes in the appropriate safety instructions (XA).

Cable entry

- Cable gland: M20x1,5 (for Ex d: cable entry)
- Cable entry: G½ or ½NPT
- PROFIBUS PA M12 plug
- FOUNDATION Fieldbus 7/8" plug

Power consumption

min. 60 mW, max. 900 mW

Current consumption

HART

Device basic current	3.6 to 22 mA, for HART Multidrop: start up current is 11 mA
Breakdown signal (NAMUR NE43)	Adjustable

PROFIBUS PA

Device basic current	max. 13 mA
Error current FDE (Fault Disconnection Electronic)	0 mA

FOUNDATION Fieldbus

Device basic current	15 mA
Device In-rush current	≤15 mA
Error current FDE (Fault Disconnection Electronic)	0 mA

FISCO

U_i	17.5 V
I_i	500 mA; with surge arrester 273 mA
P_i	5.5 W; with surge arrester 1.2 W
C_i	5 nF
L_i	0,01 mH

Ripple HART	47 to 125 Hz: Uss = 200 mV (at 500 Ω)
Max. noise HART	500 Hz to 10 kHz: Ueff = 2.2 mV (at 500 Ω)
Overvoltage protector	The level transmitter Micropilot M with T12-housing (housing version "D", see Ordering information, → 67) is equipped with an internal overvoltage protector (600 V surge arrester) according to EN/IEC 60079-14 or EN/IEC 60060-1 (impulse current test 8/20 µs, Î = 10 kA, 10 pulses). Connect the metallic housing of the Micropilot M to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.

Performance characteristics

Reference operating conditions	▪ Temperatur = +20 °C ±5 °C (+68 °F ±41 °F) ▪ Pressure = 1013 mbar abs. ±20 mbar (15.19 psi ±0.3 psi) ▪ Relative humidity (air) = 65% ±20% ▪ Ideal reflector ▪ No major interference reflections inside the signal beam
Maximum measured error	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: **FMR230, FMR231:** ▪ to 10 m (33 ft): ±10 mm (0.39 in) ▪ ex 10 m (33 ft): ±0.1% of measuring range **FMR240, FMR244, FMR245:** ▪ **Not** for max. measuring range = 70 m (230 ft) – to 1 m (3.3 ft): ±10 mm (0.39 in) ▪ For max. measuring range = 40 m (131 ft) – to 10 m (33 ft): ±3 mm (0.12 in) – ex 10 m (33 ft): ±0.03% of measuring range ▪ For max. measuring range = 70 m (230 ft) – to 1 m (3.3 ft): ±30 mm (1.18 in) – ex 1 m (3.3 ft): ±15 mm (0.59 in) or 0.04% of measuring range, whatever is larger
Resolution	Digital/analog in % 4 to 20 mA: 1 mm (0.04 in)/ 0.03% of measuring range
Reaction time	The reaction time depends on the parameter settings (min. 1 s). In case of fast level changes, the device needs the reaction time to indicate the new value.
Influence of ambiente temperature	The measurements are carried out in accordance with EN61298-3: ▪ Digital output (HART, PROFIBUS PA, FOUNDATION Fieldbus): – **FMR24x** Average T_K: 2 mm (0.08 in) /10 K, max. 5 mm (0.2 in) over the entire temperature range -40 to +80 °C (-40 to +176°F). – **FMR230** Average T_K: 3 mm (0.12 in) /10 K, max. 10 mm (0.39 in) over the entire temperature range -40 to +80 °C (-40 to +176°F). – **FMR231** Average T_K: 5 mm (0.2 in) /10 K, max. 15 mm (0.59 in) over the entire temperature range -40 to +80 °C (-40 to +176°F). ▪ Current output (additional error, in reference to the span of 16 mA): – **Zero point (4 mA)** Average T_K: 0,03%/10 K, max. 0,45% over the entire temperature range -40 to +80 °C (-40 to +176°F). – **Span (20 mA)** Average T_K: 0,09%/10 K, max. 0,95% over the entire temperature range -40 to +80 °C (-40 to +176°F).

Effect of gas phase

High pressures reduce the propagation velocity of the measuring signals in the gas/vapor above the fluid. This effect depends on the kind of gas/vapor and of its temperature. This results in a measuring error that gets bigger as the distance increases between the device zero point (flange) and product surface. The following table illustrates this measured error for a few typical gases/vapors (with regard to the distance; a positive value means that too large a distance is being measured):

Gas phase	Temperature	Pressure in bar (psi)				
	°C (°F)	1 (14.5)	10 (145)	50 (725)	100 (1450)	160 (2320)
Air Nitrogen	20 (68)	0.00%	0.22%	1.2%	2.4%	3.89%
	200 (392)	-0.01%	0.13%	0.74%	1.5%	2.42%
	400 (752)	-0.02%	0.08%	0.52%	1.1%	1.70%
Hydrogen	20 (68)	-0.01%	0.10%	0.61%	1.2%	2.00%
	200 (392)	-0.02%	0.05%	0.37%	0.76%	1.23%
	400 (752)	-0.02%	0.03%	0.25%	0.53%	0.86%
Water (saturated steam)	100 (212)	0.20%	-	-	-	-
	180 (356)	-	2.1%	-	-	-
	263 (505.4)	-	-	8.6%	-	-
	310 (590)	-	-	-	22%	-
	364 (687.2)	-	-	-	-	41.8%

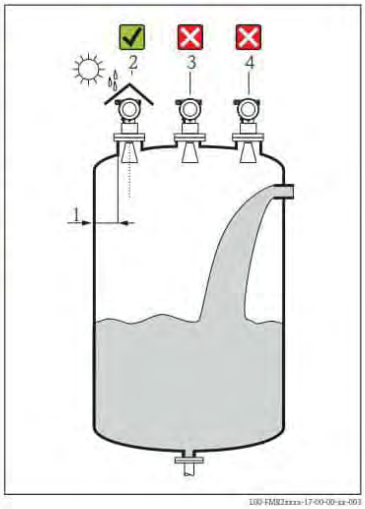
Note!
When the pressure is known and constant, this measured error can, for example, be compensated by means of linearization.

Operating conditions: Installation

Installation instructions

Orientation

- Recommended distance (1) wall – **outer edge** of nozzle: ~1/6 of tank diameter. Nevertheless the device should not be installed closer than
  – 30 cm (11.8 in) (FMR230/231)
  – 15 cm (5.91 in) (FMR240/244/245)
  to the tankwall.
- Not in the centre (3), interference can cause signal loss.
- Not above the fill stream (4).
- It is recommended to use a weather protection cover (2) in order to protect the transmitter from direct sun or rain. Assembly and disassembly is simply done by means of a tension clamp (→ 🖹 82, "Accessories").



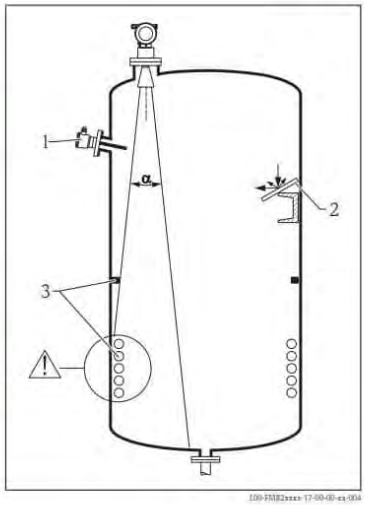
Tank installations

- Avoid any installations (1), like limit switches, temperature sensors, etc., inside the signal beam (→ 🖹 28, "Beam angle").
- Symmetrical installations (2), i.e. vacuum rings, heating coils, baffles, etc., can also interfere with the measurement.

Optimization options

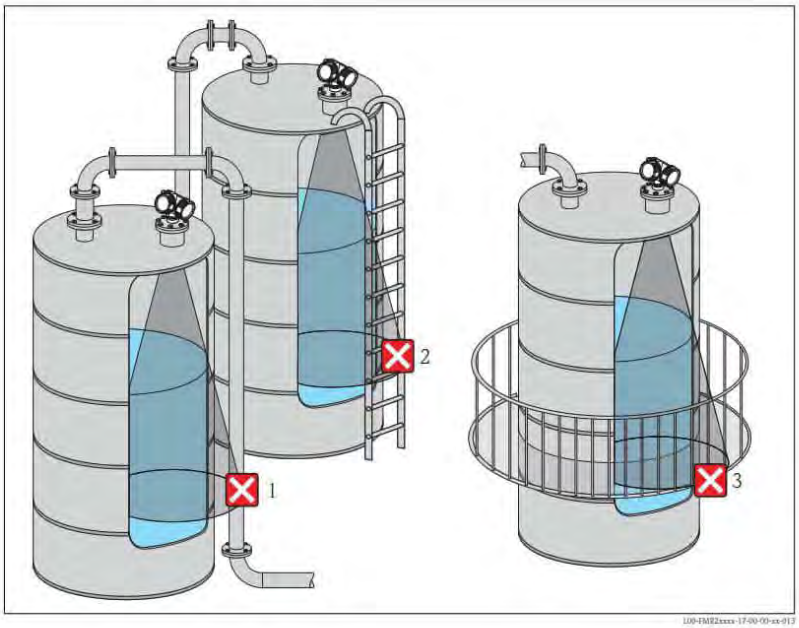
- Antenna size: the bigger the antenna, the smaller the beam angle, the less interference echoes.
- Mapping: the measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment: refer to "optimum mounting position", → 🖹 29.
- Stilling well: a stilling well can always be used to avoid interference.
- Metallic screens (3) mounted at a slope spread the radar signals and can, therefore, reduce interference echoes.

Please contact Endress+Hauser for further information.



Measurement in a plastic tank

If the outer wall of the tank is made of a non-conductive material (e.g. GRP), microwaves can also be reflected off interfering installations outside the signal beam (e.g. metallic pipes (1), ladders (2), grates (3), ...). Therefore, there should be no such interfering installations in the signal beam. Please contact Endress+Hauser for further information.

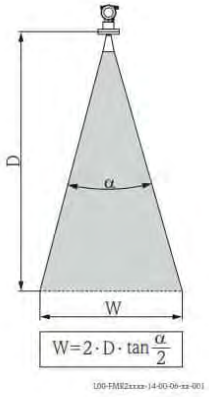


Beam angle

The beam angle is defined as the angle α where the energy density of the radar waves reaches half the value of the maximum energy density (3dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations. Beam diameter **W** as function of antenna type (beam angle **α**) and measuring distance **D**:

Antenna size (horn diameter)	FMR230			FMR231
	150 mm (6")	200 mm (8")	250 mm (10")	Rod
Beam angle α	23°	19°	15°	30°

Measuring distance (D)	Beamwidth diameter (W)			
	150 mm (6")	200 mm (8")	250 mm (10")	Rod
3 m (9.8 ft)	1,22 m (4 ft)	1,00 m (3.3 ft)	0,79 m (2.6 ft)	1,61 m (5.3 ft)
6 m (20 ft)	2,44 m (8 ft)	2,01 m (6.6 ft)	1,58 m (5.2 ft)	3,22m (11 ft)
9 m (30 ft)	3,66 m (12 ft)	3,01 m (9.9 ft)	2,37 m (7.8 ft)	4,82 m (16 ft)
12 m (39 ft)	4,88 m (16 ft)	4,02 m (13 ft)	3,16 m (10 ft)	6,43 m (21 ft)
15 m (49 ft)	6,10 m (20 ft)	5,02 m (16 ft)	3,95 m (13 ft)	8,04 m (26 ft)
20 m (66 ft)	8,14 m (27 ft)	6,69 m (22 ft)	5,27 m (17 ft)	10,72 m (35 ft)

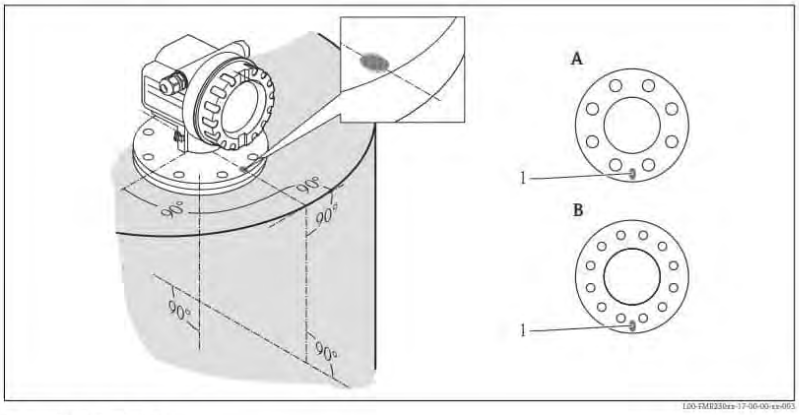


Antenna size (horn diameter)					
	FMR240	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")
	FMR244	40 mm (1½")	—	80 mm (3")	—
	FMR245	—	50 mm (2")	80 mm (3")	—
Beam angle α		23°	18°	10°	8°

Measuring distance (D)	Beamwidth diameter (W)			
	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")
3 m (9.8 ft)	1,22 m (4 ft)	0,95 m (3.1 ft)	0,53 m (1.7 ft)	0,42 m (1.4 ft)
6 m (20 ft)	2,44 m (8 ft)	1,90 m (6.2 ft)	1,05 m (3.4 ft)	0,84 m (2.8 ft)
9 m (30 ft)	3,66 m (12 ft)	2,85 m (9.4 ft)	1,58 m (5.2 ft)	1,26 m (4.1 ft)
12 m (39 ft)	4,88 m (16 ft)	3,80 m (12 ft)	2,10 m (6.9 ft)	1,68 m (5.5 ft)
15 m (49 ft)	6,10 m (20 ft)	4,75 m (16 ft)	2,63 m (8.6 ft)	2,10 m (6.9 ft)
20 m (66 ft)	8,14 m (27 ft)	6,34 m (21 ft)	3,50 m (11 ft)	2,80 m (9.2 ft)
25 m (82 ft)	10,17 m (33 ft)	7,92 m (26 ft)	4,37 m (14 ft)	3,50 m (11 ft)
30 m (98 ft)	—	9,50 m (31 ft)	5,25 m (17 ft)	4,20 m (14 ft)
35 m (115 ft)	—	11,09 m (36 ft)	6,12 m (20 ft)	4,89 m (16 ft)
40 m (131 ft)	—	12,67 m (42 ft)	7,00 m (23 ft)	5,59 m (18 ft)
45 m (148 ft)	—	—	7,87 m (26 ft)	6,29 m (21 ft)
60 m (197 ft)	—	—	10,50 m (34 ft)	8,39 m (28 ft)
70 m (230 ft)	—	—	—	9,79 m (32 ft)

Installation in tank (free space) FMR230

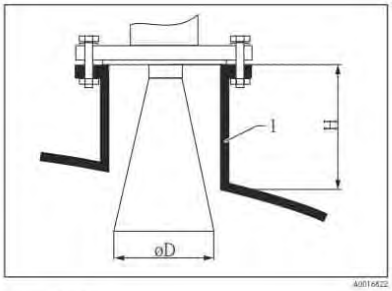
Optimum mounting position



A DN 150, ANSI 6"
B DN 200 to 250, ANSI 8 to 10"
1 Marker at device flange

Standard installation

- Observe installation instructions, → 26.
- Marker is aligned towards tank wall.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- The horn antenna must extend below the nozzle, otherwise use antenna extension FAR10.
- Align horn antenna vertically.

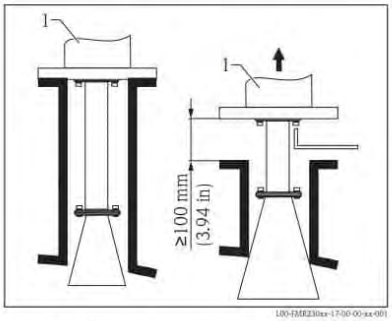


1 Nozzle

Antenna size	150 mm (6")	200 mm (8")	250 mm (10")
D [mm (in)]	146 (5.75)	191 (7.52)	241 (9.49)
H [mm (in)]	< 205 (8.07)	< 290 (11.4)	< 380 (15)

Antenna extension FAR10

- The antenna extension has to be selected such that the horn extends below the nozzle.
- If the horn diameter is greater than the nominal width of the nozzle, the antenna including the extension is mounted from inside the vessel. The bolts are tightened from outside, with the device lifted up. The extension has to be selected such that the device can be lifted by at least 100 mm (3.94 in).
- Recommended torque: 10 Nm (7.37 lbf ft).

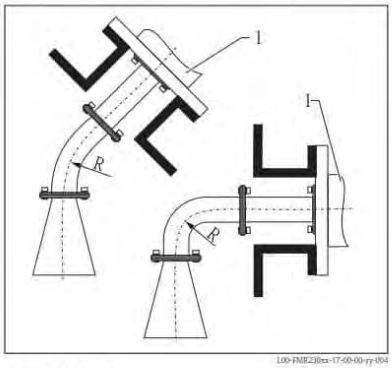


1 FMR230

Special extensions

- If the antenna has to be mounted on a sloping or vertical vessel wall, an extension with a 45° respectively 90° bend is available.
- The smallest possible radius R for the bend is 300 mm (11.8 in).

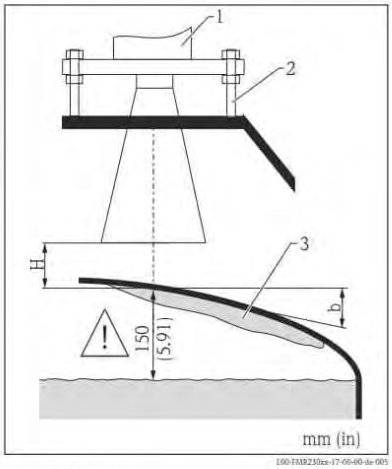
Please contact Endress+Hauser for further information.



1 FMR230

Measurement from the outside through plastic walls

- Medium with dielectric constant $\varepsilon r > 10$.
- Maximum level 15 cm (5.91 in) below tank ceiling.
- Distance H greater than 100 mm (3.94 in).
- Preferred mounting by means of stand-offs for adjustment of the ideal distance H.
- If possible, **avoid mounting location where condensation or build-up might occur**. In case of outdoor mounting, the space between antenna and vessel has to be protected from the elements.
- Optimum angle β between 15° to 20°
- Select vessel construction material with low dielectric constant and corresponding thickness. No conductive (black) plastics (refer to table).
- If possible, use an antenna DN 250 (10").
- Do not mount any potential reflectors (i.e. pipes) outside the tank in the signal beam.

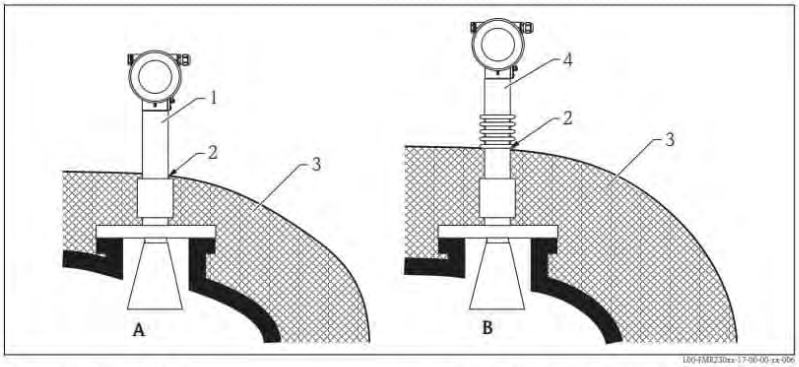


1 FMR230
2 Bolt
3 Condensation and build-up attenuate the measuring signal

Penetrated material	PE	PTFE	PP	Perspex
DK / εr	2.3	2.1	2.3	3.1
Optimum thickness [mm (in)][1]	15,7 (0.62)	16,4 (0.65)	15,7 (0.62)	13,5 (0.53)

1) Other possible values for the thickness are multiples of the values listed (i.e. E: 31,4 mm (1.24 in), 47,1 mm (1.85 in), ...)

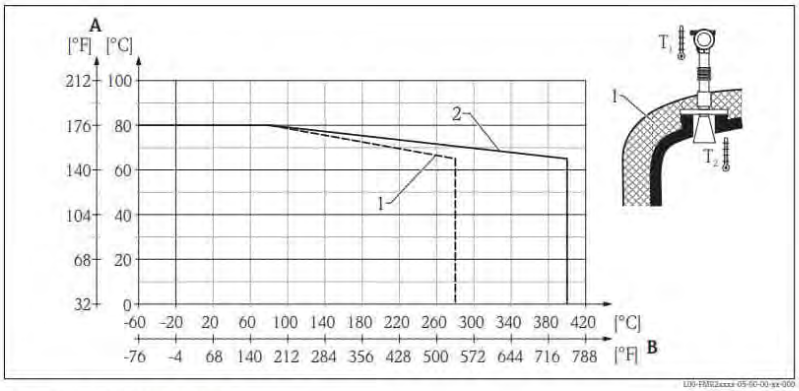
Installation FMR230 with heat insulation



A Max. 280 °C (536 °F)
B Max. 400 °C (752 °F)

1 Extended temperature version (type of antenna L)
2 MAX
3 Tank insulation
4 High temperature version (type of antenna M)

- To avoid the electronics heating up as a result of heat radiation or convection, the FMR230 must be incorporated into the tank insulation at high process temperature (≥ 200 °C (392 °F)).
- The isolation should nod exceed the points marked with "**MAX**" within the scetch.

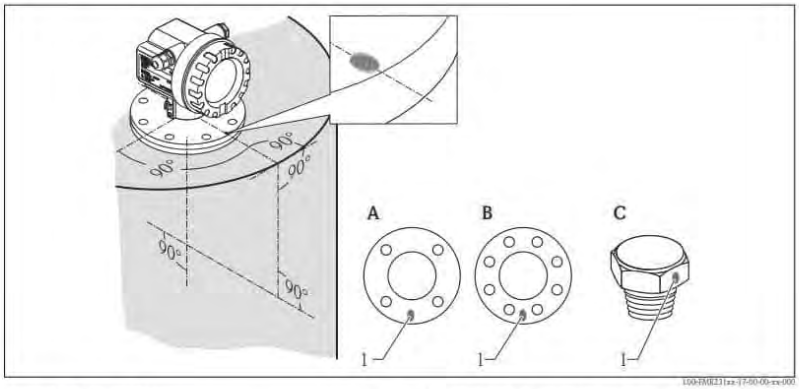


A Max. ambient temperature T_1
B Max. process connection temperature T_2
1 FMR230 with type of antenna L (extended temperature)
2 FMR230 with type of antenna M (high temperature)

For process connection temperatures (T_2) above 80 °C (176 °F), the allowed ambient temperature (T_1) at the housing is reduced according to the above diagram.

Installation in tank (free space) FMR231

Optimum mounting position

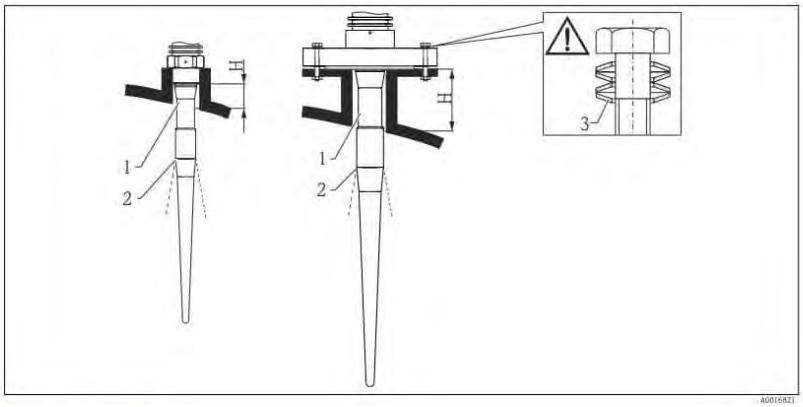


A DN 50, ANSI 2"
B DN 80 to 150, ANSI 3 to 6"
C R1½ oder 1½ NPT

1 Marker at device flange or threaded boss

Standard installation

- Observe installation instructions, → 26.
- Marker is aligned towards tank wall.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- Use spring washers (1) (see Fig.).
  Note!
  It is recommended to retighten the flange bolts periodically, depending on process temperature and pressure.
  Recommended torque: 60 to 100 Nm (44.24 to 73.75 lbf ft).
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- The inactive part of the rod antenna must extend below the nozzle.
- The rod antenna must be aligned vertically.

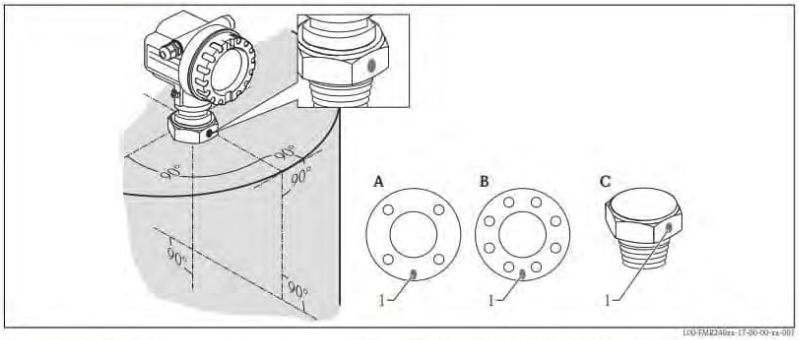


1 Inactive length
2 Beam launched here
3 Spring washers

Material	PPS		PTFE	
Antenna length [mm (in)]	360 (14.2)	510 (20.1)	390 (15.4)	540 (21.3)
H [mm (in)]	< 100 (3.94)	< 250 (9.84)	< 100 (3.94)	< 250 (9.84)

Installation in tank (free space) FMR240, FMR244, FMR245

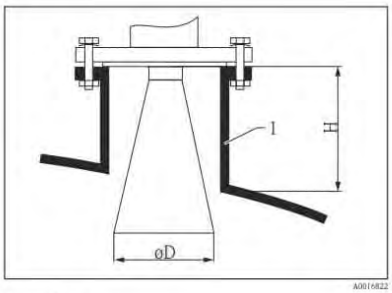
Optimum mounting position



A *DN50, ANSI 2"*
B *DN80 to 150, ANSI 3 to 6"*
C *R1½, G1½ (FMR244) oder 1½ NPT*
1 *Marker at device flange or threaded boss*

Standard installation FMR240

- Observe installation instructions, → 🖹 26.
- Marker is aligned towards tank wall.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- For optimum measurement, the horn antenna should extend below the nozzle. Select version with 100 mm (3.94 in) antenna extension if necessary. Nozzle heights up to 500 mm (19.7 in) can be accepted if this should not be possible due to mechanical reasons.
  Note!
  Please contact Endress+Hauser for application with higher nozzle.



1 *Nozzle*

- **The horn antenna must be aligned vertically.**
  Caution!
  The maximum range may be reduced, if the horn antenna is not vertically aligned.
- For mounting in solid applications use the variable flange seal to align the device towards the product surface (→ 🖹 82, "Accessories").

Antenna size	40 mm (1½")	50 mm (2")	80 mm (3")	100 mm (4")
D [mm (in)]	40 (1.57)	48 (1.85)	75 (2.95)	95 (3.74)
H [mm (in)]	< 85 (3.35)	< 115 (4.53)	< 210 (8.27)	< 280 (11)

Measurement from the outside through plastic walls

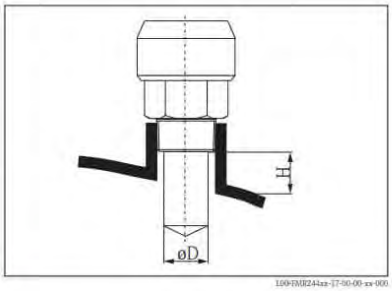
- Observe instructions, → 🖹 26.
- If possible, use an antenna 100 mm (4").

Penetrated material	PE	PTFE	PP	Perspex
DK / εr	2,3	2,1	2,3	3,1
Optimum thickness [mm (in)][1)]	3,8 (0.15)	4,0 (0.16)	3,8 (0.15)	3,3 (0.13)

1) Other possible values for the thickness are multiples of the values listed (i.e. E: 7,6 mm (0.3 in), 11,4 mm (0.45 in), ...)

Standard installation FMR244 - 40 mm (1½") antenna

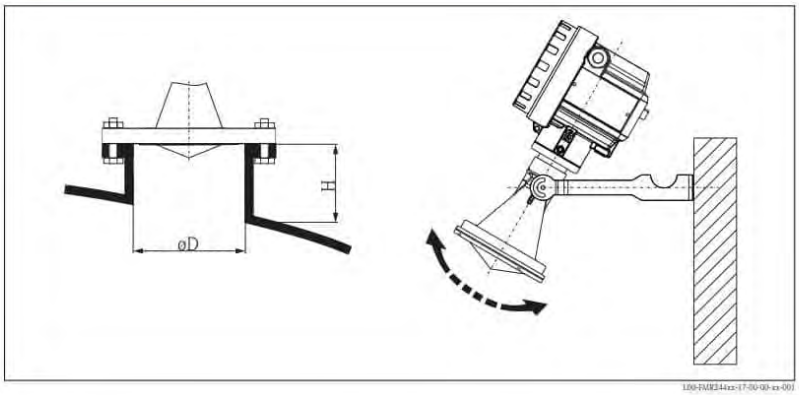
- Observe installation instructions, → 26.
- Marker is aligned towards tank wall.
- Install the device using the threaded boss (AF60) only. Observe the max. torque of 20 Nm (14.75 lbf ft).
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- For optimum measurement, the tip of the antenna should extend below the nozzle. Nozzle heights up to 500 mm (19.7 in) can be accepted if this should not be possible due to mechanical reasons.
  Note!
  Please contact Endress+Hauser for application with higher nozzle.
- The antenna must be aligned vertically.



Antenna size	40 mm (1½")
D [mm (in)]	39 (1.54)
H [mm (in)]	< 85 (3.35)

Standard installation FMR244 - 80 mm (3") antenna

- Observe installation instructions, → 26.
- Marker is aligned towards tank wall.
- The marker is located directly below the housing neck on the stainless steel feedthrough.
- As an option for flange mounting, a variable flange seal (→ 82, "Accessories") can be used to align the device (solid applications).
- If using a mounting bracket (→ 82, "Accessories"), the device can be aligned at the bracket (solid applications).
- After mounting (flange), the housing can be turned 350° in order to simplify access to the display and the terminal compartment.



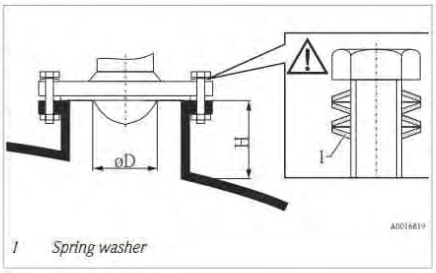
Antenna size	80 mm (3")		
D [mm (in)]	80 (3.15)	100 (3.94)	150 (5.91)
H [mm (in)]	< 500 (19.7)	< 500 (19.7)	< 500 (19.7)

Standard installation FMR245

- Observe installation instructions, → 26.
- Marker is aligned towards tank wall.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- Use spring washers (1) (see Fig.).
  Note!
  It is recommended to retighten the flange bolts periodically, depending on process temperature and pressure.
  Recommended torque: 60 to 100 Nm (44.25 to 73.75 lbf ft).
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- **The antenna must be aligned vertically.**
  Caution!
  The maximum range may be reduced, if the antenna is not vertically aligned.

Note!
Please contact Endress+Hauser for application with higher nozzle.

Antenna size	50 mm (2")	80 mm (3")
D [mm (in)]	48 (1.89)	75 (2.95)
H [mm (in)]	< 500 (19.7)	< 500 (19.7)

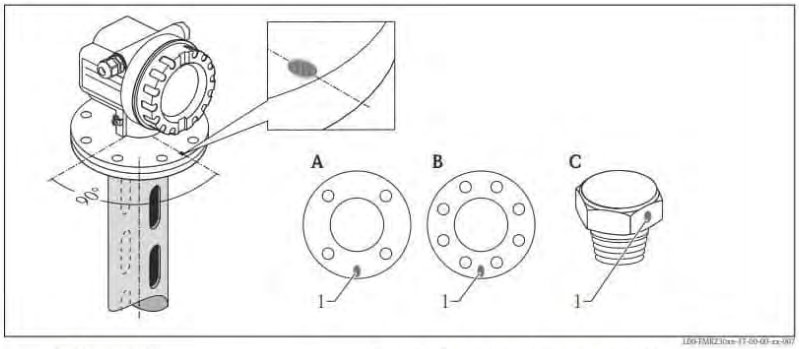


1 Spring washer

Note!
The PTFE plating of the FMR245 is used for sealing to the process. Usually no other sealing is necessary.

