# Corrigendum

# Request for Proposal

# for

# Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System

**Issued on.: December 19, 2025**

**Request for Proposal No.:** TPC/OPS/OCB/Gen-AS/2025-26/005

**Procuring Entity.:** TransPeshawar (The Urban Mobility Company)

# Preface

This Request for Proposal is prepared by TransPeshawar (The Urban Mobility Company) and will be used for hiring Service Provider for Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System. The procedure of bidding is Single Stage- Two Envelope.

# Table of Contents - Summary Description


## PART I BIDDING PROCEDURES

**Section 1 - Instructions to Service Providers (ITSP)---------- 1-1**
This section specifies the procedures Service Providers should follow when preparing and submitting their Proposals. Information is also provided on the submission, opening, evaluation of Proposals, and on the award of contract.

**Section 2 - Data Sheet (DS) ---------- 2-1**
This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section 1 (Instructions to Service Providers).

**Section 3 - Eligibility and Responsiveness Criteria (ERC) ---------- 3-1**
This section contains the criteria to be used to determine the responsiveness of Service Providers.

**Section 4 - Standard Forms (SF) ---------- 4-1**
This section contains the forms to be completed by the Service Provider and submitted as part of its Proposal.

## PART II REQUIREMENTS

**Section 5 - Schedule of Requirements (SoR)---------- 5-1**

This section contains scope of services, area of operation, operation and maintenance obligations to be provided by service provider for Operation and Maintenance Services of Generator and Allied Services in Peshawar BRT System

## PART III CONDITIONS OF CONTRACT AND CONTRACT FORMS

**Section 6 - General Conditions of Contract (GCC) ---------- 6-1**
This section contains the general clauses that govern the Contract. These Conditions are subject to the variations and additions set out in Section 7 (Particular Conditions of Contract).

**Section 7 - Particular Conditions of Contract (PCC) ---------- 7-1**
This section contains provisions that are specific to each contract and that modify or supplement the General Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the General Conditions of Contract.

**Section 8 - Contract Forms (COF) ---------- 8-1**
This section contains forms that, once completed, will form part of the Contract. The forms for Performance Security, when required, shall only be completed by the successful Service Provider after contract award.

# Section 1 - Instructions to Service Providers

This Section specifies the procedures to be followed by Service Providers in the preparation and submission of their Proposals. Information is also provided on the submission, opening, evaluation of Proposals, and on the award of contract.

## Table of Clauses

**A. General ..... 1-3**
1. Scope of Proposal ..... 1-3
2. Source of Fund ..... 1-3
3. Fraud and Corruption ..... 1-3
4. Eligible Service Providers ..... 1-4
5. Eligible Materials, Equipment, and Services ..... 1-5

**B. Contents of Request for Proposal Document ..... 1-5**
6. Sections of Request for Proposal Document ..... 1-5
7. Clarification of Request for Proposal Document, Site Visit, Pre-Bid Meeting ..... 1-6
8. Amendment of Request for Proposal Document ..... 1-7

**C. Preparation of Proposals ..... 1-7**
9. Cost of Bidding ..... 1-7
10. Language of Proposal ..... 1-7
11. Documents Comprising the Proposal ..... 1-7
12. Letters of Proposal and Schedules ..... 1-8
13. Alternative Proposals ..... 1-8
14. Proposal Prices ..... 1-8
15. Currencies of Proposal and Payment ..... 1-8
16. Period of Validity of Proposals ..... 1-8
17. Bid Security ..... 1-9
18. Format and Signing of Proposal ..... 1-9

**D. Submission and Opening of Proposals ..... 1-10**
19. Sealing and Marking of Proposals ..... 1-10
20. Deadline for Submission of Proposals ..... 1-10
21. Late Proposals ..... 1-11
22. Withdrawal, Substitution, and Modification of Proposals ..... 1-11
23. Proposal Opening ..... 1-11

**E. Evaluation and Comparison of Proposals ..... 1-13**
24. Confidentiality ..... 1-13

25. Clarification of Proposals…… 1-14
26. Deviations, Reservations, and Omissions 1-14
27. Examination of Technical Proposals 1-14
28. Responsiveness of Technical Proposals 1-14
29. Nonmaterial Nonconformities….. 1-15
30. Correction of Arithmetical Errors.. 1-15
31. Evaluation of Friancial Proposals 1-16
32. Comparison of Proposals……. 1-16
33. Employer's Right to Accept Any Proposal, and to Reject Any or All Proposals 1-16

**F. Award of Contract……1-16**
34. Award Criteria…….. 1-16
35. Notification of Award…… 1-16
36. Signing of Contract……. 1-16
37. Performance Security 1-16

# Section 1 - Instructions to Service Providers

## A. General

**1. Scope of Proposal**

1.1 In connection with the Invitation for Request for Proposal (RFP) as indicated in the **Data Sheet (DS)**, the Procuring Entity, as indicated in the **DS**, issues this Request for Proposal document for the scope of Services as specified in Section 5 (Schedule of Requirements). The name, identification, and number of contracts of the open competitive bidding (OCB) are provided in the **DS**.

1.2 Throughout this Request for Proposal document,

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

**2. Source of Funs**

2.1 The source of funds required by the Procuring Entity for undertaking this procurement is as indicated in the **DS**.

**3. Fraud and Corruption**

3.1 It is required that Service Providers shall observe the highest standard of ethics during the procurement and execution of contract. Khyber Pakhtunkhwa Public Procurement of Goods, Works and Services Rules, 2014 defines corrupt and fraudulent practices as follows:

(i) "Corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "Fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "Coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) "Collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(v) "obstructive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation

into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially impede the exercise of inspection and audit rights provided for under these rules and

3.2 The Procuring Entity will reject a proposal for award if it determines that the Service Provider during bidding or while recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract apart from other remedies provided for under the relevant laws.

**4. Eligible Service Providers**

4.1 A Service Provider may be a natural person or private entity, or any combination thereof with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture or as indicated in **DS**. In the case of a Joint Venture,

(a) all partners shall be jointly and severally liable; and

(b) the Joint Venture shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the Joint Venture during the bidding process and, in the event the Joint Venture is awarded the Contract, during contract execution.

4.2 A Service Provider, and all parties constituting the Service Provider, shall have the nationality of Pakistan. A Service Provider shall be deemed to have the nationality of Pakistan if the Service Provider is a citizen of Pakistan or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of Pakistan.

4.3 A Service Provider shall not have a conflict of interest. All Service Providers found to have a conflict of interest shall be disqualified. A Service Provider may be considered to be in a conflict of interest with one or more parties in this bidding process if any of, including but not limited to, the following apply:

(a) they have controlling partners in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this proposal; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the proposal of another Service Provider, or influence the decisions of the Procuring Entity regarding this bidding process; or

(e) a Service Provider participates in more than one proposal in this bidding process, either individually or as a partner in a joint venture, except for alternative offers permitted under ITSP 13 of the Request for Proposal Document. This will result in the

disqualification of all Proposals in which it is involved; or

(f) a Service Provider or any affiliated entity, participated as a consultant in the preparation of the design or technical specifications of the procurement that is the subject of the proposals; or

4.4 Service Providers shall provide such evidence of their continued eligibility satisfactory to the Procuring Entity, as the Procuring Entity shall reasonably request.

4.5 Apart from above, the Service Providers shall provide their eligibility satisfactory to the Procuring Entity, as indicated in **DS**.

**5. Eligible Materials, Equipment and Services**

5.1 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Procuring Entity's request, Service Providers may be required to provide evidence of the origin of materials, equipment, and services.

5.2 For purposes of ITSP 5.1 above, "origin" means the place where the materials and equipment are mined, grown, produced, or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

## B. Contents of Request for Proposal Document

**6. Sections of Request for Proposal Document**

6.1 The Request for Proposal document consist of Parts I, II, and III, which include all the sections indicated below, and should be read in conjunction with any addenda issued in accordance with ITSP 8.

**PART I Bidding Procedures**
Section 1 - Instructions to Service Providers (ITSP)
Section 2 - Data Sheet (DS)
Section 3 – Eligibility and Qualification Criteria (EQC)
Section 4 - Bidding Forms (BDF)

**PART II Requirements**
Section 5 – Schedule of Requirements (SoR)

**PART III Conditions of Contract and Contract Forms**
Section 6 - General Conditions of Contract (GCC)
Section 7 - Particular Conditions of Contract (PCC)
Section 8 - Contract Forms (COF)

6.2 The Invitation for RFP issued by the Procuring Entity is not part of the Request for Proposal document.

6.3 The Procuring Entity is not responsible for the completeness of the Request for Proposal document and their addenda, if they were not obtained directly from the source stated by the Procuring Entity in the

Invitation for RFP.

6.4 The Service Provider is expected to examine all instructions, forms, terms, and specifications in the Request for Proposal document. Failure to furnish all information or documentation required by the Request for Proposal document may result in the rejection of the Proposal.

**7. Clarification of Request for Proposal Document, Site Visit, Pre-Bid Meeting**

7.1 A prospective Service Provider requiring any clarification on the Request for Proposal document shall contact the Procuring Entity in writing through EPADS on or before the date and time indicated in the **DS** or raise his inquiries during the pre-bid meeting if provided for in accordance with ITSP 7.4. The Procuring Entity will respond to any request for clarification in the manner as indicated in the **DS**. Should the Procuring Entity deem it necessary to amend the Request for Proposal document as a result of a request for clarification, it shall do so following the procedure under ITSP 8 and ITSP 20.2.

7.2 The Service Provider is advised to visit and examine the Premises and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the Proposal and entering into a contract. The costs of visiting the Premises shall be at the Service Provider's own expense.

7.3 The Service Provider and any of its personnel or agents will be granted permission by the Procuring Entity to enter its premises and lands for the purpose of such visit, but only upon the express condition that the Service Provider, its personnel, and agents will release and indemnify the Procuring Entity and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7.4 The Service Providers are encouraged to attend a pre-bid meeting, if provided for in the **DS**. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be disseminated in a manner as indicated in **DS**. Any modification to the Request for Proposal document that may become necessary as a result of the pre-bid meeting shall be made by the Procuring Entity exclusively through the issue of an addendum pursuant to ITSP 8 and not through the minutes of the pre-bid meeting.

7.6 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Service Provider.

**8. Amendment of Request for Proposal Document**

8.1 The Procuring Entity may amend the Request for Proposal document by issuing addenda at least five (05) days before the deadline for submission of Proposals.

8.2 Any addendum issued shall be part of the Request for Proposal document and shall be communicated in manner as indicated in **DS**

8.3 To give prospective Service Providers reasonable time in which to take an addendum into account in preparing their Proposals, the Procuring Entity may, at its discretion, extend the deadline for the submission of Proposals, pursuant to ITSP 20.2.

## C. Preparation of Proposals

**9. Cost of Bidding**

9.1 The Service Provider shall bear all costs associated with the preparation and submission of its Proposal, and the Procuring Entity shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

**10. Language of Proposal**

10.1 The Proposal, as well as all correspondence and documents relating to the Proposal exchanged by the Service Provider and the Procuring Entity, shall be written in the language specified in the **DS**. Supporting documents and printed literature that are part of the Proposal may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the **DS**, in which case, for purposes of interpretation of the Proposal, such translation shall govern.

**11. Documents Comprising the Proposal**

11.1 The Proposal shall comprise two separate files submitted simultaneously through EPADS portal, one called the Technical Proposal containing the documents listed in TABLE-1, “CONTENTS OF TECHNICAL PROPOSAL” and TABLE-2, “CONTENTS OF FINANCIAL PROPOSAL” under Section 4 (Bidding Forms) of Request of Proposal document.

11.2 In addition to the requirements under ITSP 11.1, Proposals submitted by a Joint Venture shall include, in Technical Proposal, a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Service Provider shall be signed by all partners and submitted with the Technical Proposal, together with a copy of the proposed agreement.

**12. Letters of Proposal and Schedules**

12.1 The Letters of Technical Proposal and Financial Proposal, Schedules along with attachments, and all documents listed under Clause 11, shall be prepared using the relevant forms in Section 4 (Bidding Forms), if so provided. The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information as required.

**13. Alternative Proposals**

13.1 Unless otherwise indicated in the **DS**, alternative Proposals shall not be considered.

**14. Proposal Prices**

14.1 The prices quoted by the Service Provider in the Letter of Financial Proposal, EPADS and in the relevant Schedule (s) shall conform to the requirements specified below.

14.2 The Service Provider shall submit Proposal for complete scope of services as indicated in Section 5 (Schedule of Requirements) on given forms as identified in Section 4 (Bidding Forms). Proposals submitted for incomplete scope shall be rejected.

14.3 The Price to be quoted in Letter of Financial Proposal and in the EPADS shall be the total price of the services. Absence of the total price in the Letter of Financial Proposal and on EPADS portal may result in the rejection of the Proposal. In case there is discrepancy/difference between the Price quoted in Letter of Financial Proposal and the one entered in EPADS portal, the proposal shall be rejected summarily.

14.4 The offered price shall be inclusive of taxes, as per requirement of Letter of Financial Proposal, and Service Provider shall be liable for payment of all applicable taxes, duties, minimum wage, and other levies under the Contract as per relevant law.

14.5 The entered prices shall be typewritten or if written by hand, must be in indelible ink. The relevant schedule not presented accordingly may be considered nonresponsive.

**15. Currencies of Proposal and Payment**

15.1 The rates shall be quoted by the Service Provider entirely in Pak Rupees.

15.2 The currency of payment of contract price shall entirely be in Pak Rupees.

**16. Period of Validity of Proposals**

16.1 Proposals shall remain valid for the period specified in the **DS** after the Proposal submission deadline prescribed by the Procuring Entity. A Proposal valid for a shorter period or absence of period of validity shall be rejected by the Procuring Entity as nonresponsive.

16.2 In exceptional circumstances, prior to the expiration of the Proposals' validity period, the Procuring Entity may request Service Providers to extend the period of validity of their Proposals. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITSP 17, it shall also be extended 28 days beyond the deadline of the extended validity period. A Service Provider may refuse the request without forfeiting its bid security. A Service Provider granting the request shall not be required or permitted to modify its Proposal.

**17. Bid Security**

17.1 Unless otherwise specified in the **DS**, the Service Provider shall furnish as part of its Proposal, in original form, a bid security in the form, amount and currency as specified in the **DS**.

17.2 Unless otherwise specified in the **DS**, any Proposal not accompanied by a substantially compliant bid security shall be rejected by the Procuring Entity as nonresponsive.

17.3 If a bid security is specified pursuant to ITSP 17.1, the bid security of unsuccessful Service Providers shall be returned promptly upon the successful Service Provider's furnishing of the performance security pursuant to ITSP 37.

17.4 If a bid security is specified pursuant to ITSP 17.1, the bid security of the successful Service Provider shall be returned as promptly as possible once the successful Service Provider has signed the Contract and furnished the required performance security.

17.5 The bid security may be forfeited, if

(a) a Service Provider withdraws its proposal during the period of proposal validity, except as provided in ITSP 16.2; or

(b) the successful Service Provider fails to

(i) sign the Contract in accordance with ITSP 36;

(ii) furnish a performance security in accordance with ITSP 37;

(iii) accept the arithmetical correction of its Proposal in accordance with ITSP 30.

17.6 . The bid security of a Joint Venture shall be submitted as indicated in **DS**.

**18. Format and Signing of Proposal**

18.1 The Service Provider shall prepare Proposal comprising the documents as described in ITSP 11.

18.2 The Proposal shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Service Provider. This authorization shall consist of a written confirmation as specified in the **DS** and shall be enclosed in Technical Proposal. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Proposal, except for unamended printed literature, shall be signed or initialed by the person signing the Proposal. If a Service Provider submits a deficient authorization, the Proposal shall not be rejected in the first instance. The Procuring Entity shall request the Service Provider to submit an acceptable/valid authorization within the number of days as specified in the **DS**. Failure to provide an acceptable/valid authorization within the prescribed period of receiving such a request shall cause the rejection of the Proposal.

18.3 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Proposal.

## D. Submission and Opening of Proposals

**19. Sealing and Marking of Proposals**

19.1 Service Providers shall submit their Proposals electronically by uploading PDF file through the KP-EPADS portal (kp.eprocure.gov.pk) under the Single Stage – Two Envelope Bidding Procedure. Procedures for sealing, marking and submission of Proposals electronically is specified in **DS**.

**20. Deadline for Submission of Proposals**

20.1 Proposals must be submitted through EPADS portal not later than the date and time as indicated in the **DS**.

20.2 The Procuring Entity may, at its discretion, extend the deadline for the submission of Proposals by amending the Request for Proposal documents in accordance with ITSP 8, in which case all rights and obligations of the Procuring Entity and Service Providers previously subject to the deadline shall thereafter be subject to the deadline as extended.

**21. Late Proposals**

21.1 In accordance with ITSP 20, the EPADS portal shall not permit the submission of any Proposal after the deadline prescribed for submission. Any attempt to submit after the deadline shall be system-restricted, and such Proposals shall neither be received nor considered by the Procuring Entity.

**22. Withdrawal, Substitution, and Modification of Proposals**

22.1 A Service Provider may modify, substitute, or withdraw its Proposal – Technical or Financial – at any time prior to the deadline for submission of Proposals, by using the relevant functions available in the EPADS portal, if any. The system shall record the latest version of the Proposal submitted before the deadline as the valid Proposal.

22.2 A Proposal withdrawn through the EPADS portal in accordance with ITC 22.1 shall not be accessible to the Procuring Entity at the time of opening.

22.3 No Proposal may be withdrawn, substituted, or modified in the interval between the deadline for submission of Proposals and the expiration of specified period of proposal validity.

**23. Proposal Opening**

23.1 The Procuring Entity will open the Technical Proposals in public at the address, on the date and time and procedure as specified in the **DS** in the presence of Service Providers designated representatives and anyone who chooses to attend. The Financial Proposals along with original bid security will remain unopened until the specified time of their opening.

23.2 All Technical Proposals shall be opened one at a time, and the following read out and recorded:

(a) the name of the Service Provider;

(b) the presence of an affidavit stating that a bid security amounting to 2 percent of proposal price without indicating the figure in the letter, has been placed in the Financial Proposal; and

(c) any other details as the Procuring Entity may consider appropriate.

Only Technical Proposals and alternative Technical Proposals, if any, read out and recorded at Proposal opening shall be considered for evaluation. No Proposal shall be rejected at the opening of Technical Proposals.

23.3 The Procuring Entity shall prepare a record of the opening of Technical Proposals that shall include, as a minimum, the name of the Service

Provider, the presence or absence of an affidavit (s) and submission of bid security. The Service Providers representatives who are present shall be requested to sign the record. The omission of a Service Provider's signature on the record shall not invalidate the contents and effect of the record. A copy of the record may be distributed to the Service Providers if so requested.

23.4 At the end of the evaluation of the Technical Proposals, the Procuring Entity will invite Service Providers who have submitted substantially responsive Technical Proposals to attend the opening of the Financial Proposal.

23.5 The date, time, and location of the opening of Financial Proposals will be advised in writing by the Procuring Entity. Service Provider shall be given reasonable notice of the opening of Financial Proposals.

23.6 The Service Provider will notify Service Providers in writing who have been rejected on the grounds of their Technical Proposals being substantially nonresponsive to the requirements of the Request for Proposal Document and return their Financial Proposals unopened.

23.7 The Procuring Entity shall conduct the opening of Financial Proposals of all Service Providers who submitted substantially responsive Technical Proposals, in the presence of Service Provider` representatives who choose to attend at the address, on the date, and time specified by the Procuring Entity. The Service Provider's representatives who are present shall be requested to sign the attendance.

23.8 All Financial Proposals shall be opened one at a time and the following read out and recorded:

(a) the name of the Service Provider;

(b) Amount of Bid Security:

(c) the Proposals Prices; and

(d) any other details as the Procuring Entity may consider appropriate.

Only Financial Proposals read out and recorded during the opening of Financial Proposals shall be considered for evaluation. No Proposal shall be rejected at the opening of Financial Proposals.

23.9 The Service Provider shall prepare a record of the opening of Financial Proposals that shall include, as a minimum, the name of the Service Provider, the Proposal Price, any discounts, and alternative offers. The Service Providers' representatives who are present shall be requested to sign the record. The omission of a Service Provider's signature on the record shall not invalidate the contents and effect of the record.

## E. Evaluation and Comparison of Proposals

**24. Confidentiality**

24.1 Information relating to the examination, evaluation, and comparison of Proposals and recommendation of contract award, shall not be disclosed to Service Providers or any other persons not officially

concerned with such process until information on the Contract award is communicated to all Service Providers.

24.2 Any attempt by a Service Provider to influence the Procuring Entity in the evaluation of the Proposals or Contract award decisions may result in the rejection of its Proposal.

24.3 Notwithstanding ITSP 24.2, from the time of proposal opening to the time of Contract award, if any wishes to contact the Procuring Entity on any matter related to the bidding process, it may do so in writing.

**25. Clarification of Proposals**

25.1 To assist in the examination, evaluation, and comparison of the Technical and Financial Proposals, the Procuring Entity may, at its discretion, ask any Service Provider for a clarification of its Proposal. Any clarification submitted by a Service Provider that is not in response to a request by the Procuring Entity shall not be considered. The Procuring Entity's request for clarification and the response shall be in writing. No change in the substance of the Technical Proposal or prices in the Financial Proposal, accept as permissible under relevant law, shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Procuring Entity in the evaluation of the Financial Proposals, in accordance with ITSP 30 or as provided for under relevant rules.

25.2 If a Service Provider does not provide clarifications of its Proposal by the date and time set in the Procuring Entity's request for clarification, its Proposal may be rejected.

**26. Deviations, Reservations, and Omissions**

26.1 During the evaluation of Proposals, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Request for Proposal Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Request for Proposal Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Request for Proposal Document.

**27. Examination of Technical Proposals**

27.1 The Procuring Entity shall examine the Technical Proposals to confirm that it is in compliance with requirement of the Request for Proposal terms and conditions and that all documents requested in ITSP 11.1 have been provided, and to determine the completeness of each document submitted.

27.2 The Procuring Entity shall confirm that the all the documents and information have been provided in the Technical Proposal as per requirement of the RFP and in accordance with ITSP clause 11. If any of the document or information is missing, the offer may be rejected.

**28. Responsiveness of Technical Proposal**

28.1 The Procuring Entity's determination of responsiveness of Technical Proposal is to be based on the contents of the Technical Proposal itself, as defined in ITSP11.

28.2 A substantially responsive Technical Proposal is one that meets the requirements of the Request for Proposal Document including Eligibility and Qualification Criteria as stipulated under Section 3 (Eligibility and Qualification Criteria) without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Services specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Request for Proposal Document, the Procuring Entity's rights or the Service Provider's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Service Providers presenting substantially responsive Proposals.

28.3 If Technical Proposal is not substantially responsive to the requirements of the Request for Proposal Document, it shall be rejected by the Procuring Entity and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

28.4 Substantial responsiveness shall be pre-requisite for opening of Financial Proposal. Financial Proposal and sealed envelope of bid security of nonresponsive Service Providers will be returned unopened.

**29. Nonmaterial Nonconformities**

29.1 Provided that Technical Proposal is substantially responsive, the Procuring Entity may waive any nonconformities in the Technical Proposal that do not constitute a material deviation, reservation, or omission.

29.2 Provided that a Technical Proposal is substantially responsive, the Procuring Entity may request that the Service Provider to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Proposal related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Financial Proposal. Failure of the Service Provider to comply with the request may result in the rejection of its Proposal.

**30. Correction of Arithmetical Errors**

30.1 During the evaluation of Financial Proposals, the Procuring Entity shall correct arithmetical errors on the following basis:

(a) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Service Provider there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected.

(b) If there is an error in a total corresponding to the addition or

subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.

(c) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), and (b) above.

30.2 If the Service Provider that submitted the lowest evaluated Financial Proposal does not accept the correction of errors, its Proposal shall be disqualified and its bid security shall be forfeited.

**31. Evaluation of Financial Proposals**

31.1 The Procuring Entity shall evaluate Financial Proposal of substantially responsive Technical Proposals only. Price adjustment due to correction of arithmetic errors, if any, will be affected in accordance with ITSP 30.

**32. Comparison of Proposals**

32.1 The Procuring Entity shall compare all substantially responsive Proposals to determine the lowest evaluated Proposal, in accordance with ITSP 31.1.

**33. Employer's Right to Accept Any Proposal, and to Reject Any or All Proposals**

33.1 The Procuring Entity reserves the right to accept or reject any Proposal, and to annul the bidding process and reject all Proposals at any time prior to contract award, without thereby incurring any liability to Service Providers. In case of annulment, all Proposals submitted and specifically, bid securities, shall be promptly returned to the Service Providers.

## F. Award of Contract

**34. Award Criteria**

34.1 The Procuring Entity shall award the Contract to the Service Provider who is substantially responsive to the requirements of Request for Proposal documents and/ or Eligibility and Qualification Criteria and whose financial offer has been determined to be the lowest evaluated financial offer and will be declared as successful Service Provider.

**35. Notification of Award**

35.1 Prior to the expiration of the period of proposal validity, the Procuring Entity shall transmit the Notification of Award using the form included in Section 8 (Contract Forms) to the successful Service Provider, in writing, that its Proposal has been accepted.

35.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

**36. Signing of Contract**

36.1 Promptly after notification, the Procuring Entity shall send the successful Service Provider the Contract Agreement.

36.2 Within 28 days of issuance of the Contract Agreement or as indicated in **DS**, the successful Service Provider shall sign, date, and return it to the Procuring Entity.

36.3 The original proposals submitted by the service providers shall be retained by the Procuring Entity

**37. Performance**

37.1 Within 28 days, or as indicated in **DS**, of the issuance of notification of award from the Procuring Entity, the successful Service Provider shall

**Security**

furnish the performance security in accordance with the Conditions of Contract, using for that purpose the Performance Security Form included in Section 8 (Contract Forms), or another form acceptable to the Procuring Entity.

37.2 Failure of the successful Service Provider to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security. In that event, the Procuring Entity may award the Contract to the next lowest evaluated Service Provider whose offer is substantially responsive.

# Section 2 - Data Sheet

## A. General

| | |
|---|---|
| **ITSP 1.1** | The number of the Invitation for Request for Proposal (RFP) is:<br>**TPC/OPS/OCB/Gen-AS/2025-26/005** |
| **ITSP 1.1** | The Procuring Entity is: **TransPeshawar (The Urban Mobility Company)** |
| **ITSP 1.1** | The name of the bidding process is:<br>**Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System**<br>The identification number of the Request for Proposal Document is:<br>**TPC/OPS/OCB/Gen-AS/2025-26/005** |
| **ITSP 2.1** | Govt. of Khyber Pakhtunkhwa. |
| **ITSP 4.1** | A Service Provider must be an Association of Persons (AOP) or a Company incorporated in or registered with Registrar of Firms or Security and Exchange Commission of Pakistan (SECP) respectively or any combination thereof in form of a Joint Venture with a formal intent to enter into an agreement or under an existing agreement. |
| **ITSP 4.5** | The Service Provider must be:<br>i. Registered with FBR for income and sales tax and reflected on active taxpayers list of FBR (In case of Joint Venture applicable to all members);<br>ii. Registered with KPRA for sales tax on services (In case of Joint Venture applicable to all members);<br>iii. A valid PEC license in category C-4 or above with EE11 or ME06 or ME07 or ME03 code of specialization (In case of Joint Venture applicable to one member);<br>iv. not be blacklisted by any federal or provincial public entity in Pakistan, is neither insolvent nor bankrupt, is not in the process of winding up nor his/her properties are under the control of receiver nor his/her business activities have been suspended nor legal proceedings for any of the foregoing are imminent or have been initiated against him/her and has fulfilled all obligations under law for the time being in force. (In case of Joint Venture applicable to all members) |

## B. Contents of Request for Proposal Document

| | |
|---|---|
| **IT**SP **7.1** | Requests for clarification should be received by the Procuring Entity on or before **January 05, 2026 at 05:00 PM (PST).** Request for clarification shall be received and responded through EPADS. |
| **ITSP 7.4** | A Pre-Bid meeting will take place. |

| | |
|---|---|
| | Date: **January 05, 2026**<br>Time: **11:30 AM (PST)**<br>Place: Main Board Room, TransPeshawar (The Urban Mobility Company), First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan<br>A site visit conducted by the Procuring entity will be organized on the date fixed for pre-bid meeting, if so conducted, on the request of prospective service providers. |
| **ITSP 7.5** | Minutes of pre-bid meeting will be hoisted on website of the Procuring Entity and sent to all Service Providers who attended pre-bid meeting apart from publishing on EPADS. |
| **ITSP 8.2** | The addendum will be hoisted on website of the Procuring Entity or KPPRA or both apart from EPADS and may be published in newspapers if the Procuring Entity deems necessary and if the amendments are of substantial nature. |

## C. Preparation of Proposals

| | |
|---|---|
| **ITSP 10.1** | The language of the Proposal is: **English** |
| **ITSP 13.1** | Alternative Proposals are not permitted. |
| **ITSP 16.1** | The Proposal validity period shall be one hundred eighty (180) days. |
| **ITSP 17.1** | Bid security shall be submitted in PKR from any scheduled bank of Pakistan to the amount of 2% of Total Proposal Price in shape Bank Guarantee on format as prescribed in Section 4, or in shape of Call Deposit Receipt in the name of Chief Executive Officer (CEO) TransPeshawar. The bid security shall be submitted from the account of the Service Provider who submits the proposal.<br><br>The Bid Security in original form (in hard form) shall be submitted in separate envelop to the procuring entity on the address given below, on or before the deadline for submission of proposal.<br><br>The copy bid security shall be kept in Financial Proposal. The Service Provider shall in addition, place an affidavit on E-Stamp paper of PKR150 or above, and duly notarized, in the Technical Proposal stating that a bid security amounting to 2 percent of the total proposal price, without indicating the figure in the letter, has been placed in the Financial Proposal. Otherwise, the Technical Proposal will be considered non-responsive and Financial Proposal will be not be opened.<br><br>The original bid security shall be kept sealed until opening of Financial Proposal.<br><br>**Procuring Entity Address:**<br><br>**Attention:** Chief Executive Officer (CEO), TransPeshawar<br>**Address:** TransPeshawar (The Urban Mobility Company), First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan |

| | |
|---|---|
| | The sealed envelope shall clearly mark with:<br>• Bidder's name and address;<br>• Name of the procurement; and<br>• The words "Original Bid Security" for [Name of Procurement]". |
| **ITSP 17.2** | Non-submission of bid security in prescribed manner shall be sufficient ground for rejection of proposal. |
| **ITSP 17.6** | In case of Joint Venture is submitting bid security in the Shape of Call Deposit Receipt, the Bid security may be in the name of any one member of Joint Venture in accordance with ITSP 17.1. |
| **ITSP 18.1** | In addition to the original Proposal, the number of copies is: **Not Applicable** |
| **ITSP 18.2** | The written confirmation of authorization to sign on behalf of the Service Provider shall consist of:<br>The authorization is required if the Service Provider is a firm or company or any combination thereof. If the Service Provider is a sole proprietor or individual, he is not supposed to submit authorization if he is not represented by any representative.<br>An authorization shall be provided on the format as given under Section 4 (Bidding Forms) specifying the representative's authority to sign the Proposal on behalf of, and to legally bind, the Service Provider. If the Service Provider is an intended or an existing Joint Venture, the authorization/power of attorney shall be signed by all partners individually and specify the authority of the named representative of the Joint Venture to sign on behalf of, and legally bind, the intended or existing Joint Venture on the relevant Schedule. If the Joint Venture has not yet been formed, also include evidence from all proposed Joint Venture partners of their intent to enter into a Joint Venture in the event of a contract award. |
| **ITSP 18.2** | The Service Provider shall submit an acceptable authorization within three (03) working days. |

## D. Submission and Opening of Proposals

| | |
|---|---|
| **ITSP 19.1** | 19.1.1. Once signed and stamped, each Proposal (Technical and Financial) shall be scanned and compiled into separate **PDF files**.<br>19.1.2. The files shall be clearly named as:<br>• *"Technical Proposal* – Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System – *[Name of Service Provider]"*<br>• *"Financial Proposal* – Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System – *[Name of Service Provider]"*<br>19.1.3. If more than one version of a file is uploaded, the version most recently uploaded **before the deadline** will be considered the **Final/Original Proposal**.<br>19.1.4. Physical sealing of proposals, except the document (s) required in |

| | |
|---|---|
| | hard, is not required. However, bidders must ensure that Technical and Financial Proposals are uploaded in **separate clearly named PDF files** as stipulated above. If the Technical Proposals and the Financial Proposals are submitted together in one file, the Procuring Entity will reject the entire Proposal.<br>19.1.5 Apart from the electronic submission the following documents shall be submitted physically (in hard form), in separate envelopes, on the address as indicated, on or before the deadline for submission of proposals.<br>i. Original bid security<br>ii. Original affidavits<br>**Client Address Documents to be Submitted Physically:**<br>**Attention:** Chief Executive Officer (CEO), TransPeshawar<br>**Address:** TransPeshawar (The Urban Mobility Company), First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan<br>19.1.5. Any document required physically in original form shall be sealed in an envelope, clearly marked with:<br>• Bidder's name and address;<br>• Title of the Procurement; and<br>• The words *"Original Bid Security" and "Original Affidavits for [Name of Procurement]"*. |
| **ITSP 20.1** | **The deadline for Proposal submission is:**<br>**Date:** January 22, 2026<br>**Time:** 11:30 AM (PST). |
| **ITSP 23.1** | The Technical Proposal opening shall take place at:<br>Main Board Room, TransPeshawar (The Urban Mobility Company), First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan<br>**Date:** January 22, 2026<br>**Time:** 12:00 PM (PST). |
| **ITSP 35** | The following sub-clauses added to ITB 35:<br>35.3. The Successful Bidder shall establish/ incorporate special purpose vehicle (new company) within 07 days of Notification of Award.<br>35.4. The Contract Agreement shall be signed by TPC with the special purpose vehicle (new company) hereinafter called "the Service provider"<br>35.5. Prior to Contract Agreement signing, the Successful Bidder shall furnish Parent Company Guarantee for each of JV member (in case of JV) or bidder bidding in isolation. |
| **ITSP 36.2** | Within seven (07) working days of after submission of Performance Security, the |

| | |
|---|---|
| | Service Provider shall sign the contact |
| **ITSP 37.1** | Performance Security shall be provided within twenty-eight (28) working days of issuance of Notification of Award.<br>The following clause is added to ITB 37<br>ITB 37.3: The Performance Security shall be submitted by the Successful Bidder on behalf of the Service Provider / special purpose company |

# Section 3 – Eligibility and Qualification Criteria

## Table of Criteria

**1. Substantial Responsiveness of Technical Proposal……..3-2**

**2. Eligibility and Qualification Criteria .....3-3**

2.1 Country of Constituion .....3-3

2.2 Conflict of Interest.....3-3

2.3 Registration with FBR.....3-3

2.4 Registration with KPRA .....3-3

2.5 Registration with PEC .....3-3

2.6 Not Blacklisted .....3-3

3.1 Financial Soundness (Historical Financial Performance) .....3-4

3.2 Financial Soundness (Average Annual Business Turnover) .....3-4

3.3 Contractual Experience .....3-4

# 1. Substantial Responsiveness of Technical Proposals

1.1. Substantial responsiveness of each proposal will be determined on the basis of following criteria:

(a) Technical Proposal shall be determined as complete in accordance with ITB Clause 27;

(b) Eligibility and Qualification of service provider will be assessed in accordance with the criteria outlined under Clause 2 and 3 below and in term of ITB Clause 4;

(c) Agree to perform services in accordance with Schedule of Requirements, Standards and best international practices;

(d) Over all in conformity with Request for Proposal Document.

# 2. Eligibility

| Criteria | Compliance Requirements | | | | Documents |
|---|---|---|---|---|---|
| Requirement | Single Entity | Joint Venture | | | Submission Requirements |
| | | All Partners Combined | Each Partner | One Partner | |
| **2.1 Country of Constitution** | | | | | |
| A Service Provider must be an AoP or a company incorporated in or registered with Registrar of Firms or Security and Exchange Commission of Pakistan (SECP) respectively or any combination thereof. | must meet requirement | Not Applicable | must meet requirement | Not Applicable | Schedule 1 or Schedule 1 &2 along with attachments |
| **2.2 Conflict of Interest** | | | | | |
| No conflicts of interest | must meet requirement | Not Applicable | must meet requirement | Not Applicable | Letter of Technical Proposal |
| **2.3 Registration with FBR** | | | | | |
| Registered with FBR for income and sales tax and reflected on active taxpayer list. | must meet requirement | Not Applicable | must meet requirement | Not Applicable | Schedule 1 or Schedule 1 &2 along with attachments |
| **2.4 Registration with KPRA** | | | | | |
| Registered with KPRA for sales tax on Services. | must meet requirement | Not Applicable | must meet requirement | Not Applicable | Schedule 1 or Schedule 1 &2 along with attachments |
| **2.5 Registration with PEC** | | | | | |
| A valid PEC license in category C-4 or above with EE11 or ME06 or ME07 or ME03 code of specialization | must meet requirement | Not Applicable | Not applicable | must meet requirement | Schedule 1 or Schedule 1 &2 as attachments |
| **2.6 Not Blacklisted** | | | | | |
| The Service Provider is not blacklisted by any federal or provincial public entity in Pakistan, is neither insolvent nor bankrupt, is not in the process of winding up nor his/her properties are under the control of receiver nor his/her business activities have been suspended nor legal proceedings for any of the foregoing are imminent or have been initiated against him/her and has fulfilled all obligations under law for the time being in force | must meet requirement | Not Applicable | must meet requirement | Not Applicable | Schedule 1 or Schedule 1 &2 along with attachments (Non-blacklisting certificate on E-Stamp Paper of PKR.150 and dully notarized (affidavit) to the effect) |

# 3. Qualification

## 3.1 Financial Soundness (Historical Financial Performance)

| Criteria | Compliance Requirements | | | | Documents |
|---|---|---|---|---|---|
| Requirement | Single Entity | Joint Venture | | | Submission Requirements |
| | | All Partners Combined | Each Partner | One Partner | |
| Submission of audited financial statements for the last three (03) years (2022, 2023 and 2024) to demonstrate the current soundness of the Bidder's financial position. As a minimum, the Bidder's net worth for the last year (2024) calculated as the difference between total assets and total liabilities should be at least PKR. 30 million. | must meet requirement | Not Applicable | Not applicable | must meet requirement | Schedule 3 with attachments |

## 3.2 Financial Soundness (Average Annual Business Turnover)

| | | | | | |
|---|---|---|---|---|---|
| Minimum average annual turnover of one hundred million Pak Rupees (PKR.100,000,000) calculated within last three (03) years from submitted financial statements. | must meet requirement | must meet requirement | Not applicable | Not Applicable | Schedule 3 with attachments |

## 3.3 Contractual Experience

| | | | | | |
|---|---|---|---|---|---|
| Executed/ongoing one similar contract (operation and/or maintenance contract of electrical and/or mechanical systems) to the worth of two hundred million Pak Rupees (PKR.200,000,000) or more in last 5 years in JV or through separate contract. | must meet requirement | Not Applicable | Not applicable | must meet requirement | Schedule 4 along with attachments. |

# Section 4 - Bidding Forms

## Table of Forms

**Contents of Technical and Financial Proposal……4-2**
**Technical Proposal**
**Letter of Technical Proposal.....4-4**
Schedule-1: Bidder's Information Sheet Service Provider's/Lead Member's Information Sheet…..4-6
Schedule-2: Joint Venture Information Sheet.....4-7
Schedule-3: Financial Soundness.....4-8
Schedule-4: Contractual Experience.....4-9
Schedule-5: Affidavit of Integrity Pact……..…….....4-10
Schedule-6: Authorization/Power of Attorney…...……4-11

**Financial Proposal**
**Letter of Financial Proposal.....4-13**
Breakup of Proposal Prices.....4-15
Bid Security in Shape of Bank Guaranttee.....4-16

## Contents of Technical and Financial Proposals

The Bidders are required to submit their Proposals in two separate envelopes marked as "1. Technical Proposal" and "2. Financial Proposal" as provided below. All the forms/format shall be properly filled and submitted with required attachments. Incomplete or partially filled forms shall not be entertained and rejected.

### 1. Technical Proposal

"Technical Proposal" shall be comprised of following documents. Order/sequence of document while preparing technical proposal shall be observed to facilitate the assessment of proposals in a systematic manner. Moreover, Technical Proposal shall be numbered.

**Table-1**

| Order | Document Number and Information Required | Check (Y/N) | Page No. |
|---|---|---|---|
| A | **Proposal Submission** | | |
| 1. | Letter of Technical Proposal | | |
| 2. | An affidavit on E-Stamp paper of PKR.150 or above and dully notarized stating that a bid security amounting to 2 percent of the total proposal price, without indicating the figure in the affidavit, has been placed in the Financial Proposal in accordance with ITSP 17.1. | | |
| 3. | **Schedule 5.** Affidavit of Integrity Pact on E-Stamp Paper of PKR.150 and dully notarized | | |
| 4. | **Schedule 6.** Authorization/Power of Attorney on E-Stamp Paper of PKR.150 and dully notarized | | |
| **B** | **Eligibility** | | |
| 5. | **Schedule 1 or Schedule 1&2 "Bidder's/Lead Partner Information Sheet" and "Joint Venture Information Sheet"** | | |
| (i) | Articles of incorporation or constitution and/or certificate of registration with Registrar of Firms or SECP | | |
| (ii) | Certificate of Registration with FBR for income and sales tax and Active Tax Payer List (ATL) showing status | | |
| (iii) | Certificate of Registration with KPRA for sale tax on services | | |
| (iv) | Valid PEC license in category C-4 or above with EE11 or ME06 or ME07 or ME03 code of specialization | | |
| (v) | Non-blacklisting certificate on E-Stamp Paper of PKR.150 and dully notarized (affidavit) to the effect that the Service Provider is not blacklisted by any federal or provincial public entity in Pakistan, is neither insolvent nor bankrupt, is not in the process of winding up nor his/her properties are under the control of receiver nor his/her business activities have been suspended nor legal proceedings for any of the foregoing are imminent or have been initiated against him/her and has fulfilled all obligations under law for the time being in force. | | |
| (vi) | A copy of the Joint Venture Agreement or a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Service Provider shall be signed by all partners and submitted with the Technical Proposal, together with a copy of the proposed agreement. (submitted in case of the Service Provider is a Joint Venture) | | |
| **C** | **Qualification** | | |

| Order | Document Number and Information Required | Check (Y/N) | Page No. |
|---|---|---|---|
| 6. | **Schedule 3. Financial Soundness** | | |
| (ii) | Audited Financial Statements of relevant years in accordance with schedule 3 | | |
| 7. | **Schedule 4: Contractual Experience** | | |
| (i) | Letter of Award/Acceptance or contract agreement or any other credible record of Executed/ongoing one similar nature contract (operation and/or maintenance of electrical and/or mechanical systems) to the worth of two hundred million Pak Rupees (PKR.200,000,000) or more in last 5 years in JV or through separate contract. | | |
| (ii) | Contract Completion Certificate or anticipated completion certificate in case the contract is in progress or certificate / letter that the contract is in progress. | | |

**Table-2**

## 2. Financial Proposal

| Order | Document Number and Information Required | Check (Y/N) | Page No. |
|---|---|---|---|
| 1. | Letter of Financial Proposal | | |
| 2. | Break up of proposal prices | | |
| 3. | Original Bid Security in accordance with ITSP Clause 17. | | |

# Letter of Technical Proposal

*The Bidder must accomplish the Letter of Technical Proposal on its letterhead clearly showing the Bidder's complete name and address. In case of Joint Venture, if applicable, Letter Head of Lead Partner.*

Date: .....

Request for Proposal Document No.: .....

To:

Chief Executive Officer (CEO), TransPeshawar,
First Floor, KPUMA Building,
Main BRT Depot, Near NHA Complex,
Chamkani, Peshawar.

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Request for Proposal Document, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8.

(b) We offer to execute in conformity with the Request for Proposal Document the following Services:

**[Insert Name of Procurement/Services]**

(c) Our Proposal consisting of the Technical Proposal and the Financial Proposal shall be valid for a period of one hundred eighty (180) days from the date fixed for the Proposal submission deadline in accordance with the Request for Proposal Document, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(d) If our proposal is accepted, we commit to obtain a performance security in accordance with the Request for Proposal Document.

(e) We are incorporated/registered in Pakistan.

(f) We do not have any conflict of interest.

(g) We are not participating, as a Bidder in more than one Proposal in this bidding process.

(h) We agree to permit the Procuring Entity or its representative to inspect our accounts and records and other documents relating to the bid submission.

(i) We understand that this Proposal, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed.

(j) We understand that you are not bound to accept the lowest evaluated Proposal or any other Proposal that you may receive.

Name of Authorized Representative .....

Designation .....

Sign of Authorized Representative .....

Name of Bidder with Seal. .....

Date .....

[Note: In case of Joint Venture Letter of Technical Proposal shall be signed by authorized representatives of all members constituting the Joint Venture along with affixing of respective seal)]

## Schedule-1

## (Eligibility)

Service Provider or Lead Member must fill out this form and attach respective documents indicated below.

| Service Provider's/Lead Member's Information Sheet | |
|---|---|
| Service Provider's name | |
| In case of Joint Venture Lead member's legal name | |
| In case of a Joint Venture, legal name of each partner | |
| Service provider's/Lead member's country of constitution | |
| Service provider's/Lead member's year of constitution | |
| Service provider's/Lead member's Year of registration with FBR for income tax and sales tax | |
| Service provider's/Lead member's Year of registration with KPRA for sales tax on service | |
| Service provider's/Lead member's year of registration with PEC for category C-4 or above with EE11 or ME06 or ME07 code of specialization | |
| Service provider's/Lead member's legal address | |
| Name of Service provider's authorized representative in case the service provider is a firm/company (In case of JV authorized representative of JV)<br>(name, address, telephone number(s), fax number(s), e-mail address) | |

**Attached are copies of the following documents.**

- ❑ 1. Articles of incorporation or constitution or certificate of registration of a firm or company (In case of JV particulars of Lead Member);
- ❑ 2. In case of a Joint Venture, a letter of intent to form a Joint Venture along with copy of proposed JV agreement, or Joint Venture agreement;
- ❑ 3. Certificate of Registration with FBR for income tax and sales tax and reflected on Active Taxpayer List (ATL) (In case of JV particulars of Lead Member);
- ❑ 4. Certificate of Registration with KPRA for Sales Tax on Services (In case of JV particulars of Lead Member);
- ❑ 5. Valid PEC license in category C-4 or above with EE11 or ME06 or ME07 or ME03 code of specialization (In case of JV particulars of one Member);
- ❑ 6. Non-blacklisting certificate on E-stamp paper of PKR.150 and duly notarized to the effect that Service Provider/Lead Member is not blacklisted by any federal or provincial public entity in Pakistan, is neither insolvent nor bankrupt, is not in the process of winding up nor his/her properties are under the control of receiver nor his/her business activities have been suspended nor legal proceedings for any of the foregoing are imminent or have been initiated against him/her and has fulfilled all obligations under law for the time being in force. (In case of Joint Venture applicable to all members)

## Schedule-2

## (Eligibility)

Each member of the Joint Venture must fill out this form separately and attach respective documents indicated below.

| Joint Venture Information Sheet | |
|---|---|
| Service Provider's name | |
| Joint Venture Partner's legal name | |
| Joint Venture Partner's country of constitution | |
| Joint Venture Partner's year of constitution | |
| Joint Venture Partner's Year of registration with FBR for income and sales tax | |
| Joint Venture Partner's Year of registration with KPRA for sales tax on service | |
| Joint Venture Partner's legal address | |
| Joint Venture Partner's authorized representative information<br>(name, address, telephone number(s), fax number(s), e-mail address) | |

**Attached are copies of the following documents.**

- ❑ 1. Articles of incorporation or constitution or certificate of registration of a firm or company;
- ❑ 2. Certificate of Registration with FBR for income tax and sales and reflected on Active Taxpayer List (ATL);
- ❑ 3. Certificate of Registration with KPRA for Sales Tax on Services;
- ❑ 4. Non-blacklisting certificate on E-stamp paper of PKR.150 and duly notarized to the effect that JV partner is not blacklisted by any federal or provincial public entity in Pakistan, is neither insolvent nor bankrupt, is not in the process of winding up nor his/her properties are under the control of receiver nor his/her business activities have been suspended nor legal proceedings for any of the foregoing are imminent or have been initiated against him/her and has fulfilled all obligations under law for the time being in force.

## Schedule-3

## Financial Soundness

Each Bidder must fill out this form.

| Financial Data for last 3 Years | | |
|---|---|---|
| **Year 1: 2022** | **Year 2: 2023** | **Year: 2024** |

### Information from Balance Sheet

| | | | |
|---|---|---|---|
| **Total Assets (TA)** | | | |
| **Total Liabilities (TL)** | | | |
| **Net Worth = TA – TL** | | | |

### Information from Income Statement

| | | | |
|---|---|---|---|
| **Total Revenues** | | | |
| **Profits Before Taxes** | | | |
| **Profits After Taxes** | | | |

❑ Attached are copies of financial statements (balance sheets including all related notes and income statements) for the last 03 years, as indicated above, complying with the following conditions.

- Unless otherwise required by Section 3 of the Request for Proposal Document, all such documents reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.
- Historical financial statements must be audited by an external auditor approved by SECP having UDIN. In case of a firm the requirement of UDIN will be assessed as per relevant law.
- Historical financial statements must be complete, including all notes to the financial statements.
- Historical financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

**Schedule-4**

**Contractual Experience**

Each Bidder must fill out this form.

| **Contract of Similar Size and Nature** | | |
|---|---|---|
| **Contract No** . . . . . **of** . . .. . | **Contract Name** | |
| **Award Date** | | **On Going/Completion Date:** |
| **Total Contract Amount** | **PKR.** | |
| **If partner in a Joint Venture or subcontractor, specify participation of total contract amount** | **Percent of Total** | **Amount** |
| **Employer's name**<br>**Address**<br>**Telephone number**<br>**Fax number**<br>**E-mail** | | |
| **Description of the Similarity in Accordance with Criterion 3.3 of Section 3 (Eligibility and Qualification Criteria)** | | |
| | | |

❑ Attached Letter of Award/Acceptance or contract agreement or any other credible record to substantiate information provided in Schedule 3.

❑ Attached Contract Completion Certificate of the relevant contract (if the project is completed) or anticipated completion certificate if the contract is in progress or letter showing that the project is in progress.

**Schedule 5**

**Affidavit of Integrity Pact**

**(To be submitted on E-stamp paper of PKR.150 and duly notarized)**

(In case of Joint Venture to be submitted by each joint venture partner)

_____ [Name of Bidder] hereby declares its intention not to obtain or induce the procurement of any contract, right, interest, privilege or other obligation or benefit from Procuring Entity/Government of Khyber Pakhtunkhwa (hereinafter called GoKP) or any administrative subdivision or agency thereof or any other entity owned or controlled by it through any corrupt and fraudulent business practice.

Without limiting the generality of the foregoing, _____[Name of Bidder] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultation fee or otherwise, with the object of obtaining or including the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from Procuring Entity/GoKP, except that which has been expressly declared pursuant hereto.

_____ [Name of Bidder] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with Procuring Entity/GoKP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

_____ [Name of Bidder] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to Procuring Entity/GoKP under any law, contract or other instrument, be voidable at the option of Procuring Entity/GoKP.

Notwithstanding any rights and remedies exercised by Procuring Entity/GoKP in this regard, _____[Name of Bidder] agrees to indemnify Procuring Entity/GoKP for any loss or damage incurred by it on account of its corrupt and fraudulent business practices and further pay compensation to Procuring Entity/GoKP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by _____[Name of Bidder] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from Procuring Entity/GoKP.

Name of Authorized Representative .....

Designation .....

Sign of Authorized Representative .....

Name of Bidder with Seal .....

Date

**Schedule 6**
**Authorization/Power of Attorney**

[For a Service Provider participating in the bidding through a representative. In case of a Joint Venture, power of attorney shall be submitted separately by each partner]

[To be submitted on E-stamp paper of PKR. 150 and duly notarized]

[Incomplete/partially filled authorization/Power of Attorney or person authorizing signatory being incompetent shall be treated as deficient]

THIS POWER OF ATTORNEY is executed at _____ **[insert Place]** on this day of_____ **[insert Date]**, by _____ **[insert name of the Service Provider]** at _____ **[insert the address]** (hereinafter, referred to as the "Grantor"), which expression wherever occur in these presents shall also mean and include its successors-in-interest and assigns.

WITNESSETH

WHEREAS the Grantor intends to submit a proposal to the TransPeshawar (The Urban Mobility Company) (hereinafter, referred to as "the Procuring Entity"), in respect of _____**[Insert Name of Procurement/Service]** (hereinafter, referred to as "the Services"), and to do the follow up related actions (hereinafter, jointly referred to as "the Transaction"), and for this purpose, the Grantor considers it necessary and expedient to appoint a representative/attorney.

WHEREAS the Instructions to Service Providers contained in the Request for Proposal Document (RFP), for the Services, warrants submission of a Power of Attorney to the said appointment.

WHEREAS the Grantor represents and warrants to the Procuring Entity that all corporate and other actions required to give effect to this Power of Attorney have been duly taken and are subsisting.

NOW THEREFORE THIS DEED WITNESSETH the Grantor does hereby, irrevocably and unconditionally, nominate, constitute and appoint Mr./Ms. _____, son/daughter of_____, residing at _____and holding CNIC No. _____as its true and lawful attorney holding designation [**insert the designation**] (hereinafter, referred to as "the Attorney") to do or cause to be done all such acts, deeds, matters, and things which the Grantor may now do or in future may become interested to do in connection with the Transaction, including:

1. to visit and inspect the Site, seek clarification of the RFP, and attend the pre-bid meeting;
2. to prepare and submit a Proposal following provisions of the RFP;
3. to attend the Proposal opening event and the bidding process in respect of the Transaction and generally to take such actions and decisions as may be necessary for the bidding;
4. to negotiate, execute (underhand or under seal), sign, and deliver all contracts, instruments, deeds, agreements, applications, and other documents, to make amendments to the same whether or not material, and to submit the same to the Procuring Entity and/or any other interested parties;
5. to receive notices, instructions, and orders for and on behalf of the Grantor(s); and
6. to do all other things and to take all necessary steps incidental to the exercise of the above powers or which the Attorney considers necessary or expedient concerning the foregoing or the effective exercise of any power listed above.

The Grantor agrees that whatever the Attorney shall do or cause to be done according to this Power of Attorney shall be binding on the Grantor.

The Grantor agrees to ratify and confirm whatever the Attorney shall do or cause to be done under this Power of Attorney.

All terms used in this instrument, but not defined herein, shall have the meaning given to them in the RFP.

This Power of Attorney has not been revoked, amended or modified and remain valid and binding on the Granter.

IN WITNESS WHEREOF, the Grantor has executed this Power of Attorney on the date and place first written above.

| WITNESSES:<br>[Signature, Name, Father's Name, and CNIC] | [INSERT NAME OF THE GRANTOR]<br>[Signature, Name, Designation, and CNIC] |
|---|---|
| 1. _____ | _____ |
| 2._____ | _____ |

NOTARY PUBLIC: (Name, Signature, Seal, Number, and Date) _____

# Letter of Financial Proposal

*The Bidder must accomplish the Letter of Financial Proposal on its letterhead clearly showing the Bidder's complete name and address. In case of Joint venture on letter head of lead partner*

Date: .....

Request for Proposal Document No.: .....

To:

Chief Executive Officer (CEO), TransPeshawar,
First Floor, KPUMA Building,
Main BRT Depot, Near NHA Complex,
Chamkani, Peshawar.

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Request for Proposal Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.

(b) We offer to execute in conformity with the Request for Proposal Documents and the Proposal submitted for the following Services:

"**[Insert Name of Procurement/Service]**"

(c) The Total Proposal Price is:

[*amount in PKR in words*], [*amount in PKR in figures*]

*The proposal price from the breakup of proposal prices should be entered by the Bidder inside this box. Absence of the proposal price in the Letter of Financial Proposal may result in the rejection of the Proposal.*

(d) Our Proposal shall be valid for a period of one hundred eighty (180) days from the date fixed for the proposal submission deadline in accordance with the Request for Proposal Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(e) If our Proposal is accepted, we commit to obtain a performance security in accordance with the Request for Proposal Documents.

(f) We understand that this proposal, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed.

(g) We understand that you are not bound to accept the lowest evaluated proposal or any other proposal that you may receive.

(h) We agree to permit the Procuring Entity or its representative to inspect our accounts and records and other documents relating to the proposal submission.

Name of Authorized Representative .....

Designation .....

Sign of Authorized Representative .....

Name of Bidder .....

Date .....

[Note: In case of Joint Venture Letter of Financial Proposal shall be signed by authorized representatives of all members constituting the Joint Venture along with affixing of respective seals]

## Breakup of Proposal Prices

1. All Bidders must read items in conjunction with requirements stipulated under Schedule of Requirements and fill the table carefully.
2. All Bidders shall quote the unit rate and total rates and prices against each item inclusive of all applicable taxes excluding sales tax on services for completion of each activity/item in all respect.
3. No cutting or over writing is allowed unless otherwise initialed by the authorized person.

| S. No | Financial Quote | Unit | Quantity (A) | Price/ Unit (PKR) (B) | Total Price in PKR (C)= A x B |
|---|---|---|---|---|---|
| 1 | Monthly Service Payments offered by the Bidder to TransPeshawar including cost of all taxes excluding sales tax on services for provision of all services mentioned in RFP/ Contract including its attachments. | Months | 60 | | |
| **Amount in Pakistani Rupees in words (Amount in integer)** | | | | | |

Name of Authorized Representative .....

Designation .....

Sign of Authorized Representative .....

Name of Bidder .....

Date:

[Note: In case of Joint Venture the breakup of proposal prices shall be signed by authorized representatives of all members constituting the Joint Venture along with affixing of respective seals]

**Bid Security**
**(Bank Guarantee)**

[*Bank's name, and address of issuing branch or office*][1]

**Beneficiary:** [*Name and address of the Procuring Entity*]

**Date:** .....

**Bid Security No.:** .....

We have been informed that **[*name of the Bidder*]** (hereinafter called "the Bidder") has submitted to you its proposal dated **[*please specify*]** (hereinafter called "the Proposal") for the execution of "[**Name of Procurement/service"** under Request for Proposal ("the RFP").

Furthermore, we understand that, according to your conditions, proposals must be supported by a bid guarantee.

At the request of the Bidder, we **[*name of bank*]** hereby irrevocably and unconditionally undertake to pay you any sum or sums not exceeding in total an amount of [*amount in words*] [*amount in figures*] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the proposal conditions, because the Bidder

(a) has withdrawn its Proposal during the period of bid validity specified by the Bidder in the Letter of Technical and/or Financial Proposal; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidder (hereinafter "the ITB"); or

(c) having been notified of the acceptance of its Proposal by the Procuring Entity during the period of bid validity, (i) fails or refuses to sign/execute the Contract Agreement, or (ii) fails or refuses to furnish the performance security, in accordance with the Request for Proposal.

This guarantee will expire (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the Performance Security issued to you upon the instruction of the Bidder; or (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy of your notification to the Bidder of the name of the successful Bidder, or (ii) 28 days after the expiration of the Bidder's proposal.

Consequently, any demand for payment under this guarantee must be received by us at the office on or before that date.

[*Authorized signature(s) and bank's seal (where appropriate)*]

---

[1] All italicized text is for use in preparing this form and shall be deleted from the final document.

# SCHEDULE OF REQUIREMENTS

TransPeshawar is currently operating BRT System in Peshawar which has equipment installed over a stretch of approximately 30 Km from Chamkani to Kharkhano including ramps, 31 BRT Stations (including proposed station at Aman Chowk). These infrastructures make part of scope of work to the extent explained below in this SOR. The scope of work includes eight vehicular underpasses and four pedestrian underpasses in stations.

TransPeshawar (The Urban Mobility Company) has been handed over multiple electrical and mechanical systems in Peshawar BRT system which were installed and / or commissioned by Peshawar Development Authority (PDA) in 2020. Most of the equipment will complete five years of service by end of December 2025. TransPeshawar operated and maintained these equipment/ systems through service provider under service-based contracts which is expected to end in 2025. TransPeshawar, in this Schedule of Requirements (SOR), requires detailed operations and maintenance services hereinafter called “Services” of these systems to meet their intended purposes for next five years or other term as may be extended in accordance with contractual requirements. These services will be provided at 31 BRT stations/locations, control centre, KPUMA Building, Aman Chowk, and allied infrastructure/ locations. Except otherwise mentioned, the KPUMA Building includes all floors area within boundary wall of the building are part of SOR.

This SOR outlines the scope, objectives, and requirements for the engagement of a qualified service provider to carry out the operation and maintenance of the electrical and mechanical systems in Peshawar BRT System, ensuring optimal performance, safety, and compliance with relevant standards and regulations. Furthermore, the Service Provider shall at its own cost and risk, coordinate with authorized agent or receive dealership from Original Equipment Manufacturer (OEM) or change equipment / software to provide services or enable Service Provider to provide services in accordance with Schedule of Requirements. This is the critical requirement of agreement as multiple OEM are involved and the Service Provider shall bear the cost of such management, coordination etc.

## 1.1 Scope Of Services

The Service Provider shall be responsible for all costs of required services mentioned in RFP, Agreement, this **SOR** and their Annexure/ attachments. The operation and maintenance services are required for following systems, sub-systems and Equipment:

a) Generators included but not limited to Engine, Alternator, Canopy, Auxiliary tank (approximate 600-liter capacity), ATS Panel, flow meter, electric motor, automation sensors, base tank, connection pipes /cable, valves, piping assemblies, software’s and any other components required for successful operations. The scope of this Agreement covers generators installed at stations, Aman Chowk, at KPUMA Building and other facilities of TransPeshawar;

b) De-watering Pumps in underpasses and fresh water pumps DB at BRT Stations included but not limited to Pumps, Control Panels, SCADA panels, Float Switches/Sensors,

Connection Pipes/Hoses, Valves, Cables, Ladders, Software or any other associated component required for intended purpose. The scope of work also includes procurement, operation and maintenance of two de-watering trucks;

c) UPS Included but not Limited to Inverter, Battery Charger, Batteries, connection cables, Isolators switch, Manual Bypass switch, DC Breaker and DB-UPS;

d) Fuel Supply for Generators Fuel including transportation to site, filling and fuel testing related services as required by TPC.;

e) Electrical System at KPUMA building includes but not limited to 01x Main Low Voltage (MLV) panel, 1xcapacitor bank, 25xDistribution Boards (DB), 2 x 20kVA UPS's along with 48x Batteries;

f) Exhaust and Ventilation system (EVS) including but not limited to exhaust and ventilation fans, associated duct system, Electrical Cables, Electrical Control System (breakers etc) at four stations (Faisal Colony BS-04, Gulbahar Station BS-07, Hashtnagari BS-08);

g) Fire Fighting System (FFS) and Fire Extinguisher installed in the ZU Complex which includes but not limited to the complete diesel pump, electric pump, jockey pump, electric motors, mechanical seals, manifold, fire hydrant, fire hose, fire hose cabinets, fires hoses reel, associated piping and fittings, all piping and fittings, all instruments, ACPs, DBs, sensors, all control systems associated to fire fighting and allied components which are required for its intended use and operations. The scope of works starts from the underground tank in KPUMA building and ends on fire hose (included fire hose cabinets) in KPUMA building. The firefighting system are installed in KPUMA to deal with fire incidents. The Service Provider shall also be responsible for upkeep of Fire Extinguishers, periodic check and refill;

h) Fire Alarm System is installed in KPUMA building and the scope of work includes panels, sensors, smoke detectors and necessary mandatory works which are required for its intended purposes;

i) Fire Suppression System FM200 system. TransPeshawar has installed Fire Suppression System in data center which are established in KPUMA Building. The Service Provider shall be responsible for the upkeep of the system;

j) Mandatory Work which are required to be done by the Service Provider; and

k) Safety, Health and Environmental services in Peshawar BRT.