Installation in stilling well FMR230, FMR240, FMR244, FMR245

Optimum mounting position



A *DN 50, ANSI 2"*
B *DN 80 to 150, ANSI 3 to 6"*
C *R1½, G1½ (FMR244) oder 1½ NPT*

1 *Marker at device flange or threaded boss*

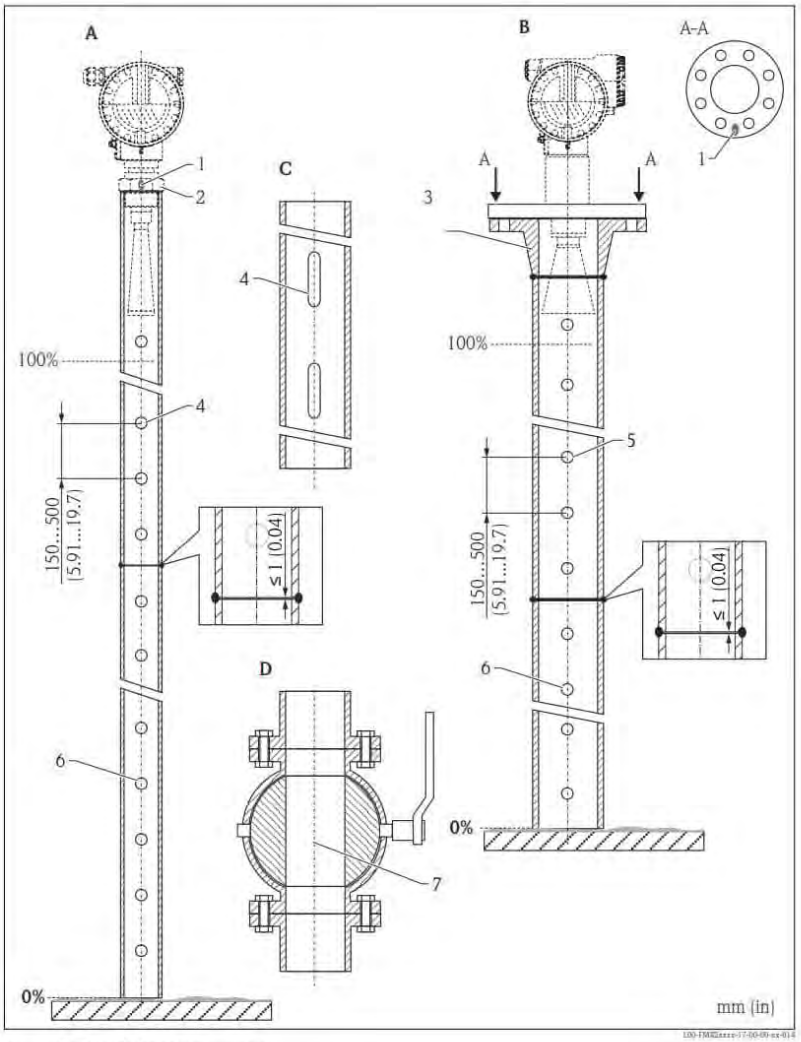
Standard installation

- Marker is aligned toward slots.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- Measurements can be performed through an open full bore ball valve without any problems.
- Additional installation instructions, → 26.

Recommendations for the stilling well

- Metal (no enamel coating, plastic on request).
- Constant diameter.
- Diameter of stilling well not larger than antenna diameter.
- Weld seam as smooth as possible and on the same axis as the slots.
- Slots offset 180° (not 90°).
- Slot width respectively diameter of holes max. 1/10 of pipe diameter, de-burred. Length and number do not have any influence on the measurement.
- Select horn antenna as big as possible. For intermediate sizes (i.e. 180 mm (7")) select next larger antenna and adapt it mechanically (FMR230/FMR240 only).
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04 in).
- The stilling well must be smooth on the inside (average roughness Rz ≤ 6.3 µm (248 µin)). Use extruded or parallel welded stainless steel pipe. An extension of the pipe is possible with welded flanges or pipe sleeves. Flange and pipe have to be properly aligned at the inside.
- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional welding through the pipe, the weld seam and any unevenness on the inside need to be carefully removed and smoothened. Otherwise, strong interference echoes will be generated and material build-up will be promoted.
- Particularly on smaller nominal widths it needs to be observed that flanges are welded to the pipe such that they allow for a correct orientation (marker aligned toward slots).

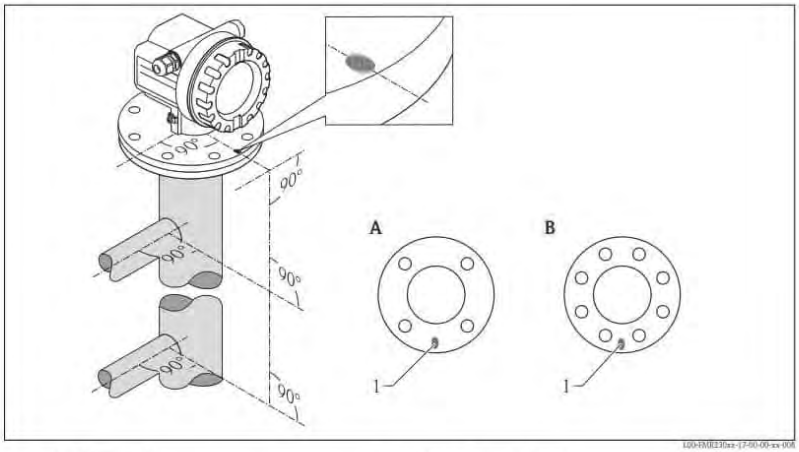
Examples for the construction of stilling wells



A FMR240, FMR244 (40 mm (1½"))
B FMR230, FMR240, FMR244 (80 mm (3")), FMR245
C Stilling well with slots
D Full bore ball valve
1 Marker
2 Threaded connection 1½"BSPT (R1½"), G1½" (FMR244) or 1½NPT
3 E.g. welding neck flange DIN2633
4 <1/10 pipe diameter
5 Hole <1/10 pipe diameter, single sided or drilled through
6 Inside of holes deburred
7 Diameter of opening of ball valve must always be equivalent to pipe diameter. Avoid edges and constrictions.

Installation in bypass FMR230, FMR240, FMR245

Optimum mounting position



A *DN 50, ANSI 2"*
B *DN 80 to 150, ANSI 3 to 6"*
1 *Marker at device flange*

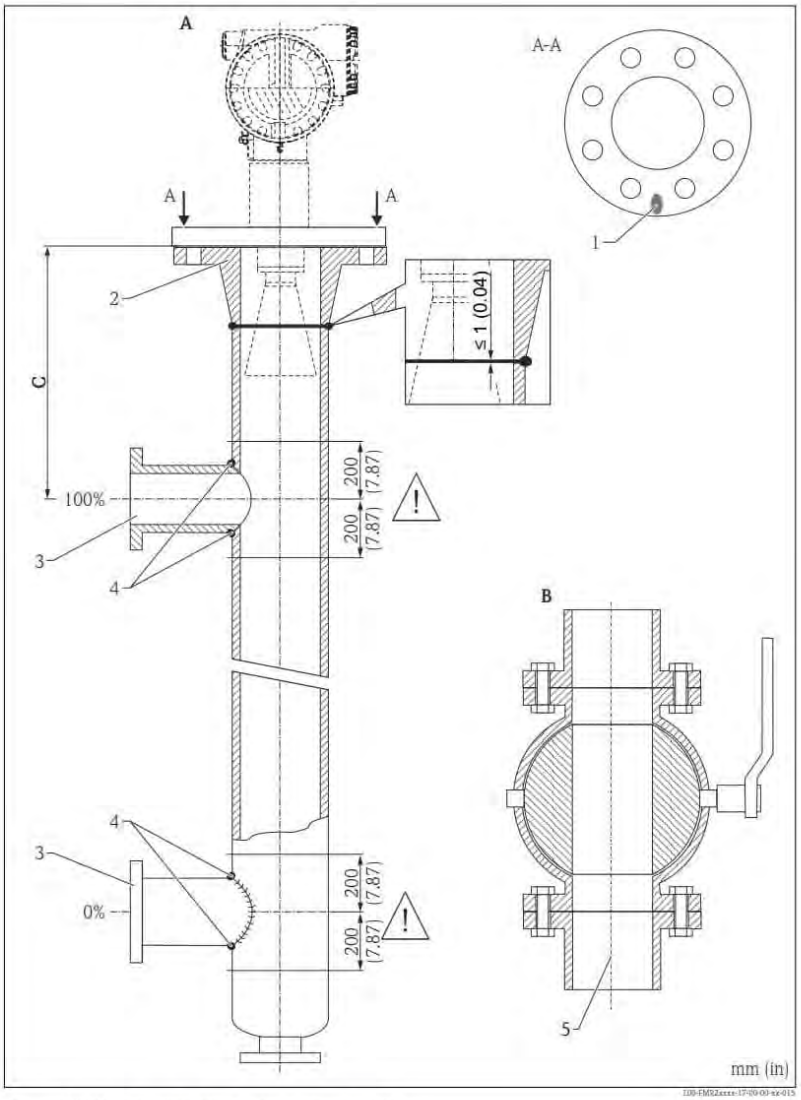
Standard installation

- Marker is aligned perpendicular (90°) to tank connectors.
- The marker is good visibly situated between the sensor neck and the bolt-holes of the flange.
- After mounting, the housing can be turned 350° in order to simplify access to the display and the terminal compartment.
- The horn must be aligned vertically.
- Measurements can be performed through an open full bore ball valve without any problems.
- Additional installation instructions, → 26.

Recommendations for the bypass pipe

- Metal (no plastic or enamel coating).
- Constant diameter.
- Select horn antenna as big as possible. For intermediate sizes (i.e. 95 mm (3.5")) select next larger antenna and adapt it mechanically (FMR230/FMR240 only).
- At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04 in).
- In the area of the tank connections (~ ±20 cm (7.87 in)) a reduced accuracy of the measurement has to be expected.

Example for the construction of a bypass.



A FMR230, FMR240, FMR244 (80 mm (3")), FMR245
B Full bore ball valve
C Recommendation: min. 400 mm (15.7 in)
1 Marker
2 E.g. welding neck flange DIN2633
3 Diameter of the connection pipes as small as possible
4 Do not weld through the pipe wall. The inside of the bypass must remain smoth.
5 Diameter of opening of ball valve must always be equivalent to pipe diameter. Avoid edges and constrictions.

Operating conditions: Environment

Ambient temperature range	Ambient temperature for the transmitter: –40 to +80 °C (–40 to +176 °F), –50 °C (–58 °F) with manufacturer declaration on request. The functionality of the LCD display may be limited for temperatures Ta < –20 °C (–4 °F) and Ta > +60 °C (+140 °F). A weather protection cover should be used for outdoor operation if the device is exposed to direct sunlight.
Storage temperature	–40 to +80 °C (–40 to +176 °F), –50 °C (–58 °F) with manufacturer declaration on request.
Climate class	DIN EN 60068-2-38 (test Z/AD)
Geometric height according to IEC61010-1 Ed.3	Up to 2 000 m (6 600 ft) above MSL. Can be expanded to 3 000 m (9 800 ft) above MSL by application of an overvoltage protection, e.g. HAW562 or HAW569.
Degree of protection	▪ With closed housing: IP65, NEMA4X (higher degree of protection e.g. IP68 on request) ▪ With open housing: IP20, NEMA1 (also ingress protection of the display) ▪ Antenna: IP68 (NEMA6P)
Vibration resistance	DIN EN 60068-2-64 / IEC 68-2-64: ▪ 20 to 2000 Hz, 1 $(m/s^2)^2/Hz$ (FMR230/231; FMR240; FMR245; FMR244 with 40 mm (1½") antenna) ▪ 20 to 2000 Hz, 0.5 $(m/s^2)^2/Hz$ (FMR244 with 80 mm (3") antenna)
Cleaning of the antenna	The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant ε_r. If the medium tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care has to be taken not to damage the antenna in the process of a mechanical or hose-down cleaning (eventually connection for cleaning liquid). The material compatibility has to be considered if cleaning agents are used! The maximum permitted temperature at the flange should not be exceeded.
Electromagnetic compatibility (EMC)	▪ Electromagnetic compatibility in accordance with all the relevant requirements of the EN 61326 series and NAMUR recommendation (NE21). For details refer to the Declaration of Conformity. Maximum deviation < 0.5% of the span. ▪ A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

Operating conditions: Process

Process temperature range/ Process pressure limits

Note!
The specified range may be reduced by the selected process connection. The pressure rating (PN) specified on the flanges refers to a reference temperature of 20 °C (68 °F), for ASME flanges to 100 °F. Observe pressure-temperature dependency.
The pressure values permitted at higher temperatures can be found in the following standards:

- EN 1092-1: 2001 Tab. 18
  With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

FMR230					
Type of antenna		**Seal**	**Temperature**	**Pressure**	**Wetted parts**
V	Standard	FKM Viton GLT	-40 to +200 °C [1] (-40 to +392 °F)	-1 to +64 bar (-14.5 to +928 psi)	PTFE, seal, 316L resp. Alloy C4
E	Standard	EPDM	-40 to +150 °C (-40 to +302 °F)		
K	Standard	Kalrez (Spectrum 6375)	-20 to +200 °C [1] (-4 to +392 °F)		
L	Extended temperature	Graphit	-60 to +280 °C (-76 to +536 °F)	-1 to +100 bar (-14.5 to +1450 psi)	Ceramic (Al_2O_3: 99,7%), Graphit, 316L
M	High temperature	Graphit	-60 to +400 °C (-76 to +752 °F)	-1 to +160 bar (-14.5 to +2320 psi)	

↑ Ordering information, → 67

1) Max. +150 °C (+302 °F) for conductive media.

FMR231					
Type of antenna		**Process connection**	**Temperature**	**Pressure**	**Wetted parts**
A, B	PPS	—	-20 to +120 °C (-4 to +248 °F)	-1 to +16 bar (-14.5 to +232 psi)	316L, Viton, PPS
E, F	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)	PVDF threaded connection	-40 to +80 °C (-40 to +176 °F)	-1 to +3 bar (-14.5 to +43.5 psi)	PVDF, PTFE
		Metal threaded connection	-40 to +150 °C (-40 to +302 °F)	-1 to +40 bar (-14.5 to +302 °F)	316L, PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)
		Flange unclad			
		Flange clad [1]		-1 to +16 bar (-14.5 to +232 psi)	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)
		Tri-Clamp 2"		-1 to +16 bar (-14.5 to +232 psi)	316L, PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)
		Tri-Clamp 3"		-1 to +10 bar (-14.5 to +145 psi)	
		Aseptic, Dairy		-1 to +25 bar (-14.5 to +362.5 psi)	

FMR231					
Type of antenna		**Process connection**	**Temperature**	**Pressure**	**Wetted parts**
H, J	PTFE antistatc (TFM4220, 2% conductive additives)	Metal threaded connection	-40 to +150 °C (-40 to +302 °F)	-1 to +40 bar (-14.5 to +302 °F)	316L, PTFE (TFM4220)
		Flange unclad			
		Flange clad [1]		-1 to +16 bar (-14.5 to +232 psi)	PTFE (TFM4220)

↑ Ordering information, → 70

1) On DN 150, 6" ANSI, JIS 150A the disc is made of antistatic PTFE (=black).

FMR240					
Type of antenna		**Seal**	**Temperature**	**Pressure**	**Wetted parts**
V	Standard	FKM Viton	-20 to +150 °C (-4 to +302 °F)	-1 to +40 bar (-14.5 to +580 psi)	PTFE, seal, 316L resp. Alloy C22
E	Standard	FKM Viton GLT	-40 to +150 °C (-40 to +302 °F)		
K	Standard	Kalrez (Spectrum 6375)	-20 to +150 °C (-4 to +302 °F)		

↑ Ordering information, → 73

FMR244					
Type of antenna		**Seal**	**Temperature**	**Pressure**	**Wetted parts**
V	Standard, completely PTFE encapsulated	FKM Viton GLT	-40 to +130 °C (-40 to +266 °F)	-1 to +3 bar (-14.5 to +43.5 psi)	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI), Viton, PVDF
S	Standard, PP clad	Silicone	-40 to +80 °C (-40 to +176 °F)		PP, Silicone, PBT

↑ Ordering information, → 76

FMR245					
Type of antenna		**Seal**	**Temperature**	**Pressure**	**Wetted parts**
B, C, F, G	Standard, PTFE clad	none	-40 to +200 °C (-40 to +392 °F)	-1 to +16 bar (-14.5 to +232 psi)	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI) [1]

↑ Ordering information, → 79

1) 3A-, EHEDG approval for Tri-Clamp process connection.

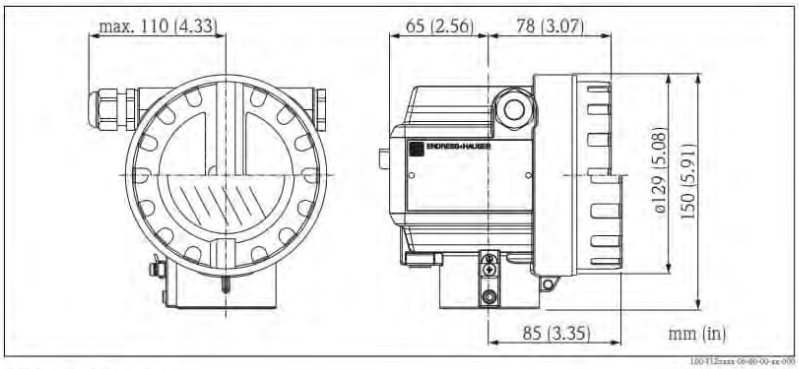
Dielectric constant

- In a stilling well: $\varepsilon r \geq 1,4$
- In free space: $\varepsilon r \geq 1,9$

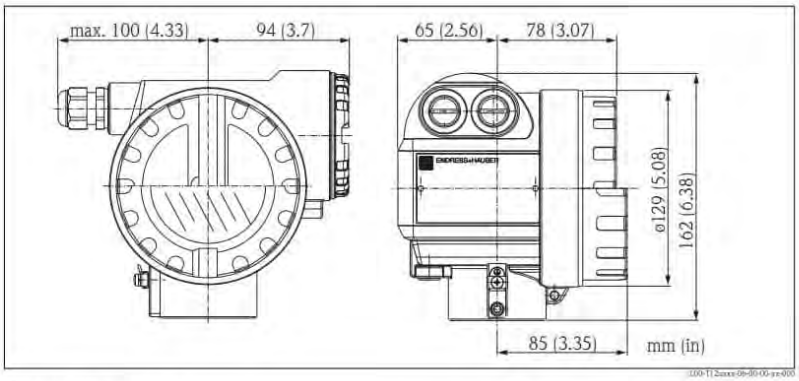
Mechanical construction

Design, dimensions

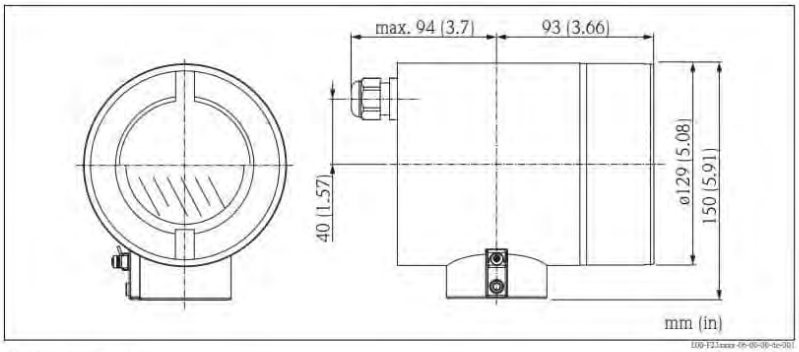
Housing dimensions



F12 housing (Aluminium)

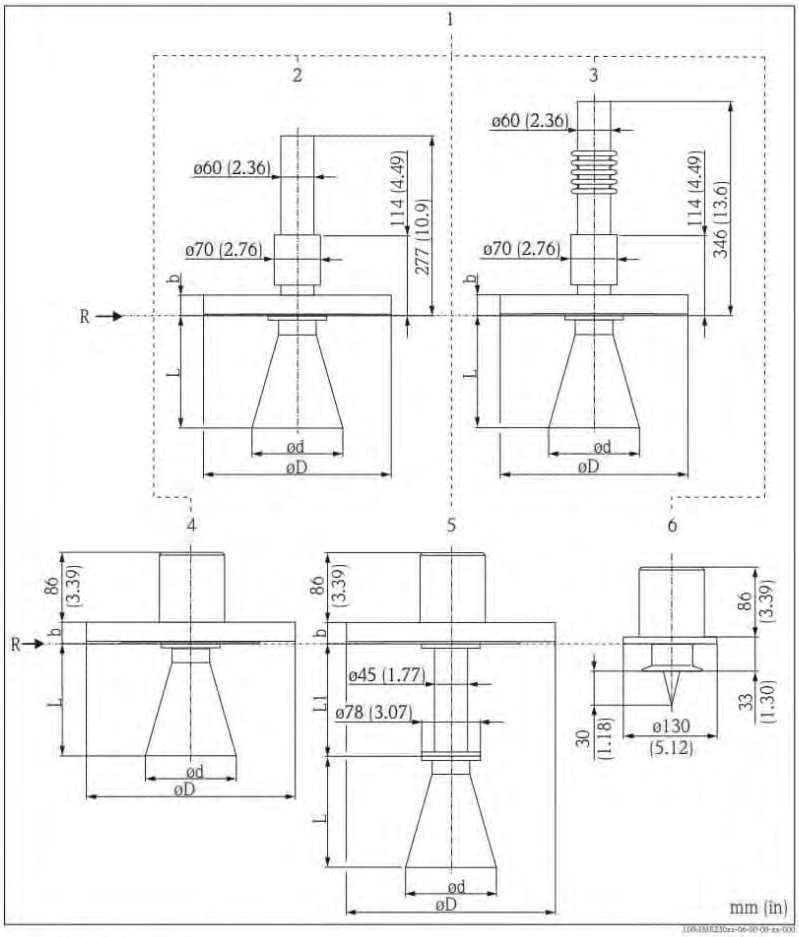


T12 housing (Aluminium)



F23 housing (316L)

Micropilot M FMR230 - Process connection and antenna



1 F12/T12/F23 housing
2 Ext. temperature version; feature 30, version L
3 High temperature version ; feature 30, version M
4 Standard antenna
5 Antenna extension
6 3" Tri-Clamp ISO 2852
R Reference point of measurement
L1 Antenna extension:
standard length 100 mm (3.94 in), 200 mm (7.87 in), 300 mm (11.8 in), 400 mm (15.7 in)

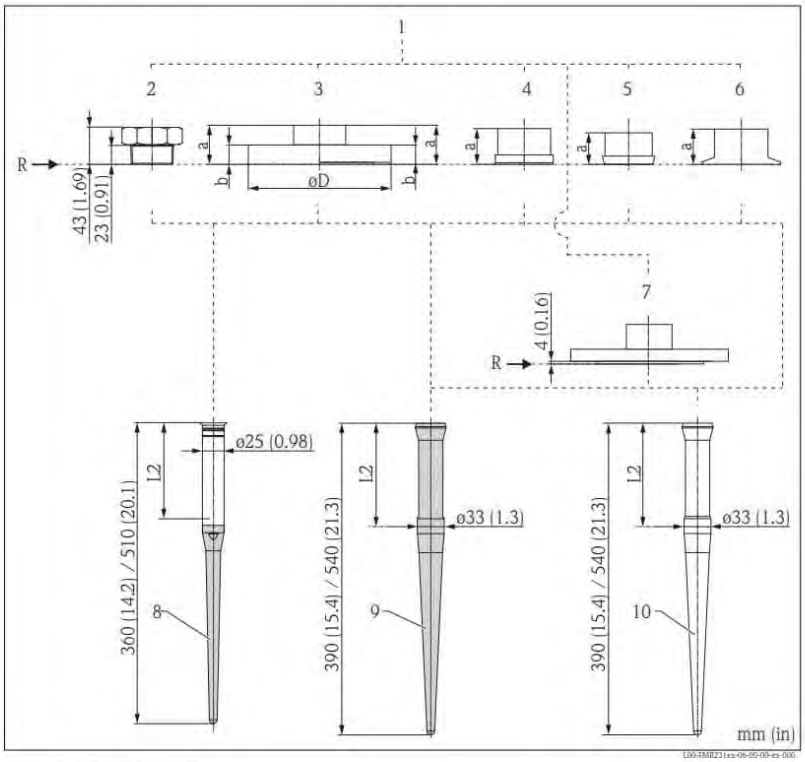
Horn antenna; mm (in)						
Antenna size		80 (3")	100 (4")	150 (6")	200 (8")	250 (10")
L	316L	68 (2.68)	105 (4.13)	185 (7.28)	268 (10.6)	360 (14.2)
	Alloy4C	74 (2.91)	119 (4.69)	204 (8.03)	289 (11.4)	379 (14.9)
d		75 (2.95)	95 (3.74)	145 (5.71)	190 (7.48)	240 (9.45)

Flange to ANSI B16.5; mm (in)						
Flange		3"	4"	6"	8"	10"
b	150 lbs	23,9 (0.94)	23,9 (0.94)	25,4 (1)	28,4 (1.12)	30,2 (1.19)
	300 lbs	28,4 (1.12)	31,8 (1.25)	-	-	-
D	150 lbs	190,5 (7.5)	228,6 (9)	279,4 (11)	342,9 (13.5)	406,4 (16)
	300 lbs	209,5 (8.25)	254 (10)	-	-	-

Flange to EN 1092-1 (agreeable to DIN 2527); mm (in)						
Flange		DN 80	DN 100	DN 150	DN 200	DN 250
b	PN16	20 (0.79)	20 (0.79)	22 (0.87)	24 (0.94)	26 (1.02)
	PN40	24 (0.94)	24 (0.94)	-	-	-
D	PN16	200 (7.87)	220 (8.66)	285 (11.2)	340 (13.4)	405 (15.9)
	PN40	200 (7.87)	235 (9.25)	-	-	-

Flange to JIS B2220; mm (in)					
Flansch	DN 80	DN 100	DN 150	DN 200	DN 250
b	18 (0.79)	18 (0.79)	22 (0.87)	22 (0.87)	24 (0.94)
D	185 (7.28)	210 (8.27)	280 (11)	330 (13)	400 (15.7)

Micropilot M FMR231 - Process connection and antenna



1 F12/T12/F23 housing
2 Threaded connection 1½"BSPT (R1½") or 1½ NPT
3 Flange DN 50 to 150 or equivalent
4 DN 50 aseptic DIN 11864-1 form A with O-ring for tubes according to DIN 11850
5 DN 50 dairy coupling DIN 11851
6 2"/3" Tri-Clamp ISO 2852
7 Flange cladded version
8 PPS, antistatic
9 PTFE, antistatic
10 PTFE, conform to FDA21 CFR177.1550 and USP<88> Class VI (in conjunction with DN 50 aseptic/diary coupling respectively Tri-Clamp)
R Reference point of measurement
L2 Inactive length, equivalent to max. nozzle height 100 mm (3.94 in), 250 mm (9.84 in)

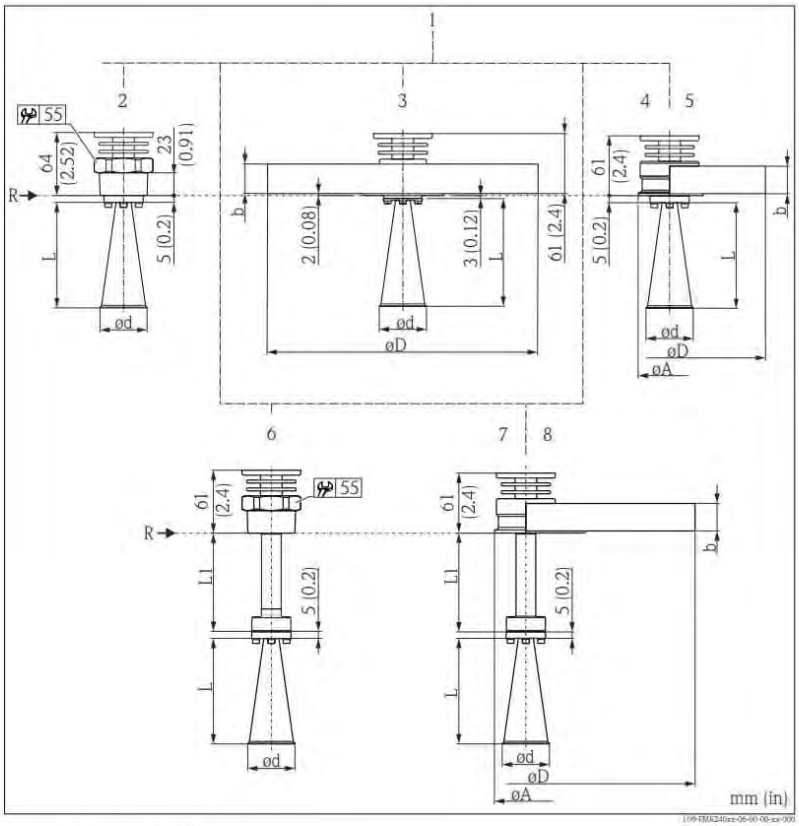
Flange to EN 1092-1 (agreeable to DIN 2527); mm (in)					
Flange		DN 50	DN8 0	DN 100	DN 150
b	PN16	20 (0.79)	20 (0.79)	20 (0.79)	22 (0.87)
	PN40	-	24 (0.94)	-	-
D	PN16	165 (6.5)	200 (7.87)	220 (8.66)	285 (11.2)
	PN40	-	200 (7.87)	-	-

Flange to ANSI B16.5; mm (in)					
Flange		2"	3"	4"	6"
b	150 lbs	19,1 (0.75)	23,9 (0.94)	23,9 (0.94)	25,4 (1)
	300 lbs	-	28,4 (1.12)	31,8 (1.25)	-
D	150 lbs	152,4 (6)	190,5 (7.5)	228,6 (9)	279,4 (11)
	300 lbs	-	209,5 (8.25)	254 (10)	-

Flange to JIS B2220 (für 10K); mm (in)				
Flange	DN 50	DN 80	DN 100	DN 150
b	16 (0.63)	18 (0.71)	18 (0.71)	22 (0.87)
D	155 (6.1)	185 (7.28)	210 (8.27)	280 (11)

Process connection; mm (in)					
Process connection		Flange DN 50 to 150	DN 50 aseptic coupling	DN 50 diary coupling	2"/3" Tri-Clamp
a	without gastight feedthrough	41 (1.61)	44,5 (1.75)	41 (1.61)	41 (1.61)
	with gastight feedthrough	77 (3.03)	80,5 (3.17)	77 (3.03)	77 (3.03)

Micropilot M FMR240 - Process connection and antenna



1 F12/T12/F23 housing
2 Screw-in adapter, compact R1½" or 1½ NPT
3 Flange plated DN 50 to 150 or equivalent
4 2"/3" Tri-Clamp ISO 2852
5 Flange DN 50 to 150 or equivalent
6 Screw-in adapter, compact R1½" or 1½ NPT
7 2"/3" Tri-Clamp ISO 2852
8 Flange DN 50 to 150 or equivalent
R Reference point of measurement
L1 With tube extension 100 mm (3.94 in)

Horn antenna; mm (in)				
Antenna size	40 (1")	50 (2")	80 (3")	100 (4")
L	86 (3.39)	115 (4.53)	211 (8.31)	282 (11.1)
d	40 (1.57)	48 (1.89)	75 (2.95)	95 (3.74)