The detail documents, drawings summery of above mention Equipment/Scope are provided in following Annexes: -

i. Details of Generators showing location, capacity and number and running hours (Annex-1)

ii. Details of De-watering Pumps showing locations & number (Annex-2)

iii. Details of UPS and Batteries showing locations and number (Annex-3)

iv. Details of Distribution Board & MLV and Specification in KUPMA Building (Annex-4)

v. Details of Exhaust and ventilation system Location and number (Annex-5)

vi. Details of Firefighting System and Fire Extinguisher Location and number (Annex-6)

vii. Details of Fire alarm system Location and number (Annex-7)

viii. Details of Fire Suppression System (FM200) (Annex-8)

ix. Specification of Generators (Annex-9)

x. Specification of De-watering Pumps (Annex-10)

xi. Specification of UPS and Batteries (Annex-11)

xii. Specifications of High-Speed Diesel (Annex-12)

xiii. Operation and Maintenance Manual of Fire Alarm System (Annex-13)

xiv. Operation and Maintenance Manual of FM-200 (Annex-14)

xv. Technical Specifications For supply of De-Watering Trucks (Annex-15)

xvi. Technical Specifications For supply of Mobile Self-Prime Automated Dewatering Pumps (Annex-16)

## 1.2 Handing Over of Equipment for Operation and maintenance

1.2.1 The Equipment, systems, subsystems as mentioned in Section 1.1 of this document will be handed over to the Service Provider in the state handed over by previous Service Provider and the current Service provider will take-over these equipment /systems for required operation and maintenance in accordance with scope of this Contract/Agreement. The Service Provider shall prepare a detail count to very minute details of each sub-system and submit to TPC for record with market-based pricing of each component duly signed within six months of the contract.

1.2.2 If both parties do not agree to extend the Agreement at Termination, the Service Provider shall seek in writing a Handing Back Certificate (HBC) from the TPC at least 60 days before the expiry of the Agreement. The TPC will issue such a certificate within 45 days provided that the equipment handed back is in good condition. Upon obtaining the HBC, the Service Provide shall be deemed clear of all obligations. However, until issuance of HBC which does not affect liability of Service Provider to keep System in fully operational condition even after expiry of Agreement, the Service Provider shall be bound to continue rendering O&M services, and the TPC shall continue to pay for such additional O&M Services. In addition, during this period, TPC and the Service Provider shall work jointly to solve any pending issues (if any). The final Invoice from the Service Provider shall include any such period of Services, which in any case shall not exceed 45 days.

## 1.3 General Maintenance Obligations of Equipment

The Service Provider shall: -

1.3.1 Ensure that all Equipment are in satisfactory operational condition (fair wear and tear excluded) so that they conform to the operational standards of first-class bus rapid transit

system and/or building. This means, in particular, that all Equipment should be clean, tidy, well-maintained, in running conditions and meeting all health and safety requirements;

1.3.2 Take responsibility for provision of all replacement parts and supplies for all maintenance issues of Equipment. The Service Provider shall procure any future spare parts and supplies (spare parts/critical spare parts/consumables lubricants, oil etc. for all equipment's in this Agreement and scope of work) pursuant to documentation provided by the manufacturer, their agent, supplier or required for maintenance and / or operation of Equipment. The spare parts shall be genuine, brand new, non-refurbished, un-altered and imported through proper channel and incorporate all recent improvements in design and material. Service Provider shall provide proof of genuine and/or imported item/spare parts to TPC on demand;

1.3.3 The Service Provider shall devise a mechanism to keep himself continuously informed about the operational status/ performance/ efficiency of all equipment and facilities under his areas of responsibilities so as to respond against any malfunctioning, poor performance, non serviceability and failure in a timely manner;

1.3.4 In case of any fault/ failure or complaint the response time for the deployed manpower at the BRT for accessing the site and attending the fault shall not exceed 5 minutes;

1.3.5 Be responsible for all material and associated costs for repair actions of Equipment caused by theft or other scheduled / unscheduled incidents;

1.3.6 Keep record of each spare part used, reason for replacement, total spare used, remaining spare parts etc. and follow Protocol issued by TPC for use, record and inventory of the same. The Service Provider shall provide to TPC such record within three days or other such time notified by TPC;

1.3.7 Arrange spare parts store within the vicinity of BRT Peshawar containing all necessary items / parts required for the maintenance of the said systems. This critical inventory list need be prepared on monthly basis;

1.3.8 Ensure that the critical spare part which may hinder the operation for prolonged duration are in stock/warehouse in sufficient quantity to ensure the smooth operations. TPC may notify such spare parts and their quantity to be always available in stock during period of the Agreement. Besides this, service provider shall maintain the inventory of critical spare parts for each month which should be at least 10 % of the installed items (covers in the scope of work) and other items separately in order to avoid any system failure in future. These critical inventory lists need be prepared on monthly basis;

1.3.9 Procure, transport and maintain any tools, software and diagnostic equipment, lifting equipment, machinery (boom buckets, lifters & cranes), calibrated test equipment, which are necessary to carry out the Services in accordance with the Agreement;

1.3.10 Coordinate with authorized agent of Equipment and /or Original Equipment Manufacturer (OEM) for defects / software issues/ maintenance/ overhaul or any other purpose to perform the required services at its own cost and risk;

1.3.11 Follow direction / Protocol of TPC regarding cleaning of Equipment, and submission of weekly, monthly and half-year maintenance schedule regarding Equipment if asked by TPC;

1.3.12 Maintain and provide tags to all electrical and mechanical equipment with QR Codes and 90 RFID tags (design and quality approved by TPC) to link with Asset Management System of TPC;

1.3.13 Maintain all conduits /pipes relevant to the scope of work. Maintain, protect and provide replacement (where required) for all types of wires and cables (both data and power cables/control cables) connecting to Equipment of the same or improved specifications. The conduits / pipes shall be kept water tight so the rain water doesn't infiltrate through those conduits / pipes to other parts/location of the facility;

1.3.14 All equipment /works covered by this Agreement must be repainted if the existing paint is scratched or has deteriorated. The surfaces to be painted should be thoroughly cleaned and washed, and scraped as necessary, prior to applying the new paint, ensuring complete satisfaction of the TPC;

1.3.15 Maintain Asset register having details of all Equipment in his custody with asset number and facilitate TPC to include in their Assets management System, if asked by TPC. Furthermore, the Service Provider shall record inventory in Asset Management System, if authorized by TPC;

1.3.16 Prepare code of conduct for its staff with approval of TPC;

1.3.17 Ensure that all staff who work on the project are registered in biometric system provided by TPC at Stations, KPUMA and other facilities. This is mandatory for permanent staff, reliever, maintenance staff, operation staff, reserve or any other staff who access to the facilities of TransPeshawar in the performance of duties. Office staff of service provider are exempted;

1.3.18 Get insurance to recover damage or theft parts, passenger or staff injury or third-party liabilities;

1.3.19 Get additional information or missing information, at its own cost, about equipment, or its maintenance and operations requirements, if required; and

1.3.20 Ensure and maintain protective devices and earthing systems are operated and maintained to reduce the risk of passengers, to equipment and operations/maintenance personnel from hazardous voltages or currents. Maintenance consists of earth connection / continuity from equipment's end to earth pit end and measuring of earth resistance with the help of standard earth resistance test meter. The Service Provider shall report to TPC

if the desired resistance value required by safety standards /equipment requirement are not maintained.

### 1.4 Operation and Control Obligations of Equipment

The Service Provider shall: -

1.4.1 Operate reliably Equipment to meet the operational requirements of bus operations, stations and buildings. The Equipment operational hours are 24 hours a day, 7 days a week and 365 days a year;

1.4.2 Engage suitable, skilled and appropriate number of human resources to satisfactorily discharge its obligations under this Agreement for safety of public, operation and maintenance of Equipment, and in accordance with minimum figures as mentioned in Section 1.23 (Minimum Personnel Requirement) of SOR or mentioned in agreement /SOR;

1.4.3 Be responsible for security of equipment which includes internal parts of equipment. TPC has provision general security for stations and corridor through another contractor / service provider. The Service provider has at least one staff for 24 x 7 at stations & KPUMA building therefore shall keep watch on the equipment.

1.4.4 Staff deployed for the assignment must be experienced and trained in their respective areas and able to perform services to the entire satisfaction of the TPC;

1.4.5 Ensure deployment of skilled professionals/manpower at strategic locations for smooth operations, immediate response/activities in case of emergency and avoiding potential damage(s) to human life and equipment;

1.4.6 Perform operation management services as per OEM recommendations, BRT applicable standards, Operational requirements, TPC regulations, and Interface Requirements (in case of interfaces with other systems);

1.4.7 Be responsible for all costs including human resource regarding operation and maintenance of equipment's which includes replacement of parts for preventive, corrective, and operational maintenance and / or defective, Equipment damaged due to whatever reason (s). These includes costs of all services mentioned in the SOR and Agreement;

1.4.8 Provide staff or train authorized representative of TransPeshawar or other Service Provider staff to perform operation on/off activity of all systems at its own responsibility. The staff provided by the Service Provider shall be in proper uniform and the uniform includes P-Cap, Personal Identification Card, Jacket (in Winter), Rain Coat (in rain), Casual black shoes, full sleeve shirt in winter & half sleeve shirt in summer with Zu logo, and dress of color as approved for different categories;

1.4.9 Prepare Operation Control and Maintenance Procedure/ Manual for all equipment mentioned in this document, and shall submit to TPC for approval, if asked by TPC.

Service Provider shall update Manual from time to time and the Manual shall include operation hours of equipment, routine checks/ daily check-list, preventive and corrective maintenance schedules, standard operation procedures of the equipment, training duration etc. Service Provider shall finalize the details format with TPC and update as and when needed;

1.4.10 Ensure safety tool in working condition and checked periodically as recommended by manufacturer. Provide safety equipment, personal protection equipment and other necessary materials as required for the execution of services under the Agreement;

1.4.11 Respond to operation and maintenance issues reported by TPC or any other approved mechanisms;

1.4.12 Follow instructions / Protocol of TPC regarding procedure of operation, duration of operation of all Equipment, Energy plan and schedule for operation of such Equipment;

1.4.13 Coordinate all hardware and software maintenance activities as well as routine maintenance activities in advance with TPC; and

1.4.14 Maintenance activities on-corridor and stations shall be conducted at night time during non-operational hours of buses.

### 1.5 Early Warnings by the Service Provider

1.5.1 The Service Provider shall inform the TPC in writing at the earliest opportunity of specific likely future events, problems or circumstances whether on Service Provider's part or on TPC's part, that may adversely affect the quality of Services. The Service Provider should also carry out corrective measures required; and

1.5.2 If the Service Provider fails to give an early warning without any justified reason, it shall be held responsible for all the consequences thereof.

### 1.6 Detailed Maintenance Obligations Regarding Software / SCADA System

SCADA system / software is provisioned in generators, and de-watering pumps etc. The Service Provider shall maintain SCADA/Remote monitoring System, PLC, website, dashboard, storage, servers and associated equipment, if provided. Ensure remote operation of equipment through SCADA from control centre.

### 1.7 Detailed Maintenance Obligations of Equipment

The Service Provider maintenance and repair obligations shall include but not be limited to: -

1.7.1 The Service Provider shall procure any future spare parts, consumables and supplies for all equipment, systems and sub-systems (lube, lubricants, oil, supplies, wires, cables, switches, electrical/ electronic / mechanical gadgets / parts, electrical/ electronic/ mechanical material, etc.) i.e. filters, PCB Cards, control cards, control module, display module, valves, relays, grease, coolant, batteries, switches, breaker, pressure gauges, pumps, motors, submersible pumps non-return valve, sensors, air blower, probe, electrical

equipment detergents, cleaners, preservative, cotton waster etc.; tools i.e. safety facilities/jackets, personal protection equipment and other necessary materials as required for the execution of duties as required by this contract/Agreement and replace/provide new upon completion of useful life of any equipment/spare parts, batteries etc. if required, pursuant to documentation provided by the manufacturer, their agent, supplier or required for maintenance and / or operation of Equipment;

1.7.2 A detailed daily, weekly, monthly, semi-annually and annual maintenance program (Master maintenance Schedule) as per OEM manuals and requirement for each particular equipment shall be developed and implemented by Service Provider. Such schedules shall be produced to TransPeshawar on demand. The operation staff shall maintain a daily operational log book and log sheet, for documenting the maintenance data, activities and events as per the requirements;

1.7.3 Preventive, corrective and operational maintenance including minor and major overhaul in accordance with the manufacturer's maintenance / operational manual shall be documented. The data documentation shall be in accordance with the maintenance requirements, mentioned herein and those which are given in the manufacturer's instruction manuals;

1.7.4 Rectify all faults occurred in relevant Equipment i.e., Water leakage, welding, short circuit, open circuit, phase sequence, under/over voltage, change, under / over voltage, phase missing, leakage current and earth faults etc or whatever reasons;

1.7.5 Any repair or replacement required, necessitated or caused as a result of, or generally resulting from, or in connection with, the following;

i) Accidental or intentional damage to Equipment;

ii) Labour disturbances attributed to the Service Provider's employee;

iii) Improper or negligent use of the Equipment;

iv) Use of Equipment in breach of the terms and conditions of the Agreement;

v) Incompetence's of the Service Provider or the employees, subcontractors or any third party in operating, handling, working, or otherwise dealing with the Equipment;

vi) Servicing, maintenance or repairs to the Equipment by any third party not in accordance with the OEM recommendations;

vii) Minor repairs strictly necessary and carried out in an emergency situation or breakdown;

viii) Theft of Equipment or their components;

ix) Failure to comply with the manuals applicable to Equipment,

x) Failure or malfunction of any component or equipment which is not provided by an OEM or TPC;

xi) Use of contaminated or non-OEM approved lubricants, additives or spare parts;

xii) Maintenance, repair or replacement, as the case may be, of or to the paintwork, approaches to Equipment, structure, stone damage, accident damage, etc. where Equipment are installed and handed over for operation and maintenance;

xiii) Attending to breakdowns and generally delivery to or collection or transportation from the point of service, salvage or breakdown;

xiv) Non-compliance by the Service Provider with any other obligations under the maintenance provisions specified in the Agreement;

xv) Tempering with the Equipment or its parts, controls and any specialized Equipment;

xvi) Operating the Equipment in a manner that may harm the Equipment, electrical, mechanical and other components;

xvii) Equipment component damage due to Service Provider negligence during maintenance and in checking and maintaining oil, lubricants and fluid levels as applicable in the applicable OEM operating manual; and

xviii) Breakdown of equipment due to whatsoever reason.

1.7.6 In addition to above, the Service Provider shall, among other things:

i) Protect the work area to ensure general public safety prior to start of any Equipment maintenance work;

ii) Perform the required regular checks, in accordance with the manuals and including the checking of coolant levels, lubricant levels, alignment, calibration, oil testing, coolant testing etc.;

iii) Replace lost parts, and safety tool of Equipment or components of Equipment;

iv) Keep reserve parts, material etc. available in enough number to keep system operational during claim period, if any. The Service Provider shall make good the Defects or damage as soon as practicable and at his own cost during claim period;

v) Protection and removal of accumulated water in generators area and electrical substations;

vi) Attend to the fitment, service or repair of any parts or equipment necessary pursuant to any applicable law which may come into force after the Signature Date;

vii) Carry out maintenance and repairs of the Equipment in accordance with industry best practices to maintain Technical Specification and meet functional Specifications;

viii) Keep and use the Equipment in a proper and prudent manner and ensure that only duly qualified and competent persons are allowed to operate the Equipment;

ix) Ensure that the OEM running-in instructions and proper responses to systems warnings are fully understood and properly observed;

x) Not use Equipment for any purpose for which it is not designed or its use is specified;

xi) Ensure that no components of the Equipment are removed or exchanged except where defective and in the course of normal service, repair or replacement and generally ensure that the Equipment are operated in complete condition;

xii) Take all reasonable steps and precautions to minimize damage to the Equipment and in particular, but without limitation, in the event of any defect or failure occurring in the Equipment;

xiii) Service the Equipment at relevant intervals in accordance with the relevant Equipment manual, best industry practices and/ or TPC's instructions;

xiv) Promptly repair the Equipment in accordance with the relevant Equipment Manual and instructions. The service provider shall provide feasible solution for repeatedly occurring faults resulting operational loss;

xv) Ensure that only fuel, spare parts and additive as prescribed by the OEM/TPC are used. In the event that the Service Provider proposes to use any alternative to the additive as prescribed by the OEM, first obtain authorization from TPC and reasonable conditions may be imposed;

xvi) Be responsible for maintenance and repair of all subsystems and equipment and recoup missing or theft items;

xvii) Allow TPC's Authorized Representative to inspect the Equipment, have access to and be entitled to, download, all information available from the Equipment (whether directly or indirectly);

xviii) Execute required improvements (holes, piping, welding, cutting, replacement, railing etc.), clear the site from all debris and restore the structure to original condition during the performance of his duties; and

xix) Responsible for all daily checks.

1.7.7 The Service Provider shall abide by the job safety and measures prevalent and laws in force in Pakistan and the Service Provider shall indemnify and hold harmless the TPC and its employees from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorneys fees and expenses, in respect of the death or injury of any person or loss of or damage to any property arising in connection with the Services and by reason of the negligence of the Service Provider, or their employees, officers or agents. If any proceedings are brought or any claim is made against the TPC that might subject the Service Provider to liability under SOR, the TPC shall promptly give the Service Provider a notice thereof and the Service Provider may at its own expense conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Service Provider fails to notify the TPC within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the TPC shall be free to conduct the same on its own behalf. The TPC shall, at the Service Provider's request, afford all available assistance to the Service Provider in conducting

such proceedings or claim and shall be reimbursed by the Service Provider for all reasonable expenses incurred in so doing.

### 1.8 Special Obligation Regarding Generators

The Service Provider Shall: -

1.8.1 Ensure 99.99 % availability (in running hour conditions) of Generators measure/evaluated in a month. Total number of Generators are 33 (± 5%).

1.8.2 Be responsible for painting of one generator cabinet per month (two coats) with high quality paint as approved by TPC. The work includes cleaning and surface finishing. The generators cabinet shall be painted once in contract life;

1.8.3 Procure and install sign board “Electrical Substation” in 2 feet x 1 feet (HIP stickers) approximately at each station (total 32 stations).

1.8.4 The Service Provider shall engage Station Operator at each Station, Aman Chowk and KPUMA (32 locations). He shall ensure:

a) Monitor Generator performance;
b) Inspection of DB-A (main DB) installed in ticket office along with breakers/ Surge Protection Device;
c) Keep watch on the equipment relevant to the scope of work;
d) Report incidents at station due to whatever reasons;
e) Operate valve between Auxiliary tank and Generator;
f) Resolve and report issues related to electric supply from Generator to ATS Output;
g) Report station condition report, deep cleaning/ steam cleaning, equipment condition at Station of other Service Provider or other activities through WhatsApp and monthly reports;
h) Dressing of power cables in Electrical Substation. The other service provider may be consulted if required their support;
i) Keep security of fuel in Generator and Auxiliary tank;
j) Operate escalators (ON and OFF), station water pumps their DB`s, exhaust fans etc.;
k) Implement energy plan; and
l) Perform such other functions/duties as assigned by TPC.

Station Operator shall be expert technician to handle day to day issues and these include but not limited to under voltage, over voltage, timers, load shifting, and frequency deviation. Report immediately in case of abnormal PESCO power load shedding and co-ordinate for resolution of issues on their part;

1.8.5 Detailed maintenance, repair, overhaul, or replacement (partial or as a whole) of Generators including ATS panels;

1.8.6 Maintain the automatic switching/ emergency cut-off of power between Generator and PESCO supply. Service provider shall ensure to effectively maintain interface with other systems;

1.8.7 Be responsible for manual restart of Generator in case of power shutdown or other similar situations. Service provider shall be responsible for the safety of staff and to secure/restrict the area from general public/ passengers and other needs/facilities required for their staff at Generator location;

1.8.8 Promptly alert TPC in case of malfunctioning issues pertaining to Generators functioning and/ or Generator running for more than 2 hours continuously or any other accident/incident;

1.8.9 Clean the facilities area including Equipment (which covers from emergency gate to nose area of station and where other TPC equipment is also positioned) on regular/daily basis. Clean exterior of Generator, Auxiliary tank, flow meters, panels, trenches, sensors, gauges, surrounding areas and platform of diesel generators system which also includes other electrical facilities in the area;

1.8.10 Stock & maintain Three (03) No. trolley mounted mobile diesel Generators for emergency back-up in case of failure of any Generator or PESCO power failure or whatever reasons of rated capacities as below:

I. 455 KVA Prime rating Diesel Generator Set: 1 No.
II. 110 KVA Prime rating Diesel Generator Set: 2 No.'s

The mobile diesel Generators shall be made available within two months of agreement signature. Mobile Generator shall be moved throughout the BRT corridor, Control centre, commercial centres and Stations along with allied accessories for successful restoration of the power at affected facility. The Service Provider shall move mobile Generator to the required location within 1 hours. The trolley mounted mobile Diesel Generator shall always be positioned (24 x 7) in KPUMA or other location identified by TPC. Service Provider shall also be responsible for service, maintenance, transportation of these Generators, interconnection of cable at location where mobile diesel Generator is required.

1.8.11 Provide fence around facility area/ generator at Aman Chowk Electrical Substation area for protection of Equipment and Fuel;

1.8.12 Ensure that regular checks are made by the Service Provider of all oils, coolants, additives and electrolyte level and that such levels are correctly maintained in accordance with the manuals. Health checks of battery electrolyte (in case of led acid battery), connections, rusting on battery terminal and battery voltage (for proper crank of Generators); and

1.8.13 Dispose-Off left over or burnt fuel/lubricant, used spare parts and other consumables in accordance with environmental laws.

### 1.9 Special Obligation Regarding De-Watering Pumps and Wet Wells

The Service Provider Shall: -

1.9.1 Ensure 100 % availability of de-watering pumps installed during rain/ storm. Total number of installed pumps are 20 (± 20%) at eight locations. If the pump capacity is not enough for emptying the wet well /underpass, the service provider shall install additional pump(s) at their own cost;

1.9.2 Be responsible for routine preventive and corrective maintenance as per the manufacturer recommendations, TPC instruction; and partial or as a whole replacement of de-watering pumps installed in case of malfunctioning or damage;

1.9.3 Be responsible for the maintenance/rectification/ replacement (partial or as a whole) of associated control panel or re-location of control panel including security of Control Panel installed above underpass in mix traffic;

1.9.4 Be responsible to arrange Mobile De-watering pump along with all required accessories for de-watering of BRT underpasses in case of installed de-watering pumps failure during the rain/flood or the installed capacity is not enough to discharge water. The Service Provider shall arrange additional mobile de-watering pump, generator to discharge the additional flow which could not be handled by existing pumps. The pump shall have the ability to pass sludge water containing up to 1 cubic inch solid particles, shoppers and other solid waste. The additional pumps shall be enough to keep underpass clear for bus operation;

1.9.5 Be responsible to regularly maintain the wet well ladders, covers and associated components including theft of any equipment from wet well;

1.9.6 Be responsible to depute personnel at De-watering control panel to check/operate pump and also physically verify water level in underpass at every 5 minutes' interval in event of rain. The staff shall wear reflective coat to facilitate bus operation;

1.9.7 Cleaning of Water well pump from debris, plastic etc. after every two months and before rain forecast and after rain;

1.9.8 Procure, supply, operate and maintain a two (02) truck-mounted flooded water / clean water / sludge vacuum tanker designed for municipal and solid waste management operations on behalf of TPC. The tanker shall include a vacuum tank, vacuum pump and usable capacity not less than 9,000 litres. Detail technical specification Attached as Annex-15. Service provider shall be responsible for registration of truck on the name of TPC along with branding and handover to TPC on completion of agreement as TPC property free of cost. The token taxes during operation phase will be paid by TPC. The truck shall be utilized in case of overflow/ flooding anywhere in ZU Complex (Station 01, depot, KPUMA, ZU Business Centre), Corridor, Commercial Centres and direct routes where bus operates and / or any place so directed by TPC. The truck shall also be used at stations and other facilities of TransPeshawar for waste suction or opening of drains or washing of BRT infrastructure (corridor, column, pillars etc.). In case of rain or rain forecast, the truck will be in operation 24 x 7 and Service Provider shall arrange additional

driver and staff to provide services in rains/ floods and emergency situation. Service shall be responsible for all costs associated with de-watering truck operation and maintenance. The truck shall always be on-call to provide services round the clock when required with 15 minutes response time. The truck shall be delivered and commissioned within six months from the Date of Commencement. The truck shall be new, per-assembled in factory and brand shall be as approved by TPC with minimum engine capacity of 5000 CC. The make of truck shall be Hino, Isuzu, Nissan, Faw, Dongfeng, Mazda, Ford or equivalent. Details are attached as Annex- 15;

1.9.9 Be responsible to maintain and replace conduits/MS pipes, valves, supports structure;

1.9.10 Be responsible to procure, operate and maintain fully two automatic auto-prime solid handling (up to 77 mm capacity) de-watering pump (Mobile Dewatering pump) with capacity not less than 2500 GPM. The pump shall be coupled with water cooled diesel engine having power not less 45 KW on a trolley. The Service Provider shall be responsible for fuelling cost. The generator shall be Perkins, Cummins or equivalent brand (specification attached as Annex-16). The Service Provider shall be responsible for arrangement of vehicles to move the mobile dewatering pump to the required location (s). The Dewatering pump shall be used for dewatering of waters along the corridor, stations, commercial centre or any other location in city. **TransPeshawar shall be the owner of two (2) mobile dewatering pumps.**

1.9.11 Be responsible for dismantling, uplifting, repair and reinstalling the pumps in case of failure; and

1.9.12 Any other activity (ies) which are required for full functioning during rain / flood and to ensure that underpasses are good for bus operations.

## 1.10 Special Obligation Regarding UPS & Batteries

The Service Provider shall: -

1.10.1 Ensure that UPS remain functional for at least 99% of the running time. Total number of UPS are 32 (± 5%) and batteries are 630 having capacity of (25-65 Ah) (± 5%);

1.10.2 Operate, maintain, and rectify the all the issues related to UPS including software and hardware components;

1.10.3 Ensure the availability & stocking of the recommended spare part & batteries;

1.10.4 Periodically inspect the UPS and Battery Bank for any wear & tear, loose connection, rusting of battery terminals and melted cables; and take corrective measures accordingly; and

1.10.5 Procure, transport and replace batteries associated with UPS in case found faulty or damaged with same as existing capacity and specifications as per requirement.

## 1.11 Special Obligation Regarding Electrical System at KPUMA Building & Control Centre

The Service Provider Shall: -

1.11.1 Ensure more than 98 % availability of the electrical system satisfactorily serving the purpose. Total number of 1 MLV and 25 (±5%) number of Distribution Boards;

1.11.2 Periodically check, operate and maintain and replace (when required) UPS, Batteries, control units, MLV's, power DB(s), breakers, capacitor banks & Protection system. Ensure that these Equipment is always in healthy and tidy condition. Make replacement of any faulty/damaged part/components including but not limited to all type of breaker, capacitors, SPD, meters, indication lamps etc.;

1.11.3 Ensure the periodic checking & maintaining of earthing pits, electrical connections and power cables; and rectify timely if required, for smooth operation;

1.11.4 Inspect lights at each floor and specifically at control room for any abnormality or fire or end of life which may cause safety issues;

1.11.5 Detailed earthing maintenance to maintain the required / designed resistance of whole KPUMA building; and

1.11.6 Perform any other functions which are required for successful operation of control centre.

### 1.12 Special Obligation Regarding Exhaust and Ventilation System (EVS) at Stations

The Service Provider shall be responsible:

1.12.1 To understand the operation and maintenance requirements of EVS at four stations (Faisal Colony BS-04, Gulbahar Station BS-07, Hashtnagari BS-08 and Malik Saad Shaheed Station BS-09) and its associated costs;

1.12.2 For the maintenance of exhaust fans, ducts, diffusers, motors and other electrical system (DBs, cables, wiring etc.) associated with the EVS;

1.12.3 For air leakage inspection of ducts and subsequent repair;

1.12.4 To conduct periodic necessary inspection, cleaning, replacement etc;

1.12.5 Installation of bracing to ducts to avoid shrinkage of the ducts where required; and

1.12.6 To conduct any other activity including procurement which are required for the operations/ intended use of the system.

### 1.13 Special Obligation Regarding Fire Fighting System and Fire Extinguishers

The Service Provider shall be responsible:

1.13.1 To understand the operation and maintenance requirements of the Fire Fighting System and its associated costs;

1.13.2 To operate the firefighting system in case of fire;

1.13.3 To check that the pressure is maintained as per the requirement of the system. The piping pressure inspection scope includes ZU Complex;

1.13.4 To provide training to the staff from the OEM or its agent and provide refresher courses at least once a year. The Service provider shall provide certificates of such trainings to TPC on demand;

1.13.5 To check system periodically and conduct mock operations (to check pressure) of the system for its functionality on quarterly basis or other duration as specified by TransPeshawar;

1.13.6 For operation and maintenance of Firefighting system installed in the building which includes 3- pumps (Jockey pump (16 GPM), electric pump (1000 GPM), 1 Engine operated pump (1000 GPM), hoses, fire hose pipes, 6 fire hose cabinets, fire extinguishers, valves, fire hose reels, sensors, Pressure Reduce Valves, 5 fire hydrants, cables, other pipe fittings etc. Service Provider shall be responsible for fueling of diesel engine pump installed for firefighting system. The pipe maintenance includes buried piping, vertical piping, pipes above ceiling etc.;

1.13.7 For proper maintenance and operations of the electrical system (DBs, cables, wiring, sensors, gauges etc.) associated with the Fire extinguisher system;

1.13.8 To check system periodically for leakage/ pressure drop of the system;

1.13.9 To check the pressure gauges, expiry of Fire Extinguisher regularly and refill whenever needed;

1.13.10 To keep electric run pump, diesel run pump, jockey pump, gauges and other equipment in running condition;

1.13.11 To maintain the pipe & all relevant equipment installed in KPUMA building, Depot, ZU Business Centre both buried and above ceilings;

1.13.12 To check and re-fill the Fire Extinguishers (17 number) installed in KPUMA Building including maintenance of stickers; and

1.13.13 To conduct any other activity which is required for the operations/ intended use of the system.

### 1.14 Special Obligation Regarding Fire Alarm System

The Service Provider shall be responsible:

1.14.1 For KPUMA building including ground floor;

1.14.2 For operation and maintenance of Fire Alarm system installed in the KPUMA building which includes Fire Alarm Control Panels (02 No.), 263 number smoke/ heat detectors (±5), sensors, associated cables, control panels equipment, 15 number emergency push

buttons, 21 number sounders etc. Service Provider shall be responsible for all the cost associated with the replacement of the parts and operation of the system;

1.14.3 To understand the operation and maintenance requirements of the Fire Alarm System and its associated equipment;

1.14.4 To check that the system is healthy and respondent to the fire incident as per the requirement of the system especially smoke detectors;

1.14.5 To provide training to the deputed staff/technician to learn the system operation and troubleshooting and provide refresher courses at least once in a year. The Service provider shall provide certificates of such training to TPC on demand;

1.14.6 To check system periodically and conduct mock operations (to check the healthiness) of the system for its functionality on quarterly basis or other duration as specified by TransPeshawar; and

1.14.7 To conduct any other activity which is required for the operations/ intended use of the system.

### 1.15 Special Obligation Regarding Fire Suppression (FM 200) System

The Service Provider shall: -

1.15.1 Check data center room regularly and operate Fire Suppression System as per two step authentication process or SOP defined by TPC. The refill in case of use shall be on part of TransPeshawar;

1.15.2 Get training and understand the condition in which it requires operation and the manner to which this to be operated;

1.15.3 Check/test in details quarterly the Fire Suppression System in presence of TransPeshawar staff through authorized technical staff that the system is healthy and good enough to respond to emergencies;

1.15.4 Prepare and submit documentation the SOP for checking, maintenance, operation and emergency procedure to TPC for approval regarding Fire Suppression System; and

1.15.5 Check the control panel, sensors, batteries, cylinders, 1 control panel for FM200, 4 detector, 2 Sounders 1st stage and 2nd stage, 2 cylinders, sprinkles, solenoid valves, associated cabling and other equipment for necessary maintenance.

### 1.16 Special Obligation Regarding Supply of Fuel

The Service Provider shall: -

1.16.1 Provide fueling in Diesel Generators in non-operational hours (11:00 PM to 5 AM) in time duration allowed and approved by TPC. In routine, generators will be re-fuelled at night in non-operational hours on need basis as scheduled by Service Provider and approved by

TransPeshawar to meet the requirements of bus operations. TPC may also allow fueling of generator's during bus operational hours (6:00 AM to 11:00 PM) in emergency situation or at a time directed by TPC. In case of emergency, TPC may direct with 6 hours' notice to service provider for fueling in generators and service provider is required to fuel the generators/auxiliary tank. Entry to corridor in operational hours will be in accordance with SOP defined by TPC. Schedule for fueling of Generators/ auxiliary tank will be provided by Service Provider and approved by TPC;

1.16.2 Make available vehicles of sufficient storage capacity to smoothly undertake and perform the fueling activity. The resources and vehicles shall be sufficient to fuel all Generators/ auxiliary tank in one night during non-operational hours. The vehicle must be in good condition and be equipped with sealed digital dispensing units, flow meter and a power supply/ source (e.g. generator) to effectively carry out the decanting process;

1.16.3 The services provider shall be responsible for the repair, replacement, and calibration of the flow meters installed on all auxiliary generators fuel tanks. The contractor must ensure that any faulty flow meters are promptly repaired or replaced as necessary, at no additional cost. Additionally, the contractor shall calibrate the flow meters annually, in accordance with applicable standards and as directed by TPC. The contractor is obligated to carry out these duties to ensure the accurate and continuous operation of the flow meters throughout the term of the Agreement.

1.16.4 Ensure accurate recording of fuel quantity supplied/decanted. The flow-meters shall be used to monitor the quantity decanted into the Auxiliary tank at each delivery; therefore, the flow-meters must be of such quality/specifications that their readings, after calibration, should match those displayed by the dispensing unit attached on the delivery vehicle. In case of difference of reading in flow meter of delivery vehicle and auxiliary tank, lowest of the two will be taken for payment of fuel. If required, the service provider shall be responsible for leveling of Auxiliary tank to measure / read the dip chart already fixed on the tank;

1.16.5 Ensure timely calibration of both the dispensing units installed on the delivery vehicles, and the flow-meters installed on the auxiliary fuel tanks, through a recognized agency/firm, as approved by TPC;

1.16.6 Within 30 days of the award of the Agreement, ensure calibration of flow meters, side glass level gauge installed in auxiliary tanks and any other equipment requires calibration. At the minimum, the calibration shall be conducted on annual basis or earlier as may be needed. The calibration reports shall be submitted to TPC within one week of the end of the year. Under no circumstances shall the flow-meters be removed / replaced without prior approval of TPC;

1.16.7 Maintain on-site as well as off-site record (e.g. log book) of all re-fuelling activity. (Generator readings, quantity delivered at each supply, flow meter, side glass gauge level.).;

1.16.8 Guard against dispensing of impure or substandard Diesel to protect warranty rights of TransPeshawar by performing basic quality tests (Graduated Cylinder (1 L) Fuel Test, water test and flash point test) at each delivery on-site at location identified by TPC;

1.16.9 Ensure security of fuel present in Generators and auxiliary tanks, on 24-hour basis, 7 days per week (including public holidays), and maintain theft prevention mechanism of encapsulate flow meter through steel and locking arrangement;

1.16.10 Control unauthorized access to flow meters, auxiliary tanks, fuel delivery pipes from auxiliary tank to base tank, base tank, and control valves;

1.16.11 Recognize, respond and take necessary actions to security threats or breaches (during fuelling process) of fuelling handling system at sites;

1.16.12 Develop detailed Standard Operating Procedures (SOPs) for the following, to the satisfaction of TransPeshawar, and strictly abide by them. SOP for decanting of fuel and lab testing shall be notified by TPC to Service Provider and amended from time to time by TransPeshawar: -

a. Lab testing of delivered fuel: i) The Service Provider shall arrange lab test report, of a randomly drawn sample of fuel taken on-site at location identified by TPC in presence of representative(s) from both TransPeshawar and the Service provider, maximum three times a month or in case of the fueling activity is less than three times a month then at each fueling activity. ii) These samples of fuel shall be taken at the cost of Service Provider. All samples shall be delivered to the laboratory in supervision of TransPeshawar and Service Provider shall bear the cost of testing. The services of a company (lab) of repute and approved by TransPeshawar shall be utilized for lab tests. The specifications of Pakistan Standards Institute (PSI) for High-Speed Diesel shall be treated as benchmark for quality.
b. Additional test if conducted by TransPeshawar shall be at the cost of TransPeshawar.

1.16.13 Conduct activities including fueling, collection of readings (including but not limited to side glass level gauge readings for auxiliary tank, engine running hours, percentage fuel level), maintain and provide fuel consumption and supply trends reports and submission of other reports as per schedule defined by the TPC. The reports shall be as per prescribed format of the TPC. The number and format of the reports are subject to change as need arises, decided by the TPC.

1.16.14 Maintain and replace flow meters as notified by TPC. In case service provider does not provide equipment within seven (07) working days, TPC may replace or maintain the required equipment and will deduct the invoice price from service provider monthly payment or reserve fund.

1.16.15 For the duration of the Agreement, irrespective of actual or anticipated fuel delivery stoppages or shortage of fuel and electricity supply, ensure that it maintains, at its own cost, at all times adequate levels of fuel, in order to ensure a seamless and uninterrupted delivery of the Services.

1.16.16 Authorize TPC to inspect decanting of fuel, condition of tank lorries, use of a Digital Testing Kit, or arrange testing of calibration of dispensing units or the flow meters in light of SOP`s provided by the Service Provider as and when it so desires. This includes existing fuel assembly which will be handed over to Service Provider in working condition.

1.16.17 Provide complete operation and maintenance of fuel supply assembly owned by TPC till base tank of Generator in complete working condition and in accordance with the specifications, requirement and/or recommendations of service provider. The assembly includes flow meters, auxiliary tanks, side glass diesel fuel tank level gauge, fuel delivery pipes from auxiliary tank to base tank, electric motor, control valves, locking arrangement and other allied equipment / parts. Operation and Maintenance shall also include periodic painting of Auxiliary tank, locking arrangement and repair / replacement / restoration of equipment/ parts of assembly without any effect to TPC ownership rights and leveling of auxiliary tanks if required. This also includes calibration, repair and maintenance of flow meters already installed by TPC between auxiliary and Generator sets;

1.16.18 Explain discrepancies (termed as “Deficient Fuel”) identified by TPC, based on data trends of diesel consumption using generator operating hours, delivered quantity and generator levels data provided by the Service provider, with adequate justification, below 95% statistical confidence level. Upon identification of such discrepancies established between and within generators, the TPC shall require the Service Provider to investigate and explain such discrepancies. The cost of Deficient Fuel as established by TPC shall be replenished by the Service Provider as a deduction from proceeding invoice. Decision of TPC in this regard shall be final and binding on the Service Provider.

### 1.17 Training and drills related to Safety and Emergency Evacuation System

The Service Provider shall conduct at least one training in six months related to safety and emergency evacuation for staff in KPUMA Building. The training drill shall be demonstrated with use of one fire extinguisher, alarm, evacuation of building and pressure checking / use of fire hose. The Service Provider shall be responsible for provision and maintenance of signage in accordance with Applicable laws of Pakistan. The Service Provider shall provide periodic training to staff related to safety of personnel and operation of emergency equipment mentioned in this document. The Service Provider shall also periodically check emergency equipment for functionality and keep such records available to TPC, if so asked.

### 1.18 Mandatory Provision of Works/ Procurement related to KPUMA Building & BRT System

The Service Provider shall execute the following mandatory works as part of the Agreement:

1.18.1 The Service Provider shall paint steel structure with high quality of paint with ~~approximately~~ 500 square meter per month of station steel structure. The work includes preparation of surface, cleaning of surface and application of two coats in design and color as approved by TransPeshawar. The work shall include paint up to height of 8 meters and

anywhere in BRT System. The service provider shall be responsible for all costs associated with completion of activities and includes but not limited to transportation, scaffolding, labor, materials etc. Including defect liability for one year of each paint starting from signing of acceptance form;

1.18.2 The Service Provider shall provide/ procure quarterly HIP sticker of 60 square feet to meet any future demand of bus operations at Station and responsible for one year as Defect Liability Period.

1.18.3 The Service Provider shall be responsible to procure, install and maintain floating switches in fresh water tanks at all stations. Furthermore, be responsible for connection (cables, accessories etc.) and automation (ON,OFF) of fresh water pump through float switch.

**1.18.4 For maintenance of six (6) floor standing Air Conditioning units (2 tons each) installed in control centre, and service of in-door / out-door units at least every six months along with drainage /leakage control, refrigerant etc.**

**1.18.5 For operation and maintenance of one (1) sump pump along with associated cabling and piping installed in pedestrian underpass of the Tehkal Payyan BRT station have capacity of 2 gpm. The work also includes inspection and cleaning of sump pit.**

### 1.19 Service Provider/ Control Centre Executives Responsibilities at Control Centre

The Service Provider shall depute full time one (01) Control Centre Executives (CCE) at same time for Control Centre for 17 hours a day with not more than 8 hours per shift and 365 days a year. The CCE`s shall be Mechanical and/or Electrical engineer. The CCE shall perform following activities in addition to his own tasks:

1.19.1 The CRE shall work as a liaison between TPC, Service Provider, and Other Service Providers and monitor / report the overall maintenance activities, and perform other duties related to the scope of the Agreement as per instruction of the TPC;

1.19.2 The CCE/ Service Provider shall maintain the fuel record, costs, comparing cost / liters with last years, etc. Each month or at any other interval the report shall be submitted to TPC in accordance with agreed format of for Fuel;

1.19.3 Coordinate with Station staff, field staff, control center staff of BRT system Service Provider / contractor, record incidents and emergencies in Incident Management System, respond to Complaint Management System, report emergencies and provide necessary support;

1.19.4 Prepare daily operation and maintenance report and share with TPC next day both in summarized and detailed format;

1.19.5 Monitor the performance of field/ station staff, activities under the Agreement and equipment performance and ensure compliance of the contractual requirement; and

1.19.6 Any other task assigned by the TPC.

All the reports produced by CCE under the Agreement shall be duly signed by the HSE expert of the Service Provider each month or any other interval as required by TPC.

### 1.20 Service Provider/ Operator Responsibilities at Stations & KPUMA Building

The Service Provider shall engage at least one Station Operator / Technician at each Station (30), Aman Chowk (01) and KPUMA building (01) for 24 x 7 and 365 days with not more than 8 hours per shift. The additional Operator at any other locations shall be as per services requirement in accordance with the Agreement. The Operator / Service Provider shall perform following activities in addition to his own tasks:

1.20.1 Maintain Log of all activities performed in night at Stations including maintenance activities of other Service Provider such as deep cleaning, steam cleaning, civil work maintenance, operational status of washroom etc. The Operator shall be responsible to report the night activity of Deep Cleaning, Steam Cleaning, and the area covered for cleaning to TPC through WhatsApp or other mechanism notified through SOP.

1.20.2 Prepare monthly assets condition /status report of the station equipment/ assets on every first month with invoice for the last period of 25th to 25th covering at least but not limited to light report at Stations, sticker condition (on fare gates, TVM, Glass, ticket Office etc.), fans operation, debris/ left/over / scrap at station/ corridor, water cooler, benches, civil work, pedestrian bridge condition, tiles condition, plants, boards, sump pumps in station underpasses, Public Service Messages report, backlit boards/ signs, ceiling, louvers, railing, etc. or any other assets installed at stations. The first report shall include count of all equipment at all stations and the following monthly report shall cover only assets which are missing or not properly maintained or having bad image for TPC. This inspection report is related to the equipment at Stations owned by TPC or other Service Provider. The assets and condition report format shall be agreed with TPC and updated as per requirements of the TPC;

1.20.3 The Operator default position for day time or in bus operation time shall be Electrical Substation Area or other area as notified by TPC. Similarly, for KPUMA building the Operator shall always do regular inspection of building / equipment; and at night specially shall be vigilant and walk on each floor after 15 minutes for checking abnormality in building. KPUMA Operator shall be responsible for timely restart of Generator upon power breakdown. The Service Provider shall also ensure that second Backup Generator is checked and provide the intended purpose;

1.20.4 Inspection of DB-A (main DB) installed in ticket office along with breakers/ Surge Protection Device (SPD) and maintenance of DB-A (main DB) and along with maintenance of breakers / SPD; and

1.20.5 All staff of the Service Provider shall be registered in Attendance Management System of the TPC and record attendance of IN & Out accordingly. No Staff shall perform duty more than 8 hours.

### 1.21 Health, Safety and Environmental Services in BRT System & Commercial Centre

The Service Provider shall ensure that Health, Safety and Environmental (HSE) responsibilities, which are crucial to protect passengers, staff, stations, equipment, buildings and the surrounding environment, are met. The scope of work area includes KPUMA building, Commercial Centers (Dabgari, Chamkani, Mall of Hayatabad), Corridor, Depots (Chamkani & Mall of Hayatabad), and BRT Stations. The Service Provider shall inspect the system on behalf of TPC. The Service Provider shall inspect and report to TPC: -

1.21.1 The Service Provider shall engage one person having 16 years of education (in Health and Safety) as HSE Expert (with minimum experience of 2 years in well reputed organization) for six days a week and during normal office working hours who shall monitor the HSE activities, conduct inspections and prepare risk assessment reports. The expert shall prepare policy, detail documents on environmental features and carbon foot print saving for various activities in Peshawar BRT. The expert shall attend any outside meeting on behalf of TPC if so directed. The expert shall perform any other such task assigned by TPC;

1.21.2 The Service Provider shall prepare a policy, and conduct a detail document/ audit/ assessment of HSE responsibilities in Peshawar BRT and Commercial Centers through Professional HSE Specialist. The Service Provider shall also prepare a detailed Check-list for regular inspection. The report shall be updated during the Agreement period by the Service Provider Staff;

1.21.3 The HSE expert will be in-charge in control center on behalf the Service Provider for supervising control center staff relevant to the contract.

1.21.4 The Service Provider shall provide training to the Service Provider team on report and inspection procedures. The Health and Safety expert shall be at least NEBOSH certified;

1.21.5 The Service Provider shall engage one Inspector per shift (with at least 16 years education and NABOSH or equivalent certified) and three supporting staff for inspection in Peshawar BRT in three shifts and 365 days a year. The Service Provider shall provide them a van branded (at least six-seater) and the vehicle shall be single cabin pickup 4 x 2 the model year shall be 2025 or most recent with customization for seating capacity (fiber glass roof etc.) and Health /Safety purposes as approved by TransPeshawar) with ZU Logo and operate in corridor for 24 hours a day & 7 days a week. The Service Provider shall provide at least one training to these staff through professional HSE specialist. The Inspector and their staff shall be in Uniform as approved by TPC. The duty of staff shall always be at Stations, KPUMA and Commercial Centre (if authorized);

1.21.6 The HSE team shall provide quarterly physical / on-job training to other Service Provider staff at Station or KPUMA building with demonstration for use of fire extinguisher. The filling of fire extinguisher used for training shall be the Service Provider responsibility. The training shall include on emergency response, drills for fire, medical, procedure in case of minor and major accident or security emergencies, or other such scenarios. The Service Provider shall be responsible for supply, installation and maintenance of four (04)

rechargeable body wearable portable audio system (Voice amplifier) and provide four (04) body worn cameras (Hikvision or equivalent) of specification as approved by TPC;

1.21.7 The Service Provider shall provide in-depth HSE training to currently deployed security at Stations and KPUMA building. TPC intends to have one security at each station per shift are trained by the Service Provider; and the Service Provider provide 32 green reflective Jackets per year with ZU Logo and mark as “Fire Team”;

1.21.8 The Service Provider shall once in year (every June) shall fill the extinguisher installed at KPUMA to maintain pressure which are reduced due to leakage and paste stickers showing filling and expiry date. The Service Provider shall check fire extinguish in routine and provide report accordingly;

1.21.9 The HSE team shall immediately reach to location where accident happens, or vehicle breakdown, or fire or any other accident or any other location relevant to service provider; and

1.21.10 The Service Provider HSE team shall check but not limited to:

- ❖ That signage and instructions are properly maintained at stations and buildings for emergency evacuation;
- ❖ Inspect platforms, handrails, and floors to prevent slips, and falls;
- ❖ Emergency exits, fire alarms (where available), and extinguishers clearly marked and functional;
- ❖ Crowd control procedures to prevent stampedes or pushing;
- ❖ Safe and timely docking of buses;
- ❖ Toilets and hand washing facilities;
- ❖ Disinfection of high-touch surfaces (handrails, ticket machines);
- ❖ Adequate waste disposal systems and litter bins;
- ❖ Air quality monitoring and ventilation;
- ❖ Availability of first aid kit;
- ❖ COVID-19 or flu-season protocols (e.g., mask reminders, sanitizers);
- ❖ Segregated recycling bins;
- ❖ Avoiding litter accumulation through regular inspection of cleaning activities;
- ❖ Noise reduction measures (e.g., soundproofing); and
- ❖ Any other measures which fall in HSE responsibilities.

## 1.22 Labor Laws Compliance for the Staff Engaged by Service Provider

The Service Provider shall ensure labor laws compliance related to the staff deployed by the Service Provider for the performance of the duties. The Service Provider shall not only ensure compliance but shall also perform the followings task and assume responsibilities: -

1.22.1 Submit salary payment schedule to TPC within seven (07) days of start of services and ensure payment within seven (07) days or other such period are paid to the staff;

1.22.2 Ensure that staff are getting regular weekly OFF, casual leaves, sick leaves and other legal leaves in accordance with Labor Laws. The Service Provider shall ensure 32 days of leaves per year against sick/ casual leaves or as per labor laws whichever is higher;

1.22.3 Ensure that staff who worked on special days (Eid Days etc.) are compensated in accordance with Labor Laws;

1.22.4 Nominate Focal person to pursue claims of the Staff in EOBI and ESSI for re-reimbursement, issuance of EOBI/ESSI Cards and other such facilitation required during service or post death by their families at Government Office;

1.22.5 Ensure Insurance for employees in accordance with labor laws. The Service Provider shall provide proof of claims of recovery or start of pension (whichever is applicable) is started within three months after the death of the employee or injury / disability;

1.22.6 Engage Reserve Staff against Staff Clause 1.23 to work on their behalf in case of weekly off, sick leave, casual Leaves and any other leave under the Applicable Law;

1.22.7 Ensure that Employee are insured (Group Insurance) with minimum of following limits or Labor laws or applicable laws whichever is higher:

Death in case off-duty: PKR 1 million

Death in case of on-duty: PKR 2 million

1.22.8 If the Employees are not insured or paid timely then such amount shall be deducted from the invoice of the Service Provider for payment to the Employees or legal heirs along with LD`s for delay; and

1.22.9 The Service Provider shall not deduct any amount more than 3 % or any other amount notified in Labor Laws against Liquidated Damages for non-performance by the employee.

## 1.23 Minimum Personnel Requirement

The minimum personnel requirements are as follows: -

| Staff Category | Requirement |
|---|---|

| | |
|---|---|
| Safety and Health Personnel | One (01) for eight hours and six days with exception of 26 days annual leave |
| Control Centre Executives (CCE) | One (01) per shift (Two shifts) for 17 hours a day and 365 days a year excluding reserve staff |
| Health, Safety and Environment (HSE) Team | One Inspector per shift (total three shifts) in field (stations, corridor etc) in Uniform<br><br>Three (03) staff per shift (in Uniform) and three shifts in field (stations, corridor etc) excluding reserve. |
| One Station Operator (Technician) 24 x 7 days and 365 days a year with not more than 8 hours a shift at 30 Stations, 01 Aman Chowk and 01 KPUMA Building | 32 Staff per Shift (Total three shifts) excluding reserve in Uniform |
| The above are minimum Personnel and the Service Provider shall depute additional staff and calculate reserve staff as required to perform scope of work, and meet KPI's.<br><br>The above designation and Personnel shall not work for more than eight (08) hours a day. The Service Provider shall estimate reserve personnel accordingly except mentioned specifically.<br><br>Service Provider shall get Uniform Approved separately for each category from TPC.<br><br>Note: In case of declared emergency by TPC, the resources under this contract can be utilized on the direction of TPC in the city outside BRT. | |

### 1.24 Additional Services

The agreement has a five-year term and over the time equipment / services may be added or removed due to changing urban dynamics or expansion of system which are relevant to scope of work. The equipment or services beyond the quantities mentioned in SOR (including permissible limit/allowance) shall be adjusted if increased or decreased. Therefore, in such situation, the following adjustment shall be made in monthly price for operation and maintenance for following equipment including allied system/ accessories/ services except where mentioned: -

a) Per Generator @ PKR 15,000 per month (Including ATS)

b) Station Operator (Technician) @ 1.4 times of minimum wage per month

c) 10-20 KVA UPS along with Battery banks @ PKR. 10,000 per month

d) Pump in underpasses @ PKR. 20,000 per month per underpass per pump

The above prices shall be adjusted for inflation with CPI for equipment. The Human Resource is linked with minimum wage. The additional cost will become part of Contract Price/ monthly service payments. Base price/ CPI index for adjustment will be same as mentioned in Payment Calculation Schedule and price will be adjusted annually after completion of year. For subsequently adjustment, the additional work/services/equipment

will be adjusted in monthly service payments as per prevailing formula. The adjustment in contract price shall be through contract amendment.

### 1.25 Monthly Operation Report

No later than 17:00 PM on the 3rd Business Day of each month, starting on the last Business Day of the first Calendar month after the Commencement Date, the Service Provider shall submit to TPC a report on the Performance of its obligations under the Agreement (on TPC demand) during the previous month, covering at a minimum:

a) List of Staff /Operator working and updated on monthly basis for the duration of the Agreement by the way of an exception report indicating the incoming and exiting staff/Operator for implementation in attendance system of TPC;

b) Report on regarding spare parts usage & balance in warehouse;

c) Detail record of all service, repair and maintenance;

d) List of tools, software, diagnostic equipment etc. maintained;

e) Full details on any Severe Defect maintenance / operations on Equipment;

f) Report regarding Fuelling in Generators;

g) Report on illegal poster / graftti / advertisement on BRT infrastructure/ pillars etc.

h) Station Assets Condition Report;

i) Monthly Fuel Comparison Report;

j) Performance on KPI`s;

k) Items required by TPC for monitoring and performance evaluations;

l) Payment made to EOBI and ESSI for the previous month; and

m) Other reports as directed by TPC.

### 1.26 KEY PERFORMANCE INDICATORS

i. The Service Provider's performance of operation, maintenance and services shall be evaluated by means of key performance indicators ("**KPIs"**). Failure to comply with KPIs ("**Failure Events"**) shall lead to the application of performance deduction as per the below table ("**Performance Deduction**" or **"PDP"**):

ii. The Service Provider shall, pay the Liquidated Damages depending on its performance in achieving the agreed performance regime as measure during course of the Agreement.

iii. The Liquidated Damages for failure to achieve Key Performance Indicators (KPI) parameters will be implemented in accordance with Key Performance Indicators.

iv. Except for information available through SCADA system /Software, Network Monitoring System or complaint management system, or other system generated reports known to the Service Provider; any other information, if any, used by the TP to evaluate KPI will be transferred to the Service Provide once a week on request. The Service Provide will have the right to justify through concrete evidence the outcome of the aforesaid systems, on as-and-when basis, that are subject to Liquidated Damages as per KPI, prior to settlement of monthly payments, but in any case, no later than one week from the submission of the Invoice.

v. The Liquidated Damages is the final and full remedy of the TPC for the Service Provider failure to achieve the KPI targets, and such Liquidated Damages shall be deemed to have offset any breach whatsoever due to the lapses/deficiencies in performance. However, revenue loss shall be additional and deducted from monthly invoice.

vi. Any breach of defined service levels will entail Liquidated Damages which shall not exceed 10% of the monthly payments to be paid under the Agreement/Contract to Service Provider.

### 1.27 General Violations and Their Liquidated Damages applicable to the Agreement

| Sr. No | KPI | Failure Event | Performance Deduction Percentage |
|---|---|---|---|
| 1 | Prevention of Severe Accidents | Accident involving Equipment and software due to the Service Provider fault or malfunctioning of equipment resulting in death or severe physical injury of a passenger or other person (**Severe Accident**) | 10% per occurrence |
| 2 | Prevention of Material Accidents | Accident involving Equipment and software due to the Service Provider fault or malfunctioning of equipment resulting in minor physical injury of a passenger or other person or material damage to the TPC assets (**Material Accident**) | 5% per occurrence |
| 3 | Prevention of strikes | Number of operating minutes in which the Service Provider or its staff did strike and shutdown system partially or fully | 5 % per incident which continue for more than 20 minutes plus loss of passenger revenue (if any) |

| Sr. No | KPI | Failure Event | Performance Deduction Percentage |
|---|---|---|---|
| 4 | Repetition of issues | Occurrence of same issues by more than 5 times in the same month in same or multiple equipment | 3 % per 5 occurrences |
| 5 | Safeguarding of operational data | Some operational data irrecoverably lost | 1% per occurrence |
| 6 | Transparent self-reporting | False or misreporting of monthly operations report | 5 % per occurrence |
| 7 | Operations and Maintenance Manual | Operation and Maintenance activity not carried out in accordance with the Manual | 3 % per occurrence |
| 8 | EVS System | Failure to respond to complaints and resolution within 30 minutes | 30 minutes – 1 hour = 1% per occurrence<br>1 – 3 hours = 2% per occurrence<br>More than 3 hours = 3% per 2 hours |
| 9 | Delay of Mandatory Works or one-time activities in SOR or Procurement and delivery of de-watering Truck or other vehicle or Mobile Generator etc., under the Agreement | Failed to execute mandatory works or other one-time activity required in SOR<br>*Note: This deduction shall be addition to non-service deductions if any*. | 10 % per month beyond six months<br>20 % per month beyond 8 months<br>*Note: This will be applied separately for each activity.* |
| 10 | Delay of Performance Security and Insurances | The Performance Security and Insurance are not submitted by Expiry Day of previous Performance Security or Insurance. | Holding of monthly payments of the month where expiry of Performance Guarantee or Insurance falls till the time Performance Guarantee and/ or Insurance submitted and 0.5 % per day for the delay period beyond Expiry Date. |

| Sr. No | KPI | Failure Event | Performance Deduction Percentage |
|---|---|---|---|
| 11 | Labor Laws Compliance | a) Minimum Wage Not Paid<br><br>b) Insurance Amount Not Paid upon death<br><br>c) EOBI & ESSI case not pursued of deceased or affected<br><br>d) No compliance of any other aspect of Labor Laws<br><br>e) Salary not paid within 7 days of starting calendar month (10 samples will be collected randomly each month) | a) Deduction of not paid amount + 0.05 % per employee<br><br>b) Deduction as Non-Service from Invoice and 2 % deduction each month till amount is paid<br><br>c) 2 % per occurrence each month per employee till amount is paid<br><br>d) 1 % per occurrence<br><br>e) LDs as follows:<br><br>10 % per occurrence for non-compliance in delay of salary for more than 50 % of sample<br><br>5 % per occurrence for non-compliance in delay of salary between 25-50 % of sample<br><br>2 % per occurrence for non-compliance in delay of salary below 25 % of sample |
| 12 | Safety, Health and Environmental Compliance | Non-compliance of any activity related to Safety, Health and Environmental Clause | 5 % per occurrence for non-compliance related to vehicle, training, drill or staff<br><br>4 % per occurrence for absence of HSE team or any member<br><br>3 % per occurrence of not performing duties in accordance with standards and requirements<br><br>2 % per occurrence for Not provision of Jacket &/or filling of fire extinguisher<br><br>1 % per occurrence any other minor violation |

| Sr. No | KPI | Failure Event | Performance Deduction Percentage |
|---|---|---|---|
| 13 | Control Centre Executives responsibilities, Service Provider KPUMA/CC responsibilities, Station Staff Responsibilities | Non-Compliance to any aspect related to responsibilities of CCE at CC, KPUMA building and Staff at Station | 5 % per occurrence for non-compliance related to qualification & availability<br>4 % per occurrence for absence of any member on permanent basis<br>3 % per occurrence for not performing duties in accordance with standards and requirements<br>2 % per occurrence for not provision of quality reporting<br>1 % per occurrence for any other minor violation |
| 14 | Non- functionality of system or sub-system | If the functioning of equipment are not working properly in a month for same function & system.<br>5 % non functionality shall be considered violation, if minimum 16 equipment are inspected and so on for other percentages. Figure work out will be rounded to nearest integer. | 5.1 % - 10 % ; PD of 5 %<br>10.1 % - 15 % ; PD of 10 %<br>More than 15 %; PD of 20 % |
| 15 | Total non-functionality of any system or sub-system | Any of the sub-system or system is completely down or not working for more than 10 days (EVS not working at station, Vehicles not available, etc) due to service provider | 10-15 days - PD of 20 %<br>15-20 days - PD of 30 %<br>20-25 days - PD of 50 %<br>More than 25 days - 60 % |

| Sr. No | KPI | Failure Event | Performance Deduction Percentage |
|---|---|---|---|
| 16 | Failure to address / replace damage parts or stickers or remove illegal stickers/ advertisements/ graffiti etc. or any other item which is quite visible and can generate complaint due to aesthetic and could be addressed without highlighting | Worn out stickers, damage buttons, damage cladding, sensors, loose wires, damage approaches to elevator / escalator, or any other similar items. | 4 % per occurrence per item |
| 17 | Dragnet clause | Any act/instance that is non-conforming or a violation of Agreement, Schedules of Requirements, Operation Specification Schedule, Rules or Regulations of TPC, Instructions given by the TPC or violation of Protocol unless covered by another KPI | 2.5 % per occurrence |
| 18 | Frequently occurred violations | Occurrence per violation listed in table below (Failure Event), unless covered by another KPI<br><br>Note: This Liquidated Damages will be only applicable, if any other Liquidated Damages is not applicable under the Agreement/Contract | 1.5 % per occurrence per item/ equipment |

a) Frequently occurred violations. The table below defines the frequently occurred violations that are covered in the KPI`s.