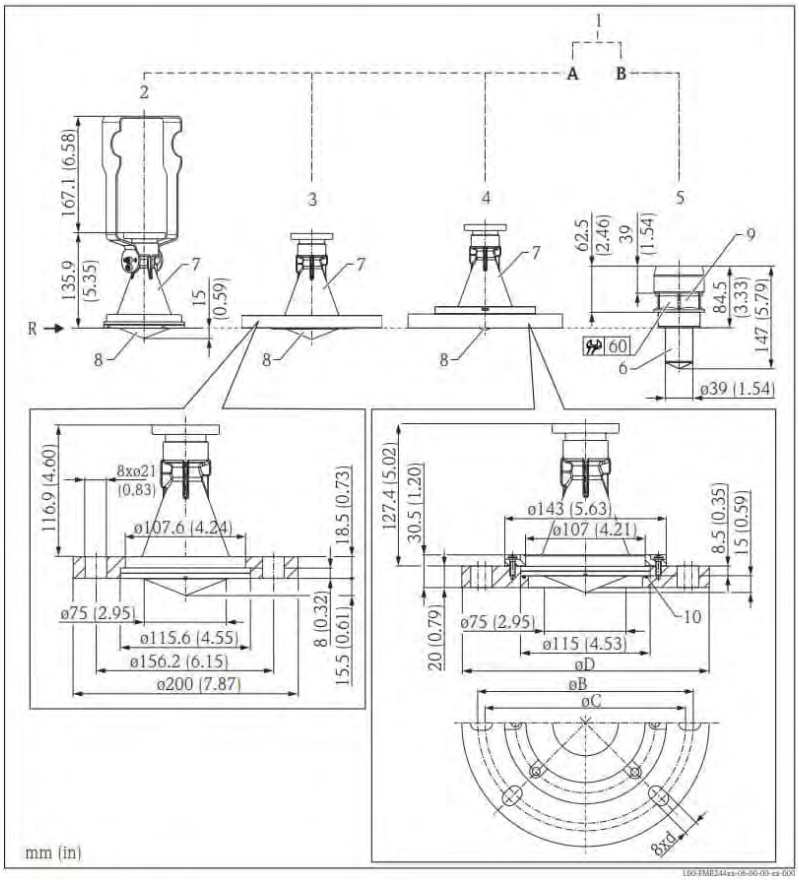
Flange to JIS B2220 (für 10K); mm (in)				
Flange	DN 50	DN 80	DN 100	DN 150
b	16 (0.63)	18 (0.71)	18 (0.71)	22 (0.87)
D	155 (6.1)	185 (7.28)	210 (8.27)	280 (11)

Flange to EN 1092-1 (passend zu DIN 2527); mm (in)					
Flange		DN 50	DN 80	DN 100	DN 150
b	PN16	18 (0.71)	20 (0.79)	20 (0.79)	22 (0.87)
	PN40	20 (0.79)	24 (0.94)	24 (0.94)	-
D	PN16	165 (6.5)	200 (7.87)	220 (8.66)	285 (11.2)
	PN40	165 (6.5)	200 (7.87)	235 (9.25)	-

Flange to ANSI B16.5; mm (in)					
Flange		2"	3"	4"	6"
b	150 lbs	19,1 (0.75)	23,9 (0.94)	23,9 (0.94)	25,4 (1)
	300 lbs	22,4 (0.88)	28,4 (1.12)	31,8 (1.25)	-
D	150 lbs	152,4 (6)	190,5 (7.5)	228,6 (9)	279,4 (11)
	300 lbs	165,1 (6.5)	209,5 (8.25)	254 (10)	-

Tri-Clamp to ISO 2852; mm (in)		
Clamp	2"	3"
A	64 (2.52)	91 (3.58)

Micropilot M FMR244 - Process connection and antenna

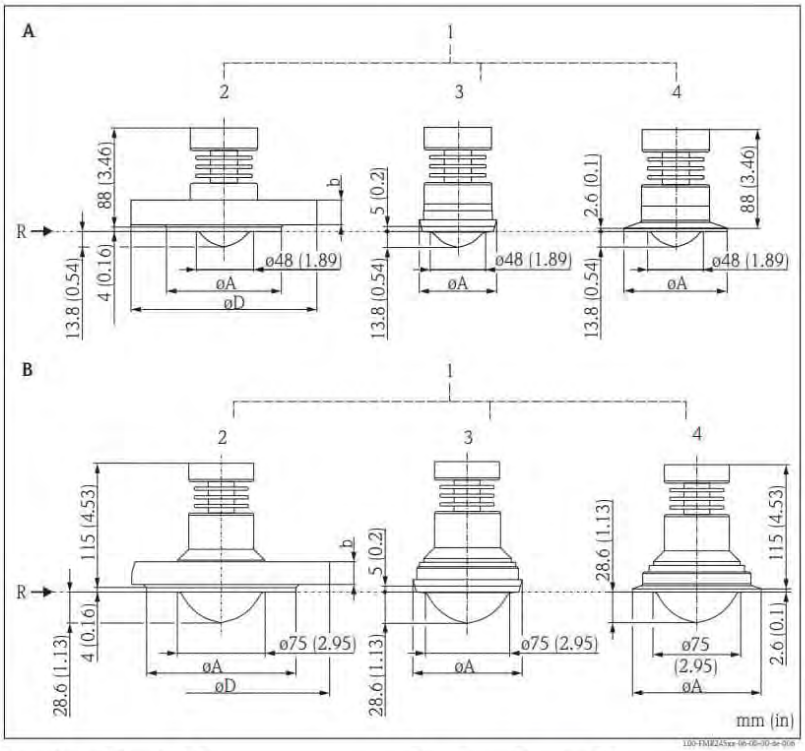


A *Feature 20, version 4*
B *Feature 20, version 2*
1 *F12/T12 housing*
2 *Standard, mounting bracket optional*[2]
3 *Endress+Hauser UNI flange DN80*[3]*; suitable for DN80 PN16 / ASME 3" 150 lbs / 10K 80*
4 *Endress+Hauser flange DN100/DN150 suitable for DN 100 PN16 / ASME 4" 150 lbs / 10K 100 and for DN 150 PN16 / ASME 6" 150lbs / 10K 150*[3]
5 *Screw-in adapter G1½", 1½ NPT*
6 *PTFE, conform to FDA21 CFR 177.1550 and USP <88> Class VI*
7 *PBT*
8 *PP*
9 *PVDF*
10 *Seal Viton*
R *Reference point of measurement*

Flange	øD	øB	øC	d
DN100	228,6 mm (9 in)	190,5 mm (7.5 in)	175 mm (6.89 in)	19 mm (0.75 in)
DN150	285 mm (11.2 in)	241,3 mm (9.5 in)	240 mm (9.45 in)	23 mm (0.91 in)

2) Housing T12: mounting limited only.
3) Installation hints: The bolt-holes have been enlarged for adaption of dimensions, therefore, the flange needs to be poperly aligned to the counterflange before the bolts are tightened.

Micropilot M FMR245 - Process connection and antenna



A	*Feature 20, version B, F*	**B**	*Feature 20, version C, G*
1	*F12/T12/F23 housing*	*1*	*F12/T12/F23 housing*
2	*Flange DN 50 or equivalent*	*2*	*Flange DN 80 or equivalent*
3	*DN 50 diary coupling DIN 11851*	*3*	*DN 80 diary coupling DIN 11851*
4	*2"/3" Tri-Clamp ISO 2852*	*4*	*4" Tri-Clamp ISO 2852*
R	*Reference point of measurement*		

Note!
Plating from PTFE (conform to FDA21 CFR 177.1550 and USP <88> Class VI):
3A / EHEDG approval with Tri-Clamp process connection.

Flange to EN 1092-1 (agreeable to DIN 2527); mm (in)					
Flange		DN 50	DN 80	DN 100	DN 150
b	PN16	20 (0.79)	20 (0.79)	20 (0.79)	22 (0.87)
D	PN16	165 (6.5)	200 (7.87)	220 (8.66)	285 (11.2)
A	PN16	102 (4.02)	138 (5.43)	158 (6.22)	212 (8.35)

Flange to ANSI B16.5; mm (in)					
Flange		2"	3"	4"	6"
b	150 lbs	19,1 (0.75)	23,9 (0.94)	23,9 (0.94)	25,4 (1)
D	150 lbs	152,4 (6)	190,5 (7.5)	228,6 (9)	279,4 (11)
A	150 lbs	92 (3.62)	127 (5)	158 (6.22)	212 (8.35)

Flange to JIS B2220 (für 10K); mm (in)				
Flange	DN 50	DN 80	DN 100	DN 150
b	16 (0.63)	18 (0.71)	18 (0.71)	22 (0.87)
D	155 (6.1)	185 (7.28)	210 (8.27)	280 (11)
A	96 (3.78)	127 (5)	151 (5.94)	212 (8.35)

Tri-Clamp; mm (in)			
Tri-Clamp	2"	3"	4"
A	64 (2.52)	91 (3.58)	119 (4.69)

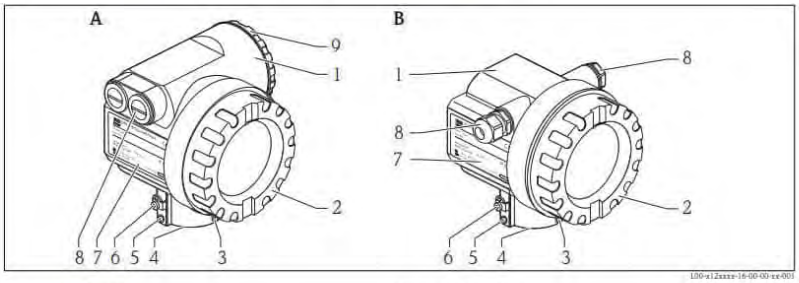
Diary coupling; mm (in)		
Diary coupling	DN 50	DN 80
A	68,5 (2.7)	100 (3.94)

Weight

Micropilot M	FMR230	FMR231	FMR240	FMR244	FMR245
F12 or T12 housing	Approx. 6 kg (13.23 lbs) + weight of flange	Approx. 4 kg (8.82 lbs) + weight of flange	Approx. 4 kg(8.82 lbs) + weight of flange	Approx. 2,5 kg (5.51 lbs)	Approx. 4 kg (8.82 lbs) + weight of flange
F23 housing	Approx. 9,4 kg (20.73 lbs) + weight of flange	Approx. 7,4 kg (16.32 lbs) + weight of flange	Approx. 7,4 kg (16.32 lbs) + weight of flange	–	Approx. 7,4 kg (16.32 lbs) + weight of flange

Material (not in contact with process)

T12 and F12 housing (seawater-resistant[1]), powder-coated)

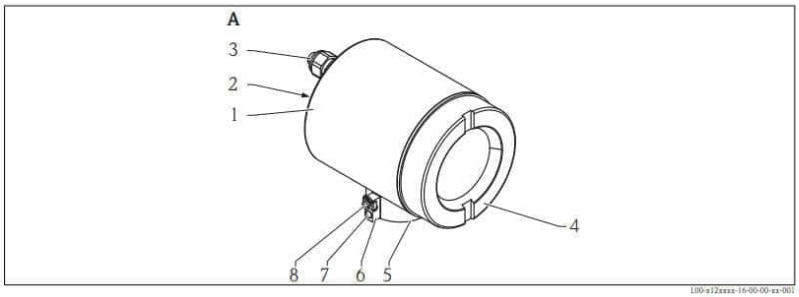


A T12 housing *B F12 housing*

Pos.	Part	Material	
1	T12 and F12 housing	AlSi10Mg	
2	Cover (Display)	AlSi10Mg	
	Sealing	Fa. SHS: EPDM 70pW FKN	
	Window	ESG-K-Glass (Toughened safety glass)	
	Sealing of the glass	Silicone sealing compound Gomastit 402	
3	Tag	304 (1.4301)	
	Rope	VA	
	Crimp sleeve	Aluminium	
4	Sealing ring	Fa. SHS: EPDM 70pW FKN	Trelleborg: EPDM E7502/E7515
5	Screws[1]	A2-70	
6	Ground terminal[1]	Screws: A2; Spring washer: A4; Clamp: 304 (1.4301) Holder: 301 (1.4310)	
7	Nameplate[1]	304 (1.4301)	
	Groove pin[1]	A2	
8	Sealing	Fa. SHS: EPDM 70 pW FKN	Trelleborg: EPDM E7502
	Cable gland	Polyamid (PA), CuZn nickel-plated	
	Plug	PBT-GF30	1.0718 galvanized
		PE	3.1655
	Adapter	316L (1.4435)	AlMgSiPb (anodized)
9	Cover (Connection compartment)	AlSi10Mg	
	Sealing	Fa. SHS: EPDM 70pW FKN	Trelleborg: EPDM E7502/E7515
	Clamp	Screws: A4; Clamp: Ms nickel-plated; Spring washer: A4	

1) Seawater-resistant on request (complete in 316L (1.4404)).

F23 housing (seawater-resistant[1]), corrosion-resistant)



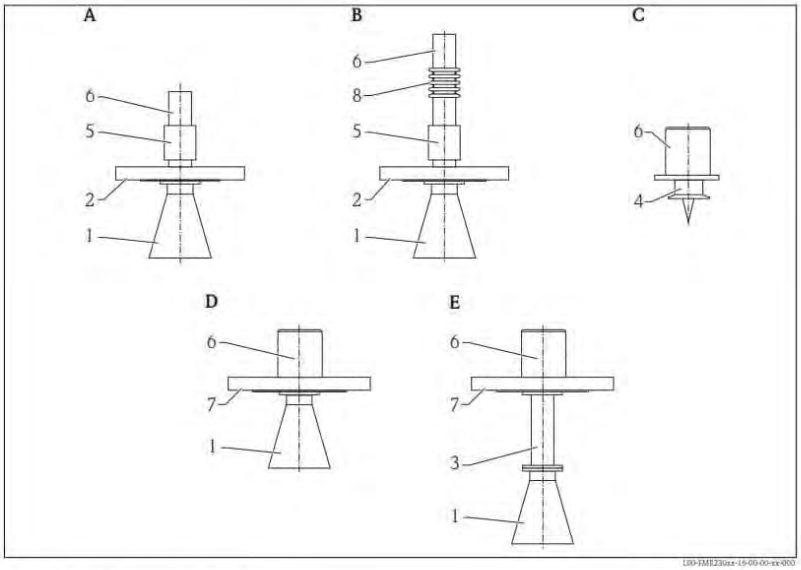
A T23 housing

Pos.	Part	Material	
1	F23 housing	Housing body: 316L (1.4404); Sensor neck: 316 L(1.4435); earth connection block: 316L (1.4435)	
2	Nameplate[1]	304 (1.4301)	
	Groove pin[1]	A2	
3	Sealing	Fa. SHS: EPDM 70pW FKN	Trelleborg: EPDM E7502
	Cable gland	Polyamid (PA), CuZn nickel-plated	
	Plug	PBT-GF30	1.0718 galvanized
		PE	3.1655
	Adapter	316L (1.4435)	
4	Cover	316L (1.4404)	
	Sealing	Fa. SHS: EPDM 70pW FKN	
	Window	ESG-K-Glass (Toughened safety glass)	
	Sealing of the glass	Silicone sealing compound Gomastit 402	
5	Sealing ring	Fa. SHS: EPDM 70pW FKN	Trelleborg: EPDM E7502
6	Tag	304 (1.4301)	
	Rope	316 (1.4401)	
	Crimp sleeve	Aluminium	
7	Screw[1]	A2-70	
8	Grounding terminal[1]	Screws: A2; Spring washer: A4; Clamp: 304 (1.4301); Holder: 301 (1.4310)	

1) Seawater-resistant on request (complete in 316L (1.4404)).

Material (in contact with process)

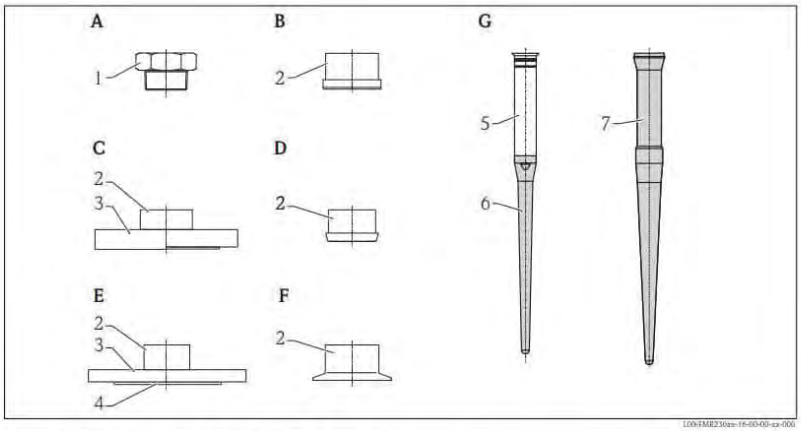
FMR230



A Extended temperature version
B High temperature version
C 3" Tri-Clamp ISO 2852
D Standard antenna
E Antenna extension

Pos.	Part	Material	
1	Horn antenna	316L (1.4404)	Hastelloy
	Screw	A4	Hastelloy
	Spring washer	A4	
2	Flange	316L (1.4404/1.4435)	
3	Antenna extension	316L (1.4435)	Hastelloy
	Screws	A4	Hastelloy
	Spring washer	A4	
4	Process connection (e.g. Tri-Clamp)	316L (1.4435)	
	Coupling		
5	Process separation	316L (1.4404)	
6	Housing adapter	304 (1.4301)	
7	Flange	316L (1.4404) optional Hastelloy plated	
	Coupling	316L (1.4435)	Hastelloy
8	Temperature reduction	304 (1.4301)	

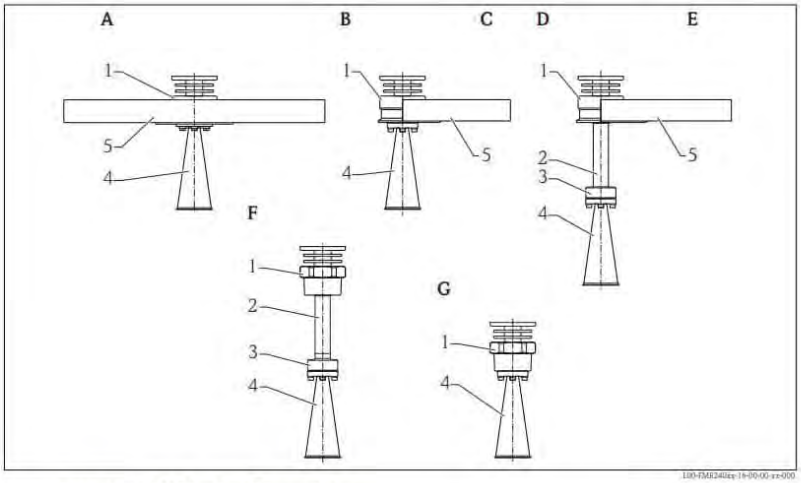
FMR231



A Threaded connection 1½" BSPT (R1½") or 1½"NPT
B DN 50 aseptic; DIN 11864-1 form A with o-ring for tubes according to DIN 11850
C Flange DN 50 to DN 150
D DN 50 diary coupling; DIN 11851
E Flange, cladded version
F 2"/3" Tri-Clamp; ISO 2852
G Antennas

Pos.	Bauteil	Werkstoff
1	Adapter	316L (1.4435)
		PVDF
2	Adapter	316L (1.4435)
3	Flange	316L (1.4404/1.4435)
4	Plating	PTFE
5	Pipe	316L (1.4435)
6	Rod antenna	PPS, antistatic
7	Rod antenna	PTFE, antistatic
		PTFE, conform to FDA 21 CFR 177.1550 and USP <88> Class VI (in conjunction with flange, DN 50 aseptic/dairy coupling respectively Tri-clamp)

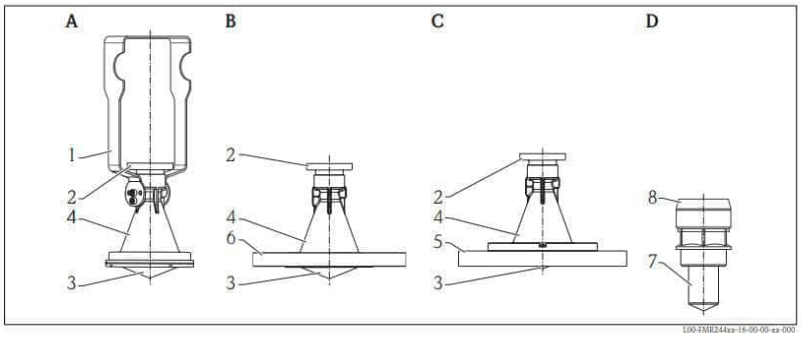
FMR240



A Flange plated, DN 50 to DN 150 or equivalent
B 2"/3" Tri-Clamp; ISO 2852
C Flange DN 50 to DN 150 or equivalent
D 2"/3" Tri-Clamp; ISO 2852
E Flange DN 50 to DN 150 or equivalent
F Screw-in adapter R1½" oder 1½"NPT
G Screw-in adapter, compact R1½" oder 1½"NPT

Pos.	Part	Material	
1	Adapter	316L (1.4404)	
	Mounting plate		
2	Pipe extension	316L (1.4404)	
3	Process adapter extension	316L (1.4404)	
	Mounting plate		
4	Horn	316L (1.4404)	Hastelloy C22
	Screws	A4	Hastelloy C22
	Spring washer	A4	
5	Flange	316L (1.4404) optional Hastelloy C22 plated	

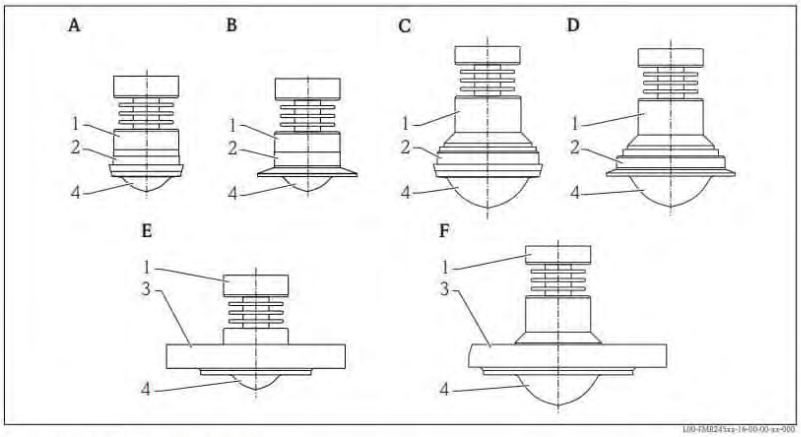
FMR244



A Standard
B Endress+Hauser UNI flange DN 80
C Endress+Hauser UNI flange DN 100/DN 150
D Screw-in adapter G1½", NPT1½"

Pos.	Part	Material
1	Mounting bracket	304 (1.4301)
	Screws	A2
	Nordlock disk	A4
2	Adapter	304 (1.4301)
3	Focusing refractor	PP
	Sealing	Silicone
4	Horn	PBT
5	Flange + adapter ring	PP
	Screws	A2
	Sealing	Viton
6	Collar flange	PP
7	Sleeve	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)
	Sealing	Viton
8	Adapter	PVDF

FMR245



A DN 50 dairy coupling; DIN 11851
B 2"/3" Tri-Clamp; ISO 2852
C DN 80 dairy coupling; DIN 11851
D 4" Tri-Clamp; ISO 2852
E Flange DN 50 or equivalent
F Flange DN 80 to DN 150 or equivalent

Pos.	Part	Material
1	Adapter	304 (1.4301)
2	Process connection	316L (1.4435)
3	Flange	316L (1.4404 / 1.4435)
4	Plating	PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI)

Flange

Endress+Hauser supplies DIN/EN flanges made of stainless steel AISI 316L with the material number 1.4404 or 1.4435. With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

Process connection

See "Ordering information", → 67.

Note!
Material process connection = material horn antenna, resp. wetted parts of the process connection.

Seal

See "Ordering information", → 67.

Antenna

See "Ordering information", → 67.

Note!
Material process connection = material horn antenna, resp. wetted parts of the process connection.

Human interface

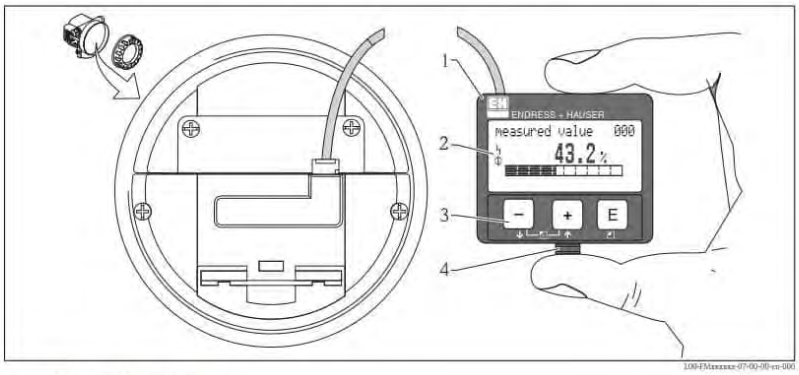
Operation concept

The display of the process value and the configuration of the Micropilot occur locally by means of a large 4-line alphanumeric display with plain text information. The guided menu system with integrated help texts ensures a quick and safe commissioning. To access the display the cover of the electronic compartment may be removed even in hazardous area (IS and XP).
Remote commissioning, including documentation of the measuring point and in-depth analysis functions, is supported via the FieldCare, the graphical operating software for Endress+Hauser time-of-flight systems.

Display elements

Liquid crystal display (LCD):

Four lines with 20 characters each. Display contrast adjustable through key combination.



1 LCD (liquid crystal display)
2 Symbols
3 3 keys
4 snap-fit

The LCD display can be removed to ease operation by simply pressing the snap-fit (see graphic above). It is connected to the device by means of a 500 mm (19.7 in) cable.

The following table describes the symbols that appear on the liquid crystal display:

Sybmol	Meaning
	ALARM_SYMBOL This alarm symbol appears when the device is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the device is locked, i.e. if no input is possible.
	COM_SYMBOL This communication symbol appears when a data transmission via e.g. HART, PROFIBUS PA or FOUNDATION Fieldbus is in progress.
	SIMULATION_SWITCH_ENABLE This communication symbol appears when simulation in FOUNDATION Fieldbus is enabled via the DIP switch.

Operating elements

The operating elements are located inside the housing and are accessible for operation by opening the lid of the housing.

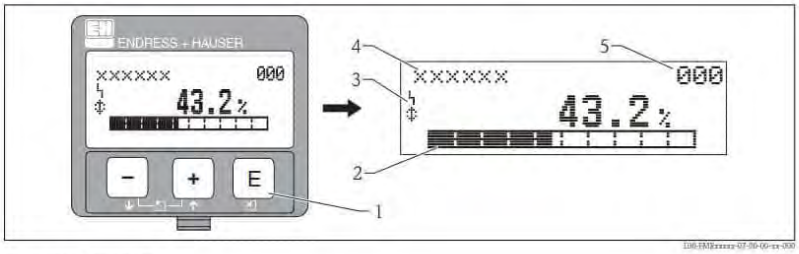
Function of the keys

Key(s)	Meaning
[+] or [↑]	Navigate upwards in the selection list. Edit numeric value within a function.
[−] or [↓]	Navigate downwards in the selection list. Edit numeric value within a function.
[ESC] [−] [+] or [←]	Navigate to the left within a function group.
[E]	Navigate to the right within a function group, confirmation.
[+] and [E] or [−] and [E]	Contrast settings of the LCD.
[+] and [−] and [E]	Hardware lock / unlock After a hardware lock, an operation of the device via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

On-site operation

Operation with device display

The LC-Display allows configuration via 3 keys directly at the device. All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration procedure.



1 *Operating keys*
2 *Bargraph*
3 *Symbols*
4 *Function name*
5 *Parameter Identification number*

Remote operation

The Micropilot M can be remotely operated via HART, PROFIBUS PA and FOUNDATION Fieldbus. On-site adjustments are also possible.

Field Xpert SFX100

Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on WindowsMobile. It offers wireless communication via the optional VIATOR Bluetooth modem as a point-to-pointconnection to a HART device, or via WiFi and Endress+Hauser's Fieldgate FXA520 to offer communication toone or more HART devices. Field Xpert also works as a stand-alone device for asset management applications.For details, refer to BA00060S/04/EN.

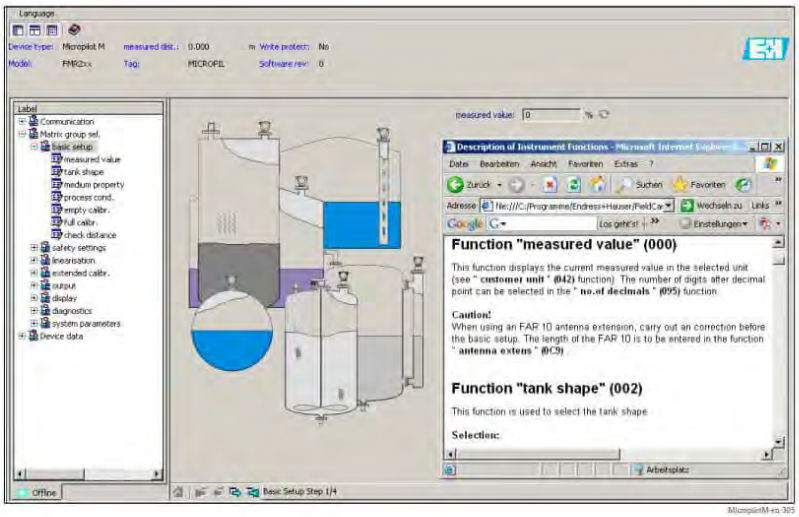
FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements you can find on the internet:
www.endress.com → select your country → search: FieldCare → FieldCare → Technical Data.

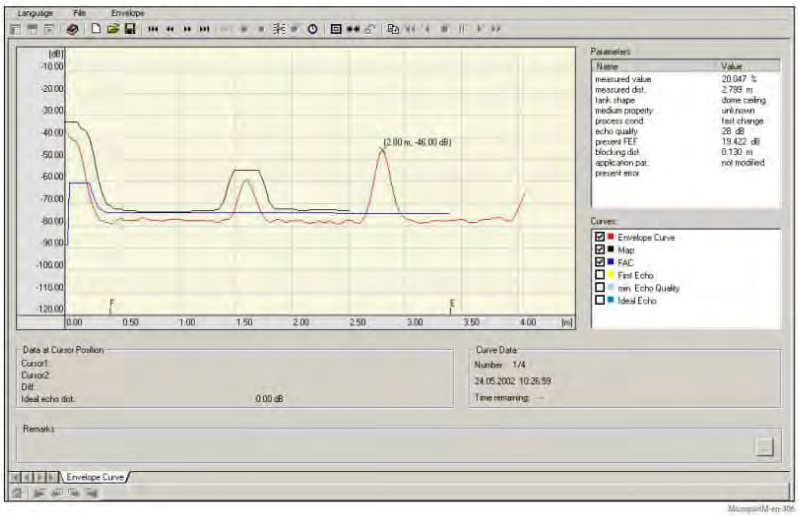
FieldCare supports the following functions:
- Configuration of transmitters in online operation
- Singal analysis via envelope curve
- Tank linearisation
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- PROFIBUS PA via segment coupler and PROFIBUS interface card
- Commubox FXA291 with ToF Adapter FXA291 (USB) via service interface

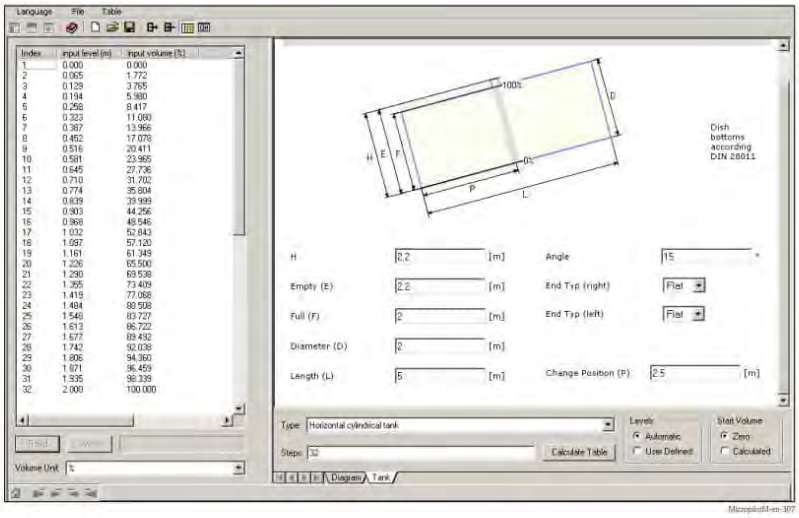
Menu-guided commissioning



Signal analysis via envelope curve



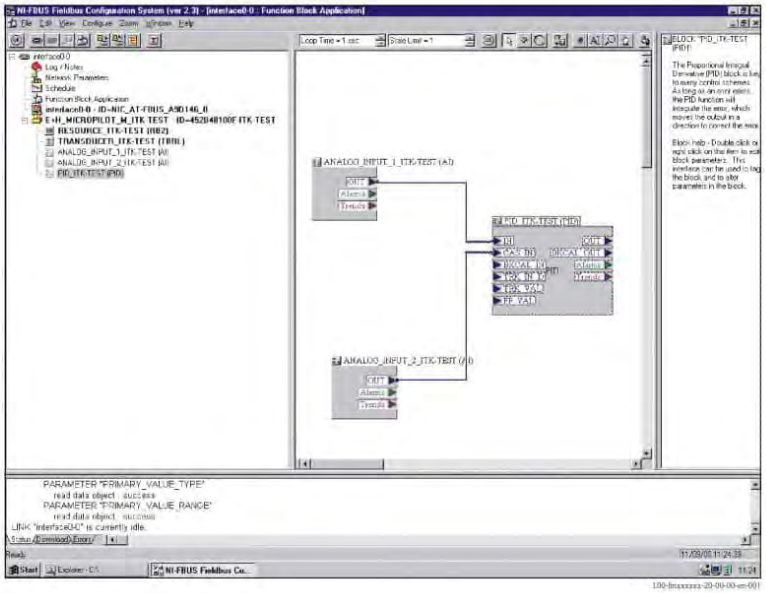
Tank linearisation



Operation with NI-FBUS configurator (only FOUNDATION Fieldbus)

The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts.

You can use the NI-FBUS Configurator to configure a fieldbus network as follows:
- Set block and device tags
- Set device addresses
- Create and edit function block control strategies (function block applications)
- Configure vendor-defined function and transducer blocks
- Create and edit schedules
- Read and write to function block control strategies (function block applications)
- Invoke Device Description (DD) methods
- Display DD menus
- Download a configuration
- Verify a configuration and compare it to a saved configuration
- Monitor a downloaded configuration
- Replace devices
- Log project download changes
- Save and print a configuration

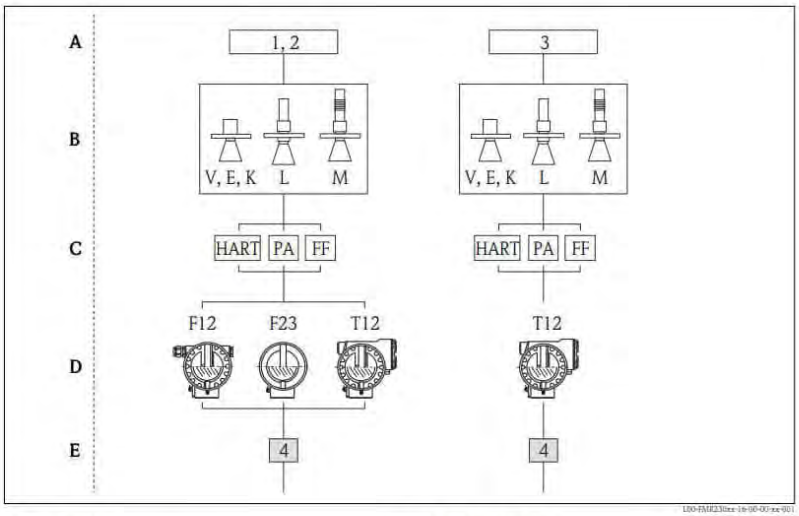


Certificates and approvals

CE approval	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the device passing the required tests by attaching the CE-mark.
Ex approval	See "Ordering information", → 67.
Sanitary compatibility	FMR231 with antenna made of PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI). FMR245 with flange cladding made of PTFE (conform to FDA 21 CFR 177.1550 and USP <88> Class VI) – 3A/EHEDG approval with Tri-clamp process connection. Note! The leak-tight connections can be cleaned with the cleaning methods usually used in this industry without leaving residues.
Overspill protection	German WHG. See "Ordering information", → 67. (see ZE00244F/00/DE). SIL 2, for 4 to 20 mA output signal (see SD00327F/00/EN "Functional Safety Manual").
Marine certificate	GL (Germanisch Lloyd), ABS, NK – HART, PROFIBUS PA – Not HT antenna
External standards and guidelines	▪ **EN 60529** Protection class of housing (IP-code). ▪ **EN 61010** Safety regulations for electrical devices for measurement, control, regulation and laboratory use. ▪ **EN 61326-X** EMC product family standard for electrical equipment for measurement, control and laboratory use. ▪ **NAMUR** User association for automation technology in process industries.
RF approvals	R&TTE, FCC
Pressure measuring device guideline	The devices of the Micropilot M product family are not subject to the scopa of the EC Directive 97/23/EC (Pressure Measuring Device Guideline).

Ordering information

Micropilot M FMR230 — **Device selection**



A	*Certificate*	*1*	*Non-hazardous area*
B	*Type of antenne / Seal*	*2*	*Ex ia IS*
C	*Communication*	*3*	*Ex em / d XP*
D	*Housing*	*4*	*Gas-tight - standard* [4]
E	*Gas-tight feed through*		

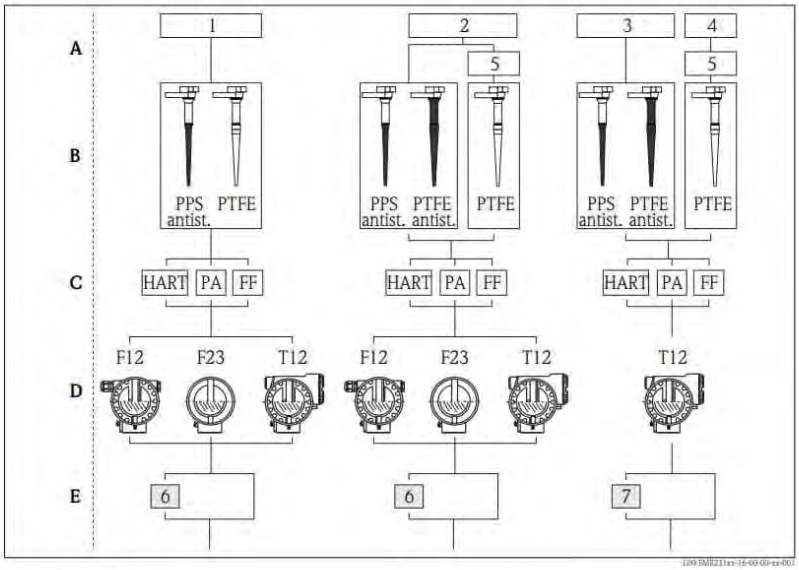
4) The gas-tight feed through of the device improves the process safety between the seal coupling the antenna to the process and the electronics compartment (connection compartment of the device).

Ordering structure Micropilot M FMR230

10	**Approval**			
	A	Non-hazardous area		
	F	Non-hazardous area, WHG		
	1	ATEX II 1/2G EEx ia IIC T6, IECEx Zone 0/1		
	2	ATEX II 1/2G EEx ia IIC T6, XA, IECEx Zone 0/1, Note safety instruction (XA) (electrostatic charging)!		
	3	ATEX II 1/2G EEx em (ia) IIC T6		
	4	ATEX II 1/2G EEx d (ia) IIC T6, IECEx Zone 0/1		
	6	ATEX II 1/2G EEx ia IIC T6, WHG, IECEx Zone 0/1		
	7	ATEX II 1/2G EEx ia IIC T6, WHG, XA, IECEx Zone 0/1, Note safety instruction (XA) (electrostatic charging)!		
	8	ATEX II 1/2G EEx em (ia) IIC T6, WHG		
	G	ATEX II 3G EEx nA II T6		
	H	ATEX II 1/2G EEx ia IIC T6, ATEX II 3D		
	S	FM IS - Cl.I Div.1 Gr. A-D, zone 0, 1, 2		
	T	FM XP - Cl.I Div.1 Group A-D, zone 1, 2		
	N	CSA General Purpose		
	U	CSA IS - Cl.I Div.1 Group A-D, zone 0, 1, 2		
	V	CSA XP - Cl.I Div.1 Group A-D, zone 1, 2		
	L	TIIS EEx d (ia) IIC T4		
	M	TIIS EEx d (ia) IIC T1		
	I	NEPSI Ex ia IIC T6		
	J	NEPSI Ex d (ia) ia IIC T6		
	R	NEPSI Ex nAL IIC T6		
	Y	Special version, TSP-no. to be spec.		
20		**Antenna**		
		1	w/o horn, for pipe installation	
		2	80mm/3"	
		3	100mm/4"	
		4	150mm/6"	
		5	200mm/8"	
		6	250mm/10"	
		Y	Special version, TSP-no. to be spec.	
30			**Antenna Seal; Temperature**	
		V	FKM Viton; -40°C...200°C/-40°F...392°F, conductive media max 150°C/302°F	
		E	EPDM; -40°C...150°C/-40°F...302°F	
		K	Kalrez; -20°C...200°C/-4°F...392°F, conductive media max 150°C/302°F	
		L	Graphit; -60°C...280°C/-76°F...536°F	
		M	Graphit; -60°C...400°C/-76°F...752°F	
		Y	Special version, TSP-no. to be spec.	
40				**Process Connection**
			CMJ	DN80 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
			CNJ	DN80 PN40 B1, 316L flange EN1092-1 (DIN2527 C)
			CQJ	DN100 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
			CQ5	DN100 PN10/16, AlloyC4 > 316Ti flange EN1092-1 (DIN2527 C)
			CRJ	DN100 PN40 B1, 316L flange EN1092-1 (DIN2527 C)
			CWJ	DN150 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
			CW5	DN150 PN10/16, AlloyC4 > 316Ti flange EN1092-1 (DIN2527)
			CXJ	DN200 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
			C6J	DN250 PN16 B1, 316L flange EN1092-1 (DIN2527 C)
			C6S	DN200 PN16, AlloyC4 > 316Ti flange EN1092-1 (DIN2527)
			UKJ	2" 300lbs RF, 316/316L flange ANSI B16.5
			ALJ	3" 150lbs RF, 316/316L flange ANSI B16.5
			AMJ	3" 300lbs RF, 316/316L flange ANSI B16.5
			APJ	4" 150lbs RF, 316/316L flange ANSI B16.5
			AQJ	4" 300lbs RF, 316/316L flange ANSI B16.5
			AVJ	6" 150lbs RF, 316/316L flange ANSI B16.5
			AV5	6" 150lbs, AlloyC4 > 316Ti flange ANSI B16.5
			A3J	8" 150lbs RF, 316/316L flange ANSI B16.5
			A35	8" 150lbs, AlloyC4 > 316Ti flange ANSI B16.5
			A5J	10" 150lbs RF, 316/316L flange ANSI B16.5
			A55	10" 150lbs, AlloyC4 > 316Ti flange ANSI B16.5
			KA2	10K 80A RF, 316Ti flange JIS B2220
			KH2	10K 100A RF, 316Ti flange JIS B2220
			KV2	10K 150A RF, 316Ti flange JIS B2220
			KD2	10K 200A RF, 316Ti flange JIS B2220
			K52	10K 250A RF, 316Ti flange JIS B2220

40	**Process Connection**	
	TL2	Tri-Clamp ISO2852 DN70-76.1 (3"), 316Ti
	UV6	6" 150lbs FF, AlloyC4, purge flange ANSI B16.5 NUS
	YY9	Special version, TSP-no. to be spec.
50	**Output; Operation**	
	A	4-20mA SIL HART; 4-line display VU331, envelope curve display on site
	B	4-20mA SIL HART; w/o display, via communication
	K	4-20mA SIL HART; Prepared for FHX40, remote display (Accessory)
	C	PROFIBUS PA; 4-line display VU331, envelope curve display on site
	D	PROFIBUS PA; w/o display, via communication
	E	FOUNDATION Fieldbus; 4-line display, envelope curve display on site
	F	FOUNDATION Fieldbus; w/o display, via communication
	Y	Special version, TSP-no. to be spec.
60	**Housing**	
	A	F12 Alu, coated IP65 NEMA4X
	B	F23 316L IP65 NEMA4X
	C	T12 Alu, coated IP65 NEMA4X, separate conn. compartment
	D	T12 Alu, coated IP65 NEMA4X+OVP, separate conn. compartment, OVP=overvoltage protection
	Y	Special version, TSP-no. to be spec.
70	**Cable Entry**	
	2	Gland M20 (EEx d > thread M20)
	3	Thread G1/2
	4	Thread NPT1/2
	5	Plug M12
	6	Plug 7/8"
	9	Special version, TSP-no. to be spec.
80	**Additional Option**	
	A	Basic version
	B	EN10204-3.1 material, watted parts (316L wetted parts) inspection certificate
	H	5-point linearity protocol, see additional spec.
	J	5-point, 3.1, NACE, 5-point linearity protocol, see additional spec., EN10204-3.1 material, NACE MR0175, (316L wetted parts) inspection certificate
	N	EN10204-3.1, material, NACE MR0175 (316L wetted parts) inspection certificate
	S	GL/ABS/NK marine certificate
	Y	Special version, TSP-no. to be spec.
995	**Marking**	
	1	Tagging (TAG), see additional spec.
	2	Bus adress, see additional spec.
FMR230-		Complete product designation

Micropilot M FMR231 **Device selection**



A Certificate
B Type of antenna / seal
C Communication
D Housing
E Gas-tight feed through

1 Non-hazardous area
2 Ex ia IS
3 Ex em / d XP
4 Ex d XP
5 Note electrostatic charging!
6 Gas-tight - standard [5)]
7 Gas-tight - standard - Essential to Ex em! [5)]

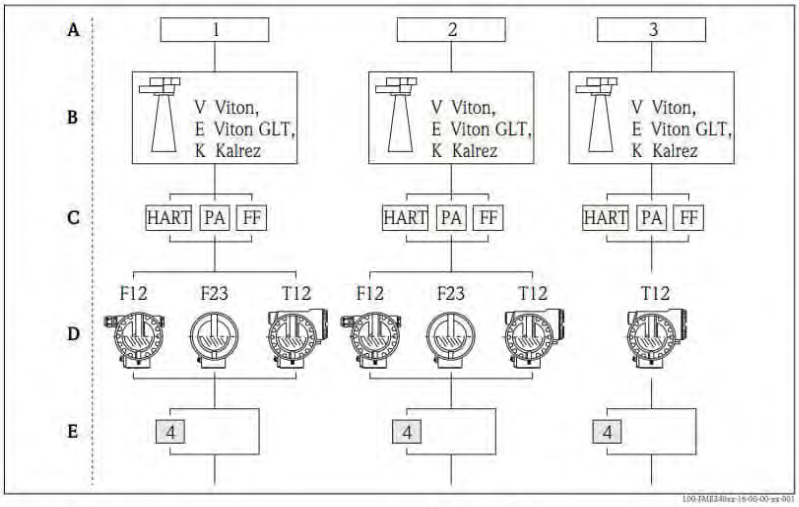
5) The gas-tight feed through of the device improves the process safety between the seal coupling the antenna to the process and the electronics compartment (connection compartment of the device).

Ordering structure Micropilot M FMR231

10			**Approval**
	A		Non-hazardous area
	F		Non-hazardous area, WHG
	1		ATEX II 1/2 G EEx ia IIC T6, IECEx Zone 0/1
	2		ATEX II 1/2 G EEx ia IIC T6, XA, IECEx Zone 0/1 Note safety instruction (XA) (electrostatic charging)!
	5		ATEX II 1/2 G EEx d (ia) IIC T6, XA, IECEx Zone 0/1 Note safety instruction (XA) (electrostatic charging)!
	6		ATEX II 1/2 G EEx ia IIC T6, WHG, IECEx Zone 0/1
	7		ATEX II 1/2 G EEx ia IIC T6, WHG, XA, IECEx Zone 0/1 Note safety instruction (XA) (electrostatic charging)!
	3		ATEX II 1/2 G EEx em (ia) IIC T6
	8		ATEX II 1/2 G EEx em (ia) IIC T6, WHG
	4		ATEX II 1/2 G EEx d (ia) IIC T, IECEx Zone 0/16
	G		ATEX II 3 G EEx nA II T6, XA, fully insutalted antenna: Note safety instruction (XA) (electrostatic charging)!
	H		ATEX II 1/2G EEx ia IIC T6, ATEX II 3D, XA, fully insutalted antenna: Note safety instruction (XA) (electrostatic charging)!
	S		FM IS - Cl.I Div.1 Gr. A-D, zone 0, 1, 2
	T		FM XP - Cl.I Div.1 Group A-D, zone 1, 2
	N		CSA General Purpose
	U		CSA IS - Cl.I Div.1 Group A-D, zone 0, 1, 2
	V		CSA XP - Cl.I Div.1 Group A-D, zonw 1, 2
	L		TIIS EEx d [ia] IIC T4
	I		NEPSI Ex ia IIC T6
	J		NEPSI Ex d (ia) ia IIC T6
	R		NEPSI Ex nAL IIC T6
	Y		Special version, TSP-no. to be spec.
20			**Antenna; Inactive Length**
	A		PPS antistatic 360mm/14", Viton, 316L; nozzle height max 100mm/4"
	B		PPS antistatic 510mm/20", Viton, 316L; nozzle height max 250mm/10"
	E		PTFE 390mm/15", fully insulated; nozzle height max 100mm/4"
	F		PTFE 540mm/21", fully insulated; nozzle height max 250mm/10"
	H		PTFE antistatic 390mm/15", fully insul.; nozzle height max 100mm/4"
	J		PTFE antistatic 540mm/21", fully insul.; nozzle height max 250mm/10"
	Y		Special version, TSP-no. to be spec.
30			**Process Connection**
		GGJ	Thread EN10226 R1-1/2, 316L
		GGS	Thread EN10226 R1-1/2, PVDF
		GNJ	Thread ANSI NPT1-1/2, 316L
		GNS	Thread ANSI NPT1-1/2; PVDF
		TEJ	Tri-Clamp ISO2852 DN40-51 (2"), 316L
		TLJ	Tri-Clamp ISO2852 DN70-76.1 (3"), 316L
		MFJ	DIN11851 DN50 PN40, slotted-nut, 316L
		HFJ	DIN11864-1 A DN50 Tube DIN11850, slotted-nut, 316L
		BFJ	DN50 PN10/16 A, 316L flange EN1092-1 (DIN2527 B)
		CFJ	DN50 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
		CFK	DN50 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)
		BMJ	DN80 PN10/16 A, 316L flange EN1092-1 (DIN2527 B)
		CMJ	DN80 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
		BNJ	DN80 PN25/40 A, 316L flange EN1092-1 (DIN2527 B)
		CNJ	DN80 PN25/40 B1, 316L flange EN1092-1 (DIN2527 C)
		CMK	DN80 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)
		BQJ	DN100 PN10/16 A, 316L flange EN1092-1 (DIN2527 B)
		CQJ	DN100 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
		CQK	DN100 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)
		BWJ	DN150 PN10/16 A, 316L flange EN1092-1 (DIN2527 B)
		CWJ	DN150 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)
		CWK	DN150 PN10/16, PTFE (black) > 316L flange EN1092-1 (DIN2527) PTFE (black) = conductive cladding
		AEJ	2" 150lbs RF, 316/316L flange ANSI B16.5
		AEK	2" 150lbs, PTFE > 316/316L flange ANSI B16.5
		ALJ	3" 150lbs RF, 316/316L flange ANSI B16.5
		AMJ	3" 300lbs RF, 316/316L flange ANSI B16.5

30			**Process Connection**							
			ALK	3" 150lbs, PTFE > 316/316L flange ANSI B16.5						
			APJ	4" 150lbs RF, 316/316L flange ANSI B16.5						
			AQJ	4" 300lbs RF, 316/316L flange ANSI B16.5						
			APK	4" 150lbs, PTFE > 316/316L flange ANSI B16.5						
			AVJ	6" 150lbs RF, 316/316L flange ANSI B16.5						
			AVK	6" 150lbs, PTFE (black) > 316/316L flange ANSI B16.5 PTFE (black) = conductive cladding						
			KEJ	10K 50A RF, 316L flange JIS B2220						
			KEK	10K 50A, PTFE > 316L flange JIS B2220						
			KLJ	10K 80A RF, 316L flange JIS B2220						
			KLK	10K 80A, PTFE > 316L flange JIS B2220						
			KPJ	10K 100A RF, 316L flange JIS B2220						
			KPK	10K 100A, PTFE > 316L flange JIS B2220						
			KVJ	10K 150A RF, 316L flange JIS B2220						
			KVK	10K 150A, PTFE (black) > 316L flange JIS B2220 PTFE (black) = conductive cladding						
			YY9	Special version, TSP-no. to be spec.						
40				**Output; Operation**						
				A	4-20mA SIL HART; 4-line display VU331, envelope curve display on site					
				B	4-20mA SIL HART; w/o display, via communication					
				K	4-20mA SIL HART; Prepared for FHX40, remote display (Accessory)					
				C	PROFIBUS PA; 4-line display VU331, envelope curve display on site					
				D	PROFIBUS PA; w/o display, via communication					
				E	FOUNDATION Fieldbus; 4-line display, envelope curve display on site					
				F	FOUNDATION Fieldbus; w/o display, via communication					
				Y	Special version, TSP-no. to be spec.					
50					**Housing**					
					A	F12 Alu, coated IP65 NEMA4X				
					B	F23 316L IP65 NEMA4X				
					C	T12 Alu, coated IP65 NEMA4X, separate conn. compartment				
					D	T12 Alu, coated IP65 NEMA4X+OVP, separate conn. compartment, OVP=overvoltage protection				
					Y	Special version, TSP-no. to be spec.				
60						**Cable Entry**				
						2	Gland M20 (EEx d > thread M20)			
						3	Thread G1/2			
						4	Thread NPT1/2			
						5	Plug M12			
						6	Plug 7/8"			
						9	Special version, TSP-no. to be spec.			
70							**Gas-Tight Feed Through**			
							A	Not selected		
							C	Selected, TSP-no. to be spec.		
80								**Additional Option**		
								A	Basic version	
								B	EN10204-3.1 material, watted parts, (316L wetted parts) inspection certificate	
								C	EN10204-3.1 material, pressurized, (316/316L pressurized) inspection certificate	
								H	5-point linearity protocol, see additional spec.	
								J	5-point, 3.1, wetted parts 5-point linearity protocol, see additional spec., EN10204-3.1 material, wetted parts, (316L wetted parts) inspection certificate	
								K	5-point, 3.1, pressurized, 5-point linearity protocol, see additional spec., EN10204-3.1 material, pressurized, (316/316L pressurized) inspection certificate	
								S	GL/ABS/NK marine certificate	
								Y	Special version, TSP-no. to be spec.	
995									**Marking**	
									1	Tagging (TAG), see additional spec.
									2	Bus adress, see additional spec.
FMR231-										Complete product designation

Micropilot M FMR240 **Device selection**



A *Certificate*
B *Type of antenne / Seal*
C *Communication*
D *Housing*
E *Gas-tight feed through*

1 *Non-hazardous area*
2 *Ex ia IS*
3 *Ex em / d XP*
4 *Gas-tight - standard* [6]

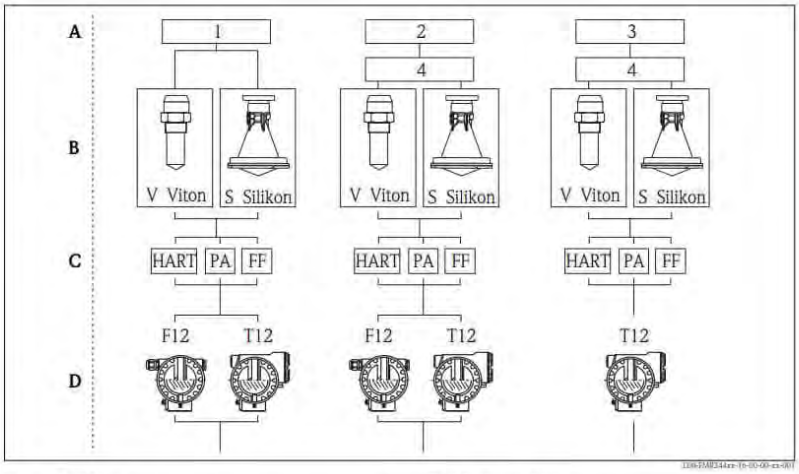
6) The gas-tight feed through of the device improves the process safety between the seal coupling the antenna to the process and the electronics compartment (connection compartment of the device).

Ordering structure Micropilot M FMR240

10						**Approval**	
	A					Non-hazardous area	
	F					Non-hazardous area, WHG	
	1					ATEX II 1/2G EEx ia IIC T6	
	6					ATEX II 1/2G EEx ia IIC T6, WHG	
	3					ATEX II 1/2G EEx em (ia) IIC T6	
	8					ATEX II 1/2G EEx em (ia) IIC T6, WHG	
	4					ATEX II 1/2G EEx d (ia) IIC T6	
	B					ATEX II 1/2G, II 1/2D, Alu blind cover, ATEX II 1/2G EEx ia IIC T6, ATEX II 1/2D	
	H					ATEX II 1/2G EEx ia IIC T6, ATEX II 3D	
	G					ATEX II 3G EEx nA II T6	
	S					FM IS - Cl.I Div.1 Gr. A-D, zone 0, 1, 2	
	T					FM XP - Cl.I Div.1 Group A-D, zone 1, 2	
	N					CSA General Purpose	
	U					CSA IS - Cl.I Div.1 Group A-D, zone 0, 1, 2	
	V					CSA XP - Cl.I Div.1 Group A-D, zone 1, 2	
	L					TIIS EEx d (ia) IIC T4	
	D					IECEx Zone 0/1, Ex ia IIC T6	
	E					IECEx Zone 0/1, Ex d (ia) IIC T6	
	I					NEPSI Ex ia IIC T6	
	J					NEPSI Ex d (ia) ia IIC T6	
	R					NEPSI Ex nAL IIC T6	
	Y					Special version, TSP-no. to be spec.	
20						**Antenna**	
		E				40mm/1-1/2", gas-tight feed through	
		F				50mm/2", gas-tight feed through	
		G				80mm/3", gas-tight feed through	
		H				100mm/4", gas-tight feed through	
		2				40mm/1-1/2"	
		3				50mm/2"	
		4				80mm/3"	
		5				100mm/4"	
		9				Special version, TSP-no. to be spec.	
30						**Antenna Seal; Temperature**	
			V			FKM Viton; -20…150°C/-4…302°F	
			E			FKM Viton GLT; -40…150°C/-40…302°F	
			K			Kalrez; -20…150°C/-4…302°F	
			Y			Special version, TSP-no. to be spec.	
40						**Antenna Extension**	
				1		Not selected	
				2		100 mm/4"	
				9		Special version, TSP-no. to be spec.	
50						**Process Connection**	
					GGJ	Thread EN10226 R1-1/2, 316L	
					GNJ	Thread ANSI NPT1-1/2, 316L	
					TDJ	Tri-Clamp ISO2852 DN40-51 (2"), 316L	
					TLJ	Tri-Clamp ISO2852 DN70-76.1 (3"), 316L	
					CFJ	DN50 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)	
					CGJ	DN50 PN25/40 B1, 316L flange EN1092-1 (DIN2527 C)	
					CFM	DN50 PN10/16, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CGM	DN50 PN25/40, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CMJ	DN80 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)	
					CNJ	DN80 PN25/40 B1, 316L flange EN1092-1 (DIN2527 C)	
					CMM	DN80 PN10/16, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CNM	DN80 PN25/40, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CQJ	DN100 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)	
					CRJ	DN100 PN25/40 B1, 316L flange EN1092-1 (DIN2527 C)	
					CQM	DN100 PN10/16, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CRM	DN100 PN25/40, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					CWJ	DN150 PN10/16 B1, 316L flange EN1092-1 (DIN2527 C)	
					CWM	DN150 PN10/16, AlloyC22 > 316L flange EN1092-1 (DIN2527)	
					AEJ	2" 150lbs RF, 316/316L flange ANSI B16.5	
					AFJ	2" 300lbs RF, 316/316L flange ANSI B16.5	
					AEM	2" 150lbs, AlloyC22 > 316/316L flange ANSI B16.5	
					AFM	2" 300lbs, AlloyC22 > 316/316L flange ANSI B16.5	
					ALJ	3" 150lbs RF, 316/316L flange ANSI B16.5	

50	**Process Connection**	
	AMJ	3" 300lbs RF, 316/316L flange ANSI B16.5
	ALM	3" 150lbs, AlloyC22 > 316/316L flange ANSI B16.5
	AMM	3" 300lbs, AlloyC22 > 316/316L flange ANSI B16.5
	APJ	4" 150lbs RF, 316/316L flange ANSI B16.5
	AQJ	4" 300lbs RF, 316/316L flange ANSI B16.5
	APM	4" 150lbs, AlloyC22 > 316/316L flange ANSI B16.5
	AQM	4" 300lbs, AlloyC22 > 316/316L flange ANSI B16.5
	AWJ	6" 150lbs RF, 316/316L flange ANSI B16.5
	AWM	6" 150lbs, AlloyC22 > 316/316L flange ANSI B16.5
	KEJ	10K 50A RF, 316L flange JIS B2220
	KEM	10K 50A, AlloyC22 > 316L flange JIS B2220
	KLJ	10K 80A RF, 316L flange JIS B2220
	KLM	10K 80A, AlloyC22 > 316L flange JIS B2220
	KPJ	10K 100A RF, 316L flange JIS B2220
	KPM	10K 100A, AlloyC22 > 316L flange JIS B2220
	KWJ	10K 150A RF, 316L flange JIS B2220
	KWM	10K 150A, AlloyC22 > 316L flange JIS B2220
	YY9	Special version, TSP-No. to be spec.
60	**Output; Operation**	
	A	4-20mA SIL HART; 4-line display VU331, envelope curve display on site
	B	4-20mA SIL HART; w/o display, via communication
	K	4-20mA SIL HART; Prepared for FHX40, remote display (accessory)
	C	PROFIBUS PA; 4-line display VU331, envelope curve display on site
	D	PROFIBUS PA; w/o display, via communication
	E	FOUNDATION Fieldbus; 4-line display, envelope curve display on site
	F	FOUNDATION Fieldbus; w/o display, via communication
	Y	Special version, TSP-no. to be spec.
70	**Housing**	
	A	F12 Alu, coated IP65 NEMA4X
	B	F23 316L IP65 NEMA4X
	C	T12 Alu, coated IP65 NEMA4X, separate conn. compartment
	D	T12 Alu, coated IP65 NEMA4X+OVP, separate conn. compartment, OVP=overvoltage protection
	Y	Special version, TSP-no. to be spec.
80	**Cable Entry**	
	2	Gland M20 (EEx d > thread M20)
	3	Thread G1/2
	4	Thread NPT1/2
	5	Plug M12
	6	Plug 7/8"
	9	Special version, TSP-no. to be spec.
90	**Additional Option**	
	A	Basic version
	B	EN10204-3.1 material, wetted parts, (316L wetted parts) inspection certificate
	F	Advanced dynamics, max. MB=70m liquids, MB=measuring range
	G	Advanced dynamics, 3.1, NACE, max. MB=70m liquids, MB=measuring range EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	H	5-point linearity protocol, see additional spec.
	J	5-point, 3.1, NACE, 5-point linearity protocol, see additional spec., EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	L	5-point, advanced dynamics, 3.1, NACE, 5-point linearity protocol, see additional spec., Advanced dynamics, max MB=70m liquids, MB=measuring range EN10204-3.1 material, NACE MR0175, (316L wetted parts) inspection certificate
	N	EN10204-3.1 material, NACE MR0175 (316L wetted parts) inspection certificate
	S	GL/ABS/NK marine certificate
	Y	Special version, TSP-no. to be spec.
995	**Marking**	
	1	Tagging (TAG), see additional spec.
	2	Bus address, see additional spec.
FMR240-		Complete product designation