| Sr.No | Failure Event |
|---|---|
| 1 | Late arrival of staff at KPUMA/ control centre as defined by TPC (calculated per person) |
| 2 | UPS or Generator not functional or any other equipment and system not functional (irrespective of power failure) (calculated per device) |

| Sr.No | Failure Event |
|---|---|
| 3 | Loose hanging parts of lights |
| 4 | Late opening or early closing of Equipment |
| 5 | Staff not available in the Control Centre (Per person per day) |
| 6 | Lazy work by staff/smoking at stations or prohibited space (per occurrence per person) |
| 7 | Staff seen spitting (per occurrence) |
| 8 | Not attending/responding complaints received on complaint management system or share through other mechanism devised by TPC (calculated per day) or reporting on incident management system |
| 9 | Reports in required format are not provided (calculated per month per report) |
| 10 | Late or non-submission of required report at start of the month (calculated per day) or date specified by TPC |
| 11 | Absence of the staff at designated points for more than 10 minutes (calculated per occurrence) |
| 12 | Failed to inform malfunctioning Equipment (per occurrence) |
| 13 | Failed to facilitate physically disabled person (calculated per instance) |
| 14 | Lack of policies that promote environment for female employee (calculated per instance) |
| 15 | Service Provider office in location that is not accessible by specially challenged persons (calculated per month) |
| 16 | Delay of repair to TPC property in TPC prescribed time caused by Service Provider (In addition to cost recovery of asset) (calculated per day) |
| 17 | Misuse of TPC infrastructure (per instance). LD may be multiplied by factor 1 to 5 upon discretion of TPC based on severity |
| 18 | Allowing or facilitating passengers to BRT without security check or fare (per instance) or travelling without fare |
| 19 | Non-availability of online attendance of staff assigned to stations (calculated per day) |
| 20 | Tools and equipment, spare parts etc. are laying in non-designated location or creating safety issues |
| 21 | Failure of any equipment or subsystem or fail to maintain system accordance with standards and specification (calculated per day per equipment) |
| 22 | Failure to carry personal or vehicle identification by staff per day |
| 23 | Refusal or failing to provide information prescribed in the Agreement (per instance) |
| 24 | To refuse to accept the visits of the TPC inspectors to station, to hide information or to provide partial or erroneous information (per instance). |
| 25 | Disruption of, or negative impacts on, the BRT Vehicle Services due to any conduct of the Service Provider such as sitting in stairs, on floor, or obstructing passage way (per instance) |
| 26 | Accumulation of water in any Equipment pits or any other location where there is a likelihood of damage to any equipment, or likelihood of mosquito infestation. (per instance) |

| Sr.No | Failure Event |
|---|---|
| 27 | Misuse of Utility Connections or their wastage (In addition to cost recovery from Service Provider) |
| 28 | Emergency not reported to TPC within 15 (fifteen) minutes of its occurrence |
| 29 | Parts/equipment installed are of inferior quality/ noncompliant to technical specifications of those under specification per instance. The LD may be multiplied from factor 1 to 5 based on discretion of TPC and severity of violation. |
| 30 | Asset Register is not maintained, not up-to-date or incomplete or RFID tags missing (per instance) |
| 31 | Log book for fuelling of gen-set not maintained as per requirements defined in the scope of work per instance. |
| 32 | Failure to disclose or inform the TPC about operational issues and/or safety incidents that have subsequent impact on operation and such information is not available through information systems, such as SCADA etc. (per instance) |
| 33 | Personnel does not adhere to code of conduct or misbehaves with TPC staff, other Service Provider Staff, its own staff or passengers (TPC can suggest the Service Provider to take punitive actions or terminate the employment of such responsible employees in addition to Liquidated Damages) |
| 34 | Execute works without precautionary measures for passengers/general public safety or without permission of TPC (per instance) |
| 35 | Non-compliance or discrimination in to vulnerable segment of society in jobs |
| 36 | Failure to remove breakdown fuel delivery vehicle or service/maintenance staff vehicle from the BRT corridor before commencement of Operations or failure to arrange or failure to arrange backup delivery vehicle within one hour in case of breakdown |
| 37 | All equipment's (Fire hose reels/fire extinguisher or other fire systems) have not a clear instruction label on the front side indicating how one is supposed to use the equipment in case of fire. (per instance) |
| 38 | Fire extinguishers expired and not removed/ re-filled OR Wall Mounting-Loose hanging equipment/Fire Extinguishers NOT sealed after every certified service. OR No Safety pin / Cap / Clip on fire extinguisher OR Rust and corrosion in fire extinguisher/valves/nozzle/FM-200 OR missing parts or any subsystem. |
| 39 | FM-200 system discharge nozzles obstructed, clogged, dirty, painted, etc. OR there is damage, corrosion, cracks, cleanliness, and general wear and tear in the Cylinder burst disc and pressure gauges and its valve OR there is damage, corrosion, cracks, cleanliness in FM-200 cylinder electronic control operated heads. OR loose electrical connections. |
| 40 | Leakage, Damage, cracks in Control Valves/piping, hose cabinets, discharge nozzles etc. assemblies OR loose connections/open hanging wires/fault in control DB in pump room installed in Fire Fighting System etc. |
| 41 | Use of Non-standard tools / stairs or wooden stair or equipment for maintenance by the staff |
| 42 | Leaking or sharing of information/ video of System with unauthorized people without permission or sharing of information which are not part of the scope of work (May lead to removal of staff from BRT System) |

### A) Fire Fighting System and Fire Suppression (FM 200) System

| Sr.NO | KPI-3: Fire Fighting/ Fire Suppression (FM 200) System Fault Rectification (FR) | | |
|---|---|---|---|
| | Fault shall be considered based on number of units effected: -<br><br>1 **Critical Category Fault (CCF):** The FM-200 fire suppression or Firefighting system not operated/ failed during emergency situation or fire incident, resulting in the system's inability to activate or function as intended.<br>2 **High Category Fault (HCF):** System Required pressure not demonstrated during mock operations. OR there is a fault in FM-200 control panel indicating the system cannot operate in an emergency OR discharge valve clogged/crack loose electrical connection etc. Resolution time is 2 hours.<br>3 **Low Category Fault (LCF):** System can operate but not as per designed and intended functional use or within acceptable limits specified. there is no likelihood of service loss or safety issue and a possible workaround exists. resolution time is 24 hours.<br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category<br><br>C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration | | |
| | **FR** | **Threshold of FR** | **Liquidated damages** |
| 1 | CCF | 100 % | 50 % PD provider in case of failure in emergency |
| 2 | HCF | 100% | 25 % PD in case of failure in mock operations |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | Performance Deduction Percentage PDP = 0.2 x $TF_{Low}$ |

**B) Fire Alarm system KPI's**

| Sr.NO | KPI-3: Fire Alarm System (FR) | | |
|---|---|---|---|
| | Fault shall be considered based on number of units effected: -<br><br>**1. Critical Category Fault (CCF):** System not operated/ failed during emergency situation or mock operation. In the event of a fire incident or emergency, the fire alarm system or smoke/fire detector failed to activate in a specific zone/room/area or throughout the entire system, meaning either the sounder did not trigger or the smoke detector did not sense the presence of smoke or fire.<br><br>**2. High Category Fault (HCF):** The fire alarm system is not maintained according to its intended requirements due to a fault in the control panel, unresolved issues, or the system failing to perform properly during mock operations in a zone/area or as a whole system. The resolution time is 2 hours.<br><br>**3. Low Category Fault (LCF):** System can operate but not as per designed and intended functional use or within acceptable limits specified. there is no likelihood of service loss or safety issue and a possible workaround exists. resolution time is 24 hours.<br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category<br><br>C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration | | |
| | **FR** | **Threshold of FR** | **Liquidated damages** |
| 1 | CCF | 100 % | 50 % of PD in case of failure in emergency |
| 2 | HCF | 100% | 25 % of PD in case of failure in mock operations |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | Performance Deduction Percentage PDP = 0.2 x $TF_{Low}$ |

## C) Distribution Boards / MLV KPI's

| Sr.No | KPI-4: Distribution Board /MLVs Fault Rectification (FR) | | |
|---|---|---|---|
| | Fault shall be considered based on number of units effected: -<br><br>1. **Critical Category Fault (CCF):** Complete shutdown of electricity in complete BRT system (Stations, Along corridor and KPUMA and any other allied infrastructure) due to MLV/Distribution Board failure leading to service loss. OR There is a situation in which MLV/distribution board may lead to safety issues for public/passengers. Resolution time is 2 hours in case no parts are required; 4 hours in case parts are required and available, and damage/fault are arisen under normal use. In case of damage/fault out of normal use, timelines to rectify are to be justified, conveyed in writing in 90 minutes and shall be adhered to.<br><br>2. **High Category Fault (HCF):** MLV/Distribution Board can operate but not as per designed and intended functional use or within acceptable limits specified and there is likelihood of service loss. Resolution time is 12 hours.<br><br>3. **Low Category Fault (LCF):** MLV/Distribution Board can operate but not as per designed and intended functional use or within acceptable limits specified. There is no likelihood of service loss or safety issue and a possible workaround exists. Resolution time is 24 hours.<br><br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category<br><br>C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration | | |
| **Sr.No** | **FR** | **Threshold of FR** | **PDP** |
| 1 | CCF= (Critical Fault solved within assigned resolution time ) / (Critical Fault solved within assigned resolution time +TF Critical) x 100 | More than 98 % | 1 x $TF_{Critical}$ |
| 2 | HCF= (High Fault solved within assigned resolution time ) / (High Fault solved within assigned resolution time +TF High) x 100 | More than 95 % | 0.5 x $TF_{High}$ |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | 0.2 x $TF_{Low}$ |

Categories under this fault category shall be defined by TPC for violation in scope of work.

**D) Dewatering Pumps KPI's, Dewatering Mobile Pumps and Dewatering Trucks**

<table>
<tr><th>Sr. NO</th><th colspan="3">KPI-1: Dewatering System Fault Rectification (FR)</th></tr>
<tr><td></td><td colspan="3">Fault shall be considered based on number of units effected: -<br><br>1. Critical Category Fault (CCF): Complete shutdown of De-watering Pump during bus operations hours leading to shutdown of bus operation. OR There is a situation in which operations of De-watering Pump may lead to shutdown of bus operation. Resolution time is 15 minutes in case no parts are required; 30 minutes in case mobile de-watering pumps are required and available. In case of damage/fault out of normal use, timelines to rectify are to be justified, conveyed in writing in 30 minutes and shall be adhered to and<br><br>Non-availability of Mobile Dewatering Pumps or Dewatering trucks leading to shutdown of bus operation. All the resources shall be mobilized within 15 minutes of critical sites.<br><br>2. High Category Fault (HCF): The De-watering Pump can operate but not as per designed and intended functional use or within acceptable limits specified and there is likelihood of service loss. Resolution time is 12 hours.<br><br>Non-availability of Mobile Dewatering Pumps or Dewatering trucks or staff leading to potential shutdown of bus operation.<br><br>3. Low Category Fault (LCF): The Dewatering Pump can operate but not as per designed and intended functional use or within acceptable limits specified. There is no likelihood of service loss or safety issue and a possible workaround exists. Resolution time is 24 hours.<br><br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category<br><br>C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration</td></tr>
<tr><td></td><td>FR</td><td>Threshold of FR</td><td>Performance Deduction Percentage (PDP)</td></tr>
<tr><td>1</td><td>CCF= (Critical Fault solved within assigned resolution time ) / (Critical Fault solved within assigned resolution time +TF Critical) x 100</td><td>More than 100 %</td><td>5 x $TF_{Critical}$</td></tr>
</table>

| | | | |
|---|---|---|---|
| 2 | HCF= (High Fault solved within assigned resolution time ) / (High Fault solved within assigned resolution time +TF High) x 100 | More than 95 % | 0.5 x $TF_{High}$ |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | 0.2 x $TF_{Low}$ |

| **FAULT CATEGORY IDENTIFICATION FOR KPI-1 AND OPERATIONAL PENALTY ON OCCURANCE** | | |
|---|---|---|
| **Sr. No** | **INCIDENT** | **FAULT CATEGORY** |
| 1 | Non-Functioning of De-watering Pump. | Critical |
| 2 | De-watering Pump is functioning but not to the designed / intended value. | High |
| 3 | Dewatering pump generating mechanical rubbing sound, leakage in valves, pipes. | High |
| 4 | Incorrect / delayed response of sensors/accumulation of water in underpass. | High |
| 5 | De-watering Pump is manually Operational but auto start stop is not working. | High |
| 6 | 1. Pump is functional but Electrical Panel is damaged of any component is faulty.<br>2. Pump is Functional but remote monitoring & control feature is inactive due to fault/lost connection in control panel. | Low |
| 6 | Others. | Category to be decided by the TPC under fault categories defined |

### E) Generators KPI's

| **Sr. No** | **KPI-2: Generators Fault Rectification (FR)** |
|---|---|
| | Fault shall be considered based on number of units effected: -<br><br>**1. Critical Category Fault (CCF):** Complete shutdown of Generator either due to fuel shortage or other reasons at station/KPUMA leading to service loss. OR There is a situation in which operations of Generator may lead to safety issues for passengers. Resolution time is 2 hours in case no parts are required; 4 hours in case parts are required and available, and damage/fault are arisen under normal use. In case of damage/fault out of normal use, timelines to rectify are to be justified, conveyed in writing in 90 minutes and shall be adhered to. |

| | | | |
|---|---|---|---|
| | **2. High Category Fault (HCF):** The Generator can operate but not as per designed and intended functional use or within acceptable limits specified and there is likelihood of service loss. Resolution time is 12 hours.<br><br>**3. Low Category Fault (LCF):** The Generator can operate but not as per designed and intended functional use or within acceptable limits specified. There is no likelihood of service loss or safety issue and a possible workaround exists. Resolution time is 24 hours.<br><br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category<br><br>C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration | | |
| **Sr. No** | **FR** | **Threshold of FR** | **Performance Deduction Percentage (PDP)** |
| 1 | CCF= (Critical Fault solved within assigned resolution time ) / (Critical Fault solved within assigned resolution time +TF Critical) x 100 | More than 98 % | 3 x $TF_{Critical}$ |
| 2 | HCF= (High Fault solved within assigned resolution time ) / (High Fault solved within assigned resolution time +TF High) x 100 | More than 95 % | 0.5 x $TF_{High}$ |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | 0.2 x $TF_{Low}$ |

| **FAULT CATEGORY IDENTIFICATION FOR KPI-3 AND OPERATIONAL PENALTY ON OCCURANCE** | | |
|---|---|---|
| **Sr. No** | **INCIDENT** | **FAULT CATEGORY** |
| 1 | Electrical failure due to leakage current, improper wire connection causing Generator to malfunction | Critical |
| 2 | Switching between PESCO and Generator not within 30 seconds under normal conditions | High |

| | | |
|---|---|---|
| 3 | Generator generating Mechanical rubbing sound | High |
| 4 | Generator did not response to Emergency Push Buttons stop. | High |
| 5 | Under/over voltage and under/over Frequency protection failed. | Critical |
| 6 | Generator is Operational but damaged / with missing parts / in dilapidated condition. | Critical |
| 7 | Any component (Volt meter, Ampere meter, Indication lights, Circuit Breakers, Timers, Relays and Auxiliary Tanks etc. ) not maintained as part of EDG system operation | High |
| 8 | Others. | Category to be decided by the TPC under fault categories defined |

**F) UPS KPI's**

| **Sr. No** | **KPI-4: UPS Fault Rectification (FR)** |
|---|---|
| | Fault shall be considered based on number of units effected: -<br><br>**1. Critical Category Fault (CCF):** Complete shutdown of UPS at station/KPUMA/Building leading to service loss. OR There is a situation in which operations of UPS may lead to safety issues for passengers. Resolution time is 2 hours in case no parts are required; 4 hours in case parts are required and available, and damage/fault are arisen under normal use. In case of damage/fault arise out of normal use, timelines to rectify are to be justified, conveyed in writing in 90 minutes and shall be adhered to.<br><br>**2. High Category Fault (HCF):** The UPS can operate but not as per designed and intended functional use or within acceptable limits specified and there is likelihood of service loss. Resolution time is 12 hours.<br><br>**3. Low Category Fault (LCF):** The UPS can operate but not as per designed and intended functional use or within acceptable limits specified. There is no likelihood of service loss or safety issue and a possible workaround exists. Resolution time is 24 hours.<br><br>TF = Total Faults Considered for KPI-1: = A + B x (C/ D)<br>A = No of Faults Responded above the assigned resolution time but within 2 times the Assigned Resolution Time for a Particular Category;<br><br>B = No of Faults Responded in more than 2 times the Assigned Resolution Time for a Particular Category |

| | | | |
|---|---|---|---|
| | C = Average Actual Resolution Time of 'B' expressed in units of Assigned Resolution Time of the Category under Consideration<br><br>D = Assigned Resolution Time of the Category under Consideration | | |
| **Sr. No** | **FR** | **Threshold of FR** | **Performance Deduction Percentage (PDP)** |
| 1 | CCF= (Critical Fault solved within assigned resolution time ) / (Critical Fault solved within assigned resolution time +TF Critical) x 100 | More than 98 % | 2 x $TF_{Critical}$ |
| 2 | HCF= (High Fault solved within assigned resolution time ) / (High Fault solved within assigned resolution time +TF High) x 100 | More than 95 % | 0.5 x $TF_{High}$ |
| 3 | LCF= (Low Faults solved within assigned resolution time) / (Low faults solved within assigned resolution time +TF Low) x 100 | More than 90 % | 0.2 x $TF_{Low}$ |

| **FAULT CATEGORY IDENTIFICATION FOR KPI-3 AND OPERATIONAL PENALTY ON OCCURANCE** | | |
|---|---|---|
| **Sr. No** | **INCIDENT** | **FAULT CATEGORY** |
| 1 | Complete failure due to short circuit, leakage current, improper wire connection collapsing the critical equipment connected. | Critical |
| 2 | Failed to withstand switching time of 30 seconds between PESCO and Generator under normal conditions | Critical |
| 3 | UPS running on bypass showing fault alarm. | Critical |
| 4 | UPS running normal showing fault alarm with interrupting the critical equipment connected. | High |
| 5 | Under/over voltage and under/over Frequency protection failed. | High |
| 6 | UPS is Operational but damaged / with missing parts / in dilapidated condition not providing the designed back-up. | High |
| 7 | Any component not maintained as part of system operation | Low |

| | | |
|---|---|---|
| 8 | Others. | Category to be decided by the TPC under fault categories defined |

**G) Fuelling KPI's**

| Sr. No. | Description of Infraction | Performance Deduction Percentage (PDP) or other Liquidated Damages |
|---|---|---|
| 1 | Disruption in Operation of BRT Service due to failure of Service Provider to timely refuel the generators (within the allocated time slot) or in sufficient quantities. | Revenue loss in passenger estimated by TPC from automated fare collection system |
| 2 | Ensure security of fuel present in auxiliary tanks, on 24-hour basis, 7 days per week (including public holidays), by implementing a system of theft prevention. | The Service Provider shall be liable to bear the actual cost of established stolen quantity estimated by the TPC in last 30 days. |
| 3 | Failure to perform basic quality testing (Graduated Cylinder Fuel Test, water test and flash point test) at each delivery, as may be reported by TPC representative/inspector. | 10% of Cost of Diesel Delivery (for that particular day) upon 1st occurrence.<br>25% of Cost of Diesel Delivery (for that particular day) upon 2nd occurrence.<br>50% of Cost of Diesel Delivery (for that particular day) upon 3rd occurrence.<br>75% of Cost of Diesel Delivery (for that particular day) upon 4thoccurrence and onwards. |
| 4 | Failure to ensure accurate recording of fuel quantity supplied/decanted as may be reported by TPC representative/inspector. | 10% of Cost of Diesel Delivery (for that particular day) upon 1st occurrence.<br>25% of Cost of Diesel Delivery (for that particular day) upon 2nd occurrence.<br>50% of Cost of Diesel Delivery (for that particular day) upon 3rd occurrence. |

| | | |
|---|---|---|
| | | 75% of Cost of Diesel Delivery (for that particular day) upon 4th occurrence and onwards. |
| 5 | Failure to contain spillage within acceptable fuel spillage levels as may be ascertained/reported by TPC representative/inspector along with photographic evidence. | 0.3 % Plus cost of fuel spillage |
| 6 | Failure to calibrate the dispensing units (installed on delivery vehicles), flow-meters (installed on fuel tanks) and auxiliary tanks or failure to provide calibration reports as per scope of the Agreement | 0.5 % per month |
| 7 | Voidance of Warranty due to supply and use of sub-standard fuel as described in scope of the Agreement | Up to10% of the replacement Cost of Generator by accessing to Reserve Funds |
| 8 | Failure to arrange lab test as per scope of the Agreement. | 1 % per occurrence |

The Service Provider shall get following incentive as reduction in Liquidated Damages in monthly payments for following activities:

a) @0.5% if the Service Provider engage female staff more than 10 % of total staff of project (for Stations and Control center staff only) in an invoice month.

b) @0.5% if the Service Provider engage special person (verifiable from CNIC as special person) more than 3 % of total staff of project (for Office, Stations and Control center staff only) in an invoice month.

c) @0.5% if the Service Provider i) gives/ arrange insurance to the deceased family within two months, ii) pursue and start EOBI pension within four months for the deceased family iii) Pursue and maintain disability allowance from ESSI during disability period. Each of the three will be treated as separate benefits for reduction of PDP.

d) @0.5% if the Service Provider installed SCADA system in all dewatering pumps in an invoice month subject to the condition if not already installed by TPC.

e) @0.5% if the Service Provider installed SCADA system in Generators (handed over at time of commencement) in an invoice month subject to the condition if not already installed by TPC.

**Note:** No credit will be carried over to next month. Furthermore, incentive will be provided up to 0 % PDP.

## DETAILS OF GENERATORS SHOWING LOCATION, CAPACITY AND NUMBER

| S.No | Location | Equipment | TAG | Rating | Running Hours |
|---|---|---|---|---|---|
| 1 | KPUMA | Generator | KPUMA-GEN-01 | 500 kVA | 2009 |
| 2 | KPUMA | Generator | KPUMA-GEN-02 | 110 kVA | 2010 |
| 3 | BS-01 | Generator | BS-01-GEN-01 | 65 kVA | 957 |
| 4 | BS-02 | Generator | BS-02-GEN-01 | 110 kVA | 6336 |
| 5 | BS-03 | Generator | BS-03-GEN-01 | 110 kVA | 6230 |
| 6 | BS-04 | Generator | BS-04-GEN-01 | 110 kVA | 4101 |
| 7 | BS-05 | Generator | BS-05-GEN-01 | 110 kVA | 4122 |
| 8 | BS-06 | Generator | BS-06-GEN-01 | 110 kVA | 4153 |
| 9 | BS-07 | Generator | BS-07-GEN-01 | 110 kVA | 4998 |
| 10 | BS-08 | Generator | BS-08-GEN-01 | 110 kVA | 4364 |
| 11 | BS-09 | Generator | BS-09-GEN-01 | 110 kVA | 4110 |
| 12 | BS-10 | Generator | BS-10-GEN-01 | 110 kVA | 2430 |
| 13 | BS-11 | Generator | BS-11-GEN-01 | 110 kVA | 1775 |
| 14 | BS-12 | Generator | BS-12-GEN-01 | 110 kVA | 2014 |
| 15 | BS-13 | Generator | BS-13-GEN-01 | 110 kVA | 2052 |
| 16 | BS-14 | Generator | BS-14-GEN-01 | 110 kVA | 2376 |
| 17 | BS-15 | Generator | BS-15-GEN-01 | 110 kVA | 2029 |
| 18 | BS-16 | Generator | BS-16-GEN-01 | 110 kVA | 2637 |
| 19 | BS-17 | Generator | BS-17-GEN-01 | 110 kVA | 1477 |
| 20 | BS-18 | Generator | BS-18-GEN-01 | 110 kVA | 5358 |
| 21 | BS-19 | Generator | BS-19-GEN-01 | 88 kVA | 5427 |
| 22 | BS-20 | Generator | BS-20-GEN-01 | 88 kVA | 5554 |
| 23 | BS-21 | Generator | BS-21-GEN-01 | 110 kVA | 5408 |
| 24 | BS-22 | Generator | BS-22-GEN-01 | 110 kVA | 16979 |
| 25 | BS-23 | Generator | BS-23-GEN-01 | 110 kVA | 3647 |
| 26 | BS-24 | Generator | BS-24-GEN-01 | 110 kVA | 3102 |
| 27 | BS-25 | Generator | BS-25-GEN-01 | 110 kVA | 11753 |
| 28 | BS-26 | Generator | BS-26-GEN-01 | 88 kVA | 2016 |
| 29 | BS-27 | Generator | BS-27-GEN-01 | 88 kVA | 1704 |
| 30 | BS-28 | Generator | BS-28-GEN-01 | 88 kVA | 2395 |
| 31 | BS-29 | Generator | BS-29-GEN-01 | 88 kVA | 2366 |
| 32 | BS-30 | Generator | BS-30-GEN-01 | 88 kVA | 2104 |
| 33 | BS-31 | Generator | BS-31-GEN-01 | 110 kVA | 9570 |

| DETAILS OF DE-WATERING PUMPS SHOWING LOCATIONS AND NUMBER | | | |
|---|---|---|---|
| **S.NO** | **LOCATION** | **EQUIPMENT** | **TAG** |
| 1 | Underpass-01 (Between BS-02 & BS-03) | De- Watering Pump | UP-01-PMP-01 |
| 2 | Underpass-01 (Between BS-02 & BS-03) | De- Watering Pump | UP-01-PMP-02 |
| 3 | Underpass-02 (Between BS-05 & BS-06) | De- Watering Pump | UP-02-PMP-01 |
| 4 | Underpass-02 (Between BS-05 & BS-06) | De- Watering Pump | UP-02-PMP-02 |
| 5 | Underpass-03 (Between BS-08 & BS-09) | De- Watering Pump | UP-03-PMP-01 |
| 6 | Underpass-03 (Between BS-08 & BS-09) | De- Watering Pump | UP-03-PMP-02 |
| 7 | Underpass-04 (Between BS-16 & BS-18) | De- Watering Pump | UP-04-PMP-01 |
| 8 | Underpass-04 (Between BS-16 & BS-18) | De- Watering Pump | UP-04-PMP-02 |
| 9 | Underpass-04 (Between BS-16 & BS-18) | De- Watering Pump | UP-04-PMP-03 |
| 10 | Underpass-05 (Between BS-19 & BS-20) | De- Watering Pump | UP-05-PMP-01 |
| 11 | Underpass-05 (Between BS-19 & BS-20) | De- Watering Pump | UP-05-PMP-02 |
| 12 | Underpass-06 (Between BS-21 & BS-22) | De- Watering Pump | UP-06-PMP-01 |
| 13 | Underpass-06 (Between BS-21 & BS-22) | De- Watering Pump | UP-06-PMP-02 |
| 14 | Underpass-07 (Between BS-22 & BS-23) | De- Watering Pump | UP-07-PMP-01 |
| 15 | Underpass-07 (Between BS-22 & BS-23) | De- Watering Pump | UP-07-PMP-02 |
| 16 | Underpass-08 (Between BS-29 & BS-30) | De- Watering Pump | UP-08-PMP-01 |
| 17 | Underpass-08 (Between BS-29 & BS-30) | De- Watering Pump | UP-08-PMP-02 |
| **Total Pumps in Underpasses** | | | **17** |

The Quantity may Vary by (± 20%)

| DETAILS OF UPS AND BATTERIES SHOWING LOCATIONS AND NUMBER | | | | | |
|---|---|---|---|---|---|
| **S.No** | **Location** | **Equipment** | **Quantity** | **Tag** | **Rating** |
| 1 | KPUMA | UPS | 2 | - | 20 KVA each |
| 2 | BS-01 | UPS | 1 | BS-01-UPS-01 | 10 kVA |
| 3 | BS-02 | UPS | 1 | BS-02-UPS-01 | 10 kVA |
| 4 | BS-03 | UPS | 1 | BS-03-UPS-01 | 10 kVA |
| 5 | BS-04 | UPS | 1 | BS-04-UPS-01 | 10 kVA |
| 6 | BS-05 | UPS | 1 | BS-05-UPS-01 | 10 kVA |
| 7 | BS-06 | UPS | 1 | BS-06-UPS-01 | 10 kVA |
| 8 | BS-07 | UPS | 1 | BS-07-UPS-01 | 10 kVA |
| 9 | BS-08 | UPS | 1 | BS-08-UPS-01 | 10 kVA |
| 10 | BS-09 | UPS | 1 | BS-09-UPS-01 | 10 kVA |
| 11 | BS-10 | UPS | 1 | BS-10-UPS-01 | 10 kVA |
| 12 | BS-11 | UPS | 1 | BS-11-UPS-01 | 10 kVA |
| 13 | BS-12 | UPS | 1 | BS-12-UPS-01 | 10 kVA |
| 14 | BS-13 | UPS | 1 | BS-13-UPS-01 | 10 kVA |
| 15 | BS-14 | UPS | 1 | BS-14-UPS-01 | 10 kVA |
| 16 | BS-15 | UPS | 1 | BS-15-UPS-01 | 10 kVA |
| 17 | BS-16 | UPS | 1 | BS-16-UPS-01 | 10 kVA |
| 18 | BS-18 | UPS | 1 | BS-18-UPS-01 | 10 kVA |
| 19 | BS-19 | UPS | 1 | BS-19-UPS-01 | 10 kVA |
| 20 | BS-20 | UPS | 1 | BS-20-UPS-01 | 10 kVA |
| 21 | BS-21 | UPS | 1 | BS-21-UPS-01 | 10 kVA |
| 22 | BS-22 | UPS | 1 | BS-22-UPS-01 | 10 kVA |
| 23 | BS-23 | UPS | 1 | BS-23-UPS-01 | 10 kVA |
| 24 | BS-24 | UPS | 1 | BS-24-UPS-01 | 10 kVA |
| 25 | BS-25 | UPS | 1 | BS-25-UPS-01 | 10 kVA |
| 26 | BS-26 | UPS | 1 | BS-26-UPS-01 | 10 kVA |
| 27 | BS-27 | UPS | 1 | BS-27-UPS-01 | 10 kVA |
| 28 | BS-28 | UPS | 1 | BS-28-UPS-01 | 10 kVA |
| 29 | BS-29 | UPS | 1 | BS-29-UPS-01 | 10 kVA |
| 30 | BS-30 | UPS | 1 | BS-30-UPS-01 | 10 kVA |
| 31 | BS-31 | UPS | 1 | BS-31-UPS-01 | 10 kVA |
| **Total UPS** | | | **32** | | |