Micropilot M FMR244 **Device selection**



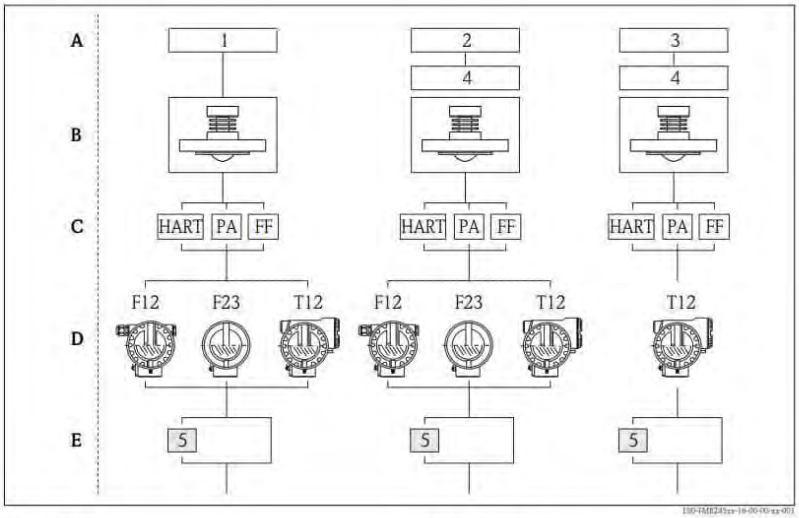
A	*Certificate*	*1*	*Non-hazardous area*
B	*Type of antenne / Seal*	*2*	*Ex ia IS*
C	*Communication*	*3*	*Ex em / d XP*
D	*Housing*	*4*	*Note electrostatic charging!*

Ordering structure Micropilot M FMR244

10	**Approval**							
	A	Non-hazardous area						
	F	Non-hazardous area, WHG						
	2	ATEX II 1/2G EEx ia IIC T6, XA note safety instruction (XA) (electrostatic charging)!						
	7	ATEX II 1/2G EEx ia IIC T6, WHG, XA note safety instruction (XA) (electrostatic charging)!						
	5	ATEX II 1/2G EEx d [ia] IIC T6, XA note safety instruction (XA) (electrostatic charging)!						
	H	ATEX II 1/2G EEx ia IIC T6, ATEX 3D, XA note safety instruction (XA) (electrostatic charging)!						
	B	ATEX II 1/2D, Alu blind cover, XA						
	C	ATEX II 1/3D, XA						
	G	ATEX II 3G EEx nA II T6						
	S	FM IS - Cl.I Div.1 Gr. A-D, zone 0, 1, 2						
	T	FM XP - Cl.I Div.1 Group A-D, zone 1, 2						
	N	CSA General Purpose						
	U	CSA IS - Cl.I Div.1 Group A-D, zone 0, 1, 2						
	V	CSA XP - Cl.I Div.1 Group A-D, zone 1, 2						
	K	TIIS EEx ia IIC T4						
	L	TIIS EEx d [ia] IIC T4						
	D	IECEx Zone 0/1, Ex ia IIC T6, XA note safety instruction (XA) (electrostatic charging)!						
	E	IECEx Zone 0/1, Ex d (ia) IIC T6, XA note safety instruction (XA) (electrostatic charging)!						
	I	NEPSI Ex ia IIC T6						
	J	NEPSI Ex d (ia) ia IIC T6						
	R	NEPSI Ex nAL IIC T6						
	Y	Special version, TSP-no. to be spec.						
20		**Antenna**						
		2	40mm/1-1/2", PTFE encapsulated					
		4	80mm/3", PP cladded					
		9	Special version, TSP-no. to be spec.					
30			**Antenna Seal; Temperature**					
			S	Silicone; -40...80°C/-40...176°F				
			V	FKM Viton GLT; -40...130°C/-40...266°F				
			Y	Special version, TSP-no. to be spec.				
40				**Process Connection**				
				GGS	Thread ISO228 G1-1/2, PVDF			
				GNS	Thread ANSI NPT1-1/2, PVDF			
				XME	Mounting bracket, 304			
				XRX	W/o slip on flange/mounting bracket, customer side connection			
				XVG	UNI slip on flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80			
				XXG	UNI slip on flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs / DN100 PN16 / 10K 100			
				X1G	UNI slip on flange 6"/DN150/150, PP max 4bar abs/58psia, suitable for 6" 150lbs / DN150 PN16 / 10K 150			
				YY9	Special version, TSP-no. to be spec.			
50					**Output; Operation**			
					A	4-20mA SIL HART; 4-line display VU331, envelope curve display on site		
					B	4-20mA SIL HART; w/o display, via communication		
					K	4-20mA SIL HART; Prepared for FHX40, remote display (Accessory)		
					C	PROFIBUS PA; 4-line display VU331, envelope curve display on site		
					D	PROFIBUS PA; w/o display, via communication		
					E	FOUNDATION Fieldbus; 4-line display, envelope curve display on site		
					F	FOUNDATION Fieldbus; w/o display, via communication		
					Y	Special version, TSP-no. to be spec.		
60						**Housing**		
						A	F12 Alu, coated IP65 NEMA4X	
						C	T12 Alu, coated IP65 NEMA4X, separate conn. compartment	
						D	T12 Alu, coated IP65 NEMA4X, separate conn. compartment, OVP=overvoltage protection	
						Y	Special version, TSP-no. to be spec.	
70							**Cable entry**	
							2	Gland M20 (EEx d > thread M20)
							3	Thread G1/2
							4	Thread NPT1/2
							5	Plug M12
							6	Plug 7/8"
							9	Special version, TSP-no. to be spec.

80	**Additional option**	
	A	Basic version
	F	Advanced dynamics, max. MB=70m liquids, max. MB=15m solids, MB=measuring range
	H	5-point linearity protocol, see additional spec.
	L	5-point, advanced dynamics, 5-point linearity protocol, see additional spec., Advanced dynamics, max MB=70m liquids, max MB=15m solids, MB=measuring range
	S	GL/ABS/NK marine certificate
	Y	Special version, TSP-no. to be spec.
995	**Marking**	
	1	Tagging (TAG), see additional spec.
	2	Bus address, see additional spec.
FMR244-		Complete product designation

Micropilot M FMR245 **Device selection**



A	*Certificate*	*1*	*Non-hazardous area*
B	*Type of antenne*	*2*	*Ex ia IS*
C	*Communication*	*3*	*Ex em / d XP*
D	*Housing*	*4*	*Note electrostatic charging*
E	*Gas-tight feed through*	*5*	*Gas-tight - standard* [7]

7) The gas-tight feed through of the device improves the process safety between the seal coupling the antenna to the process and the electronics compartment (connection compartment of the device).

Ordering structure Micropilot M FMR245

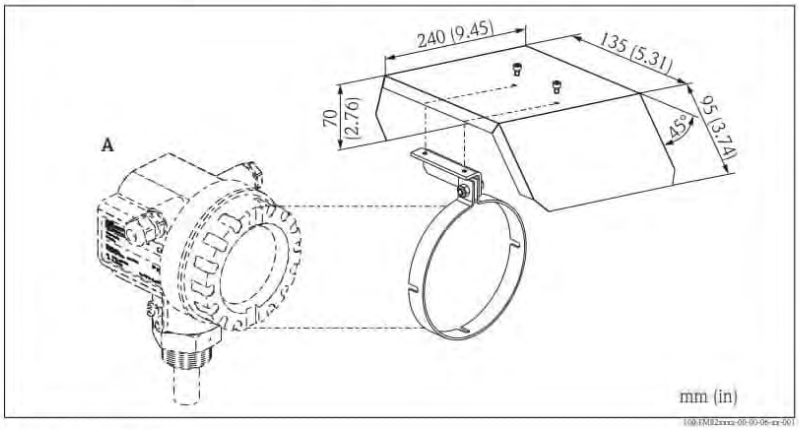
10	**Approval**				
	A	Non-hazardous area			
	F	Non-hazardous area, WHG			
	2	ATEX II 1/2G EEx ia IIC T6, XA, Note safety instruction (XA) (electrostatic charging)!			
	7	ATEX II 1/2G EEx ia IIC T6, WHG, XA, Note safety instruction (XA) (electrostatic charging)!			
	5	ATEX II 1/2G EEx d [ia] IIC T6, XA, Note safety instruction (XA) (electrostatic charging)!			
	H	ATEX II 1/2G EEx ia IIC T6, ATEX 3D, XA, Note safety instruction (XA) (electrostatic charging)!			
	B	ATEX II 1/2G, ATEX II 1/2D, XA, Alu blind cover ATEX II 1/2G EEx ia IIC T6, ATEX II 1/2D, Note safety instruction (XA) (electrostatic charging)!			
	G	ATEX II 3G EEx nA II T6, Note safety instruction (XA) (electrostatic charging)!			
	S	FM IS - Cl.I Div.1 Gr. A-D, zone 0, 1, 2			
	T	FM XP - Cl.I Div.1 Group A-D, zone 1, 2			
	N	CSA General Purpose			
	U	CSA IS - Cl.I Div.1 Group A-D, zone 0, 1, 2			
	V	CSA XP - Cl.I Div.1 Group A-D, zone 1, 2			
	K	TIIS EEx ia IIC T4			
	L	TIIS EEx d [ia] IIC T4			
	D	IECEx Zone 0/1, Ex ia IIC T6, XA, Note safety instruction (XA) (electrostatic charging)!			
	E	IECEx Zone 0/1, Ex d (ia) IIC T6, XA, Note safety instruction (XA) (electrostatic charging)!			
	I	NEPSI Ex ia IIC T6			
	J	NEPSI Ex d (ia) ia IIC T6			
	R	NEPSI Ex nAL IIC T6			
	Y	Special version, TSP-no. to be spec.			
20		**Antenna**			
		B	50mm/2", -40...200°C/-40...392°F		
		C	80mm/3", -40...200°C/-40...392°F		
		F	50mm/2", -40...200°C/-40...392°F, gas-tight feed through		
		G	80mm/3", -40...200°C/-40...392°F, gas-tight feed through		
		9	Special version, TSP-no. to be spec.		
30			**Process Connection**		
			CFK	DN50 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)	
			CMK	DN80 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)	
			CQK	DN100 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)	
			CWK	DN150 PN10/16, PTFE > 316L flange EN1092-1 (DIN2527)	
			AEK	2" 150lbs, PTFE > 316L flange ANSI B16.5	
			ALK	3" 150lbs, PTFE > 316L flange ANSI B16.5	
			APK	4" 150lbs, PTFE > 316L flange ANSI B16.5	
			AVK	6" 150lbs, PTFE > 316L flange ANSI B16.5	
			KEK	10K 50A, PTFE > 316L flange JIS B2220	
			KLK	10K 80A, PTFE > 316L flange JIS B2220	
			KPK	10K 100A, PTFE > 316L flange JIS B2220	
			KVK	10K 150A, PTFE > 316L flange JIS B2220	
			MRK	DIN11851 DN50 PN25, slotted-nut, PTFE > 316L	
			MTK	DIN11851 DN80 PN25, slotted-nut, PTFE > 316L	
			TDK	Tri-Clamp ISO2852 DN51 (2"), PTFE > 316L, 3A	
			TFK	Tri-Clamp ISO2852 DN76.1 (3"), PTFE > 316L, 3A	
			THK	Tri-Clamp ISO2852 DN101.6 (4"),PTFE > 316L, 3A	
			YY9	Special version, TSP-no. to be spec.	
40				**Output; Operation**	
				A	4-20mA SIL HART; 4-line display VU331, envelope curve display on site
				B	4-20mA SIL HART; w/o display, via communication
				K	4-20mA SIL HART; Prepared for FHX40, remote display (Accessory)
				C	PROFIBUS PA; 4-line display VU331, envelope curve display on site
				D	PROFIBUS PA; w/o display, via communication
				E	FOUNDATION Fieldbus; 4-line display, envelope curve display on site
				F	FOUNDATION Fieldbus; w/o display, via communication
				Y	Special version, TSP-no. to be spec.

50		**Housing**
	A	F12 Alu, coated IP65 NEMA4X
	B	F23 316L IP65 NEMA4X
	C	T12 Alu, coated IP65 NEMA4X, separate conn. compartment
	D	T12 Alu, coated IP65 NEMA4X+OVP, separate conn. compartment, OVP=overvoltage protection
	Y	Special version, TSP-no. to be spec.
60		**Cable Entry**
	2	Gland M20 (EEx d > thread M20)
	3	Thread G1/2
	4	Thread NPT1/2
	5	Plug M12
	6	Plug 7/8"
	9	Special version, TSP-no. to be spec.
70		**Additional Option**
	A	Basic version
	C	EN10204-3.1 material, pressurized, (316/316L pressurized) inspection certificate
	F	Advanced dynamics, max. MB=70m liquids, MB=measuring range
	G	Advanced dynamics, 3.1, max. MB=70m liquids, MB=measuring range, EN10204-3.1 material (316L pressurized) inspection certificate
	H	5-point linearity protocol, see additional spec.
	K	5-point, 3.1, pressurized, 5-point linearity protocol, see additional spec., EN10204-3.1 material, pressurized, (316/316L pressurized) inspection certificate
	L	5-point, advanced dynamics, 3.1, 5-point linearity protocol, see additional spec., Advanced dynamics, 3.1 material, max MB=70m liquids, MB=measuring range EN10204-3.1 material, (316L pressurized) inspection certificate
	S	GL/ABS/NK marine certificate
	Y	Special version, TSP-no. to be spec.
995		**Marking**
	1	Tagging (TAG), see additional spec.
	2	Bus address, see additional spec.
FMR245-		Complete product designation

Accessories

Weather protection cover

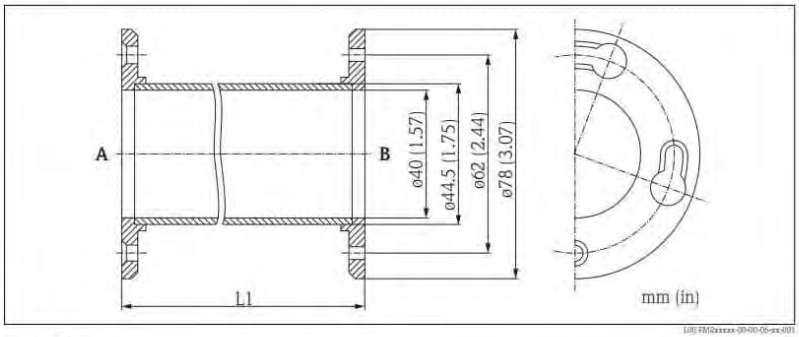
A Weather protection cover made of stainless steel is recommended for outdoor mounting (order code: 543199-0001). The shipment includes the protective cover and tension clamp.



A F12/T12 housing

Antenna extension FAR10 (for FMR230)

Dimensions



A Device
B Horn

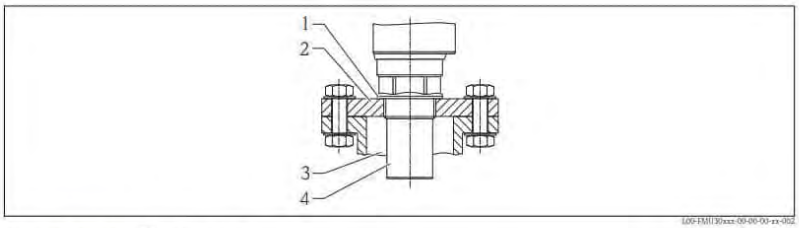
Ordering information:

010		Material
	6	316L
	7	316L + EN10204-3.1, NACE MR1075 (316L wetted parts) inspection certificate
	4	AlloyB2
	5	AlloyC4
	9	Special version, TSP-no. to be spec.

020		Extension
	A	100 mm / 4"
	B	200 mm / 8"
	C	300 mm / 12"
	D	400 mm / 16"
	Y	Special version, TSP-no to be spec.

FAR10-			Complete product designation

Screw in flange for FMR244 - 40 mm (1½") antenna



A Sealing ring EPDM (supplied)
B Screw in flange
C Sensor
D Nozzle

Ordering information:

015		Material
	BR1	DN50 PN10/16 A, steel flange EN1092-1
	BS1	DN80 PN10/16 A, steel flange EN1092-1
	BT1	DN100 PN10/16 A, steel flange EN1092-1
	JF1	2" 150lbs FF, steel flange ANSI B16.5
	JG1	3" 150lbs FF, steel flange ANSI B16.5
	JH1	4" 150lbs FF, steel flange ANSI B16.5
	JK2	8" 150lbs FF, PP max 3bar abs/44psia flange ANSI B16.5
	XIF	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIG	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XIJ	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	XJF	UNI flange 3"/DN80/80, PVDF max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJG	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XJJ	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	XKF	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XKJ	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	XLF	UNI flange 6"/DN150/150, PVDF max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLG	UNI flange 6"/DN150/150, PP max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XLJ	UNI flange 6"/DN150/150, 316L max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
	XMG	UNI flange DN200/200, PP max 4bar abs/58psia, suitable for DN200 PN16/10K 200
	XNG	UNI flange DN250/250, PP max 4bar abs/58psia, suitable for DN250 PN16/10K 250
	YYY	Special version, TSP-no to be spec.

020		Sensor Connection
	A	Thread ISO228 G3/4
	B	Thread ISO228 G1
	C	Thread ISO228 G1-1/2
	D	Thread ISO228 G2
	E	Thread ANSI NPT3/4
	F	Thread ANSI NPT1
	G	Thread ANSI NPT1-1/2
	H	Thread ANSI NPT2
	Y	Special version, TSP-no to be spec.

FAX50-			Vollständige Produktbezeichnung

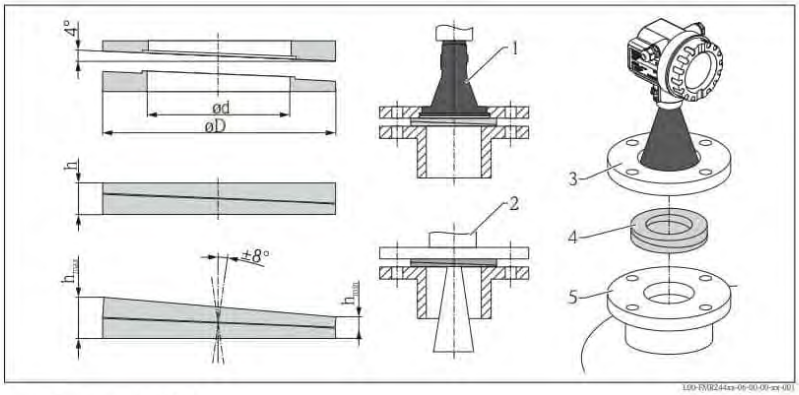
Variable flange seal for FMR244 - 80 mm (3") antenna and FMR240 -100 mm (4") horn antenna

Technical data and ordering information

Variable flange seal	DN 80	DN 100	DN 150
compatible with	DN 80 PN10-40 ANSI 3" 150lbs JIS 10K 80A	DN 100 PN10-40 ANSI 4" 150lbs JIS 10K 100A	DN 150 PN10-40 ANSI 6" 150lbs JIS 10K 150A
Material	EPDM		
Process pressure	-0.1 to 0.1bar (-1.45 to 1.45 psi)		
Process temperature	-40 to +80 °C (-40 to +176 °F)		
Order code	71074263	71074264	71074265

Note for Ex-applications:
The material and process conditions of the adjustable flange seal must fit the process properties (temperature, pressure, resistance).

Dimensions



1 E.g. FMR244 - DN 80
2 E.g. FMR240 - 100 mm (4") horn
3 UNI slip on flange
4 Variable flange seal
5 Nozzle

Variable flange seal	DN 80 [1]	DN 100 [1] [2]	DN 150 [1] [2]
D [mm (in)]	142 (5.59)	162 (6.38)	218 (8.58)
d [mm (in)]	89 (3.5)	115 (4.53)	169 (6.65)
h [mm (in)]	22 (0.87)	23.5 (0.93)	26.5 (1.04)
h_{min} [mm (in)]	14 (0.55)	14 (0.55)	14 (0.55)
h_{max} [mm (in)]	30 (1.18)	33 (1.3)	39 (1.54)

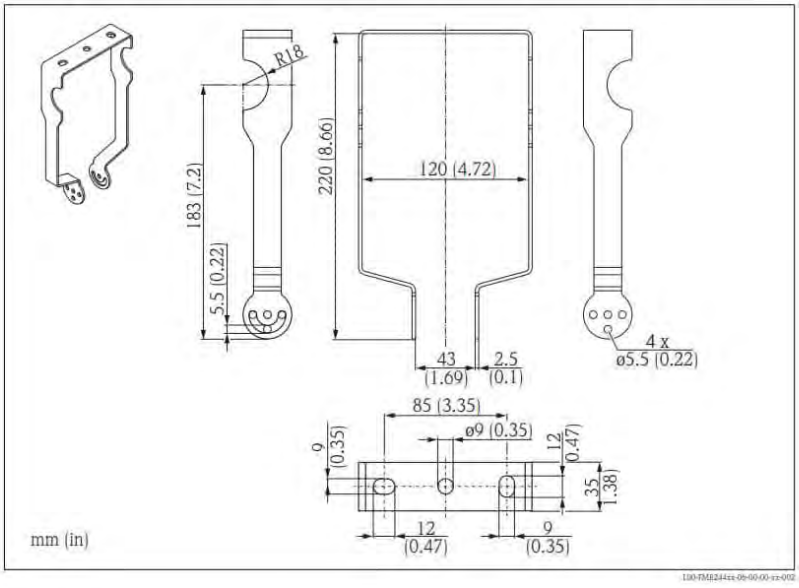
1) For FMR244 with process connection XVG, XXG or X1G (UNI slip on flange).

2) For FMR240 with 100 mm (4") horn antenna and flange mounting process connection.

Mounting bracket for FMR244

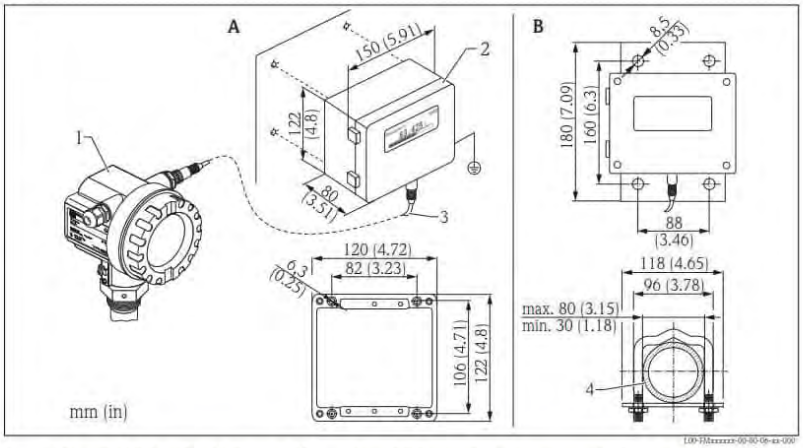
Dimensions

Mounting bracket to the alignment of FMR244 in solid applications uses(order code: 71091643).



Note!
With T12 housing it's not possible to mount the device direct at the ceiling.

Remote display FHX40



1 Micropilot M, Levelflex M, Prosonic M
2 Separate housing FHX40 (IP65)
3 Cabel
4 Pipe

A Wall mounting (without mounting bracket)
B Pipe mounting (mounting bracket and plate supplied optionally, see product structure)

Note!
For the device families Micropilot FMR2xx, Levelflex FMP4x and Prosonic FMU4x, the remote display FHX40 must be only used for the HART communication version.

Ordering information:

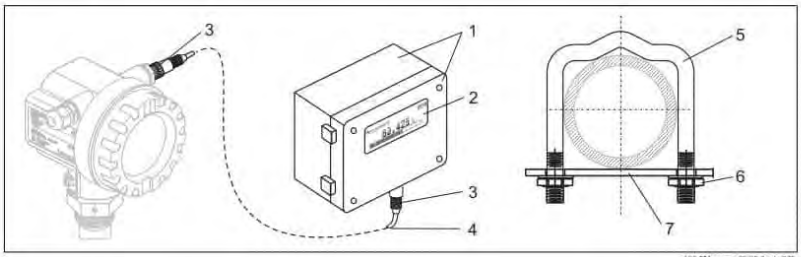
010	**Approval**					
	A	Non-hazardous area				
	2	ATEX II 2G Ex ia IIC T6				
	3	ATEX II 2D Ex ia IIIC T80°C				
	G	IECEx zone1 Ex ia IIC T6/T5				
	S	FM IS Cl.I Div.1 Gr.A-D, zone 0				
	U	CSA IS Cl.I Div.1 Gr.A-D, zone 0				
	N	CSA General Purpose				
	K	TIIS Ex ia IIC T6				
	C	NEPSI Ex ia IIC T6/T5				
	Y	Special version, TSP-no. to be spec.				
020		**Cable**				
		1	20m/65ft; for HART			
		5	20 m/65 ft (> PROFIBUS PA / FOUNDATION Fieldbus)			
		9	Special version, TSP-no. to be spec.			
030			**Additional option**			
			A	Basic version		
			B	Mounting bracket, pipe 1"/ 2"		
			Y	Special version, TSP-no. to be spec.		
995				**Marking**		
				1	Messstelle (TAG), see additional spec.	
FHX40 -						Complete product designation

For connection of the remote display FHX40 use the cable which fits the communication version of the respective instrument.

Technical data (cable and housing)

Max. cable length	20 m (66 ft) (fixed length including the cast-on plugs)
Temperature range	-40 to +60 °C (-40 to +140 °F)
Degree of protection	IP65/67 (housing); IP68 (cable) acc. to IEC 60529
Materials	Housing: AlSi12; cable glands: nickle plated brass
Dimensions [mm (in)	122x150x80 (4.8x5.91x3.15) / HxWxD

Materials



Position	Part	Material
1	Housing/Cover	AlSi12, Screw: V2A
	Ground terminal	CuZn nickel-plated, Screw: V2A
2	Display	Glass
3	Cable gland	CuZn nickel-plated
4	Cable	PVC
5	Mounting bracket	316 Ti (1.4571) or 316 L (1.4435) or 316 (1.4401)
6	Nut	V4A
7	Plate) Screw set (M5	316 Ti (1.4571) Spring washer: 301 (1.4310) or V2A Screw: V4A, Nut: V4A

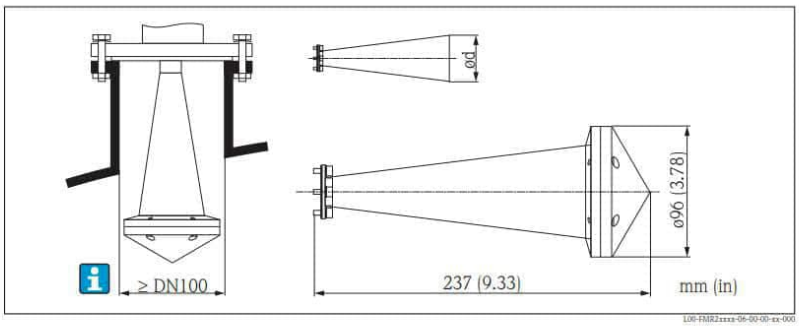
Horn cover for 80 mm (3") and 100 mm (4") horn antenna

Technical data

Materials	
Horn cover	PTFE
Screws	316L
Holding ring	316L
Contact ring	316L
O-ring seal	Silicone
Flat seal	PTFE

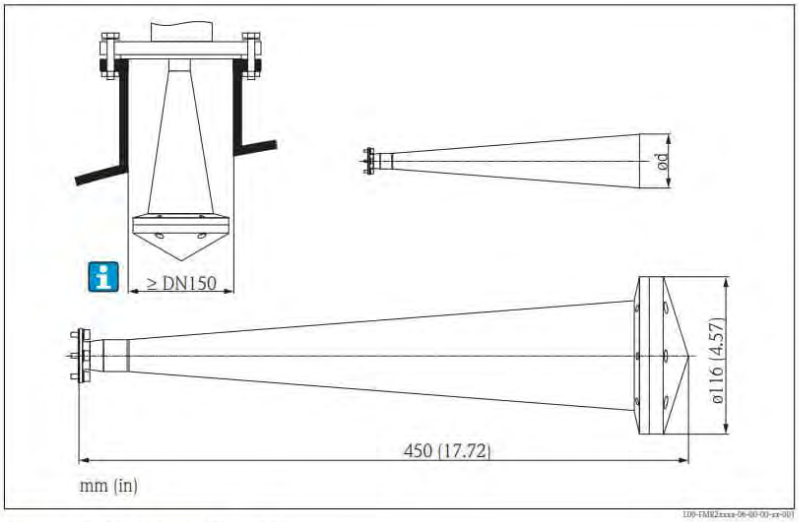
Process conditions	
Vessel pressure max.	0.5 bar (7.252 psi)
Process temperature max.	130 °C (266 °F)

Dimensions



Horn cover for horn antenna 80 mm (3")
- *For antenna diameter d = 75 mm (2.95 in)*
- *For FMR240: antenna variant G, 4*
- *For FMR250: antenna variant D*

Note!
The horn cover is not allowed to use in areas, where explosion proofed equipment is necessary.



Horn cover for horn antenna 100 mm (4")
- *For antenna diameter d = 95 mm (3.74 in)*
- *For FMR240: antenna variant H, 5*
- *For FMR250: antenna variant E*

Note!
The horn cover is not allowed to use in areas, where explosion proofed equipment is necessary.

Ordering information

Horn antenna	80 mm (3")	100 mm (4")
Order code	71105890	71105889

Commubox FXA195 HART

For intrinsically safe communication with FieldCare via the USB interface.
For details refer to TI00404F/00/EN.

Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field devices with CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a notebook.
For details refer to TI00405C/07/EN.

Note!
For the device you need the "ToF Adapter FXA291" as an additional accessory.

ToF Adapter FXA291

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal computer or a notebook to the device. For details refer to KA00271F/00/A2.

Field Xpert SFX100

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output or FOUNDATION Fieldbus.
For details refer to Operating Instructions BA00060S/04/EN

Documentation

Special Documentation

Continuous level measurement in liquids

Selection and engineering guide for the process industry, CP00023F/00/EN.

Radar Tank Gauging brochure

For inventory control and custody transfer applications in tank farms and terminals, SO00001G/00/EN.

Technical Information

Tank Side Monitor NRF590

Technical Information for Tank Side Monitor NRF590, TI00402F/00/EN.

Fieldgate FXA520

Technical Information for Fieldgate FXA520, TI00369F/00/EN.

Operating Instructions

Micropilot M

Correlation of operating instructions to the device:

Device	Output	Communication	Operating Instructions	Description of Device Functions	Brief Operating Instructions (in the device)
FMR230	A, B, K	HART	BA00218F/00/EN	BA00221F/00/EN	KA00159F/00/A2
	C, D, L	PROFIBUS PA	BA00225F/00/EN	BA00221F/00/EN	KA00159F/00/A2
	E, F, M	FOUNDATION Fieldbus	BA00228F/00/EN	BA00221F/00/EN	KA00159F/00/A2
FMR231	A, B, K	HART	BA00219F/00/EN	BA00221F/00/EN	KA00159F/00/A2
	C, D, L	PROFIBUS PA	BA00226F/00/EN	BA00221F/00/EN	KA00159F/00/A2
	E, F, M	FOUNDATION Fieldbus	BA00229F/00/EN	BA00221F/00/EN	KA00159F/00/A2
FMR240	A, B, K	HART	BA00220F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	C, D, L	PROFIBUS PA	BA00227F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	E, F, M	FOUNDATION Fieldbus	BA00230F/00/EN	BA00291F/00/EN	KA00235F/00/A2
FMR244	A, B, K	HART	BA00248F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	C, D, L	PROFIBUS PA	BA00249F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	E, F, M	FOUNDATION Fieldbus	BA00250F/00/EN	BA00291F/00/EN	KA00235F/00/A2
FMR245	A, B, K	HART	BA00251F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	C, D, L	PROFIBUS PA	BA00252F/00/EN	BA00291F/00/EN	KA00235F/00/A2
	E, F, M	FOUNDATION Fieldbus	BA00253F/00/EN	BA00291F/00/EN	KA00235F/00/A2

Tank Side Monitor NRF590

Operating Instructions for Tank Side Monitor NRF590, BA00256F/00/EN.
Description of Device Functions for Tank Side Monitor NRF590, BA00257F/00/EN.

Certificates

Correlation of safety instructions (XA, XC) and certificates (ZD, ZE) to the device:

Authority	Version	Designation	Housing			Output	Document	Type
			F12	T12	F23			
ATEX	FMR240/245: B	II 1/2 G Ex ia IIC T6 II 1/2 D	X	X[1]	X	HART, HART für FHX40, PA, FF	XA00406F XA00407F	240 245
	FMR244: B, C	II 1/2 G Ex ia IIC T6 II 1/2 D II 1/3D					XA00408F	244
ATEX IECEx	H, 1, 6,	II 1/2 G Ex ia IIC T6 Zone 0/1	X			HART	XA00099F	230, 231, 240
				X[1]			XA00207F	230, 231, 240
					X		XA00203F	230, 231, 240
			X			HART für FHX40	XA00099F	230, 231, 240
					X		XA00203F	230, 231, 240
			X			PA, FF	XA00102F	230, 231, 240
					X		XA00204F	230, 231, 240
				X[1]			XA00208F	230, 231, 240
ATEX IECEx	FMR230/231: 1, 6, FMR240/244/245: D	II 1/2 G Ex ia IIC T6 Zone 0/1			X	HART	XA00366F XA00367F	230, 231, 240 245,
				X[1]			XA00368F XA00369F	230, 231, 240 244, 245,
			X				XA00354F XA00358F	230, 231, 240 244, 245
					X	HART für FHX40	XA00366F XA00367F	230, 231, 240 245,
			X				XA00354F XA00358F	230, 231 244, 245
			X			PA, FF	XA00357F XA00361F	230, 231, 240 244, 245
					X		XA00362F XA00363F	230, 231, 240 245,
				X[1]			XA00364F XA00365F	230, 231, 240 244, 245
ATEX	H	II 3 D	X	X[1]	X	HART, HART für FHX40, PA, FF	XA00277F	230, 231, 240, 245
			X	X[1]			XA00277F	244,
ATEX	3, 8	II 1/2 G Ex em (ia) IIC T6		X		HART, PA, FF	XA00100F	230, 231, 240
ATEX IECEx	FMR230/231: 4 FMR240: E	II 1/2 G Ex d (ia) IIC T6 Zone 0/1		X		HART, PA, FF	XA00101F XA00356F	230, 231, 240 230, 231, 240
						HART für FHX40	XA00356F	230, 231, 240
ATEX	FMR230/231/240: 5 FMR244/245: E	II 1/2 G Ex d (ia) IIC T6 Zone 0/1		X		HART, PA, FF	XA00105F XA00360F	230, 231, 244 245
						HART für FHX40	XA00360F	230, 231, 244, 245

Authority	Version	Designation	Housing			Output	Document	Type
			F12	T12	F23			
ATEX IECEx	H, 2[2], 7[2]	II 1/2 G Ex ia IIC T6 Zone 0/1	X			HART	XA00103F	230, 231, 244
				X[1]			XA00209F	230, 231, 244, 245
					X		XA00205F	230, 231, 245
			X			HART für FHX40	XA00103F	230, 231, 244
					X		XA00205F	230, 231, 245
			X			PA, FF	XA00106F	230, 231, 244
				X[1]			XA00210F	230, 231, 244, 245
					X		XA00206F	230, 231, 245
ATEX IECEx	2[2], 7[2]	II 1/2 G Ex ia IIC T6 Zone 0/1	X			HART	XA00358F	230, 231
				X[1]			XA00369F	230, 231
					X		XA00367F	230, 231
			X			HART für FHX40	XA00358F	230, 231
					X		XA00367F	230, 231
			X			PA, FF	XA00361F	230, 231
					X		XA00363F	230, 231
				X[1]			XA00365F	230, 231
ATEX	G	II 3 G Ex nA II T6	X	X[1]	X	HART, HART für FHX40, PA, FF	XA00233F	230, 231, 240, 245
			X	X[1]			XA00233F	244,

1) Housing with overvoltage protection (OVP)

2) Note safety instructions (XA) (electrostatic charging)!

Authority	Version	Designation	Housing			Output	Document	Type
			F12	T12	F23			
NEPSI	I	Ex ia IIC T6	X	X[1]	X	HART, HART für FHX40	XA00370F XA00372F	230, 231, 240 230, 231, 245
			X	X[1]			XA00372F	244
			X	X[1]	X	PA, FF	XA00373F XA00375F	230, 231, 240 230, 231, 245
			X	X[1]			XA00375F	244
	J	Ex d (ia) ia IIC T6		X		HART, HART für FHX40, PA, FF	XA00371F XA00374F	230, 231, 240 230, 231, 244, 245
	R	Ex nAL IIC T6	X	X[1]	X	HART, HART für FHX40, PA, FF	XC00007F	230, 231, 240, 245
			X	X[1]			XC00007F	244

1) Housing with overvoltage protection (OVP)

Authority	Version	Designation	Housing			Output	Document	Type
			F12	T12	F23			
FM	S	IS Cl. I Div. 1 Gr. A-D Zone 0, 1, 2	X			HART	ZD00055F	230, 231, 240, 244, 245
				X[1]			ZD00127F	230, 231, 240, 244, 245
					X		ZD00126F	230, 231, 240, 245
			X			HART für FHX40	ZD00055F	230, 231, 240, 244, 245
					X		ZD00126F	230, 231, 240, 245
			X			PA, FF	ZD00056F	230, 231, 240, 244, 245
			X	X[1]	X		ZD00021F	230, 231, 240, 245
			X	X[1]			ZD00021F	244
				X[1]			ZD00129F	230, 231, 240, 244, 245
					X		ZD00128F	230, 231, 240, 245
	T	XP Cl. I Div. 1 Gr. A-D Zone 1, 2		X		HART, PA, FF	ZD00058F	230, 231, 240, 244, 245
CSA	U	IS Cl. I Div. 1 Gr. A-D Zone 0, 1, 2	X			HART	ZD00059F	230, 231, 240, 244, 245
				X[1]			ZD00133F	230, 231, 240, 244, 245
					X		ZD00132F	230, 231, 240, 245
			X			HART für FHX40	ZD00059F	230, 231, 240, 244, 245
					X		ZD00132F	230, 231, 240, 245
			X			PA, FF	ZD00060F	230, 231, 240, 244, 245
				X[1]			ZD00135F	230, 231, 240, 244, 245
					X		ZD00134F	230, 231, 240, 245
	V	XP Cl. I Div. 1 Gr. A-D Zone 1, 2		X		HART, PA, FF	ZD00062F	230, 231, 240, 244, 245

1) Housing with overvoltage protection (OVP)

Authority	Version	Designation	Housing			Output	Document	Type
			F12	T12	F23			
WHG	FMR2xx: F FMR230/231/240: 6 FMR230/231/244/245: 7[1] FMR230/231/240: 8	Ex-freier Bereich, WHG	X	X, X[1]	X	HART, PA	ZE00244F	230, 231, 240, 245
						HART für FHX40		230, 231, 240, 244

1) Only for FMR230, FMR231, FMR244

Safety Manual Functional safety manual for Micropilot M (→ SD00327F/00/EN).

This product may be protected by at least one of the following patents.
Further patents are pending.

- US 5,387,918 ≙ EP 0 535 196
- US 5,689,265 ≙ EP 0 626 063
- US 5,659,321
- US 5,614,911 ≙ EP 0 670 048
- US 5,594,449 ≙ EP 0 676 037
- US 6,047,598
- US 5,880,698
- US 5,926,152
- US 5,969,666
- US 5,948,979
- US 6,054,946
- US 6,087,978
- US 6,014,100

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Endress+Hauser
People for Process Automation

TI00345F/00/EN/15.12
71182793
FM+SGML 9.0 ProMoDo

71182793

11232.2.7 TEMPERATURE TRANSMITTER

Temperature Transmitter shall be Devar Inc. Model d-RTTI or Equivalent

DEVAR Inc.

MODEL d-RTTI

DIGITAL ROOM TEMPERATURE TRANSMITTER / INDICATOR

- RTD Sensor and Transmitter Assembly
- Fits Standard Electrical Outlet Box
- Splash Resistant Front Panel
- 4/20 mA Temperature Output
- True 2-Wire Operation
- Push-Button Configuration

GENERAL DESCRIPTION

The Model d-RTTI Digital, Room-Temperature, Transmitter-Indicator is designed to accurately sense ambient room temperature and provide a 4 to 20 mA output signal that is linear to the measured temperature to within ±0.1°F.

The d-RTTI provides a 0.4-inch high, seven-segment, red, LED display to indicate the ambient room temperature across an operating range of -40°F to 180°F (-40°C to 82°C) with a display resolution of 0.1 degrees. The 4 to 20 mA output signal can be configured to represent any temperature span within the operating range of the instrument. The milliamp output range can be specified when ordering, or can be easily configured in the field using the push buttons on the backside of the device.

A high precision 1000 ohm RTD sensor is used to detect the ambient temperature. The sensor is attached to the backside of the black anodized aluminum heat sink visible on the front of the instrument. An option is also available that accepts an input from an external 1000 ohm platinum RTD sensor.

These are true two-wire devices with signal and power being provided over a single pair of wires. The required operating voltage for the d-RTTI ranges from 10 to 28 Volts DC.

The d-RTTI is housed inside of a flat plastic, splash resistance panel that is mounted on a gray painted, cast aluminum, water tight junction box. The front panel can also be mounted on any single gang electrical box. Front panels are fitted with a rear gasket seal and can be safely mounted in areas requiring periodic wash down.

SPECIFICATIONS

GENERAL

Display:	4 Digit LED with 0.4 inch high, red characters
Housing:	Splash resistant faceplate with rear gasket seal
Material:	ABS Plastic faceplate with polycarbonate window and black anodized aluminum heat sink
Sensor:	1000 Ohm Platinum RTD, Conforms to DIN Standard EN 60751, Class A
Open RTD:	Output goes upscale
Temp. Range:	-40°F to 180 °F or -40°C to 82 °C
RFI Immunity:	Rated class 3-C

DISPLAY

Range:	-40.0°F to 180 .0°F or –40.0°C to 82 1°C
Accuracy:	±0.5 °F (±0.3 °C) at 77 °F (25 °C)
Thermal Effect:	Zero Shift: ±0.002 × (Reading-77 °F) Span Shift: ±0.004 × (Reading-77 °F)

MILLIAMP OUTPUT

Range:	4 to 20 mA
Accuracy:	±0.7 °F (±1.3 °C) + 0.1% of Span
Thermal Effect:	Zero: Display Shift ± 0.01% of Span per °F Span: Display Shift ± 0.01% of Span per °F
Supply:	10 to 28 VDC
Max Load:	$R_{ohms} = (V_{supply} - 10V) / 0.020A$
Supply effect:	0.01% of Span per Volt
Load Effect:	0.05% of Span per 300 Ohm Change

STANDARD CALIBRATION

Displayed Temperature Range:	-40 to 180 °F
4 to 20mA Output Represents:	0 to 100 °F

FIELD CALIBRATION

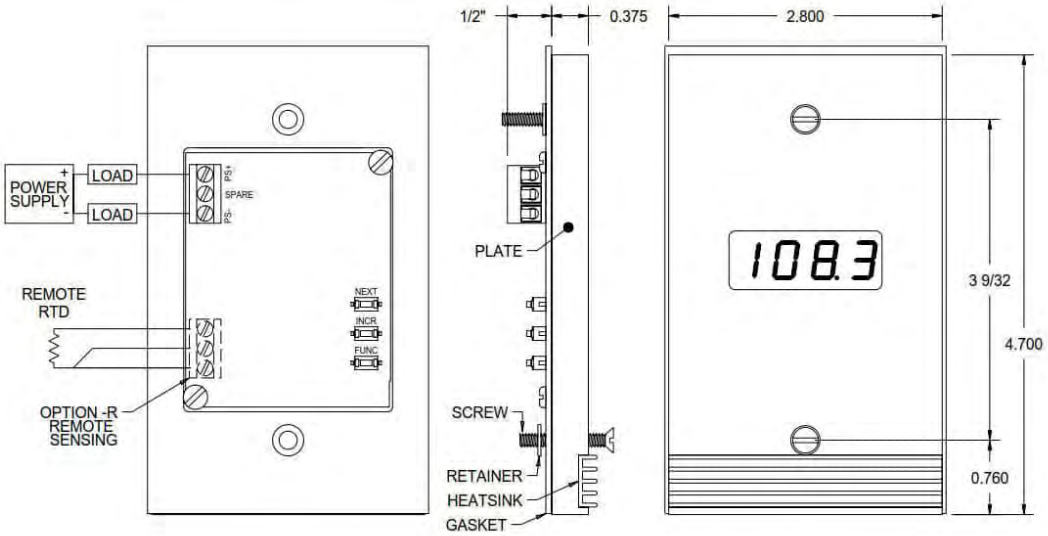
Display:	-40 to 180 °F or -40 to 82°C
Output Loop:	Milliamp output can be set to represent any temperatures within the displayable range
Caution:	The recommended minimum span for the Milliamp output is 35 °F (20 °C). Narrower spans will degrade system performance.
Method:	Push buttons on back of panel

ORDERING

Standard Cal:	d-RTTI
Custom Cal:	d-RTTI [Temp at 4 mA / Temp at 20 mA] (e.g. d-RTTI -30/120 °F)
Options:	-R Replace internal sensor with external 1000 ohm platinum RTD input (e.g. d-RTTI-R-0/85 °F)

WARRANTY: 2 YEARS, *Made in USA*

DIMENSIONS:
Front Panel without junction box shown below. Dimensions with junction box are H 4.7" × W 2.8" × D 2.5"



DEVAR Inc.
706 Bostwick Ave. Bridgeport, CT. 06605
TEL: (203) 368-6751, 800-566-6822
FAX: (203) 368-3747 http://www.devarinc.com

BULLETIN: d-RTTI Rev. B

11230.2.8 Day Tank Scale

Scale shall be Force Flow 55 Gallon Scale with Solo G2 display or Equivalent

TYPICAL SPECIFICATION
SOLO® G2
55-GALLON DRUM SCALE

SPECIFICATION SECTION 11245 - Chemical Feeders
SPECIFICATION SECTION 11240 - Chemical Metering Pumps

A quantity of drum scales shall be provided and shall be of the digital readout/electronic load cell type. Scale platform shall be sized to accept an 18" (457mm) to 24" (610mm) diameter drum. Platform height shall be no more than 2" (51mm) to permit easy loading and unloading of drums. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact and UV light.

Scale shall be of the single load cell design. Weight shall be transferred via a pivoted platform to a single, NTEP approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 20'/6M standard.

The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure. All operations shall be performed via a keypad with menu driven display prompts. No setting adjustment shall require entry into the enclosure. The alphanumeric LCD readout shall have backlighting for readability in low light conditions. Power requirement shall be 110/220 VAC.

A 6-digit numerical display shall give operator the ability to monitor chemical by weight (lb or kg) or volume (gallons or liters). A bar graph display shall read 0-100% for the net contents. A dual mode TARE key shall allow user to enter the tare weight of the vessel or enter the net weight of the chemical depending on application needs. A diagnostics menu shall allow recalibration without the need to apply field test weights. A user adjustable filter function shall stabilize display in the event of vibration from local pumps or mixers.

Indicator shall output net amount for each channel via a 4-20mA output for remote monitoring. Output span and trim shall be fully adjustable via the display and keypad. Indicator shall have four adjustable set points to display low or high level conditions on the indicator.

OPTIONAL: Set points shall activateForm C dry contact relays rated at 2A@30VDC, 60W max power, 220VDC/250VAC max voltage.

Scale shall carry a Full Five (5) Year Factory Warranty. "Limited" Warranties shall be considered unacceptable. Full scale accuracy shall be better than 1/4 of 1%. Scale shall be DRUMM-SCALE™ with TUF-COAT™ coating, Model 27-DR-DS and SOLO® G2 digital display Model SRG2 as manufactured by FORCE FLOW, 2430 Stanwell Drive, Concord, CA 94520 USA (www.forceflowscales.com).

INDICATOR:
- **SRG2-1** One Channel
- **SRG2-2** Two Channel

PLATFORMS:

TUF-COAT Platform:	Model No. (Capacity)	Metric Model (Capacity)
	27-DR5DS (500 lb)	**27-DR2KDS** (250 kg)
	27-DR10DS (1,000 lb)	**27-DR5KDS** (500 kg)
Stainless Steel Platform:		
	27-DR5DSS (500 lb)	**27-DR2KDSS** (250 kg)
	27-DR10DSS (1,000 lb)	**27-DR5KDSS** (500 kg)

Standard Drumm-Scale platforms are 27.5" x 27.5"

55-Gallon DRUM/SOLOG2
REV: NOV2019

11232.2.9 Basket Strainer

All thermoplastic basket strainers shall be manufactured with PVC Type 1, Grade 1 (ASTM D1784, Cell Classification 12454), CPVC (ASTM D1784, Cell Classification 23447), or glass filled Polypropylene (ASTM D4101, Cell Classification 85580). All O-rings shall be EPDM or FPM. Sizes 1/2" – 4" shall be onepiece molded body, true union type design. 6" and 8" sizes shall be fabricated design, and shall be flanged. Bodies shall contain (3) ports to accommodate in-line or loop-style flow patterns. Bodies shall contain interrupted external cover thread for safety purposes. Each body shall have an integral mounting base. Covers shall contain a vent plug, and bodies shall contain a drain plug. Both plugs shall be hand-removable. Covers shall have an integral liquid-displacing dome on the underside of each cover. Strainer baskets shall be 1/32" perforation (20-mesh) for 1/2" – 1" sizes, and 1/8" perforation for 1-1/2" – 8" sizes. Alternative basket perforation sizes and materials shall be available to meet the installation requirements. All 1/2" through 8" basket strainers shall be pressure-rated for 150 PSI at 70°F non-shock. All Thermoplastic Basket Strainers shall carry a three-year global warranty, shall be manufactured by Hayward® Flow Control and in the USA.

Specification:

Make: Hayward
Model #: **SB2200STE116**

Pipe Size: 2 in
Body Material: CPVC
Body End Connector Material: CPVC / CPVC
Basket Material: CPVC 1/16 in Perf
Sealing Material: EPDM
Seal: EPDM

End Connection Material: CPVC
End Connection Type: Socket/Threaded
Pressure Rating: 150 PSI
Cv Coefficient: 60.0000
Chassis Description: Standard Body

SPECIAL PROVISION

CHLORINATION BUILDING	SECTION SP 13210

13210.1 DESCRIPTION

13210.1.1 Furnish and install a chlorination building as shown on the DRAWINGS and as required by these SPECIFICATIONS. The building shall consist of, but not necessarily be limited to, the concrete, reinforcing steel, doors, insulation, wall finish materials, paint, storage shelves, piping, valves and all other miscellaneous items necessary to complete the structure as shown on the DRAWINGS, or as required by these specifications.

13210.1.2 RELATED WORK

Section 02105 - Earthwork Materials
Section 02201 - Earthwork for Structures
Section 02222 - Water Pipe Installation
Section 02230 - Waterline Valves and Hydrant
Section 02232 - Water System Control Valves
Section 03050 - Portland Cement Concrete
Section 03100 - Concrete Forming, Finishing and Curing
Section 03200 - Concrete Reinforcement
Section 03500 - Concrete Structures and Slab Work
Section 09910 - Painting
Section 10125 - Electric Space Heaters
Section 10210 - Electric Ventilators
Section 10215 - Ventilators
Section 11230 - Chlorination Equipment

13210.1.3 SUBMITTALS

13210.1.3.1 Descriptive literature which identifies the manufacturer, model numbers, capacity, size and materials used for fabrication for all piping, valves, fittings, control valves, miscellaneous valves, gauges and electrical materials shall be provided by the CONTRACTOR in accordance with Section 01300 of these SPECIFICATIONS.

13210.1.3.2 Certification of compliance to the standards and SPECIFICATIONS contained herein shall be obtained from the manufacturer and provided by the CONTRACTOR at the time of delivery of these materials to the project site.

13210.1.3.3 Manufacturer's installation, operation and maintenance literature for each equipment item shall be furnished to the OWNER prior to the time of final acceptance for payment.

13210.2 MATERIALS

13210.2.1 Materials not specifically described herein shall conform to the requirements of those Sections of the SPECIFICATIONS indicated above in Paragraph 13210.1.2.

13210.2.2 INTERIOR WALL FINISHING

13210.2.2.1 Furring lumber shall be No. 2 grade or higher. Appropriate additional framing shall be installed to support electrical control panel boxes.

13210.2.2.2 Insulation shall consists of 1 1/2 inch thick rigid foam insulation board attached to the concrete walls with adhesive recommended by the foam board manufacturer.

13210.2.2.3 Wall covering shall be 1/2 inch AC plywood. All exposed edges at door and vent openings shall be concealed with paint grade wood casing and moldings.

13210.2.2.4 Vinyl base shall be installed at the base of wall to form a seal with the floor.

13210.2.3 PAINTING

All exposed pipe, equipment, wall surfaces, trim, doors and casings, ceiling surfaces, and floor surfaces shall be painted in accordance with Section 09910.

13210.2.4 HEATING AND VENTILATION

13210.2.4.1 Heating and ventilation shall be provided in the chlorine cylinder room and the valve room in accordance with the details shown on the DRAWINGS and with Sections 10125, 10210 and 10215 of these SPECIFICATIONS.

13210.2.4.2 Both rooms of the chlorination building shall have exhaust fans of the size required to force one complete exchange of air in one minute.

13210.2.5 DOORS AND HARDWARE

Entry doors shall be insulated steel exterior doors with frames and hardware, which are furnished and installed to meet the requirements of Section 08110 of these SPECIFICATIONS.

13210.2.6 AIR PACK ENCLOSURE

The air pack enclosure shall be a NEMA Type I panel enclosure and shall be located as shown on the DRAWINGS. The panel shall be mounted so that the emergency air pack is accessible from the inside or the outside of the building and shall be inset in the concrete wall so that the front of the panel is flush with the exterior face of the chlorination building wall. The panel shall be securely fastened to the concrete wall using a mechanical means meeting the approval of the ENGINEER.

13210.2.7 FLOOR DRAIN

A floor drain shall be furnished and installed as described herein and as shown and located on the DRAWINGS.

13210.2.7.1 Drain Inlets - Drain inlet shall be of cast iron construction consisting of removable cap and screen. Each drain shall dispense through a p-trap into the sewer system; or into the drain gravel sump; or to daylight, as shown on the DRAWINGS.

13210.2.7.2 Floor Slope - Floor slope shall be a minimum 1/2 inch and a maximum 3/4 inch drop from the walls to the drain, or a 1% slope.

13210.2.7.3 Drain Pipe - Drain pipe shall be of the size and type as called for on the DRAWINGS.

13210.2.8 ELECTRICAL WIRING FIXTURES AND CONTROLS

Electrical WORK shall be provided in accordance with Sections 16010 and 16210 of these SPECIFICATIONS and the DRAWINGS.

13210.2.9 PIPING

Main line water piping valves and components within the chlorination building shall be of the materials required on the DRAWINGS or as required by the applicable sections of these specifications.

13210.2.10 PRESSURE GAUGES

Pressure gauges shall be Ametek Model 550L or approved equal. Pressure gauges shall have a stainless steel case. Rings shall be crimped stainless steel. Windows shall be flat polycarbonate sealed with a BUNA-N gasket. Bourdon tubes shall be 316 stainless steel. Connections shall be 1/4 inch ANPT-LM stainless steel. The pressure gauge shall operate with the pointer near mid scale at the pressures shown on the DRAWINGS.

13210.2.11 EMERGENCY SHOWER AND EYEWASH

Global Industrial Emergency Combination Shower with Eyewash Station or Equivalent

GLOBAL® globalindustrial.com | GLOBAL® globalindustrial.ca

Assembly Instructions	Instrucciones de Ensamblaje	Directives d'assemblage
Customer Service US: 1-800-645-2986	Servicio de atención al Cliente US: 1-800-645-2986	Service à la clientèle Canada: 888-645-2986

Standing Combination Eye Wash Shower & Station Model no. 708383

The Global Industrial Combo Eye Wash Station is essential for industrial spaces where accidents can occur with chemicals or hazardous substances. These units provide immediate, reliable and effective treatment as needed. High quality and durable components ensure these stations comply and meet ANSI Standard Z358.1.

Table of Contents	Page
General Information	2
Parts List	3
Product Dimensions	4
Assembly instructions	5
Assembly Checklist	11
Warranty Info	12

PRODUCT INFO

Pipe & Fittings - Schedule 40 galvanized steel includes safety yellow polyethylene covers for corrosion resistance and easy visibility.

Shower Head – ABS plastic, 10" Dia.

Spray Head – Includes "flip top" covers to protect from dust particles.

Eye Wash Bowl – 11.5" ABS Plastic.

Supply & Waste – Inlet and Outlet Tees allow inflow for water supply and separate outflow for waste disposal.

Quality Assurance – Valves and Spray heads are tested at factory to assure efficiency.

Please read this manual completely and save these instructions for reference. Upon receiving, inspect the unit for any damage. If damage is evident, notify the carrier immediately to file a claim. These products must be handled with caution.

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1

GENERAL INFORMATION & GUIDELINES

Emergency eye wash stations are designed to deliver water to rinse chemical substances from a person's eyes, face or body.

WARNING: Eye wash stations are NOT to be used as substitutes for primary protective equipment (such as gloves, masks, eye protection, and protective clothing) when handling dangerous substances. Simply installing these stations is not sufficient to assure worker safety. Staff must be trained in the use, maintenance, and knowledge of the eye wash station. A response plan and action should be in place in the event that an accident does occur and employees have guidelines to follow for injured personnel.

Below are guidelines that should be followed in accordance with the eye wash station when applicable. Note OSHA regulations, accessibility & surroundings, and water connections before assembling and installing the eye wash combo station. There are certain circumstances where these guidelines may not be adequate.

LOCATION OF EMERGENCY EQUIPMENT

- Per ANSI Specifications, emergency equipment must be installed on the same level as the possible incident (e.g. stairs/ramps must not be required to use the unit).
- It is advised that emergency equipment be installed within 10 seconds (approx. 55 feet) of walking time/distance from the location of the possible incident.

WATER TEMPERATURE

- Water temperature should be between 60°F(15.5°C) – 100°F(37.8°C). This can vary depending on the chemical substance and should be consulted with a safety counselor.

SHUT OFF VALVES

- These stationary eye wash units are designed to be connected to a clean and viable water supply line.
- A shut off valve on the water line is advised to easily maintain/repair the station.
- If a shut off valve is installed, make sure necessary procedures are established to prevent misuse of the valve. Only authorized personal should be installing/maintaining the shut off valve.

CORROSION & RUST RESISTANCE

- All parts of the system must be constructed of materials that will not corrode.

FREEZING CONDITIONS

- Emergency equipment that must be installed in potential freezing conditions should be installed with the proper equipment to protect against freezing per ANSI Z358.1 Section 4.5.5, 5.4.5.
- Freeze resistant equipment includes but is not limited to:
  1. Temperature actuated bleed valve that permits water to flow through the unit when the temperature drops below freezing.
  2. Remote-activated valves or electrically heated units/heated enclosures.

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DISPOSAL OF WATER

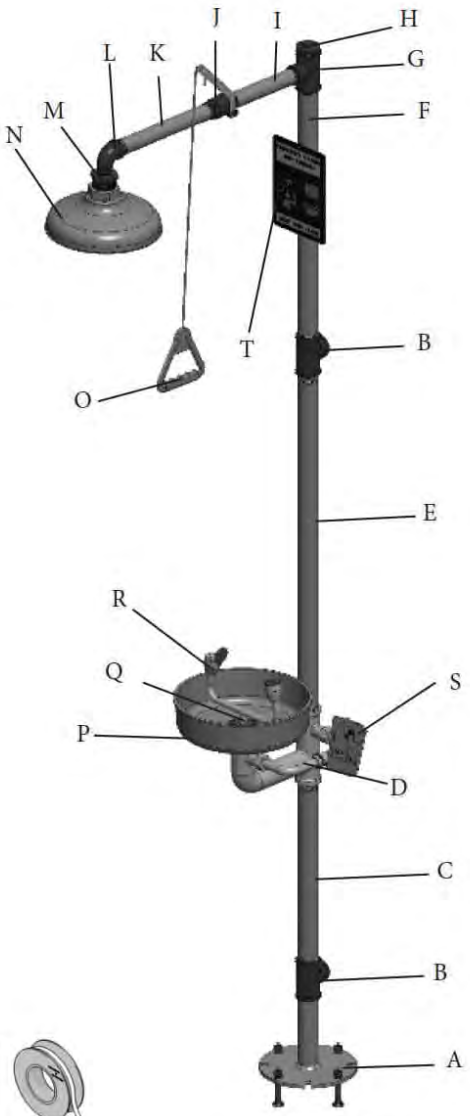
- Waste water must be treated with care to avoid creating any hazards. It is highly recommended that emergency shower stations should be connected to drain piping or flood drains. Depending on the chemical substances, drainage into an acid waste disposal system may be recommended.

NOTE: Prior to first use after installation, use ANSI checklist on page 11 to make sure unit is compliant and assembled/installed correctly.

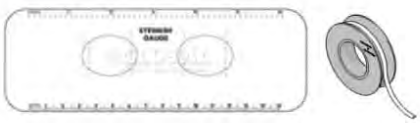
MODEL NO. 708383 PARTS LIST

WARNING:Use Caution when tightening connections with a pipe wrench to avoid damaging/scratching protective coating.

PARTS LIST		
Item	**Description**	**QTY**
A	Base WITH 1-1/4" tube	1
B	1-1/4" NPT Tee	2
C	1-1/4" IPS x 16-1/2" Pipe	1
D	Valve Assembly	1
E	1-1/4" IPS x 30-1/2" Pipe	1
F	1-1/4" IPS x 22-7/8" Pipe	1
G	1-1/4" x 1" NPT Reducing Tee	1
H	1-1/4" NPT Plug	1
I	1" IPS x 11" Lg. Pipe	1
J	1" IPS Shut-off Valve	1
K	1" IPS x 8" Pipe	1
L	90 Deg. Elbow Reducer	1
M	NPT Pipe Reducer Bushing	1
N	Shower Head	1
O	Pull Handle	1
P	Eye Wash Container Bowl	1
Q	Drain Filter	1
R	Spray Head Assembly	1
S	Push Handle	1
T	Universal Sign	1
H1	5/16-18 Hex Nut (Not shown)	4
H2	Lock Washer (Not shown)	4
H3	Plain Washer (Not shown)	4
H4	Sleeve (Not shown)	4
H5	Concrete anchor (not shown)	4



NOTE: The Eye Wash Gauge and Plumber's Tape is included



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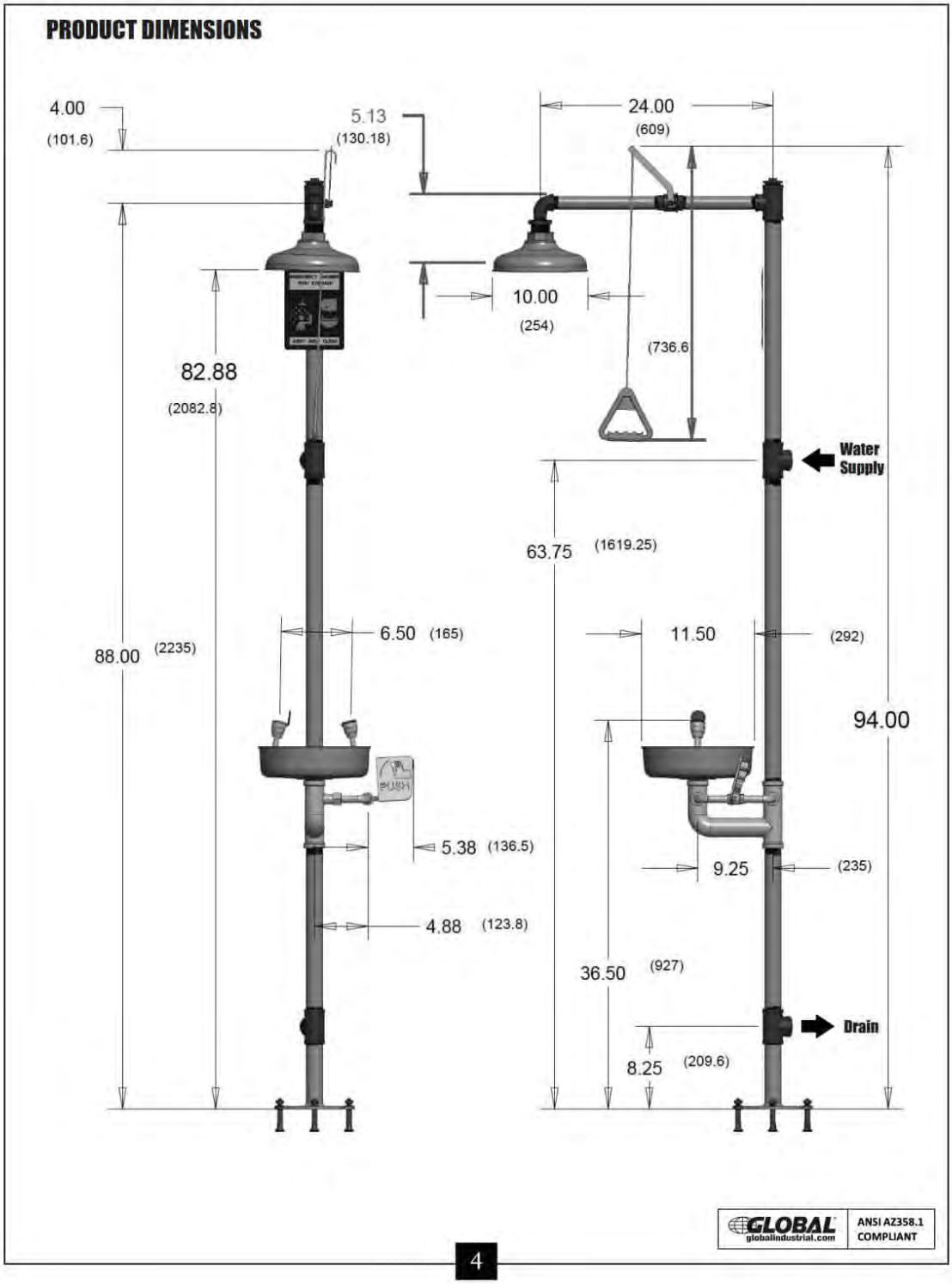
PRODUCT DIMENSIONS
4.00
(101.6)
5.13
(130.18)
24.00
(609)
10.00
(254)
(736.6
82.88
(2082.8)
Water Supply
63.75 (1619.25)
88.00 (2235)
6.50 (165)
11.50 (292)
94.00
5.38 (136.5)
9.25 (235)
4.88 (123.8)
36.50 (927)
Drain
8.25 (209.6)
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COMPLIANT
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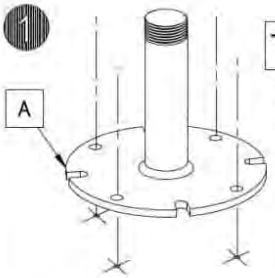
ASSEMBLY INSTRUCTIONS

⚠WARNING⚠
Before drilling
check for electrical wire,
rebar or other hidden
obstruction in floor.