Total UPS are 32 and batteries are 546 having capacity of (25 Ah to 40 Ah) (± 5%)
UPS Made: ABB and Any other Company

| DETAILS OF DISTRIBUTION BOARD & MLV IN KUPMA BUILDING | | | | |
|---|---|---|---|---|
| **KPUMA** | | | | |
| 1 | Ground Floor<br>Electrical Room-1 | MLV Panel | 1 | |
| 2 | Ground Floor Electrical<br>Room 1& 2 | Distribution Board for Floor | 4<br>2 Normal & 2 UPS | |
| 3 | First Floor<br>Electrical Room-1 & 2 | Distribution Board for Floor | 4<br>2 Normal & 2 UPS | |
| 4 | Second Floor<br>Control Center | Distribution Board for Control/data Center | 4<br>2 Normal & 2 UPS | |
| 5 | Second Floor<br>Electrical Room-1 & 2 | Distribution Board for Floor | 4<br>2 Normal & 2 UPS | |
| 6 | Roof Top<br>Electrical Room | Distribution Board for Floor | 4<br>2 HVAC & 2 Normal | |
| 7 | Outside Building | Distribution Board for Pump and External Lighting | 5<br>1 Gate office & 4 Pumps | |
| **Total** | | | **26** | |

| Details of Exhaust and Ventilation System Installed | | | |
|---|---|---|---|
| S. No. | Equipment Type | Location | Quantity |
| 1 | Difusers | BS-09 Malak Saad | 22 |
| 2 | Exhaust Fans (1500 CFM) | BS-09 Malak Saad | 3 |
| 3 | Ducting System (75 meters) | BS-09 Malak Saad | 1 |
| 4 | Difusers | BS-08 Hashtnagri | 16 |
| 5 | Exhaust Fans (1500 CFM) | BS-08 Hashtnagri | 2 |
| 6 | Ducting System (50 meters) | BS-08 Hashtnagri | 1 |
| 7 | Difusers | BS-07 Gulabahar | 18 |
| 8 | Exhaust Fans (1500 CFM) | BS-07 Gulabahar | 2 |
| 9 | Ducting System (75 meters) | BS-07 Gulabahar | 1 |
| 10 | Difusers | BS-04 Faisal Colony | 14 |
| 11 | Exhaust Fans (1500 CFM) | BS-04 Faisal Colony | 2 |
| 12 | Ducting System (50 meters) | BS-04 Faisal Colony | 1 |
| | Total | | 83 |

Note: The quantities may vary in the limit of +/- 5%

# Annex-6

| Details of Fire Fighting Units Installed | | | |
|---|---|---|---|
| **S. No.** | **Device Type** | **Location** | **Quantity** |
| 1 | Diesel Engine Powered Fire Fighting Pump ( 1000 GPM) | KPUMA Building | 1 |
| 2 | Electric Pump (1000 GPM) | KPUMA Building | 1 |
| 3 | Jockey Pump (16 GPM) | KPUMA Building | 1 |
| 4 | Fire Hose Cabinet-complete in all respect | KPUMA Building- Ground Floor | 2 |
| 5 | Fire Hose Cabinet-complete in all respect | KPUMA Building- First Floor | 2 |
| 6 | Fire Hose Cabinet-complete in all respect | KPUMA Building- Second Floor | 2 |
| 7 | Control Panels | KPUMA Building | 1 |
| 8 | Distribution Pipes and Fitting (500 meters) | KPUMA Building | 1 |
| 9 | Fire Extinguishers Cylinders (4 to 6 kg) Powder Type | KPUMA Building 3 Floors | 17 |
| | **Total Units Installed** | | **28** |

Note: The quantities may vary in the limit of +/- 5%

# Annex-7

| Details of Fire Alarm System Installed | | | |
|---|---|---|---|
| **S. No.** | **Equipment Type** | **Location** | **Quantity** |
| 1 | Fire Alram Control Panel | KPUMA Building- 2nd Floor | 2 |
| 2 | Smoke Detector | KPUMA Building | 263 |
| 3 | Sounder | KPUMA Building | 21 |
| 5 | Push-Buttons (Break-Glass) | KPUMA Building | 15 |
| 6 | Cables (1500 meter) | KPUMA Building | 1 |
| 6 | | | |
| | **Total** | | **302** |

Note: The quantities may vary in the limit of +/- 5%

# Annex-8

| Details of FM-200 System Installed | | | |
|---|---|---|---|
| **S. No.** | **Equipment Type** | **Location** | **Quantity** |
| 1 | Control Panel-FM200 | KPUMA Building- 2nd Floor | 1 |
| 2 | Detector | KPUMA Building-Data Center | 4 |
| 3 | Sounder 1st Stage Alram | KPUMA Building-Data Center | 1 |
| 5 | Sounder 2nd Stage Alram | KPUMA Building-Data Center | 1 |
| 6 | Cylinders | KPUMA Building-Data Center | 2 |
| 6 | Cables (150 meter) | KPUMA Building-Data Center | 1 |
| | **Total** | | **10** |

Note: The quantities may vary in the limit of +/- 5%

## SUMMARY/ GENERAL SPECIFICATIONS OF GENERATORS

| | DE88E0 | DE110E2 | 455 |
|---|---|---|---|
| Manufacturer | Caterpillar | Caterpillar | Caterpillar |
| Engine Model | Cat C4.4 | Cat C4.4 | C15 |
| Gross Engine Power kW (hp) | | | |
| Standby 50Hz | 80.7 (108.0) | 103.0 (138.0) | 400 (536.4) |
| Standby 60Hz | 93.0 (125.0) | 117.5 (158.0) | |
| Prime 50Hz | 73.4 (98.0) | 93.6 (126.0) | 360 (482.76) |
| Prime 60Hz | 84.5 (113.0) | 106.8 (143.0) | |
| Tank Capacity: Liters (US gal) | 219 (57.9) | 250 (66.0) | 839 (222) |
| Governing type | Mechanical | Electronic | Elec |
| Compression Ratio | 17.25:1 | 18.3:1 | 16.1:1 |
| Bore/Stroke: mm (in) | 105.0 (4.1) / 127.0 (5.0) | 105.0 (4.1) / 127.0 (5.0) | 137 (5.4) /171 (6.8) |
| Speed (RPM) – 50 Hz | 1500 | 1500 | 1500 |
| Estimated Fuel Consumption @ 110% load: L/hr (US gal/hr) | | | |
| 50 Hz | 20.1 (5.3) | 23.9 (6.3) | |
| 60 Hz | 23.2 (6.1) | 29.0 (7.7) | |
| Estimated Fuel Consumption @ 100% load: L/hr (US gal/hr) | | | |
| 50 Hz | 18.2 (4.8) | 21.7 (5.7) | 94.5 (25) |
| 60 Hz | 21.0 (5.5) | 26.1 (6.9) | |
| Estimated Fuel Consumption @75% load: L/hr (US gal/hr) | | | |
| 50 Hz | 13.6 (3.6) | 16.5 (4.4) | 71.8 (19) |
| 60 Hz | 16.0 (4.2) | 19.7 (5.2) | |
| Estimated Fuel Consumption @50% load: L/hr (US gal/hr) | | | |
| 50 Hz | 9.5 (2.5) | 11.6 (3.1) | 51.5 (13.6) |
| 60 Hz | 11.4 (3.0) | 14.1 (3.7) | |

# Cat® C15 DIESEL GENERATOR SETS

**Standby & Prime: 50Hz; 380, 400V & 415V**



Image shown might not reflect actual configuration

| | |
|---|---|
| Engine Model | Cat® C15 ACERT In-line 6, 4-cycle diesel |
| Bore x Stroke | 137mm x 171mm (5.4in x 6.8in) |
| Displacement | 15.2 L (928 in³) |
| Compression Ratio | 16.1:1 |
| Aspiration | Turbocharged Air-to-Air Aftercooled |
| Fuel Injection System | MEUI |
| Governor | Electronic ADEM™ A4 |

| Model | Standby | Prime | Emission Strategy |
|---|---|---|---|
| **DE500E0** | **500 kVA, 400 ekW** | **450 kVA, 360 ekW** | **Non-Certified Emissions** |

## PACKAGE PERFORMANCE

| Performance | Standby | Prime |
|---|---|---|
| Frequency | 50 Hz | 50 Hz |
| Genset Power Rating | 500 kVA | 450 kVA |
| Gen set power rating with fan @ 0.8 power factor | 400 ekW | 360 ekW |
| Fuelling strategy | Non-Certified Emissions | Non-Certified Emissions |
| Performance Number | DM8491 | DM8490 |
| **Fuel Consumption** | | |
| 100% load with fan | 103.7 L/hr 27.4 gal/hr | 94.5 L/hr 25.0 gal/hr |
| 75% load with fan | 77.9 L/hr 20.6 gal/hr | 71.8 L/hr 19.0 gal/hr |
| 50% load with fan | 55.3 L/hr 14.6 gal/hr | 51.5 L/hr 13.6 gal/hr |
| 25% load with fan | 33.4 L/hr 8.8 gal/hr | 31.6 L/hr 8.3 gal/hr |
| **Cooling System[1]** | | |
| Radiator air flow restriction (system) | 0.12 kPa, 0.48 in. Water | 0.12 kPa, 0.48 in. Water |
| Radiator air flow | 476 m3/min, 16809 cfm | 476 m3/min, 16809 cfm |
| Engine coolant capacity | 20.8 L, 5.5 gal | 20.8 L, 5.5 gal |
| Radiator coolant capacity | 37 L, 9.7 gal | 37 L, 9.7 gal |
| Total coolant capacity | 57.8 L, 15.2 gal | 57.8 L, 15.2 gal |
| **Inlet Air** | | |
| Combustion air inlet flow rate | 29.3 m³/min 1036.4 cfm | 27.3 m³/min 965.0 cfm |
| Max. Allowable Combustion Air Inlet Temp | 48 ° C 118 ° F | 46 ° C 114 ° F |
| **Exhaust System** | | |
| Exhaust stack gas temperature | 523.6 ° C 974.4 ° F | 515.3 ° C 959.5 ° F |
| Exhaust gas flow rate | 79.4 m³/min 2802.2 cfm | 73.1 m³/min 2580.2 cfm |
| Exhaust system backpressure (maximum allowable) | 10.0 kPa, 40.0 in. water | 10.0 kPa, 40.0 in. water |
| **Heat Rejection** | | |
| Heat rejection to jacket water | 151 kW 8583 Btu/min | 139 kW 7923 Btu/min |
| Heat rejection to exhaust (total) | 377 kW 21425 Btu/min | 344 kW 19561 Btu/min |
| Heat rejection to aftercooler | 71 kW 4053 Btu/min | 61 kW 3450 Btu/min |
| Heat rejection to atmosphere from engine | 44 kW 2477 Btu/min | 42 kW 2396 Btu/min |
| Heat Rejection to Atmosphere from Generator | 28 kW 1592 Btu/min | 22 kW 1251 Btu/min |

| Emissions (Nominal)[2] | | | | | | |
|---|---|---|---|---|---|---|
| NOx | 3458.8 mg/Nm³ 6.8 g/hp-hr | | | 3357.6 mg/Nm³ 6.6 g/hp-hr | | |
| CO | 171.2 mg/Nm³ 0.3 g/hp-hr | | | 159.3 mg/Nm³ 0.3 g/hp-hr | | |
| HC | 5.2 mg/Nm³ 0.0 g/hp-hr | | | 6.6 mg/Nm³ 0.0 g/hp-hr | | |
| PM | 7.8 mg/Nm³ 0.0 g/hp-hr | | | 8.8 mg/Nm³ 0.0 g/hp-hr | | |
| **Alternator[3]** | | | | | | |
| Voltages | **415V** | | **400V** | | **380V** | |
| Motor Starting Capability @ 30% Voltage Dip | 1439 skVA | | 1066 skVA | | 1207 skVA | |
| Current | Standby: 695A \| Prime: 626A | | Standby: 722A \| Prime: 650A | | Standby: 747A \| Prime: 650A | |
| Frame Size | A2975L4 | | A2975L4 | | A2975L4 | |
| Excitation | SE | | SE | | SE | |
| Temperature Rise | SB:163°C, 325°F | PP: 125°C, 257°F | SB:163°C, 325°F | PP: 125°C, 257°F | SB:163°C, 325°F | PP: 125°C, 257°F |

SB: Standby PP: Prime Power

## DEFINITIONS AND CONDITIONS

[1] For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.

[2] Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77° F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 BTU/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

[3] UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40° C ambient per NEMA MG1-32.

## APPLICABLE CODES AND STANDARDS:

AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200, NFPA37, NFPA70, NFPA99, NFPA110, IBC, IEC60034-1, ISO3046, ISO8528, NEMA MG1-22, NEMA MG1-33, 2006/95/EC, 2006/42/EC, 2004/108/EC.

Note: Codes may not be available in all model configurations. Please consult your local Cat Dealer representative for availability.

**STANDBY:** Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

**PRIME:** Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year

**RATINGS:** Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions.

Fuel Rates are based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/litre (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Caterpillar representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Cat dealer.

Media Number: LEHE1637-00

BUILT FOR IT.™

www.Cat.com/electricpower
©2017 Caterpillar All rights reserved. Materials and specifications are subject to change without notice. CAT, CATERPILLAR, their respective logos, ADEM, S•O•S, BUILT FOR IT, "Caterpillar Yellow", the "Power Edge" trade dress as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.

# DIESEL GENERATOR SET




Image shown may not reflect actual package

## DE110E2

EU stage II emissions compliant.

## Output Ratings

| Generator Set Model - 3 Phase | Prime* | Standby* |
|---|---|---|
| 400/230 V, 50 Hz | 100.0 kVA<br>80.0 kW | 110.0 kVA<br>88.0 kW |
| 480/277 V, 60 Hz | 113.0 kVA<br>90.4 kW | 125.0 kVA<br>100.0 kW |

* Refer to ratings definitions on page 4.
Ratings at 0.8 power factor.

## Technical Data

| | | |
|---|---|---|
| **Engine Make & Model:** | Cat® C4.4 | |
| **Generator Model:** | R2253L4 | |
| **Control Panel:** | EMCP 4.1 | |
| **Base Frame Type:** | Heavy Duty Fabricated Steel | |
| **Circuit Breaker Type:** | 3 Pole MCCB | |
| **Frequency:** | **50 Hz** | **60 Hz** |
| **Engine Speed:** RPM | 1500 | 1800 |
| **Fuel Tank Capacity:** litres (US gal) | 250 (66.0) | |
| **Fuel Consumption, Prime**: l/hr (US gal/hr) | 21.7 (5.7) | 26.1 (6.9) |
| **Fuel Consumption, Standby** : l/hr (US gal/hr) | 23.9 (6.3) | 29.0 (7.7) |

# DIESEL GENERATOR SET

## Engine Technical Data

### Physical Data

| | |
|---|---|
| **Manufacturer:** | Caterpillar |
| **Model:** | C4.4 |
| **No. of Cylinders/Alignment:** | 4 / In Line |
| **Cycle:** | 4 Stroke |
| **Induction:** | Turbocharged Air To Air Charge Cooled |
| **Cooling Method:** | Water |
| **Governing Type:** | Electronic |
| **Governing Class:** | ISO 8528 G2 |
| **Compression Ratio:** | 18.3:1 |
| **Displacement:** l (cu.in) | 4.4 (268.5) |
| **Bore/Stroke**: mm (in) | 105.0 (4.1)/127.0 (5.0) |
| **Moment of Inertia:** kg m² (lb. in²) | 1.51 (5160) |
| **Engine Electrical System:** | |
| **-Voltage/Ground:** | 12/Negative |
| **-Battery Charger Amps:** | 65 |
| **Weight:** kg (lb) **- Dry:** | 401 (884) |
| **- Wet:** | 414 (912) |

### Air System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Air Filter Type:** | Replaceable Element | |
| **Combustion Air Flow:** | | |
| m³/min (cfm) **-Standby:** | 6.3 (221) | 7.8 (275) |
| **-Prime:** | 6.0 (212) | 7.8 (274) |
| **Max. Combustion Air Intake Restriction:** kPa (in $H_2O$) | 8.0 (32.1) | 8.0 (32.1) |
| **Radiator Cooling Air Flow:** m³/min (cfm) | 187.8 (6632) | 244.2 (8624) |
| **External Restriction to Cooling Air Flow:** Pa (in $H_2O$) | 125 (0.5) | 125 (0.5) |

### Cooling System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Cooling System Capacity:** l (US gal) | 17.5 (4.6) | 17.5 (4.6) |
| **Water Pump Type:** | Centrifugal | |
| **Heat Rejected to Water & Lube Oil:** kW (Btu/min) | | |
| **-Standby:** | 50.7 (2883) | 64.0 (3640) |
| **-Prime:** | 46.1 (2622) | 57.7 (3281) |
| **Heat Radiation to Room:** Heat radiated from engine and alternator | | |
| kW (Btu/min) **-Standby:** | 16.2 (921) | 19.3 (1098) |
| **-Prime:** | 13.9 (790) | 17.2 (978) |
| **Radiator Fan Load:** kW (hp) | 2.8 (3.8) | 4.8 (6.4) |

Cooling system designed to operate in ambient conditions up to 50°C (122°F). Contact your local Cat dealer for power ratings at specific site conditions.

### Lubrication System

| | |
|---|---|
| **Oil Filter Type:** | Spin-On, Full Flow |
| **Total Oil Capacity** l (US gal): | 8.0 (2.1) |
| **Oil Pan l** (US gal): | 7.0 (1.8) |
| **Oil Type:** | API CC/SE |
| **Cooling Method:** | Water |

### Performance

| | 50 Hz | 60 Hz |
|---|---|---|
| **Engine Speed:** RPM | 1500 | 1800 |
| **Gross Engine Power:** kW (hp) | | |
| **-Standby:** | 103.0 (138.0) | 117.5 (158.0) |
| **-Prime:** | 93.6 (126.0) | 106.8 (143.0) |
| **BMEP:** kPa (psi) | | |
| **-Standby:** | 1873.0 (271.7) | 1781.0 (258.3) |
| **-Prime:** | 1702.0 (246.9) | 1619.0 (234.8) |
| **Regenerative Power:** kW | 8.2 | 13.8 |

### Fuel System

**Fuel Filter Type:** Replaceable Element

**Recommended Fuel:** Class A2 Diesel or BSEN590

**Fuel Consumption:** l/hr (US gal/hr)

| | 110% Load | 100% Load | 75% Load | 50% Load |
|---|---|---|---|---|
| **Prime** | | | | |
| 50 Hz | 23.9 (6.3) | 21.7 (5.7) | 16.5 (4.4) | 11.6 (3.1) |
| 60 Hz | 29.0 (7.7) | 26.1 (6.9) | 19.7 (5.2) | 14.1 (3.7) |
| **Standby** | | | | |
| 50 Hz | | 23.9 (6.3) | 18.0 (4.8) | 12.6 (3.3) |
| 60 Hz | | 29.0 (7.7) | 21.6 (5.7) | 15.3 (4.0) |

(based on diesel fuel with a specific gravity of 0.85 and conforming to BS2869, Class A2)

### Exhaust System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Silencer Type:** | Industrial | |
| **Silencer Model & Quantity:** | EXSY1 (1) | |
| **Pressure Drop Across Silencer System:** kPa (in Hg) | 2.10 (0.620) | 3.56 (1.051) |
| **Silencer Noise Reduction Level:** dB | 22 | 17 |
| **Max. Allowable Back Pressure:** kPa (in. Hg) | 18.0 (5.3) | 15.0 (4.4) |
| **Exhaust Gas Flow:** | | |
| m³/min (cfm) **-Standby:** | 16.3 (576) | 20.4 (720) |
| **-Prime:** | 15.2 (537) | 18.4 (650) |
| **Exhaust Gas Temperature:** °C (°F) | | |
| **-Standby:** | 543 (1009) | 574 (1065) |
| **-Prime:** | 514 (957) | 517 (963) |

# DIESEL GENERATOR SET

## Generator Performance Data

| Data Item | 50 Hz | | | | 60 Hz | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 415/240V | 400/230V 230/115V 200/115V | 380/220V 220/110V | 220/127V | 480/277V 240/139V | 380/220V 220/110V | 240/120V 208/120V | | 440/254V 220/127V |
| **Motor Starting Capability* kVA** | 189 | 168 | 168 | 210 | 168 | 126 | 126 | | 147 |
| **Short Circuit Capacity** % ** | 300 | 300 | 300 | 300 | 300 | 300 | 300 | | 300 |
| **Reactances: Per Unit** | | | | | | | | | |
| **Xd** | 2.430 | 2.620 | 2.900 | 2.160 | 2.470 | 2.860 | 3.290 | | 2.930 |
| **X'd** | 0.190 | 0.200 | 0.220 | 0.170 | 0.190 | 0.290 | 0.250 | | 0.220 |
| **X''d** | 0.088 | 0.094 | 0.104 | 0.078 | 0.089 | 0.138 | 0.119 | | 0.106 |

Reactances shown are applicable to prime ratings.
*Based on 30% voltage dip at 0 power factor and SHUNT excitation system.
**With optional Auxiliary Winding.

## Generator Technical Data

| Physical Data | |
|---|---|
| **R Frame** | |
| **Model:** | R2253L4 |
| **No. of Bearings:** | 1 |
| **Insulation Class:** | H |
| **Winding Pitch - Code:** | 2/3 - M0 |
| **Wires:** | 12 |
| **Ingress Protection Rating:** | IP23 |
| **Excitation System:** | SHUNT |
| **AVR Model:** | Mark V |

| Operating Data | |
|---|---|
| **Overspeed:** RPM | 2250 |
| **Voltage Regulation: (steady state)** | +/- 0.5% |
| **Wave Form NEMA = TIF:** | 50 |
| **Wave Form IEC = THF:** | 2.0% |
| **Total Harmonic Content LL/LN:** | 2.0% |
| **Radio Interference:** | Suppression is in line with European Standard EN61000-6 |
| **Radiant Heat: kW (Btu/min)** | |
| -50 Hz: | 8.7 (495) |
| -60 Hz: | 9.9 (563) |

# DIESEL GENERATOR SET

## Technical Data

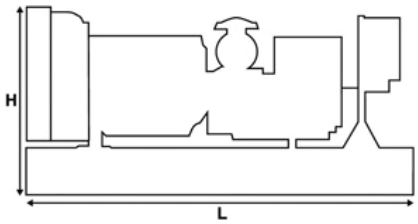
| Voltage 50 Hz | Prime | | Standby | |
|---|---|---|---|---|
| | kVA | kW | kVA | kW |
| 415/240V | 100.0 | 80.0 | 110.0 | 88.0 |
| 400/230V | 100.0 | 80.0 | 110.0 | 88.0 |
| 380/220V | 100.0 | 80.0 | 110.0 | 88.0 |
| 230/115V | 100.0 | 80.0 | 110.0 | 88.0 |
| 220/127V | 100.0 | 80.0 | 110.0 | 88.0 |
| 220/110V | 100.0 | 80.0 | 110.0 | 88.0 |
| 200/115V | 100.0 | 80.0 | 110.0 | 88.0 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

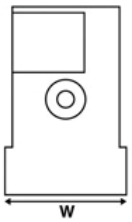
| Voltage 60 Hz | Prime | | Standby | |
|---|---|---|---|---|
| | kVA | kW | kVA | kW |
| 480/277V | 113.0 | 90.4 | 125.0 | 100.0 |
| 220/127V | 113.0 | 90.4 | 125.0 | 100.0 |
| 380/220V | 110.0 | 88.0 | 121.0 | 96.8 |
| 240/120V | 113.0 | 90.4 | 125.0 | 100.0 |
| | | | | |
| 440/254V | - | - | - | - |
| 220/110V | 110.0 | 88.0 | 121.0 | 96.8 |
| 208/120V | 113.0 | 90.4 | 125.0 | 100.0 |
| 240/139V | 113.0 | 90.4 | 125.0 | 100.0 |
| | | | | |
| | | | | |
| | | | | |

## Weights & Dimensions

| **Weights:** kg (lb) | |
|---|---|
| **Net (+ lube oil)** | 1198 (2641) |
| **Wet (+ lube oil & coolant)** | 1215 (2679) |
| **Fuel, lube oil & coolant** | 1427 (3145) |

| **Dimensions:** mm (in) | |
|---|---|
| **Length** | 2089 (82.2) |
| **Width** | 1120 (44.1) |
| **Height** | 1375 (54.1) |




**Note:** General configuration not to be used for installation. See general dimension drawings for detail.

## Definitions

### Standby Rating

Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

### Prime Rating

Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12.
Overload operation cannot exceed 25 hours per year.

### Standard Reference Conditions

Note: Standard reference conditions 25°C (77°F) air inlet temp, 100m (328ft) A.S.L. 30% relative humidity. Fuel consumption data at full load with diesel fuel with specific gravity of 0.85 and conforming to BS2869: 1998, Class A2.

## General Data

### Documents

A full set of operation and maintenance manuals and circuit wiring diagrams.

### Quality Standards

The equipment meets the following standards: **IEC60034-1, IEC60034-22, ISO3046, ISO8528, NEMA MG 1-32, NEMA MG 1-33, 2004/108/EC, 2006/42/EC, 2006/95/EC.**


www.Cat-ElectricPower.com



© 2016 Caterpillar
All rights reserved.

Materials and specifications are subject to change without notice.
The International System of Uniyts (SI) is used in this publication.

CAT, CATERPILLAR, their respective logos, "Caterpillar Yellow," the "Power Edge" trade dress, as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.



Price List: C4.4PGBI, C4.4PGBT

Gen. Arr. Number: 502-7326

Source: China, Europe

LEHE1113-00 (06/16)

# DIESEL GENERATOR SET




Image shown may not reflect actual package

## DE88E0

## Output Ratings

| Generator Set Model - 3 Phase | Prime* | Standby* |
|---|---|---|
| 400/230 V, 50 Hz | 80.0 kVA<br>64.0 kW | 88.0 kVA<br>70.4 kW |
| 480/277 V, 60 Hz | 90.0 kVA<br>72.0 kW | 100.0 kVA<br>80.0 kW |

* Refer to ratings definitions on page 4.
Ratings at 0.8 power factor.

## Technical Data

| | | |
|---|---|---|
| **Engine Make & Model:** | Cat® C4.4 | |
| **Generator Model:** | R1973L4 | |
| **Control Panel:** | EMCP 4.1 | |
| **Base Frame Type:** | Heavy Duty Fabricated Steel | |
| **Circuit Breaker Type:** | 3 Pole MCCB | |
| **Frequency:** | **50 Hz** | **60 Hz** |
| **Engine Speed:** RPM | 1500 | 1800 |
| **Fuel Tank Capacity:** litres (US gal) | 219 (57.9) | |
| **Fuel Consumption, Prime**: l/hr (US gal/hr) | 18.2 (4.8) | 21.0 (5.5) |
| **Fuel Consumption, Standby** : l/hr (US gal/hr) | 20.1 (5.3) | 23.2 (6.1) |

# DIESEL GENERATOR SET

## Engine Technical Data

### Physical Data

| | |
|---|---|
| **Manufacturer:** | Caterpillar |
| **Model:** | C4.4 |
| **No. of Cylinders/Alignment:** | 4 / In Line |
| **Cycle:** | 4 Stroke |
| **Induction:** | Turbocharged |
| **Cooling Method:** | Water |
| **Governing Type:** | Mechanical |
| **Governing Class:** | ISO 8528 G2 |
| **Compression Ratio:** | 17.25:1 |
| **Displacement:** l (cu.in) | 4.4 (268.5) |
| **Bore/Stroke**: mm (in) | 105.0 (4.1)/127.0 (5.0) |
| **Moment of Inertia:** kg m² (lb. in²) | 1.14 (3896) |
| **Engine Electrical System:** | |
| **-Voltage/Ground:** | 12/Negative |
| **-Battery Charger Amps:** | 65 |
| **Weight:** kg (lb) **- Dry:** | 463 (1021) |
| **- Wet:** | 485 (1069) |

### Air System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Air Filter Type:** | Replaceable Element | |
| **Combustion Air Flow:** | | |
| m³/min (cfm) **-Standby:** | 5.1 (180) | 6.5 (230) |
| **-Prime:** | 4.8 (170) | 6.2 (219) |
| **Max. Combustion Air Intake Restriction:** kPa (in $H_2O$) | 8.0 (32.1) | 8.0 (32.1) |
| **Radiator Cooling Air Flow:** m³/min (cfm) | 121.2 (4280) | 140.4 (4958) |
| **External Restriction to Cooling Air Flow:** Pa (in $H_2O$) | 120 (0.5) | 120 (0.5) |

### Cooling System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Cooling System Capacity:** l (US gal) | 13.0 (3.4) | 13.0 (3.4) |
| **Water Pump Type:** | Centrifugal | |
| **Heat Rejected to Water & Lube Oil:** kW (Btu/min) | | |
| **-Standby:** | 51.0 (2900) | 57.0 (3242) |
| **-Prime:** | 46.0 (2616) | 53.0 (3014) |
| **Heat Radiation to Room:** Heat radiated from engine and alternator | | |
| kW (Btu/min) **-Standby:** | 21.6 (1228) | 24.0 (1365) |
| **-Prime:** | 19.6 (1115) | 21.7 (1234) |
| **Radiator Fan Load:** kW (hp) | 1.0 (1.3) | 1.7 (2.3) |

Cooling system designed to operate in ambient conditions up to 50°C (122°F). Contact your local Cat dealer for power ratings at specific site conditions.

### Lubrication System

| | |
|---|---|
| **Oil Filter Type:** | Spin-On, Full Flow |
| **Total Oil Capacity** l (US gal): | 8.0 (2.1) |
| **Oil Pan l** (US gal): | 7.0 (1.8) |
| **Oil Type:** | API CG4 / CH4 15W-40 |
| **Cooling Method:** | Water |

### Performance

| | 50 Hz | 60 Hz |
|---|---|---|
| **Engine Speed:** RPM | 1500 | 1800 |
| **Gross Engine Power:** kW (hp) | | |
| **-Standby:** | 80.7 (108.0) | 93.0 (125.0) |
| **-Prime:** | 73.4 (98.0) | 84.5 (113.0) |
| **BMEP:** kPa (psi) | | |
| **-Standby:** | 1468.0 (212.9) | 1409.0 (204.4) |
| **-Prime:** | 1335.0 (193.6) | 1280.0 (185.7) |
| **Regenerative Power:** kW | 7.0 | 9.0 |

### Fuel System

**Fuel Filter Type:** Replaceable Element

**Recommended Fuel:** Class A2 Diesel or BSEN590

**Fuel Consumption:** l/hr (US gal/hr)

| | 110% Load | 100% Load | 75% Load | 50% Load |
|---|---|---|---|---|
| **Prime** | | | | |
| 50 Hz | 20.1 (5.3) | 18.2 (4.8) | 13.6 (3.6) | 9.5 (2.5) |
| 60 Hz | 23.2 (6.1) | 21.0 (5.5) | 16.0 (4.2) | 11.4 (3.0) |
| **Standby** | | | | |
| 50 Hz | | 20.1 (5.3) | 14.9 (3.9) | 10.3 (2.7) |
| 60 Hz | | 23.2 (6.1) | 17.4 (4.6) | 12.3 (3.3) |

(based on diesel fuel with a specific gravity of 0.85 and conforming to BS2869, Class A2)

### Exhaust System

| | 50 Hz | 60 Hz |
|---|---|---|
| **Silencer Type:** | Industrial | |
| **Silencer Model & Quantity:** | EXSY1 (1) | |
| **Pressure Drop Across Silencer System:** kPa (in Hg) | 1.17 (0.345) | 1.97 (0.581) |
| **Silencer Noise Reduction Level:** dB | 16 | 16 |
| **Max. Allowable Back Pressure:** kPa (in. Hg) | 10.0 (3.0) | 15.0 (4.4) |
| **Exhaust Gas Flow:** | | |
| m³/min (cfm) **-Standby:** | 13.3 (470) | 15.9 (560) |
| **-Prime:** | 12.5 (441) | 15.0 (530) |
| **Exhaust Gas Temperature:** °C (°F) | | |
| **-Standby:** | 580 (1076) | 560 (1040) |
| **-Prime:** | 555 (1031) | 535 (995) |

# DIESEL GENERATOR SET

## Generator Performance Data

| Data Item | 50 Hz | | | | 60 Hz | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 415/240V | 400/230V 230/115V 200/115V | 380/220V 220/110V | 220/127V | 480/277V 240/139V | 380/220V 220/110V | 240/120V 208/120V | | 440/254V 220/127V |
| **Motor Starting Capability* kVA** | 125 | 116 | 105 | 140 | 139 | 87 | 105 | | 117 |
| **Short Circuit Capacity** % ** | 300 | 300 | 300 | 300 | 300 | 300 | 300 | | 300 |
| **Reactances: Per Unit** | | | | | | | | | |
| **Xd** | 2.880 | 3.100 | 3.430 | 2.560 | 2.910 | 3.100 | 3.780 | | 3.380 |
| **X'd** | 0.240 | 0.260 | 0.290 | 0.214 | 0.240 | 0.350 | 0.320 | | 0.280 |
| **X''d** | 0.092 | 0.099 | 0.110 | 0.082 | 0.093 | 0.135 | 0.121 | | 0.108 |

Reactances shown are applicable to prime ratings.
*Based on 30% voltage dip at 0 power factor and SHUNT excitation system.
**With optional Auxiliary Winding.