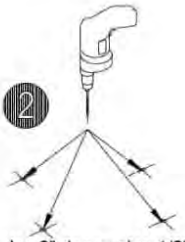
1



To be installed in concrete

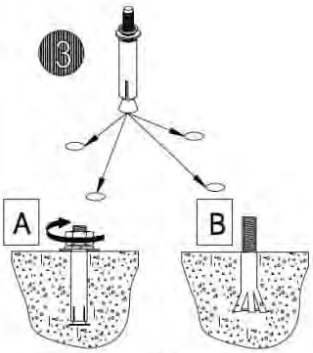
Using the base as a template,
mark the (4) holes

2



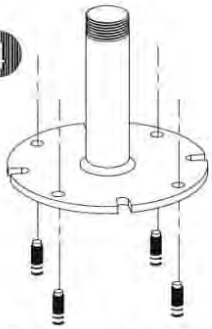
Drill the (4) holes 2" deep using 1/2" diameter
concrete drill bit (Provided)

3



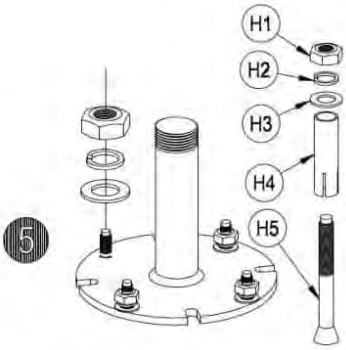
Insert the (4) expansion bolt into the holes
Hammer down until the sleeve
is level with concrete

4



Affix the base to the studs

5



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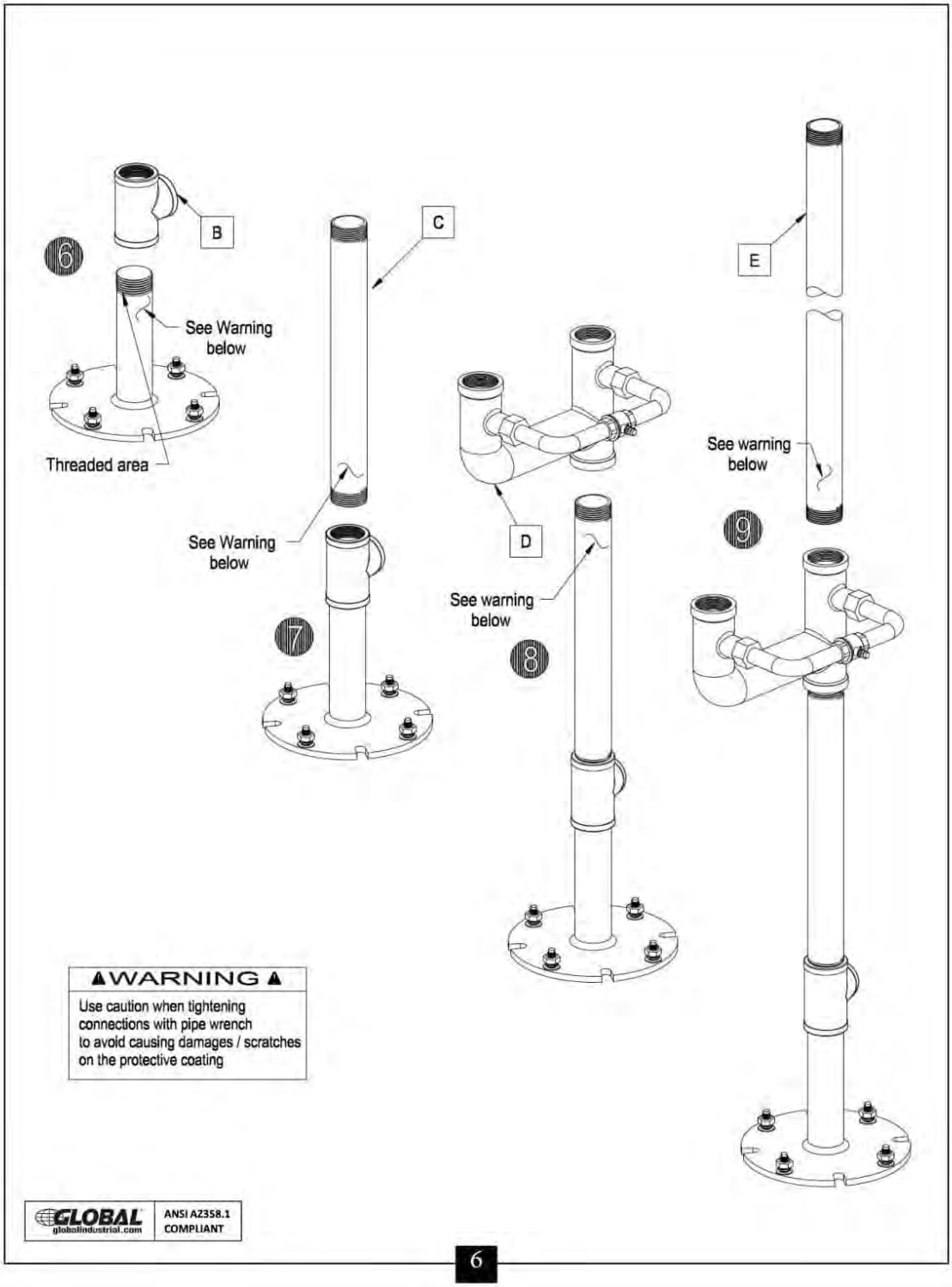
Note:

1. Before each connection,
   Apply plumber's tape to threaded areas
   (minimum two revolutions)
   Typical for all male threads.

2. Tighten ALL connections for
   proper alignment before
   moving on to the next step.

3. Use caution when tightening
   connections with pipe wrench
   to avoid causing damages / scratches
   on the protective coating

5


B
C
E
6
See Warning below
Threaded area
See Warning below
7
D
See warning below
8
See warning below
9
WARNING
Use caution when tightening connections with pipe wrench to avoid causing damages / scratches on the protective coating
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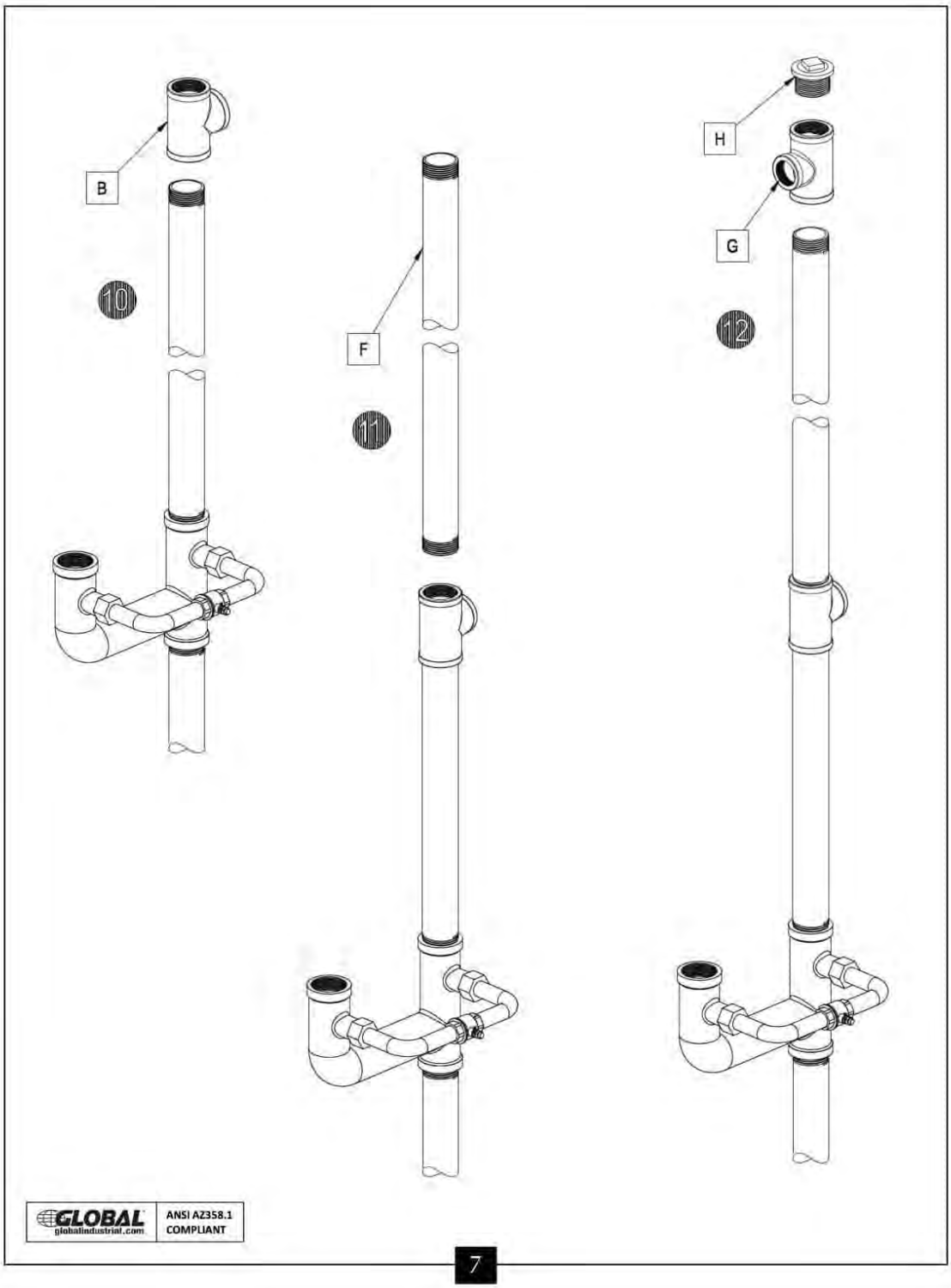
B
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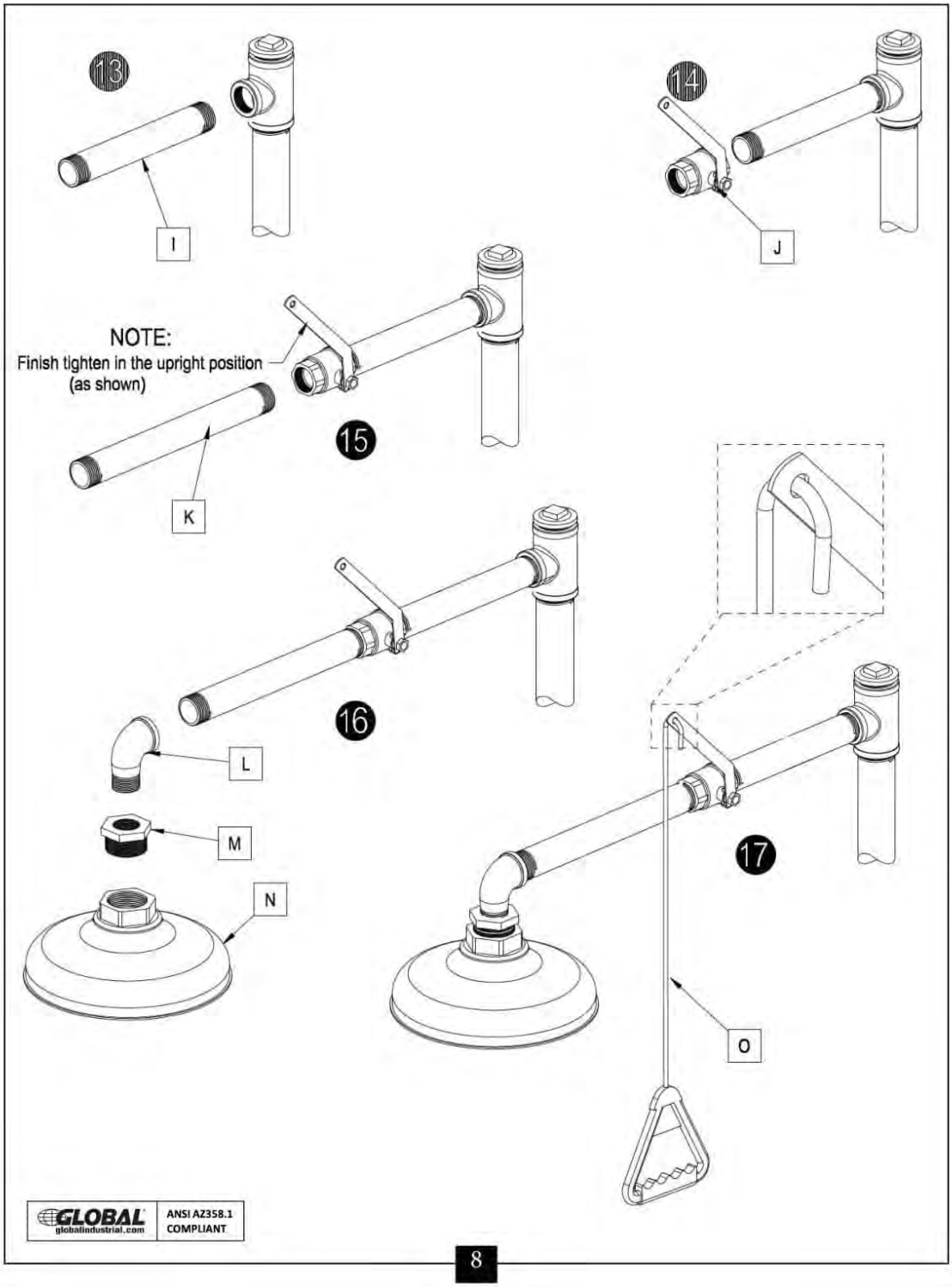
13
I
14
J
NOTE:
Finish tighten in the upright position
(as shown)
15
K
16
L
M
N
17
O
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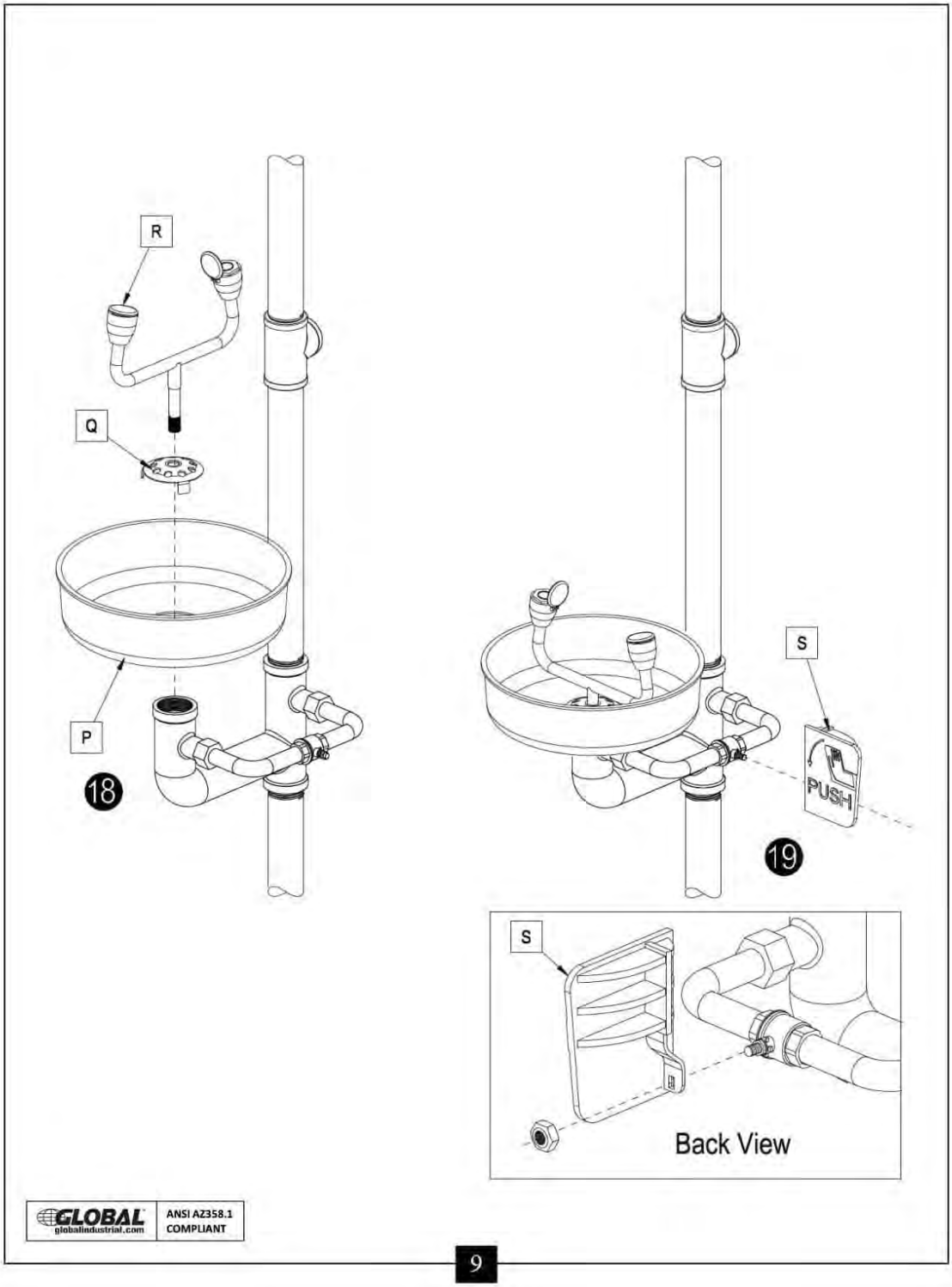
8


R
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S
PUSH
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Back View
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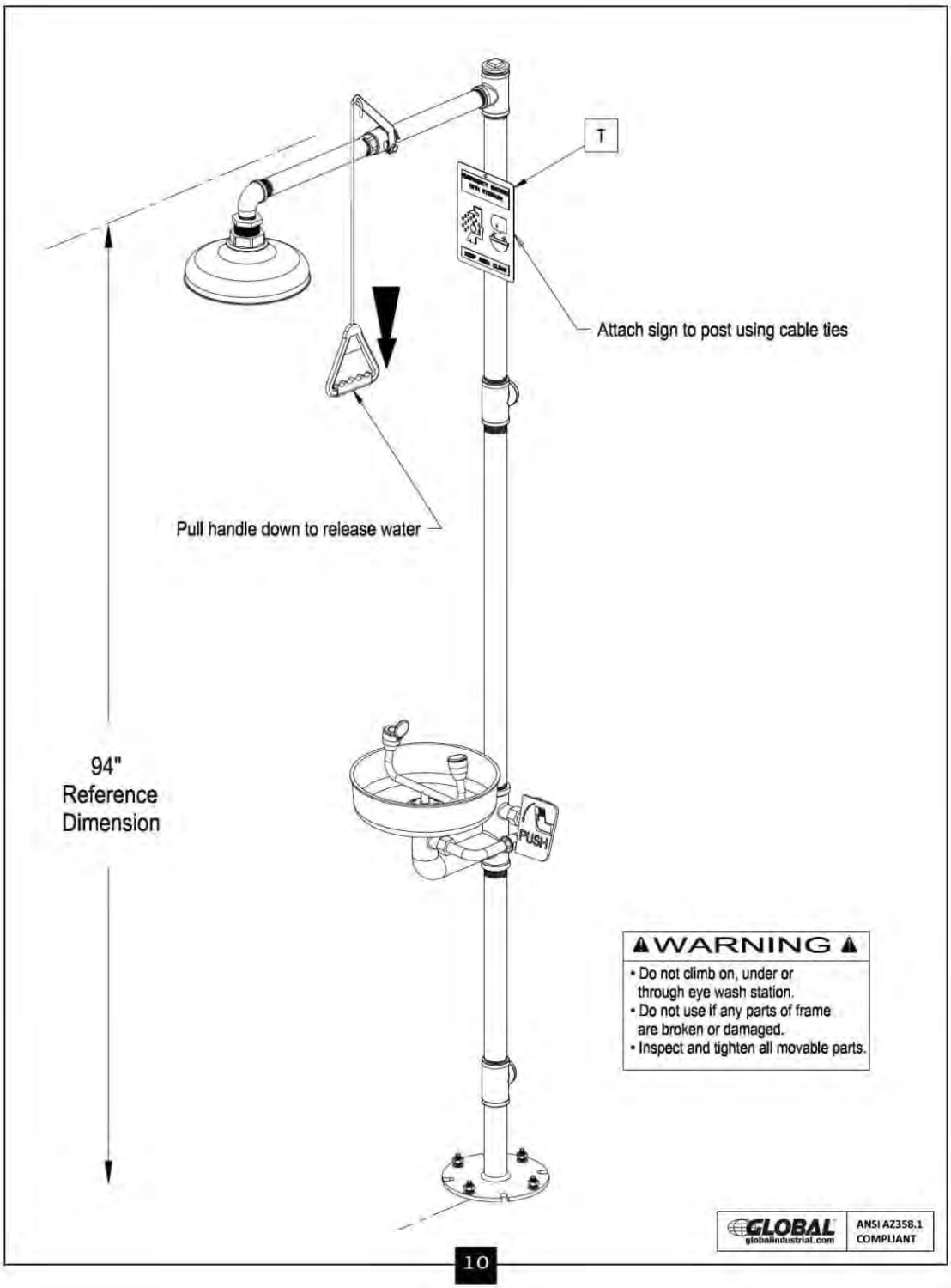
T
Attach sign to post using cable ties
Pull handle down to release water
94" Reference Dimension
PUSH
WARNING
• Do not climb on, under or through eye wash station.
• Do not use if any parts of frame are broken or damaged.
• Inspect and tighten all movable parts.
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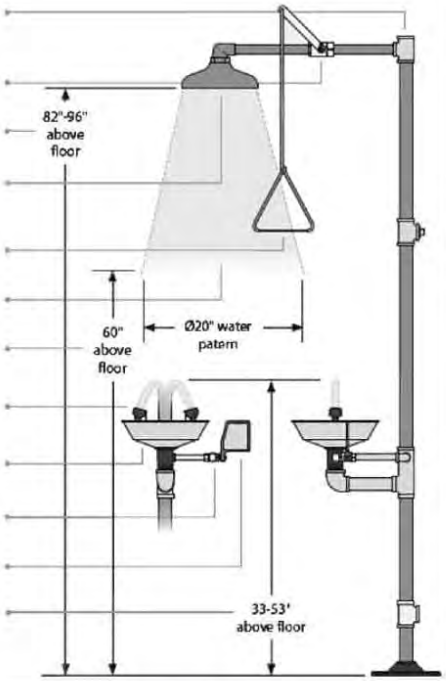
10

CHECKLIST PER ANSI Z358.1

After assembly and installation of the unit, below summary of checkpoints should be used to ensure compliance with ANSI 358.1.

- ☐ Water supply delivers required flow when shower and eye or eye/face are operated simultaneously. *(Section 4.5.5, 7.4.4)*
- ☐ Hands-free stay-open valve activities in one second or less. *(Section 4.2)*
- ☐ Height of water column is between 82" (209.3 cm) and 96" (243.8 cm) above the floor. *(Section 4.1.3, 4.5.4)*
- ☐ Shower delivers 20 gallons (75.7 liters) of water per minute for 15 minutes in the required pattern. *(Section 4.1.2, 4.5.5)*
- ☐ Easily located, accessible actuator is no more than 69" (173.3 cm) above floor. *(Section 4.2)*
- ☐ Center of the water pattern is at least 16" (40.6 cm) from any obstruction. *(Section 4.1.4, 4.5.4)*
- ☐ At 60" (152.4 cm) above the floor, the water pattern is at least 20" (50.8 cm) in diameter. *(Section 4.1.4)*
- ☐ Spray heads are protected from airborne contaminants. Cover are removed by water flow. *(Section 5.1.3, 6.1.3)*
- ☐ Unit delivers at least 3.0 GPM (11.4 liters) (for eye/face wash) or 0.4 GPM (1.5 liters) (for eyewash) for 15 minutes. *(Section 5.1.6, 6.1.6, 6.4.5)*
- ☐ Hands-free stay-open valve activates in one second or less. *(Section 5.2, 6.1.4, 6.2)*
- ☐ Valve actuator is easy to locate and readily accessible to user. *(Section 5.2, 6.2)*
- ☐ Water flow pattern is positioned between 33" (83.8 cm) and 53" (132.6 cm) from the floor and at least 6" (15.3 cm) from the wall or nearest obstruction. *(Section 5.4.4, 6.4.4)*



- ☐ **Identification:** Identify safety station location with highly visible sign. Area around safety station shall be well-lit. *(Section 7.4.3)*
- ☐ **Water Temperature:** Water delivered by safety station shall be tepid (60-100F). *(Section 7.4.5; B6)*
- ☐ **Training:** Instruct all employees in the location and proper use safety station. *(Section 7.5.4)*
- ☐ **Maintenance/Inspection:** Activate safety station at least weekly. *(Section 7.5.2)* Inspect all safety stations annually for compliance with standard. *(Section 7.5.5)*

☐ **Eyewash Gauge Instructions:**
Place the gauge on top of the stream of the eyewash; the flushing fluid should cover the areas between the lines 3.18 cm (1-1/4 inches) apart and the lines 8.26 cm (3-1/4 inches) apart when the gauge is not more than 20.2 cm (8 inches) above the eyewash nozzles.

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We can supply that.

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http://www.globalindustrial.com/wr or http://www.globalindustrial.ca/wr

Global Limited 1 Year Warranty

1. LIMITED WARRANTY

Global Equipment Company Inc. (DBA Global Industrial) ("Global") hereby warrants to you, the original purchaser and end user ("you" or "your"), that the products that you purchased which accompany this Limited Warranty ("Products") shall be free from defects in materials and workmanship under normal use consistent with the accompanying documentation for 1 year commencing upon the date of purchase (the "Warranty Period").

Global will repair or replace any Product determined to be defective and which has been returned, as set forth in section 3 herein, to Global. A Product may be replaced with a new or used product and/or current or prior revision. Where Global determines in its sole judgment that repair or replacement of such Product is not reasonable, Global will keep the non-conforming Product and refund to you the amount you paid for such Product. Returned Products shall be subject to the balance of the Warranty Period otherwise applicable. Any reconditioned parts used by Global shall be subject to all the same provisions as otherwise applicable to new parts.

THE FOREGOING DESCRIBES THE SOLE LIABILITY OF GLOBAL, AND YOUR SOLE REMEDY, FOR ANY BREACH OF WARRANTY. IF YOU DO NOT AGREE WITH THE TERMS OF THIS LIMITED WARRANTY, YOU MUST RETURN THE PRODUCTS UNUSED AND IN THEIR ORIGINAL PACKAGING WITHIN THREE (3) DAYS AND YOUR PURCHASE PRICE WILL BE REFUNDED.

2. WARRANTY EXCLUSIONS AND LIMITATION OF LIABILITY

This Limited Warranty does not cover: (i) defects or damages resulting from acts of God, casualty, accident, misuse or abuse, overloading, exceeding the recommended weight capacity, neglect, alterations, modification, service or repair by other than Global or its independent third party service providers, including without limitation by you; (ii) improper assembly or installation or de-installation, operation or maintenance, improper connections with peripherals or other causes not arising out of defects in the materials or workmanship of Products; (iii) any Product for which the warranty sticker has been removed, modified or defaced; (iv) shipping containers, batteries, cabinets, media, software or accessories; (v) normal wear and tear; (vi) damage to or loss of repaired or replaced Products during shipping by Global except when such damage or loss is caused by poor or inadequate packaging by Global; or (vii) Products purchased outside the United States or Canada.

UNDER NO CIRCUMSTANCES WILL GLOBAL BE LIABLE FOR ANY LOSS OF USE, INTERRUPTION OF BUSINESS OR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES OF ANY KIND (INCLUDING LOST PROFITS) REGARDLESS OF THE FORM OF ACTION WHETHER IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT PRODUCT LIABILITY OR OTHERWISE, EVEN IF GLOBAL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL THE TOTAL LIABILITY OF GLOBAL HEREUNDER EXCEED THE GREATER OF $50 OR THE AMOUNT YOU ACTUALLY PAID FOR THE PRODUCT GIVING RISE TO SUCH LIABILITY, REGARDLESS OF THE CAUSE OF ACTION, IN CONTRACT, TORT, STRICT LIABILITY OR OTHERWISE. NOT ALL JURISDICTIONS ALLOW SUCH LIMITATIONS OF DAMAGES SO THE FOREGOING LIMITATIONS MAY NOT APPLY TO YOU.

3. PROCEDURE FOR WARRANTY SERVICE

Prior to returning any Products to Global for warranty service, you must first contact Global, by telephone at (800) 645-2986 (US) or (888) 645-0878 (Canada) to confirm that such Products are covered by this Limited Warranty. If such Products are so covered, you shall obtain from Global a return materials authorization ("RMA") number and shipping instructions prior to any shipment of such Products to Global, and you must include such RMA number with any corresponding Product shipment, along with a true and correct copy of the original receipt showing the date of Product purchase by you, and a detailed, written description of any associated Product problems.

Please note that you are responsible for all shipping charges incurred in returning an item for exchange or repair. Global shall pay for return shipping of repaired and/or replaced Products to addresses within the United States and Canada only, and return shipments to all other addresses outside of the United States or Canada is your responsibility. If Global determines that any Product is not covered by this Limited Warranty, you must pay all parts, labor charges and return shipping for such Product.

4. WARRANTY DISCLAIMER AND LIMITATIONS

EXCEPT AND TO THE EXTENT EXPRESSLY SET FORTH ABOVE THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND GLOBAL EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN.