## Generator Technical Data

| Physical Data | |
|---|---|
| **R Frame** | |
| **Model:** | R1973L4 |
| **No. of Bearings:** | 1 |
| **Insulation Class:** | H |
| **Winding Pitch - Code:** | 2/3 - M0 |
| **Wires:** | 12 |
| **Ingress Protection Rating:** | IP23 |
| **Excitation System:** | SHUNT |
| **AVR Model:** | Mark V |

| Operating Data | |
|---|---|
| **Overspeed:** RPM | 2250 |
| **Voltage Regulation: (steady state)** | +/- 0.5% |
| **Wave Form NEMA = TIF:** | 50 |
| **Wave Form IEC = THF:** | 2.0% |
| **Total Harmonic Content LL/LN:** | 2.0% |
| **Radio Interference:** | Suppression is in line with European Standard EN61000-6 |
| **Radiant Heat: kW (Btu/min)** | |
| -50 Hz: | 7.6 (432) |
| -60 Hz: | 9.0 (512) |

# DIESEL GENERATOR SET

## Technical Data

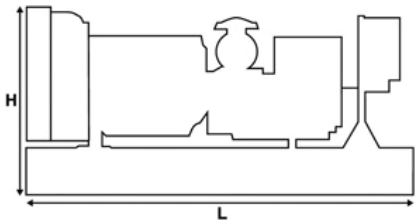
| Voltage 50 Hz | Prime | | Standby | |
|---|---|---|---|---|
| | kVA | kW | kVA | kW |
| 415/240V | 80.0 | 64.0 | 88.0 | 70.4 |
| 400/230V | 80.0 | 64.0 | 88.0 | 70.4 |
| 380/220V | 80.0 | 64.0 | 88.0 | 70.4 |
| 230/115V | 80.0 | 64.0 | 88.0 | 70.4 |
| 220/127V | 80.0 | 64.0 | 86.0 | 68.8 |
| 220/110V | 80.0 | 64.0 | 88.0 | 70.4 |
| 200/115V | 80.0 | 64.0 | 88.0 | 70.4 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

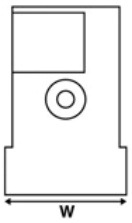
| Voltage 60 Hz | Prime | | Standby | |
|---|---|---|---|---|
| | kVA | kW | kVA | kW |
| 480/277V | 90.0 | 72.0 | 100.0 | 80.0 |
| 220/127V | 88.0 | 70.4 | 96.8 | 77.4 |
| 380/220V | 82.0 | 65.6 | 90.0 | 72.0 |
| 240/120V | 88.0 | 70.4 | 96.8 | 77.4 |
| | | | | |
| 440/254V | - | - | - | - |
| 220/110V | 82.0 | 65.6 | 90.0 | 72.0 |
| 208/120V | 88.0 | 70.4 | 96.8 | 77.4 |
| 240/139V | 88.0 | 70.4 | 96.8 | 77.4 |
| | | | | |
| | | | | |
| | | | | |

## Weights & Dimensions

| **Weights:** kg (lb) | |
|---|---|
| **Net (+ lube oil)** | 1083 (2388) |
| **Wet (+ lube oil & coolant)** | 1096 (2416) |
| **Fuel, lube oil & coolant** | 1281 (2825) |

| **Dimensions:** mm (in) | |
|---|---|
| **Length** | 1925 (75.8) |
| **Width** | 1120 (44.1) |
| **Height** | 1361 (53.6) |




**Note:** General configuration not to be used for installation. See general dimension drawings for detail.

## Definitions

### Standby Rating

Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

### Prime Rating

Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12.
Overload operation cannot exceed 25 hours per year.

### Standard Reference Conditions

Note: Standard reference conditions 25°C (77°F) air inlet temp, 100m (328ft) A.S.L. 30% relative humidity. Fuel consumption data at full load with diesel fuel with specific gravity of 0.85 and conforming to BS2869: 1998, Class A2.

## General Data

### Documents

A full set of operation and maintenance manuals and circuit wiring diagrams.

### Quality Standards

The equipment meets the following standards: **IEC60034-1, IEC60034-22, ISO3046, ISO8528, NEMA MG 1-32, NEMA MG 1-33, 2004/108/EC, 2006/42/EC, 2006/95/EC.**


www.Cat-ElectricPower.com



© 2016 Caterpillar
All rights reserved.
Materials and specifications are subject to change without notice.
The International System of Uniyts (SI) is used in this publication.
CAT, CATERPILLAR, their respective logos, "Caterpillar Yellow," the "Power Edge" trade dress, as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.



Price List: C4.4PGBI, C4.4PGBT
Gen. Arr. Number: 507-7324
Source: China, Europe
LEHE1112-00 (0616)

# Pump's Specifications & Compliance

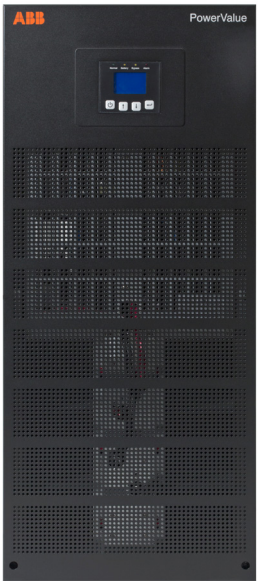
| Pump's Information | Specifications | Compliance | Deviation (If Any) | Remarks |
|---|---|---|---|---|
| Number of pumps | 02 per underpass/ per site | | - | |
| Pump Type | Submersible | | | |
| Country of Origin | German prefferably OR any European | | | |
| Power Input-P1 | 4-5 KW OR Fit for the purpose | | | |
| Power Input-P2 | 4 KW | | | |
| Main Frequency | 50 Hz | | | |
| Liquid Type | Muddy Water/Drainage Water/ Stingy Water | | | |
| Flow Rate/ Discharge Rate | > 260 GPM(US) | | | |
| Maximum Head (TDH) | 11-12 METER | | | |
| Type Of Impeller | Super Vortex/S-Tube Impeller (*Which is Suitable) | | | |
| Treatment of All Cast Iron Parts | Cataphoresis Treatment | | | |
| Approvals | CE. EN12050-1 | | | |
| Pump Inlet | 100 mm | | | |
| Discharge Pipe size | 100 mm | | | |
| Maximum Particle Size | 3 1/8 inch | | | |
| Pump Housing | Cast Iron (EN-GJL-250)EN-GJL-250 | | | |
| Impeller Housing | Cast Iron (EN-GJL-250)EN-GJL-250 | | | |
| Motor Housing | Cast Iron (EN-GJL-250)EN-GJL-250 | | | |
| Primary Shaft Seal | SIC | | | |
| Secondary Shaft Seal | Carbon/ Ceramics | | | |
| Rated Voltages | 3 X 380-415 Volts | | | |
| Voltages Tolerance | +10/-10% | | | |
| Maximum Starts Per Hour | ≥ 20 | | | |
| Rated Current | 10.1 - 10.1 Amps | | | |
| Rated Current at 3/4 load | Specified by the manufacturer | | | |
| Rated Current at 1/2 load | Specified by the manufacturer | | | |
| Starting Current | < 70 Amps | | | |
| Cos Phi-Power Factor | 0.72 | | | |
| Cos phi - p.f. at 3/4 load | 0.63 | | | |
| Cos phi - p.f. at 1/2 load | 0.5 | | | |
| Rated Speed | 1400-1500 RPM | | | |
| Locked-rotor torque | Specified by the manufacturer | | | |
| Breakdown torque | Specified by the manufacturer | | | |
| Moment of inertia | Specified by the manufacturer | | | |
| Motor Efficiency at Full Load | 87.40% | | | |
| Motor Efficiency at 3/4 Load | 87.10% | | | |
| Motor Efficiency at 1/2 Load | 85.00% | | | |
| Number of Poles | 4 | | | |
| Start Method | Star/Delta OR Direct Online | | | |
| Enclosure Class (IEC 34-5) | IP68 | | | |
| Insulation Class (IEC 85) | H | | | |
| Motor Protection | THERMAL SWITCH | | | |
| Thermal Protection Internal | Yes | | | |
| Length of Cable | As per site requirement | | | |
| Cable Type | LYNIFLEX | | | |
| Max Hydraulic Efficiency | 59% | | | |
| Max Ambient Temperature | 104 F | | | |
| Max Operating Pressure | 87 psi | | | |
| Flange Standard | DN | | | |
| Pump Outlet | DN 80 | | | |
| Presure Stage | PN 10 | | | |
| Max Installation Depth | 65.6 Feet | | | |
| Density | 62.29 lb per cubic feet | | | |
| Pump Liquid | Muddy water, stringy solids and debris-laden liquids | | | |
| Liquid Temp Range | 32 F - 104 F | | | |
| Remote Monitoring through SCADA | Interface with SCADA | | | |
| Discharge Pipe Type | HDPE type/ UPVC | | | |
| Discharge Pipe dia | 100 mm inner dia | | | |
| SCADA Interface | Remote Monitoring and Control with CIM Module | | | |
| Level Sensors | Automatic "ON and OFF" | | | |
| Protection | Dry Run Protection | | | |
| **Accessories Schedule** | **As per Drawing** | | | |
| Discharge Pipe dia | 100 mm | | | |
| Long Radius Bends 90 Degree | As per Drawing/Requiremnt at site | | | |
| Dismanteling Joints | As per requirement | | | |
| Non Return Valves(NRV) | As per requirement | | | |
| Gate Valves(GV) | As per requirement | | | |
| Tees | As per requirement | | | |
| Guide Rails | As per requirement | | | |
| Lifting Chain | As per requirement on site | | | |
| Complete from al auspects till opertional including softwares interface with SCADA, CIM Module, cables & their terminations AND including accessories/pipes, NRVs, Joints, GVs, all plumbing Work PLUS Fault Self Diagnostic | Contractor's Scope | | | |
| Provision, Installation & Commissioning of all pumps as per agreed terms | Contractor's Scope | | | |
| FAT/Pre shipment Inspection at manufacturer's facility | FAT/Pre shipment Inspection for Two Officals (ONE Client & ONE Consultant) including boarding, lodging, TADA & Return Ticket at contractor's cost | | | |
| Complete O&M for TWO years & training to the Owner's technical team. | Contractor's Scope | | | |
| Provision of O&M Manuals & relevant pumping software | Contractor's Scope | | | |

Feb 26, 2018
(Nadeem Qureshi)
E&M Expert
BRT, EPCM, MMM

(Younas Abideen)
CRE

# PowerValue 11 / 31 T

## The single-phase UPS for IT rooms, networks and other critical applications




The PowerValue 11/31 T UPS delivers reliable power, low running costs, long battery life, easy maintenance and high levels of flexibility. Featuring double-conversion, voltage and frequency independent (VFI) topology, the PowerValue 11/31 T is available in both 10 and 20 kVA versions, with the option to configure up to four units in parallel to boost power capability or provide redundancy.

Three-phase or single-phase inputs can also be accommodated, as well as single- or dual-supply inputs – allowing the customer to manage two independent power sources. Simple to install and with a small footprint, the PowerValue 11/31 T provides stable, regulated, transientfree, pure sine wave AC power with extremely tight output voltage regulation.

**High reliability**
- Online double conversion topology
- Parallelable up to four units to provide system redundancy
- Programmed and automated battery tests ensure optimized battery management

**Low cost of ownership**
- Simple power increase by paralleling up to four units
- High operating efficiency, regardless of loading
- Reduced installation costs
- Compact design

**Flexible design**
- Different autonomy variations with inbuilt batteries or additional battery cabinets
- Long backup models available
- Single- or three-phase input – adaptable to installation requirements (field configurable)
- Single- or dual-input power source compatible (field configurable)
-

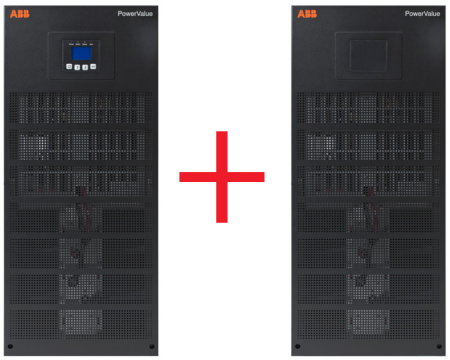
**Efficient service concept**
- Integrated manual bypass switch
- Easy to install and maintain
- User-friendly display
- User-replaceable batteries
- Remote monitoring and connectivity options

# PowerValue 11 / 31 T
## Product features

**Compact power protection up to 80 kVA**
PowerValue 11 / 31 T 10 and 20 kVA UPS can be installed in parallel to increase the total system power up to 80 kVA or to add redundancy to the system. The UPSs are delivered with an inbuilt parallel board and paralleling cables. No additional hardware is required for this installation.

PowerValue 11 / 31 T can be configured with up to two matching battery cabinets to satisfy extended runtime demands. Easily accessible and replaceable batteries increase availability and reduce mean time to repair (MTTR).

Up to **4** UPSs in parallel



Up to **2** battery cabinets in parallel

**Battery runtime at full / half nominal load**

| | 10 kVA | | 10 kVA S | | 10 kVA B | | 10 kVA B2 | | 20 kVA | | 20 kVA S | | 20 kVA B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100% | 50% | 100% | 50% | 100% | 50% | 100% | 50% | 100% | 50% | 100% | 50% | 100% | 50% |
| **UPS internal battery** | – | – | – | – | 4 | 12 | 12 | 30 | – | – | – | – | 4 | 12 |
| **UPS + A*** | 12 | 30 | – | – | 21 | 49 | 30 | 69 | 4 | 12 | – | – | 12 | 29 |
| **UPS + B**** | 30 | 69 | 30 | 69 | 39 | 87 | 49 | 109 | 12 | 29 | 12 | 29 | 21 | 49 |
| **UPS + A + B*/**** | 49 | 109 | 49 | 109 | 58 | 130 | 69 | 151 | 21 | 49 | 21 | 49 | 29 | 69 |
| **UPS + 2B**** | 69 | 151 | 69 | 151 | 79 | 176 | 87 | 208 | 29 | 69 | 29 | 69 | 39 | 97 |

in minutes at full / half load

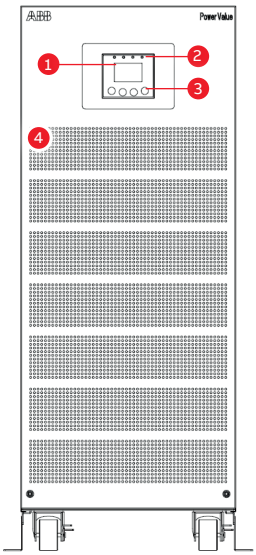
| Battery cabinet | Batteries |
|---|---|
| Configuration A* | 2 × 24 × 9 Ah |
| Configuration B** | 4 × 24 × 9 Ah |

**Frequency conversion**
Operating as a frequency converter, PowerValue 11 / 31 T not only converts the power supply frequency (50 Hz to / from 60 Hz), but it also protects the load from power disturbances and guarantees additional battery power in case of mains failure.

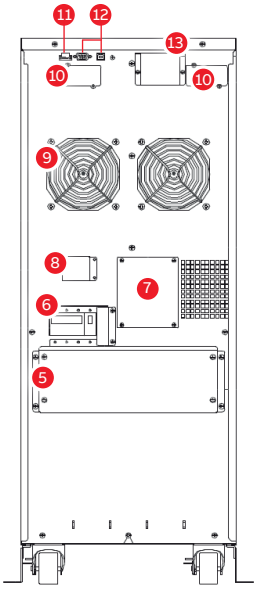
The operation and installation is simple and consisys merely of correctly wiring the UPS and selecting the frequency conversion mode in the LCD.

- Input frequency range: 40–70 Hz
- Output frequency: 50 Hz or 60 Hz
- Output derating:
  - Single-phase input: 60%
  - Three-phase input: no derating

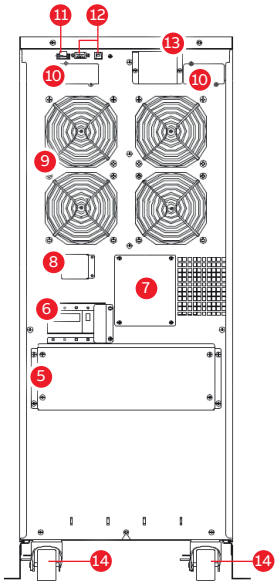
# PowerValue 11 / 31 T
## Available models



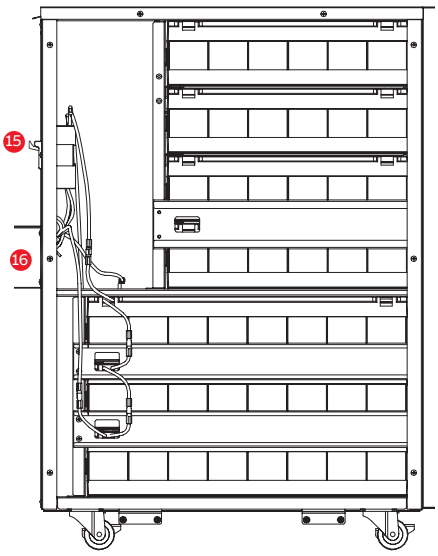

10 / 20 kVA




10 kVA




20 kVA




Battery cabinet (A and B)

| | | | |
|---|---|---|---|
| **1** LCD | **5** Connection terminals | **9** Fans | **13** Parallel port |
| **2** LEDs | **6** Input breaker | **10** Network interface / AS400 slot | **14** Wheels / support and brakes |
| **3** Control keys | **7** Manual bypass | **11** EPO contact | **15** Fuse holder |
| **4** Ventilation inlets | **8** Back-feed protection terminals | **12** RS-232 port / USB port | **16** Battery connection terminals |

**UPS cabinet configuration**

- Online double conversion UPS
- Efficiency in online mode up to 93.9%
- Efficiency in eco-mode up to 97%
- Paralleling up to four units allows for increase of capacity or redundancy
- Same model supports different wiring schemes
- Three-phase and single-phase input
- Single- and dual-input feed
- LCD
- Frequency converter operation (50 Hz or 60 Hz)
- Interfaces: USB, RS-232, ModBus, potential-free contacts, EPO contact inputs
- Emergency power-off for remote shutdown

**Options**

- Dry-contact card – relay interface card enables advanced communication between the UPS systems
- Network interface cards – control and monitoring of the UPS via a web browser
- Sensors – combined with the network interface card, humidity and temperature sensors can be integrated into the system and monitored remotely
- Additional battery cabinets that match perfectly with the UPS for scaling autonomy time

# PowerValue 11 / 31 T
## Technical specification

| General data | 10 kVA | 10 kVA S | 10 kVA B | 10 kVA B2 | 20 kVA | 20 kVA S | 20 kVA B |
|---|---|---|---|---|---|---|---|
| **Output rated power** | 9 kW | | | | 18 kW | | |
| **Output power factor** | 0.9 | | | | | | |
| **Topology** | Online double conversion | | | | | | |
| **Parallel configuration** | Up to 4 units | | | | | | |
| **Inbuilt batteries** | No | No | Yes | Yes | No | No | Yes |
| **Input** | | | | | | | |
| **Nominal input voltage** | 1 ph + N: 220 / 230 / 240 VAC<br>3 ph + N: 380 / 400 / 415 VAC | | | | | | |
| **Input voltage tolerance** | 1 ph + N: 110–276 VAC<br>3 ph + N: 190–486 VAC | | | | | | |
| **Input current THDi** | <5% linear load, <7% non linear load | | | | | | |
| **Frequency range** | 45–55 Hz for 50 Hz systems / 55–65 Hz for 60 Hz system | | | | | | |
| **Power factor** | ≥0.99 | | | | | | |
| **Output** | | | | | | | |
| **Rated output voltage** | 220 / 230 / 240 VAC | | | | | | |
| **Voltage tolerance** | ±2% | | | | | | |
| **Voltage distortion** | ≤2% linear load, ≤5% non linear load | | | | | | |
| **Overload capability (linear load)** | 1 min: 110–130% / 5 min: 105–110%<br>100 ms: >150% / 10 s: 130–150% | | | | | | |
| **Nominal frequency** | 50 Hz or 60 Hz | | | | | | |
| **Crest factor** | 3:1 (load supported) | | | | | | |
| **Efficiency** | | | | | | | |
| **Overall efficiency** | Up to 93.1% | | | | Up to 93.9% | | |
| **In eco-mode** | ≥97% | | | | | | |
| **Environment** | | | | | | | |
| **Protection rating** | IP 20 | | | | | | |
| **Storage temperature** | –15 °C to +60 °C for UPS, 0 °C to approx. +35 °C for battery | | | | | | |
| **Operating temperature** | 0 °C to +40 °C | | | | | | |
| **Relative humidity** | 0% to 95% (Non-condensing) | | | | | | |
| **Altitude (above sea level)** | 1000 m without derating | | | | | | |
| **Battery** | | | | | | | |
| **Type** | VRLA (vented lead-acid) | | | | | | |
| **Inbuilt batteries** | – | – | 1 × 24 | 2 × 24 | – | – | 2 × 24 |
| **Battery capacity** | – | – | 9 Ah | 9 Ah | – | – | 9 Ah |
| **Charging current** | 4 A | 8 A | 4 A | 4 A | 4 A | 8 A | 4 A |
| **Recharge time** | – | – | 3 h to 90% | 8 h to 90% | – | – | 8 h to 90% |
| **Communications** | | | | | | | |
| **User interface** | LCD | | | | | | |
| **Communication cards (option)** | Network interface (SNMP card), dry-contact card (AS400) | | | | | | |
| **Standards** | | | | | | | |
| **Safety** | IEC / EN 62040-1 | | | | | | |
| **EMC** | IEC / EN 62040-2 | | | | | | |
| **Performance** | IEC / EN 62040-3 | | | | | | |
| **Manufacturing** | ISO 9001:2015, ISO 14001:2015, OHSAS18001 | | | | | | |
| **Weight, dimensions** | | | | | | | |
| **Weight** | 56 kg | 65 kg | 116 kg | 178 kg | 67 kg | 68 kg | 190 kg |
| **Dimensions w × h × d** | 350 × 890 × 715 mm | 350 × 890 × 715 mm | 350 × 890 × 715 mm | 350 × 890 × 715 mm | 350 × 890 × 715 mm | 350 × 890 × 715 mm | 350 × 890 × 715 mm |

**abb.com/ups**

© Copyright 2017 ABB. All rights reserved.
Specifications subject to change without notice.

4NWP102348R0001

# SPECIFICATIONS OF HIGH SPEED DIESEL

| Sr. No. | Test Description | Units | Test Method ASTM/IP | Specs | Max/Min |
|---|---|---|---|---|---|
| 1 | Specific gravity @ 15.6°C, 60°F | - | D-1298 | 0.8250 – 0.8350 | - |
| 2 | Color | - | D1500 | 3 | Max |
| 3 | Flash Point | °C | D-93 | 54 | Min |
| 4 | Cloud Point<br>a) Summer (March-Oct)<br>b) Winter (Nov-Feb) | °C | D-2500 | <br>9<br>6 | Max |
| 5 | Pour point<br>a) Summer (March-Oct)<br>b) Winter (Nov-Feb) | °C | D-97 | <br>6<br>3 | Max |
| 6 | Cetane Index (calculated) | - | D-976 | 45 | Min |
| 7 | Sulfur | wt % | IP-63 | 1.0 | Max |
| 8 | Copper strip 3 hrs. corrosion at 100°C | - | D-130 | 1 | Max |
| 9 | Conradson carbon % wt of 10% residue | wt % | D-189 | 0.20 | Max |
| 10 | Sediments | % wt | D-473 | 0.01 | Max |
| 11 | Water | % Vol | D-95 | 0.05 | Max |
| 12 | Ash contents | % wt | D-482 | 0.01 | Max |
| 13 | Neutralization Value<br>a) Total Acid No.<br>b) Strong Acid No. | mg KOH/g | D-974/664 | <br>0.5<br>NIL | Max |
| 14 | Kinematic viscosity @40°C | Cst | D-445 | 1.5<br>6.5 | Min<br>Max |
| 15 | Distillation<br>a) 50% Vol. Rec.<br>b) 90% Vol. Rec. | °C | D-86 | <br>290<br>365 | <br>Max<br>Max |

**Fire and voice alarm systems**
Product catalogue

Cooper

# Complete fire systems for the protection of life and property



Powering Business Worldwide




## Powering business worldwide

As a global power management company, we help customers worldwide manage the power needed for buildings, aircraft, trucks, cars, machinery and businesses.

Eaton's innovative technologies help customers manage electrical, hydraulic and mechanical power more reliably, efficiently, safely and sustainably.

EATON

*Powering Business Worldwide*






## We deliver:

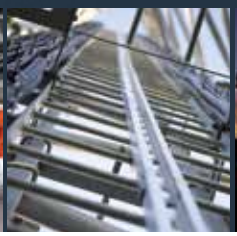
- **Electrical solutions** that use less energy, improve power reliability and make the places we live and work safer and more comfortable
- **Hydraulic and electrical solutions** that enable machines to deliver more productivity without wasting power
- **Aerospace solutions** that make aircraft lighter, safer and less costly to operate, and help airports operate more efficiently
- **Vehicle drivetrain and powertrain solutions** that deliver more power to cars, trucks and buses, while reducing fuel consumption and emissions

We provide integrated solutions that help make energy, in all its forms, more practical and accessible.

With 2014 sales of $22.6 billion, Eaton has approximately 100,000 employees around the world and sells products in more than 175 countries.









## Eaton's electrical business

**Eaton is a global leader with expertise in:**

- Power distribution and circuit protection
- Backup power protection
- Solutions for harsh and hazardous environments
- Lighting and security
- Structural solutions and wiring devices
- Control and automation
- Engineering services

Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges. With 100 years of electrical experience behind us, we're energized by the challenge of powering up a world that demands twice as much energy as today. We're anticipating needs, engineering products and creating solutions to energize our markets today and in the future.

We are dedicated to ensuring that reliable, efficient and safe power is available when it's needed most.

**Eaton.com**



**Leadenhall Building**
London, UK

# Excellence and innovation in fire safety solutions.

When it comes to protecting life and property there's no room to compromise. You need a partner that can support you with tried and tested products, global capabilities and local delivery.

Eaton is a leading manufacturer and global supplier of high quality fire systems. With our ability to provide complete systems, not just components, you can be confident in the knowledge that all of our products have been specifically designed and tested to ensure that they are all fully compatible to form a reliable and compliant fire detection and alarm system.

Our large multi-disciplined research and development team is responsible for the integration of the latest technology into the full range of fire products, ensuring that our products are designed to the latest fire industry standards and manufactured to the highest levels of quality. The many innovative, new and improved products featured in this catalogue demonstrate our commitment to staying at the leading edge of technological development for fire detection and alarm equipment.

Our core values and aims are:

- Investment in people
- To partner with our customers to develop open, long term relationships
- To have an unpretentious, straightforward and honest approach to business
- The continued investment in research and development
- Investment in manufacturing facilities to ensure they remain world class
- To produce products that are in full compliance with standards
- To operate in an environmentally friendly way - in the products we design and the facilities in which we make them
- To have high ethical standards

Our solutions and services are recognised by a wide range of accreditation bodies, so you can count on products that comply with national and industry standards, while receiving full support, from initial system design to monitoring and service.

# Introduction
## Distinctive capabilities



**Ankara Esenboğa International Airport**
Ankara, Turkey




**St Pancras Station**
London, UK



**Doncaster Cultural and Civic Quarter**
Doncaster, UK

# Manufacturing fire solutions is just one small element of what we do.

## Services

We believe that ownership of fire detection systems extends beyond the initial purchase of the products themselves. We therefore offer customers a wide range of services to ensure that their installations not only meet basic operational and safety requirements on day one, but will continue to do so throughout their lifetime.

From training and support on how to select products for a specific application through to the provision of routine on-site testing and maintenance. You can be sure that Eaton is ready to support you, whatever your needs.

## Major projects

Design and installation of a fire detection system can often be a complex process, with each project often bringing its own challenges in making sure the system is compliant, reliable and easy to operate. Our team of engineers will partner with your project management team using our expertise to meet the specific requirements of your project.

Eaton has a great deal of experience handling major projects across the globe. We can help not just with the product and technical support but also by providing guidance and advice to specifiers and project management teams on topics such as standards and regulations.

We are BAFE SP203 certified for design, commissioning and maintenance of fire detection systems, giving our customers the peace of mind they need that our systems conform with all necessary safety requirements.

## Technical support

Our dedicated technical support team are able to offer customers around the world advice and guidance on a wide variety of technical matters via telephone or email. In the vast majority of cases, a process of systematic questioning enables the team to diagnose the challenge and advise the customer on the appropriate solution.

Sometimes more detailed troubleshooting and analysis methods may be used to determine the actual requirements and the best way of resolving it. If necessary, the technical support team will also call on the knowledge and expertise of Eaton's product management, R&D and design departments to help resolve the customer's issue.

In addition, the technical support team can provide customers with assistance on product information, installation and operating instructions, and the legislative requirements of your fire detection systems.



**Mariner's Quay Apartment Complex**
Newport



# Contents

**1. Introduction**

| | |
|---|---|
| An introduction to fire systems | 10 |
| Conventional and two-wire systems | 12 |
| Addressable systems | 13 |
| Emergency voice communication systems | 14 |
| UL listed fire systems | 15 |
| Voice alarm systems | 15 |

**2. Intelligent addressable systems**

| | |
|---|---|
| Fire panels and repeater panels | 18 |
| Addressable devices | 24 |

**3. UL intelligent addressable systems**

| | |
|---|---|
| Fire panels and repeater panels | 44 |
| UL listed devices | 46 |

**4. Conventional systems**

| | |
|---|---|
| Fire panels and repeater panels | 58 |
| Conventional devices | 64 |

**5. Emergency voice communications**

| | |
|---|---|
| VoCALL control panels | 86 |
| VoCALL devices | 90 |
| Emergency assist alarm | 92 |

**6. Voice alarm systems**

| | |
|---|---|
| Control panels and amplification | 96 |
| Speakers | 98 |

**7. Appendix**

| | |
|---|---|
| Notes | 100 |
| Contact details | 103 |

# An introduction to fire systems

Eaton manufacture and supply a range of different types of fire systems, meaning we can provide a high quality fire solution whatever your need is.

There are a vast array of fire detection systems and devices on the market today, ranging from the relatively simple to the most technically sophisticated. Modern automatic fire detection systems are available in two types, conventional and addressable - which, broadly speaking, tend to be used in smaller and larger installations respectively. For more detail you can read our fire systems guide over the next few pages.

## The basics of fire detection

A control panel is the hub of the detection system. All the devices which are part of the fire detection system are connected to this central panel which processes the signals received from the input devices and gives out signals to the output devices. Input devices such as detectors measure signals of combustion and communicate with panels, which in turn trigger output devices such as an audible or visual alarm device. Fire alarm panels can be further sub segmented into addressable or conventional panels.

There are various types of fire detection systems each suited to different applications or building types. A fire detection system can vary significantly in both complexity and price, from a single panel with a detector and sounder in a small commercial property to a complex intelligent addressable system in a multi-occupancy building.