EXCEPT AND TO THE EXTENT EXPRESSLY SET FORTH ABOVE, THE PRODUCTS ARE PROVIDED ON AN "AS IS" BASIS, AND GLOBAL MAKES NO ADDITIONAL WARRANTIES, EXPRESS, IMPLIED, ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, OR STATUTORY, AS TO THE PRODUCTS OR ANY MATTER WHATSOEVER. THIS IS A LIMITED WARRANTY AND IS THE ONLY WARRANTY MADE BY GLOBAL. THE AGENTS, EMPLOYEES, DISTRIBUTORS, AND DEALERS OF GLOBAL ARE NOT AUTHORIZED TO MAKE MODIFICATIONS TO THIS LIMITED WARRANTY, OR MAKE ADDITIONAL WARRANTIES BINDING ON GLOBAL. ACCORDINGLY, ADDITIONAL STATEMENTS SUCH AS DEALER ADVERTISING OR PRESENTATION, WHETHER ORAL OR WRITTEN, DO NOT CONSTITUTE WARRANTIES BY GLOBAL AND SHOULD NOT BE RELIED UPON. GLOBAL DOES NOT WARRANT THAT THE PRODUCTS WILL OPERATE WITHOUT FAILURE, OR THAT THE PRODUCTS WILL MEET YOUR NEEDS OR EXPECTATIONS. NOT ALL JURISDICTIONS ALLOW SUCH WARRANTY LIMITATIONS SO THE FOREGOING LIMITATIONS MAY NOT APPLY TO YOU.

5. CHOICE OF LAW AND JURISDICTION

FOR PURCHASES WITHIN THE US - This Limited Warranty shall be subject solely to the laws of the State of New York as applied to contracts entered into in the State of New York between New York residents. Any dispute arising hereunder shall be subject to the sole jurisdiction of the State and Federal Courts located in Nassau County, New York. The parties hereby consent to the personal jurisdiction of such courts.

FOR PURCHASES WITHIN CANADA - This Limited Warranty shall be subject solely to the laws of the Province of Ontario. Any dispute arising hereunder shall be subject to the sole jurisdiction of Ontario, Canada. The parties hereby consent to the personal jurisdiction of such courts.

REGISTRARSE EN LÍNEA EN

http://www.globalindustrial.com/wr or http://www.globalindustrial.ca/wr

Garantía global limitada de 1 año

1. GARANTÍA LIMITADA

Global Equipment Company Inc. (DBA Global Industrial) ("Global") por la presente garantiza al comprador original y usuario final ("usted" o "su"), que los productos adquiridos por usted que incluyen esta Garantía limitada ("Productos ") se considerarán libres de defectos respecto de sus materiales y mano de obra en condiciones normales de uso de conformidad con la documentación adjunta durante 1 año a partir de la fecha de compra (el" Plazo de duración de la garantía ").

Global reparará o reemplazará todo producto calificado como defectuoso y que hubiere sido devuelto a Global, según lo establecido en la sección 3 de la presente garantía. Un Producto puede ser reemplazado por un producto nuevo o usado y/o quedar sujeto a una revisión actual o previa. En los casos que Global establezca, a su exclusivo criterio, la inviabilidad de la reparación o el reemplazo de dicho Producto, Global conservará el Producto no conforme y le reembolsará a usted el monto abonado por dicho Producto. De ser aplicable, los Productos devueltos estarán sujetos al tiempo restante del "Plazo de Duración de la Garantía. Todas las piezas reacondicionadas utilizadas por Global estarán también sujetas a dichas disposiciones mencionadas anteriormente, aplicables de igual modo a las piezas nuevas, si correspondiere

LA CLÁUSULA MENCIONADA ANTERIORMENTE DESCRIBE LA RESPONSABILIDAD EXCLUSIVA DE GLOBAL, Y SU ÚNICO RECURSO, POR CUALQUIER INCUMPLIMIENTO DE LA PRESENTE GARANTÍA. SI USTED NO ESTÁ DE ACUERDO CON LOS TÉRMINOS Y CONDICIONES DE LA PRESENTE GARANTÍA LIMITADA, USTED DEBERÁ DEVOLVER LOS PRODUCTOS SIN HABERLOS UTILIZADO Y EN SU EMBALAJE ORIGINAL EN EL PLAZO DE TRES (3) DÍAS Y USTED RECIBIRÁ EL REEMBOLSO DEL DINERO DE SU COMPRA.

2. EXCLUSIONES DE LA PRESENTE GARANTÍA Y LIMITACIÓN DE RESPONSABILIDAD

La presente Garantía limitada no cubre los siguientes supuestos: (i) defectos o daños causados por fuerza mayor, accidentes, uso inapropiado o excesivo, sobrecarga que supere la capacidad del peso recomendado, negligencia, alteraciones, modificación, reparación o mantenimiento realizados por proveedores técnicos independientes o ajenos a Global, entre los que se incluyen las siguientes acciones realizadas por usted ; (ii) ensamblaje o instalación o desinstalación inadecuados, operación o mantenimiento, conexiones periféricas, funcionamiento o mantenimiento incorrectos, o cualquier otra causa que no surja de un defecto en los materiales o en la mano de obra del Producto; (iii) todo Producto que no contenga el sticker de garantía o cuando dicho sticker haya sido retirado, modificado o esté dañado; (iv) contenedores de envío, baterías, gabinetes, medios, software o accesorios; (v) desgaste normal por el paso del tiempo; (vi) daño o pérdida de los Productos reparados o reemplazados durante el envío por parte de Global en los casos en que dicho daño o pérdida se hubieren producido por un mal o inadecuado embalaje por parte de Global; o (vii) Productos adquiridos fuera de los Estados Unidos o Canadá.

EN NINGÚN CASO GLOBAL SERÁ RESPONSABLE POR LA PÉRDIDA DE USO, INTERRUPCIÓN DE NEGOCIOS O CUALQUIER TIPO DE DAÑO INDIRECTO, ESPECIAL, INCIDENTAL, PUNITIVO O CONSECUENTE (INCLUIDA LA PÉRDIDA DE GANANCIAS), INDEPENDIENTEMENTE DEL TIPO DE ACCIÓN LEGAL, YA SEA EMANADOS DE UN CONTRATO, DE UN ACTO ILÍCITO (INCLUIDA LA CULPA), RESPONSABILIDAD OBJETIVA SOBRE EL PRODUCTO U OTROS. LO ANTERIOR SE APLICARÁ AÚN EN LOS CASOS EN QUE GLOBAL HAYA SIDO ADVERTIDA SOBRE LA POSIBILIDAD DE DICHOS DAÑOS. EN NINGÚN CASO, EN VIRTUD DE LA PRESENTE GARANTÍA, EL MONTO INDEMNIZATORIO POR RESPONSABILIDAD DE GLOBAL PODRÁ EXCEDER LOS USD 50.00 O LA SUMA QUE USTED HAYA PAGADO POR EL PRODUCTO OBJETO DE DICHA RESPONSABILIDAD, INDEPENDIENTEMENTE DE LA CAUSAL DE LA ACCIÓN LEGAL, POR EL CONTRATO, ACTO ILÍCITO, RESPONSABILIDAD OBJETIVA U OTRAS. DADO QUE NO EN TODAS LAS JURISDICCIONES RIGEN DICHAS LIMITACIONES EN LAS INDEMNIZACIONES, LAS LIMITACIONES ANTERIORES PUEDEN NO SER APLICABLES EN SU CASO.

3. PROCEDIMIENTO PARA EL SERVICIO DE GARANTÍA

Antes de devolver un Producto a Global para obtener el servicio de garantía, Usted debe contactar a Global, por teléfono al (800) 645-2986 (Estados Unidos) ó 888) 645-0878 (Canadá) a los fines de confirmar que dicho Producto esté contemplado en la presente Garantía Limitada. Si dicho Producto estuviera cubierto por la Garantía, usted recibirá un número de autorización de devolución de materiales de Global (en adelante, "ADM") y las instrucciones de envío previas al envío del Producto mencionado a Global. Usted deberá incluir su número de ADM con el envío del Producto correspondiente, junto con una copia fiel del recibo original que incluya la fecha de la compra del Producto realizada por usted.

Por favor tenga en cuenta que usted será responsable de todos los gastos de envío resultantes de la devolución de un artículo para su reemplazo o reparación. Global deberá abonar el envío de devolución del Producto reparado o reemplazado a direcciones dentro de Estados Unidos y Canadá solamente. Los gastos de envío a todas las demás direcciones fuera de Estados Unidos y Canadá quedan bajo su responsabilidad. En el caso de que Global estableciera que un Producto no se encuentra contemplado en la presente Garantía Limitada, usted deberá pagar todos los repuestos, la mano de obra y los gastos de envío por la devolución de dicho Producto

4. EXCLUSIONES Y LIMITACIONES DE LA GARANTÍA

SALVO EN LA MEDIDA EXPRESAMENTE ESTABLECIDA ANTERIORMENTE, NO EXISTEN DENTRO DE LA PRESENTE GARANTÍAS EXPRESAS O IMPLÍCITAS, INCLUIDAS, AUNQUE SIN LIMITACIÓN, GARANTÍAS IMPLÍCITAS DE COMERCIABILIDAD O IDONEIDAD PARA UN PROPÓSITO DETERMINADO Y GLOBAL RECHAZA CUALQUIER TIPO DE GARANTÍA NO INCLUIDA EN LA PRESENTE.

SALVO EN LA MEDIDA EXPRESAMENTE ESTABLECIDA ANTERIORMENTE, LOS PRODUCTOS SON ENTREGADOS EN EL "ESTADO EN QUE SE ENCUENTRAN". GLOBAL NO OFRECE GARANTÍA ALGUNA, NI EXPRESA NI IMPLÍCITA, QUE PUDIERA SURGIR DURANTE EL TRANSCURSO DE UNA NEGOCIACIÓN O EL USO O QUE SEAN ESTABLECIDAS POR LEY, EN LO QUE RESPECTA A LOS PRODUCTOS O A CUALQUIER OTRO ASUNTO. LA PRESENTE CONSTITUYE UNA GARANTÍA LIMITADA Y ES LA ÚNICA GARANTÍA OTORGADA POR GLOBAL. LOS MANDATARIOS, EMPLEADOS, DISTRIBUIDORES Y COMERCIANTES DE GLOBAL NO PODRÁN REALIZAR MODIFICACIONES A LA PRESENTE GARANTÍA LIMITADA NI PRESTAR GARANTÍAS ADICIONALES QUE OBLIGUEN LEGALMENTE A GLOBAL. EN CONSECUENCIA, TODA DECLARACIÓN ADICIONAL, TALES COMO PUBLICIDADES O PRESENTACIONES DEL COMERCIANTE, YA SEAN ORALES O ESCRITAS, NO CONSTITUIRÁN GARANTÍAS OTORGADAS POR GLOBAL Y NO DEBERÁN CONSIDERARSE VÁLIDAS. GLOBAL NO GARANTIZA QUE LOS PRODUCTOS FUNCIONEN SIN FALLAS O QUE SATISFAGAN SUS NECESIDADES O EXPECTATIVAS. DADO QUE NO EN TODAS LAS JURISDICCIONES RIGEN DICHAS LIMITACIONES EN LAS INDEMNIZACIONES, LAS LIMITACIONES DE LA CLÁUSULA PUEDEN NO SER DE APLICACIÓN EN SU CASO.

5. ELECCIÓN DE LA LEGISLACIÓN Y JURISDICCIÓN

PARA COMPRAS REALIZADAS DENTRO DE LOS ESTADOS UNIDOS, la presente Garantía Limitada estará sujeta únicamente a las leyes del Estado de Nueva York, según se aplica a los contratos celebrados en el Estado de Nueva York entre residentes del Estado de Nueva York. Toda controversia que surja en virtud de la presente Garantía quedará sujeta a la sola jurisdicción de los Tribunales Estatales y Federales ubicados en el Condado de Nassau, Nueva York. Por medio de la presente Garantía, las partes acuerdan someterse a la jurisdicción personal de dichos tribunales.

PARA COMPRAS REALIZADAS EN CANADÁ - La presente Garantía Limitada quedará sujeta únicamente a las leyes de la Provincia de Ontario. Toda controversia que surja en virtud de la presente Garantía quedará sujeta a la sola jurisdicción de Ontario, Canadá. Por medio de la presente Garantía, las partes acuerdan someterse a la jurisdicción personal de dichos tribunales.

INSCRIVEZ-VOUS EN LIGNE AU

http://www.globalindustrial.com/wr or http://www.globalindustrial.ca/wr

Garantie globale limitée de 1 an

1. GARANTIE LIMITÉE

Global Equipment Company Inc. (DBA Global Industrial) («Global») vous garantit, l'acheteur initial et à l'utilisateur («vous» ou «votre»), que les produits que vous avez achetés et qui accompagnent cette garantie limitée («produits») sont exempts de tout défaut de matériaux et fabrication dans des conditions normales d'utilisation conformément à la documentation suivant pour une période d'un an débutant à la date d'achat (la «période de garantie»).

Global réparera ou remplacera tout produit jugé défectueux et qui a été retourné, tel que stipulé à la section 3 ci-dessous, à Global. Un produit peut être remplacé par un produit neuf ou usagé et/ou par une révision actuelle ou antérieure. Lorsque global détermine à son seul jugement que la réparation ou le remplacement de ce produit n'est pas raisonnable, Global gardera le produit non conforme et vous remboursera le montant que vous avez payé pour ce produit. Les produits retournés sont soumis au reste de la période de garantie applicable par ailleurs. Toutes les pièces reconditionnées utilisées par Global sont soumises à toutes les mêmes dispositions que celles qui s'appliquent autrement aux nouvelles pièces.

CE QUI PRÉCÈDE DÉCRIT LA RESPONSABILITÉ EXCLUSIVE DE GLOBAL, ET VOTRE SEUL RECOURS, POUR TOUT MANQUEMENT À LA GARANTIE. SI VOUS N'ÊTES PAS D'ACCORD AVEC LES TERMES DE CETTE GARANTIE LIMITÉE, VOUS DEVEZ RETOURNER LES PRODUITS INUTILISÉS ET DANS LEUR EMBALLAGE D'ORIGINE DANS LES TROIS (3) JOURS ET VOTRE PRIX D'ACHAT SERA REMBOURSÉ.

2. EXCLUSIONS DE GARANTIE ET LIMITATION DE RESPONSABILITÉ

La présente garantie limitée ne couvre pas: (i) les défauts ou dommages résultant d'actes de Dieu, d'accident, de mauvais usage ou d'abus, de surcharge, du dépassement de la capacité de poids recommandée, de négligence, des altérations, modification, service ou réparation par autre que Global ou ses fournisseurs de services tiers indépendants, y compris sans vos limites; (ii) d'un montage ou d'une installation ou d'une désinstallation, d'un fonctionnement ou d'un entretien incorrects, des connexions incorrectes avec des périphériques ou d'autres causes ne résultant pas de défauts dans les matériaux ou la fabrication de produits; (iii) tout produit pour lequel la vignette de garantie a été enlevée, modifiée ou défigurée; (iv) des conteneurs, piles, armoires, supports, logiciels ou accessoires d'expédition; (v) d'une usure normale; (Vi) des dommages ou la perte de produits réparés ou remplacés pendant l'expédition par Global, sauf si ces dommages ou pertes sont causés par des emballages pauvres ou inadéquats par Global; ou (vii) des produits achetés en dehors des États-Unis ou du Canada.

GLOBAL NE POURRA EN AUCUN CAS ÊTRE TENU RESPONSABLE DE TOUTE PERTE D'UTILISATION, D'INTERRUPTION D'ACTIVITÉ OU DE TOUT DOMMAGE INDIRECT, SPÉCIAL, ACCIDENTEL, PUNITIF OU CONSÉCUTIF DE QUELQUE NATURE QUE CE SOIT (Y COMPRIS LES PERTES DE PROFITS), QUELLE QUE SOIT LA FORME D'ACTION CONTRACTUELLE, DÉLICTUELLE (Y COMPRIS LA NÉGLIGENCE), LA RESPONSABILITÉ STRICTE OU PRODUIT OU AUTRE, MÊME SI GLOBAL A ÉTÉ AVISÉ DE LA POSSIBILITÉ DE TELS DOMMAGES. EN AUCUN CAS LA RESPONSABILITÉ ENTIÈRE CI-DESSOUS DE GLOBAL NE DÉPASSERA CE QUI EST PLUS ÉLEVÉ ENTRE $50 OU LE MONTANT QUE VOUS AVEZ EFFECTIVEMENT PAYÉ POUR LE PRODUIT DONNANT LIEU À CETTE RESPONSABILITÉ, INDÉPENDAMMENT DE LA CAUSE D'ACTION, DANS LE CONTRAT, LE DÉLIT, LA RESPONSABILITÉ STRICTE OU AUTREMENT. TOUTES LES JURIDICTIONS N'AUTORISENT PAS CES LIMITATIONS DE DOMMAGES, DE SORTE QUE LES LIMITATIONS QUI PRÉCÈDENT PEUVENT NE PAS S'APPLIQUER À VOUS.

3. PROCÉDURE DE SERVICE SOUS GARANTIE

Avant de retourner tous les produits à Global pour le service de garantie, vous devez d'abord contacter Global, par téléphone au (800) 645-2986 (US) ou (888) 645-0878 (Canada) pour confirmer que ces produits sont couverts par cette garantie limitée. Si ces produits sont ainsi couverts, vous obtiendrez de Global un numéro d'autorisation de retour de matériel («ARM») et des instructions d'expédition avant toute expédition de ces produits à global et vous devez inclure ce numéro ARM avec n'importe quelle expédition correspondante de produit, ainsi qu'une copie exacte et correcte du reçu original indiquant la date d'achat de l'achat de votre produit, ainsi qu'une description détaillée et écrite de tout problème de produit associé.

Veuillez noter que vous êtes responsable de tous les frais d'expédition engagés pour retourner un article pour un échange ou une réparation. Global doit payer pour l'expédition de retour des produits réparés et/ou remplacés aux adresses aux États-Unis et au Canada seulement ainsi que pour les expéditions de retour à toutes les autres adresses à l'extérieur des États-Unis ou du Canada en revient de votre responsabilité. Si Global détermine que n'importe quel produit n'est pas couvert par cette garantie limitée, vous devez payer toutes les pièces, frais de main-d'œuvre et expédition de retour pour ce produit.

4. DÉNI DE GARANTIE ET LIMITATIONS

SAUF ET DANS LA MESURE EXPRESSÉMENT ÉNONCÉE CI-DESSUS IL N'Y A AUCUNE GARANTIE, EXPRESSE OU IMPLICITE, Y COMPRIS MAIS SANS S'Y LIMITER À TOUTE GARANTIE DE QUALITÉ MARCHANDE OU D'ADAPTATION À UN USAGE PARTICULIER ET GLOBAL DÉCLINE EXPRESSÉMENT TOUTES LES GARANTIES NON MENTIONNÉES DANS LE PRÉSENT DOCUMENT.

SAUF ET DANS LA MESURE EXPRESSÉMENT ÉNONCÉE CI-DESSUS, LES PRODUITS SONT FOURNIS SUR UNE BASE «TEL QUEL» ET GLOBAL NE FAIT AUCUNE GARANTIE ADDITIONNELLE, EXPRESSE, IMPLICITE, DÉCOULANT DE COURS DE TRAITEMENT OU D'UTILISATION DU COMMERCE OU STATUTAIRE, QUANT AUX PRODUITS OU QUELQUE MATIÈRE QUE CE SOIT. IL S'AGIT D'UNE GARANTIE LIMITÉE ET EST LA SEULE GARANTIE FAITE PAR GLOBAL. LES AGENTS, LES EMPLOYÉS, LES DISTRIBUTEURS ET LES CONCESSIONNAIRES DE GLOBAL NE SONT PAS AUTORISÉS À APPORTER DES MODIFICATIONS À CETTE GARANTIE LIMITÉE, OU À FAIRE DES GARANTIES SUPPLÉMENTAIRES CONTRAIGNANTES POUR GLOBAL. PAR CONSÉQUENT, DES DÉCLARATIONS SUPPLÉMENTAIRES TELLES QUE LA PUBLICITÉ OU LA PRÉSENTATION DES CONCESSIONNAIRES, QU'ELLES SOIENT ORALES OU ÉCRITES, NE CONSTITUENT PAS DES GARANTIES GLOBALES ET NE DEVRAIENT PAS ÊTRE INVOQUÉES. GLOBAL NE GARANTIT PAS QUE LES PRODUITS FONCTIONNERONT SANS DÉFAILLANCE, OU QUE LES PRODUITS RÉPONDRONT À VOS BESOINS OU À VOS ATTENTES. PAS TOUTES LES JURIDICTIONS NE PERMETTENT DE TELLES LIMITATIONS DE GARANTIE AINSI LES LIMITATIONS CI-DESSUS PEUVENT NE PAS S'APPLIQUER À VOUS.

5. CHOIX DE LA LOI ET DE LA JURIDICTION

POUR LES ACHATS AUX ÉTATS-UNIS : cette garantie limitée est soumise aux seules lois de l'état de New York, telles qu'appliquées aux contrats conclus dans l'état de New York entre les résidents de New York. Tout litige découlant des présentes est soumis à la seule compétence de l'État et des tribunaux fédéraux situés dans le comté de Nassau, New York. Les parties consentent par la présente à la compétence personnelle de ces tribunaux.

POUR LES ACHATS AU CANADA : cette garantie limitée est assujettie uniquement aux lois de la province de l'Ontario. Tout différend découlant des présentes est assujetti à la seule compétence de la province de l'Ontario, au Canada. Les parties consentent par la présente à la compétence personnelle de ces tribunaux.

13210.2.11 WATER HEATER

EEMAX 240V Tankless Water Heater Model SPEX35 or Equivalent

FlowCo™

Specifications
Electric Tankless Water Heater

Point-of-use non-thermostatic heater- Ideal for handwashing and fixed-flow applications

Applications

- Handwashing
- Kitchen/bar/utility sinks
- Fixed-flow
- Designed for a single sensor faucet or meter faucet

Performance Features

- Self-diagnostics
- Intelligent controls
- InfoCue - visible LED indicator
- SafeStart™ technology
- Mounts in any orientation
- Compact size
- Only one cold water line needed for installation
- No T&P relief valve needed (check local codes)
- Integral 3/8" compression fittings
- Control system activates heater only on demand
- Bare wire technology
- High temperature limit switch (ECO - automatic energy cut-off)
- Low activation flow starting at 0.25 GPM turn on (model dependent)
- Warranty, five (5) years limited on leaks, one (1) year parts

Benefits

- Endless hot water – no storage capacity to run out
- Fits almost anywhere; suitable for ADA compliant facilities
- Save water and time by installing unit at point-of-use to eliminate long pipe runs
- Reduces installation cost and materials
- Cut energy waste (no standby heat loss)
- No venting
- Purge technology engages upon start-up to avoid dry-fire occurrence
- Easy, flexible installation
- Ready out of the box
- Over temperature protection
- Real-time response to flow
- Operation feedback via an intuitive LED indicator
- Blinking patterns indicate system status

System Specifications

Dimensions:	10.5" H x 5.25" W x 3" D
Product Weight: (model dependent)	2.75 lb/3 lb
Cover:	ABS-UL 94 5VA
Color:	White
Minimum Operating Pressure:	30 PSI
Maximum Operating Pressure:	150 PSI
Element:	Replaceable nichrome cartridge insert
Fittings:	3/8" compression fittings

U.S. Patent Pending Technology

CLASSIFIED C UL US Water Heater in accordance with NSF/ANSI 372 MH49688

Assembled In USA

NO LEAD* *The wetted surface of this product contacted by water contains less than 0.25% lead and meets ANSI/NSF 372

Note: For optimum performance, mounting location should be within 2 feet of fixture.

Special Design Service

Inquiries for units for unique applications are welcome.
Call our Technical Service department at **1-800-543-6163**.

Suggested Specification

Replace suggested spec text on PDF w/ the following:

Tankless water heater shall be an Eemax model number SPEX_____.

Unit shall have ABS UL 94 5VA rated cover. Unit shall allow mounting in any orientation. Element shall be replaceable cartridge insert. Element shall be iron-free, nickel-chrome material. Unit shall have replaceable filter in the inlet connector. Unit shall include an integrated flow meter to ensure accurate turn-on / turn-off flow rate. Heater shall be fitted with 3/8" compression fittings to eliminate the need for soldering. Maximum operating pressure of 150 PSI. Diagnostic features to include LED error/fault indicator. Heater shall employ technology that engages upon start-up to avoid dry-fire occurrence. Hot water storage tanks prohibited. Unit shall be Eemax or approved equal.

NOTE: Refer to rating chart for product information.

Eemax® Hot Water Solutions Made Easy

Eemax, 400 Captain Neville Drive, Waterbury, CT 06705
(800) 543-6163 | info@eemaxinc.com | **www.eemax.com**

FlowCo™

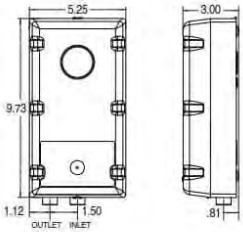
Point-of-use non-thermostatic heater- Ideal for handwashing and fixed-flow applications

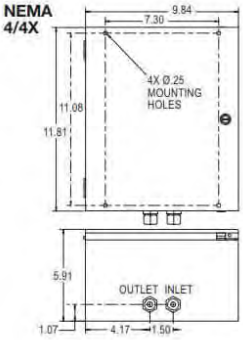
Specifications
Electric Tankless Water Heater

	MODEL NUMBER	kW	AMPS	RECOMMENDED WIRE SIZE: (75° C/CU)	TURN ON (GPM)	TEMPERATURE RISE °F 0.3 GPM	0.5 GPM	0.75 GPM	1.0 GPM	1.5 GPM	2.0 GPM
	VOLTS 120										
C	**SPEX1812**	1.8	15	14 AWG	0.2	41°	25°	16°	12°	8°	6°
C	**SPEX1812CA** (Canadian model)	1.8	15	14 AWG	0.2	41°	25°	16°	12°	8°	6°
C	**SPEX2412**	2.4	20	14 AWG	0.25	55°	33°	22°	16°	11°	8°
C	**SPEX2412CA** (Canadian model)	2.4	20	14 AWG	0.25	55°	33°	22°	16°	11°	8°
C	**SPEX3012**	3.0	25	12 AWG	0.25	68°	41°	27°	20°	14°	10°
C	**SPEX3012CA** (Canadian model)	3.0	25	12 AWG	0.25	68°	41°	27°	20°	14°	10°
C	**SPEX3512**	3.5	29	10 AWG	0.3	80°	48°	32°	24°	16°	12°
C	**SPEX3512CA** (Canadian model)	3.5	29	10 AWG	0.3	80°	48°	32°	24°	16°	12°
C	**VOLTS 208 Single Phase**										
C	**SPEX3208**	3.0	15	14 AWG	0.25	68°	41°	27°	20°	14°	10°
C	**SPEX3208CA** (Canadian model)	3.0	15	14 AWG	0.25	68°	41°	27°	20°	14°	10°
C	**SPEX4208**	4.1	20	14 AWG	0.4	–	56°	37°	28°	19°	14°
C	**SPEX4208CA** (Canadian model)	4.1	20	14 AWG	0.4	–	56°	37°	28°	19°	14°
C	**SPEX8208**	8.3	40	8 AWG	0.7	–	–	76°	57°	38°	28°
C	**SPEX8208CA** (Canadian model)	8.3	40	8 AWG	0.7	–	–	76°	57°	38°	28°
	VOLTS 240*										
C	**SPEX35**	3.5	15	14 AWG	0.3	80°	48°	32°	24°	16°	12°
	SPEX35 (derated 208V performance)	2.6	13	14 AWG	0.3	59°	36°	24°	18°	12°	9°
C	**SPEX35CA** (Canadian model)	3.5	15	14 AWG	0.3	80°	48°	32°	24°	16°	12°
C	**SPEX48**	4.8	20	14 AWG	0.4	–	66°	44°	33°	22°	16°
	SPEX48 (derated 208V performance)	3.6	17	14 AWG	0.4	–	49°	33°	25°	16°	12°
C	**SPEX48CA** (Canadian model)	4.8	20	14 AWG	0.4	–	66°	44°	33°	22°	16°
C	**SPEX55**	5.5	23	12 AWG	0.5	–	75°	50°	38°	25°	19°
	SPEX55 (derated 208V performance)	4.1	20	12 AWG	0.5	–	56°	37°	28°	19°	14°
C	**SPEX55CA** (Canadian model)	5.5	23	12 AWG	0.5	–	75°	50°	38°	25°	19°
C	**SPEX65**	6.5	27	10 AWG	0.7	–	–	59°	44°	30°	22°
	SPEX65 (derated 208V performance)	4.8	23	10 AWG	0.7	–	–	44°	33°	22°	16°
C	**SPEX65CA** (Canadian model)	6.5	27	10 AWG	0.7	–	–	59°	44°	30°	22°
C	**SPEX75**	7.5	32	10 AWG	0.7	–	–	68°	51°	34°	26°
	SPEX75 (derated 208V performance)	5.6	27	10 AWG	0.7	–	–	51°	38°	25°	19°
C	**SPEX75CA** (Canadian model)	7.5	32	10 AWG	0.7	–	–	68°	51°	34°	26°
C	**SPEX95**	9.5	40	8 AWG	0.8	–	–	–	65°	43°	32°
	SPEX95 (derated 208V performance)	5.6	34	8 AWG	0.8	–	–	–	38°	25°	19°
C	**SPEX95CA** (Canadian model)	9.5	40	8 AWG	0.8	–	–	–	65°	43°	32°
	VOLTS 277 Single Phase										
	SPEX100	10.0	36	8 AWG	0.8	–	–	–	68°	46°	34°
C	**SPEX100CA** (Canadian model)	10.0	36	8 AWG	0.8	–	–	–	68°	46°	34°
	SPEX3277	3.0	11	14 AWG	0.25	68°	41°	27°	20°	14°	10°
C	**SPEX3277CA** (Canadian model)	3.0	11	14 AWG	0.25	68°	41°	27°	20°	14°	10°
	SPEX4277	4.1	15	14 AWG	0.4	–	56°	37°	28°	19°	14°
C	**SPEX4277CA** (Canadian model)	4.1	15	14 AWG	0.4	–	56°	37°	28°	19°	14°
	SPEX60	6.0	22	12 AWG	0.7	–	–	55°	41°	27°	20°
C	**SPEX60CA** (Canadian model)	6.0	22	12 AWG	0.7	–	–	55°	41°	27°	20°
	SPEX80	8.0	29	10 AWG	0.7	–	–	73°	55°	36°	27°
C	**SPEX80CA** (Canadian model)	8.0	29	10 AWG	0.7	–	–	73°	55°	36°	27°
	SPEX90	9.0	33	10 AWG	0.7	–	–	82°	61°	41°	31°
C	**SPEX90CA** (Canadian model)	9.0	33	10 AWG	0.7	–	–	82°	61°	41°	31°

* 240V units can be used on 208V single phase with 25% reduced temperature output. Please note per UL standards the rating plate and installation instructions will all be according to a 240V applied voltage. Check with local officials prior to derating the electrical infrastructure.

"C" indicates evaluation and compliance to either Underwriters Laboratories (UL) or Intertek (ETL) under CAN/CSA-C22.2 No. 64/No. 88.





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13210.3 CONSTRUCTION REQUIREMENTS

13210.3.1 The CONTRACTOR shall complete construction of the chlorination building, its equipment, piping, exterior grading and surfacing and etc., in a manner that conforms with the requirements of the DRAWINGS and these SPECIFICATIONS, using good workmanship practices, and applicable building regulations.

13210.4 METHOD OF MEASUREMENT

13210.4.1 Unless noted otherwise in Section 1019 Special Provisions, measurement of the chlorination building shall be "lump sum" for the building, foundation excavation and gravel support materials, valves, piping, electrical wiring and controls, chlorination equipment, painting and incidental materials needed to complete the building.

13210.4.2 Where modifications or equipment replacement is required in an existing chlorination building, measurement for those equipment items will be "lump sum" for that item as identified in the BID Schedule.

13210.5 BASIS OF PAYMENT

The accepted quantity will be paid for at the contract unit price for:

PAY ITEM	UNIT
Chlorination Building	Lump Sum