A fire detection system can comprise of detection devices, notification devices and manual callpoints. The size of the building determines the number of detectors that would be required. The system works via the control panel receiving signals from the detection devices and then sending transmitting signals to the notification devices.


Fire
Zone Fault
Zone Disabled
Conventional Fire Alarm Panel




FIRE

## Conventional systems (p64-83)

The philosophy of a conventional system revolves around dividing the building into a number of areas called zones. The detectors and call points within each zone are then wired on a dedicated separate circuit.

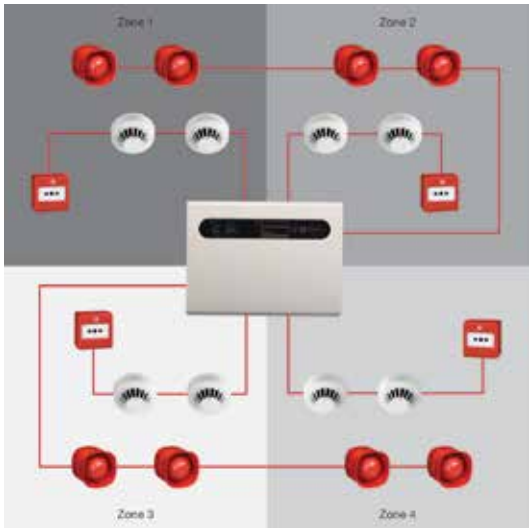
In the event of a detector or call point being triggered, the panel is able to identify which circuit contains the triggered device and thereby indicate which zone the fire alarm has come from. The indicated zone can then be manually searched to locate the triggered device.

With this type of functionality a conventional system is best used in smaller builds where it wouldn't be difficult to locate the triggered device in a given zone.

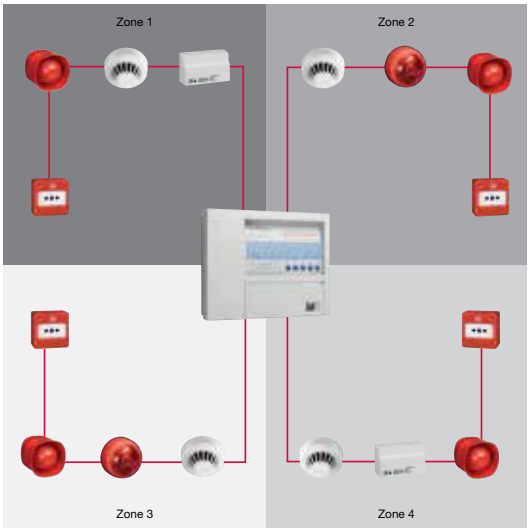
## Two-wire systems (p58-63)

Two-wire systems are based on standard conventional system technology, but it also incorporates additional functionality to enable the callpoints, detectors and sounders for each separate zone to be wired on a single common circuit.

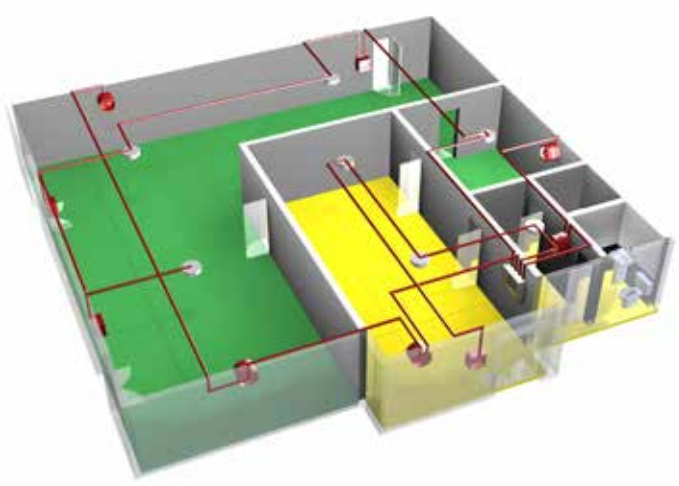
By combining both the detection and the alarm annunciation wiring into a single circuit, considerable savings in installation time and cabling can be achieved.



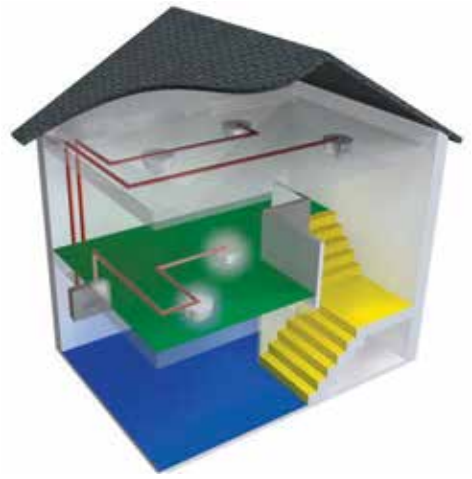
Typical conventional system architecture




Typical two-wire system architecture



Example conventional system layout



Example two-wire system layout



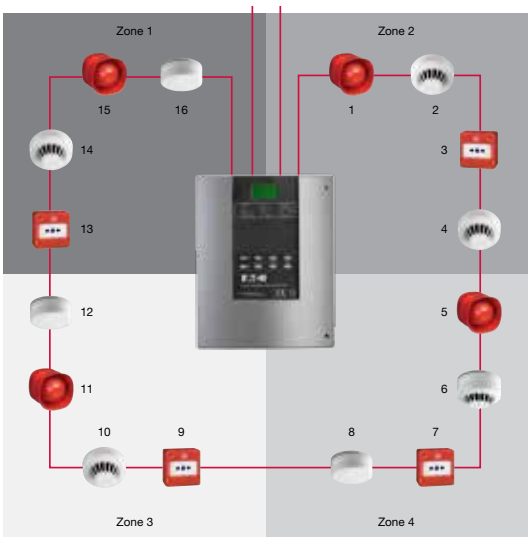
## Addressable systems (p17-41)

Intelligent addressable systems overcome the limitations of conventional systems as each fire detecting sensor or call point is electronically coded with a unique identification or 'address' which is programmed into the device during installation.

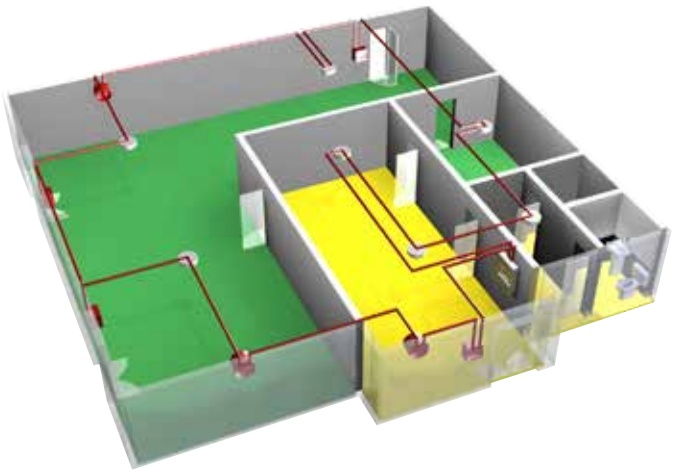
By using each devices' unique address, the control panel is able to conduct two way communication with any of the addressable devices connected to the system.

Under normal conditions the control panel continuously interrogates each device in sequence and analyses the reply to determine the status of each sensor or call point. The panel checks whether each device is functioning correctly and also the amount of smoke or heat that the device is currently sensing.

With the functionality of being able to pinpoint exactly which device is being triggered in an alarm or for a fault, addressable systems are perfect for mid to large size builds with multiple rooms and floors.




Typical addressable system architecture



Example addressable system layout



# Emergency voice communication systems (EVCS) (p85-93)

## What is disabled refuge?

A disabled refuge is a relatively safe area within a building or exit staircase for mobility impaired occupants, allowing building management and emergency services to safely assist these people from the building.

Mobility impairment is defined as not being able to walk 200m continuously without aid, and includes arthritis sufferers, people with leg and back injuries and women over 6 months term pregnancy.

## What is a fire telephone?

Fire telephones are hardwired full duplex communications systems with monitoring and battery backup and are required in buildings over four storeys in many countries in the world (in the UK this is governed by BS9999, 2008). These are provided as a backup to traditional fireman's radio systems, which can fail to operate in many high rise environments due to the large amount of steel in the building, and the "corona" effect of fire on radio broadcasts.

Fire telephones are also required in fire fighting lift lobbies when these lifts are provided within a building. Fire telephones can also be used for fire wardens to call the control point during fire drills and primary evacuation phases before the fire services arrive and assume control.

## What is a disabled refuge EVC system?

An EVC System (Emergency Voice Communication System) is a fixed, monitored and maintained, bi-directional, full duplex voice communication system. These systems are designed to assist the orderly evacuation of disabled or mobility impaired people and enhance fire fighters' communication during emergencies.

A disabled refuge system is not just for use during a fire and must be available at all times. Building regulations insist all new non-domestic buildings with more than one storey provide 'refuge' areas – relatively safe places where people who cannot easily use fire escapes and evacuation lifts, can call for assistance and wait until help arrives. Simple, effective two-way communication (refuge system) in these areas is essential, firstly to assist rescue teams in determining where assistance is required and secondly to reassure people help is on the way.

## UL listed fire systems (p44-56)

Underwriters Laboratories Inc. (UL) is an independent product safety certification organisation, established in 1894, to develop standards and test procedures for products, materials, components, assemblies, tools and equipment. Chiefly dealing with product safety it also evaluates and certifies the efficiency of a company's business processes through its magnificent system registration programs.

Since the launch of our UL Listed fire product range, several prestigious projects worldwide have been supplied including Hyatt Resort and Spa, Shangri-la at the Fort and Times Square projects in South East Asia and several major projects in the Middle East including the prestigious Riyadh Financial District in the Kingdom of Saudi Arabia.

The Eaton UL range is designed to provide a solution for all sizes of project, from the simple small stand alone system to the large multi panel networked system with PA/VA and BMS integration.

SIGNALING
UL
LISTED
4AC5
FIRE ALARM
EQUIPMENT

## Public address/voice alarm systems (p95-99)

Under BS5839 Pt.8 2013, voice alarm (VA) systems are recommended for all public buildings and multi-storey buildings over four floors. VA systems are the quickest way to evacuate the public and staff from a building.

Following fire detection, automated messages control the flow of people in stair wells and corridors allowing an orderly evacuation without panic. These messages are supplemented by spoken messages from the fire service or management suite confirming the validity and need to leave the building. This positive confirmation speeds evacuation and avoids the "false alarm" mentality reducing the risk of death from fire.







# Contents

## Intelligent addressable systems

### Panels

CF2000 addressable panel 18


CF1100VDS addressable panel 20


CF3000 addressable panel 22



### Devices

Sensors 24


Bases 26


Callpoints 28


Wall sounders and VADs 29


Beam detector 31


Duct probe 31


Interfaces 32


Micro interfaces 35



Networking interfaces 36



Ancillaries 38


Software 40


Test equipment 41


# CF2000GCPD
## Intelligent addressable control panel




"The CF2000GCPD serves as the optimum solution for buildings requiring smaller addressable systems."

The Eaton CF2000GCPD is an entry level intelligent addressable control panel which can be configured for either 1 or 2 loop operation, and is certified to EN54 parts 2 & 4.

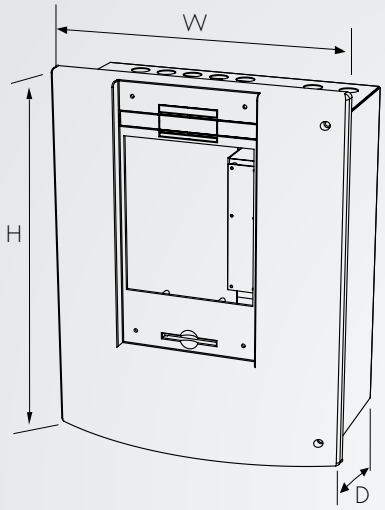
The panel has a graphic display, providing a simple menu driven end user interface. With the CF2000GCPD's ability to support Eaton cause and effect programming and a range of user controllable functions it makes the panel suitable for a varied range of projects from small warehouses to small/ medium office developments as well as many small industrial applications.

As with all Eaton intelligent addressable panels, the CF2000GCPD uses "spur tolerant" soft addressing to minimise installation time and remove the potential for errors often associated with many forms of manual addressing.

### Benefits

- Configurable as a 1 or 2 loop panel
- Up to 200 addresses per loop (up to 60 sounders/beacons and up to 20 I/Os, subject to loop loading calculations)
- Soft addressing
- Menu-driven graphic screen
- Multi-language selection capability
- Integral battery and power supply
- 2x7Ah batteries included
- Easy to operate end user controls
- Full system integrity with Eaton developed protocol
- Core range of compatible devices
- 4 sounder circuits
- Monitored for open and short circuit (max 3.0A combined)

## Dimensions




| H (mm) | W (mm) | D (mm) |
|---|---|---|
| 400 | 320 | 170 |

| Features | CF2000GCPD |
|---|---|
| Ingress protection | IP30 |

## Catalogue numbers

| Description | Code |
|---|---|
| Intelligent addressable 2 loop control panel | CF2000GCPD |
| Standard repeater panel | CF3000PRG |
| Fire alarm system log book | MFALOG |

## Compatible repeater panels

The CF2000GCPD has a standard repeater panel available. Ideal for larger sites, the repeater allows you to display the system information from multiple locations.



24V dc output

| Features | CF3000PRG |
|---|---|
| Active or passive option | ✓ |
| Integral battery and power supply | ✓ |
| Supervisor and engineer modes through code access | ✓ |
| Ingress protection | IP30 |



# CF1100VDS
## Intelligent addressable control panel




"The simplicity of operation, powerful cause and effect programming capability and competitive pricing make the system suitable for a wide range of small to medium sized projects."

The CF1100VDS is a high specification addressable panel for medium sized builds that is equipped with a versatile touch screen user interface. It is available as a 1 (CF1100VDS) or 2 (CF1200VDS) loop panel.

The powerful cause and effect programming capability and competitive pricing make the system suitable for a wide range of small to medium sized projects. The panels can operate as standalone or as part of a network with our other addressable panels (additional network card required).

| | CF1100VDS | CF1200VDS* |
|---|---|---|
| No. of loops | 1* | 2* |
| Addresses per loop | 200** | 200** |
| No. of conventional sounder circuits | 2*** | 2*** |
| Ingress protection | IP30 | IP30 |

* No zonal LEDs
** Up to 60 sounders/beacons and up to 20 I/Os
***Monitored for open and short circuit (max 1.5A combined)

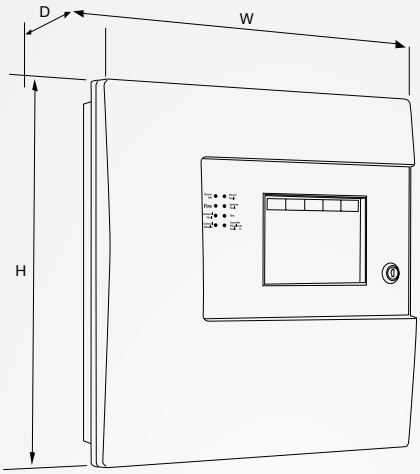
### Benefits

- Soft addressing
- Large versatile touch screen user interface
- Multi-language selection capability
- Integral battery and power supply
- 2x7Ah batteries included
- Flexible distributed network capability
- Full range of compatible devices
- Flexible and easy to design, system cause and effect using site installer software
- Compatible with our addressable repeaters (see p21)



CE VdS Approved product

## Dimensions




| | H (mm) | W (mm) | D1 (mm) |
|---|---|---|---|
| Panel | 375 | 357 | 95 |
| Cutout | 345 | 325 | 50 |



CF1100VDS pictured with a range of compatible devices

## Catalogue numbers

| Description | Code |
|---|---|
| 1 loop control panel | CF1100VDS |
| 2 loop control panel | CF1200VDS |
| Add to end of product code if network card required | NC |
| Add to end of product code if dual redundancy network card required | NCDR |
| Network kit (for retro fit) | DF61NETKIT |
| Passive repeater panel | CF3000PRG |
| Touch-screen repeater panel | CTPR3000 |
| Fire routing equipment PCB | ZPCB2187FRE |
| Fire alarm system log book | MFALOG |



# CF3000
## Intelligent addressable control panel




"The large capacity, ability to support complex cause and effect programming and wide range of user controllable functions make the system suitable for a diverse range of projects"

The CF3000 series are high specification intelligent addressable control panels, which are fully certified to EN54 parts 2 and 4.

The panel comes with options for an integral printer for system posterity and an extended battery. Each panel is networkable with up to 126 other Eaton addressable control panels, only requiring the addition of one of our network cards for this functionality.

| | CF30002G | CF30004G |
|---|---|---|
| No. of Loops | 2 | 4 |
| Addresses per Loop | 200* | 200* |
| No. of Conventional Sounder Circuits | 4** | 4** |
| Ingress protection | IP30 | IP30 |

* Up to 60 sounders/beacons and up to 20 I/Os
**Monitored for open and short circuit (max 1.5A combined)

### Benefits

- Soft addressing
- Large versatile touch screen user interface
- Multi-language selection capability
- Integral printer (optional)
- Integral battery and power supply
- 2x 12Ah batteries included
- Extended battery option allows for 72 hours standby (subject to loop loading calculations)
- Flexible distributed network capability
- Full range of compatible devices
- Easy to design system cause and effect using site installer software
- Additional functionality through FRE & FPE (Fire Routing Equipment & Fire Protection Equipment) which are both monitored outputs

## Class change functionality

Our CF3000 panel has a variety of easy to use additional software options on top of the standard class change facility; this provides benefits for a number of regions.

Class change input on the CF3000 can be used for functions such as Australian Fire Brigade, HMO operation, Swedish mode, Australian tone sounders for class change and different tones.




## Compatible repeater panels

The CF3000 has both a passive and a touchscreen repeater panel available. Ideal for larger sites, the repeater allows you to display the system information at multiple locations.

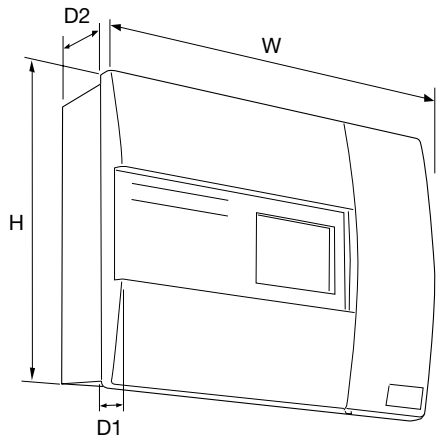




| Features | CF3000PRG | CTPR3000 |
|---|---|---|
| Active or passive option | ✓ | ✓ |
| No programming required | ×* | ✓ |
| Programmable input | × | ✓ |
| Integral battery and power supply | ✓ | ✓ |
| Supervisor and engineer modes through code access | ✓ | ✓ |
| Fire and fault volt free programmable relays | × | ✓ |
| Adjustable volume from panel | × | ✓ |
| Ingress protection | IP30 | IP30 |

*Programming not required on network version.

## Dimensions




| | H (mm) | W (mm) | D1 (mm) | D2 (mm) |
|---|---|---|---|---|
| Standard | 397 | 497 | 55 | 125 |
| EB* | 397 | 497 | 55 | 225 |

*Extended battery version

## Catalogue numbers

| Description | Code |
|---|---|
| 2 loop control panel | CF30002G |
| 4 loop control panel | CF30004G |
| 2 loop control panel, integral printer | CF30002GP |
| 4 loop control panel, integral printer | CF30004GP |
| 2 loop control panel, extended battery | CF30002GEB |
| 4 loop control panel, extended battery | CF30004GEB |
| 2 loop control panel, integral printer, extended battery | CF30002GPEB |
| 4 loop control panel, integral printer, extended battery | CF30004GPEB |
| Add to end of product code if network card required | NC |
| Add to end of product code if loop card required | LC |
| Network kit (for retro fit) | DF6000NETKIT |
| Printer kit (for retro fit) | CF3000PKIT |
| Hinged protective cover kit | CF3000COV |
| Passive repeater panel | CF3000PRG |
| Touch-screen repeater panel | CTPR3000 |
| Fire alarm system log book | MFALOG |

# Sensors

Our addressable range has multiple options for intelligent addressable sensors. All sensors are designed for optimum functionality in mid-large sized builds. They are all soft addressed and have integral short circuit isolators. We also offer a loop connected remote indicator, designed to offer discreet remote indication and an ability to monitor multiple sensors. This helps to minimise wiring requirements.

## Optical smoke sensor
**CAP320**



### Typical applications:

Suitable for most applications.

Fastest response to slow burning or smouldering fires which give rise to large visible smoke particles.

## Photo-thermal sensor
**CAPT340***



### Typical applications:

Responds quickly to fast clean burning fires.

Maintains the advantage of optical sensors when detecting smouldering fires.

## Heat sensor
**CAH330**



### Typical applications:

Environments where the ambient conditions might cause false alarms with smoke detectors.

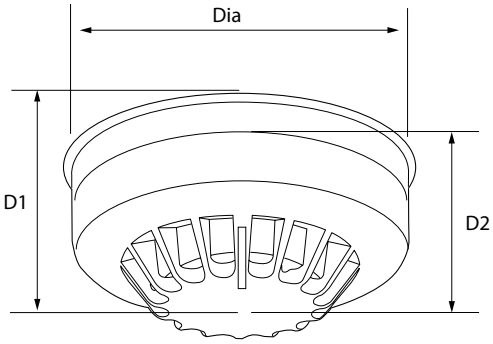
Examples include areas with high levels of dust or fumes.

The CAH330 can operate in 3 modes: rate of rise, fixed heat 77°C and fixed heat 90°C.

These modes are set by the panel.

*The CAPT340 has day/night modes available, programmeable from the site installer software. The day mode uses the heat aspect of the sensor for areas which may have smoky environments during, for example working hours. The night mode uses a combination of A2S and smoke detection. If not programmed, the sensor defaults to dual mode.

## Dimensions




| Description | Diameter (mm) (incl base) | Depth (mm) (excl base) | Depth (mm) (incl base) |
|---|---|---|---|
| Optical | 104 | 33 | 45 |
| Photo-thermal | 104 | 43 | 55 |
| Heat | 104 | 43 | 55 |

## Performance

| Feature | CAP320 | CAPT340 | CAH330 | CAH330 | CAH330 |
|---|---|---|---|---|---|
| Mode | Optical | Photo-thermal | Rate of rise | Fixed heat 77°C | Fixed heat 90°C |
| Area coverage* | 100m$^2$ | 100m$^2$ | 50m$^2$ | 50m$^2$ | 50m$^2$ |
| Heat class | N/A | A2S | A2R | BS | CS |
| Alarm temperature | N/A | 60 °C | 60 °C | 77 °C | 92 °C |
| Ingress protection | IP30 | IP30 | IP30 | IP30 | IP30 |

*(subject to local standards)

## Catalogue numbers

| Description | Code |
|---|---|
| Optical smoke sensor - CAP320 | 400002FIRE-0002X |
| Photo-thermal sensor - CAPT340 | 400004FIRE-0004X |
| Multi-mode heat sensor - CAH330 | 400003FIRE-0003X |

# Indicators

Our indicators are designed as additional indication devices when sensors have been triggered. These products are designed to be used as indicators only, and not visual alarm devices (see p26 and 29 for EN54-23 certified VADs).

## Addressable remote indicator
**MRIAD**



### Typical applications:

Monitoring multiple sensors within a specific area.

Must be configured through site installer. The remote indicator can be programmed as a sounder.

## Standard remote indicator
**CIR301**



### Typical applications:

The CIR301 can only be connected to one sensor and is powered by this sensor.

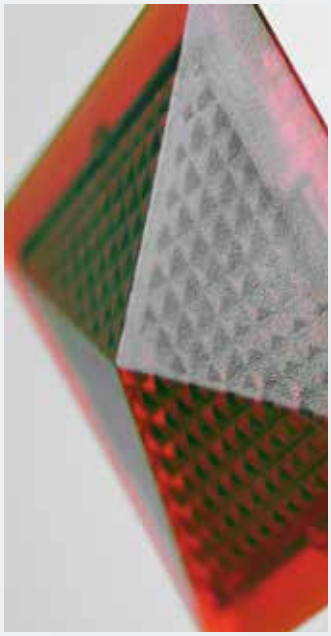
There is a weather resistant version also available. (Not IP65).

## Staff warning device
**CAB382**



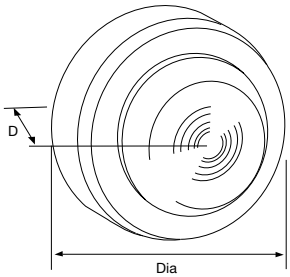
### Typical applications:

As this product does not meet EN54-23 requirements as a beacon we recommend it as an internal warning device in offices, schools or manned reception areas.

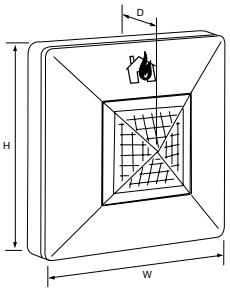


Remote indicator lens detail

## Dimensions




Staff warning device




Remote indicators

| Description | Diameter (mm) | Depth (mm) |
|---|---|---|
| Staff warning device | 101 | 33 |

| Description | Height (mm) | Width (mm) | Depth (mm) |
|---|---|---|---|
| Remote indicators | 87 | 87 | 30 |

## Catalogue numbers

| Description | Code |
|---|---|
| Loop connected remote indicator | MRIAD |
| Standard remote indicator | CIR301 |
| Weather resistant standard remote indicator | CIR301WP |
| CAB382 Staff warning device | 666028FULL-0066 |

# Bases

We stock a variety of bases, providing a wide functionality for different situations. The standard base (CAB300) provides a foundation for our addressable sensors. The range of bases also includes capability for additional sounder and sounder beacon operation. Both our sounder base (CAS380) and VAD sounder beacon base (CASBB394) can be used as standalone devices when fitted with our cover plate (CASC).

## Standard base
**CAB300**



### Typical applications:

General use product, recommended for use in all environments

## Sounder base
**CAS380**



### Typical applications:

Areas of limited extent, where lower output volume is required

Areas with limited cable space

Concrete ceilings, to save cabling

## Sounder beacon base
**CASBB394 (CASBB384)**




### Typical applications:

The CASBB394 is an EN54-23 certified Visual Alarm Device (VAD) sounder beacon base.

It is compatible with the Eaton range of intelligent addressable sensors and can also be used as a dedicated discreet standalone device.

(The CASBB384 sounder beacon base is also available for indication purposes, where EN 54-23 is not a requirement.)

## Sounder base with cover
**CAS380 + CASC**



### Typical applications:

Optional cover plate can be used to enable the sounder to operate as a dedicated discreet stand alone device



VAD sounder beacon base shown with optical sensor

### Features

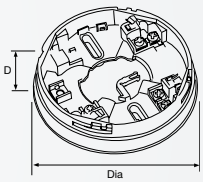
| | CAB300 | CAS380 | CASBB384 | CASBB394 |
|---|---|---|---|---|
| First fix base | ✓ | ✓ | ✓ | ✓ |
| Loop integrity switch | ✓ | ✓ | ✓ | ✓ |
| Multiple cable entry points | ✓ | × | × | × |
| Selectable tones | × | ✓ | ✓ | ✓ |
| Ingress protection | | IP40 | IP40 | IP21C |

## Performance

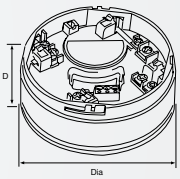
| | CAS380 | CASBB394 |
|---|---|---|
| **Sound output** | | |
| Low volume | 84dB at < 4mA | 77dB at < 6.6mA |
| Medium volume | 92dB at < 8mA | 89dB at < 8mA |
| High volume | 95dB at < 12mA | 90dB at < 9mA |
| **Flash rate** | n/a | 0.5 Hz flash* |

*Polar dispersion infromation available on datasheet

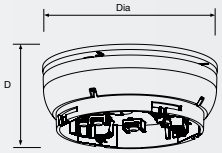
## Dimensions



Standard base



Sounder base



Sounder beacon base

| Description | Diameter (mm) | Depth (mm) |
|---|---|---|
| Standard base | 104 | 22 |
| Sounder base | 102 | 40 |
| Sounder beacon base | 115 | 44 |



## Catalogue numbers

| Description | Code |
|---|---|
| Standard base | CAB300 |
| Sounder base | CAS380 |
| VAD sounder beacon base | CASBB394 |
| Sounder beacon base | CASBB384 |
| Cover plate (pack of 5) | CASC |
| Bell tone sounder base | CAS380B |
| Australian sounder base* | CAS380AU* |
| Addressable relay base | MAB800R |
| Base shroud | BAR3000 |

* Only for Australian market

# Callpoints

Two versions of the intelligent addressable callpoint are available, the surface/flush mounted CBG370S or the weatherproof CBG370WP. Both have an integral short circuit isolator and are very simple to install. The callpoints are packaged with 2 frangible glass elements and test key, with a comprehensive range of further accessories available.

## Surface/flush mounted callpoint
**CBG370S**



### Typical applications:

General use product, suitable for use in most indoor applications.

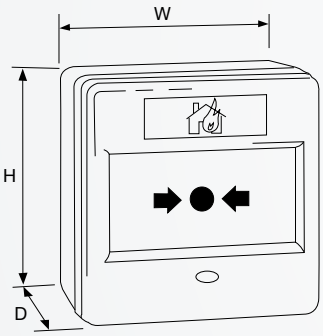
## Weatherproof callpoint
**CBG370WP**



### Typical applications:

Builds requiring a callpoint in harsh conditions. For example, outside or in a wash down area.

## Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Surface mounted | 87 | 87 | 36 |
| Flush mounted | 87 | 87 | 57 |
| Weatherproof | 87 | 87 | 59 |

## Features

| | CBG370S | CBG370WP |
|---|---|---|
| Fast fit clip | ✓ | ✓ |
| High Visibility LED | ✓ | ✓ |
| Heavy duty terminals | ✓ | ✓ |
| Ingress protection | IP42 | IP65 |

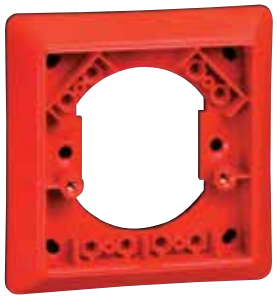
## Catalogue numbers

| Description | Code |
|---|---|
| Surface/flush callpoint | CBG370S |
| Weatherproof callpoint | CBG370WP |
| CXPC Protective hinged cover (pack of 10) | 4990001FUL-0022 |
| Spacer plates (pack of 10) | MBGSP |
| MBGBEZ Recessing bezels (pack of 10) | 4990005FUL-0194 |
| MBGREKIT Resettable element kit (pack of 10) | 4990010FUL-0045 |
| UBSG Spare break glasses (pack of 5) | 516200FULL-5017 |
| MFBGKEY3 Callpoint keys (pack of 10) | 4990009FUL-0040 |

## Further accessories:



Callpoint shown with protective hinged cover



Callpoint recessing bezel

# Wall sounders and VADs

There are also two versions of our intelligent addressable wall sounder, the internal (CAS381) and the weatherproof (CAS381WP). Their highly efficient design offers excellent sound output levels despite the low current consumption. They both contain an integral short circuit isolator and have multiple tones and volume levels which can be controlled from the panel globally, or individually via site installer.

We also offer a new open class Visual Alarm Device (CASB393), combining the high output sound of the wall sounders with a stronger LED to meet the EN54-23 VADs requirements. The open class functionality allows the VADs to be installed in open areas such as warehouses or airport terminals.

## Wall sounder
**CAS381/CAS381WP**



## Typical applications:

Both an indoor and weatherproof variant of the wall sounder are available, allowing for consistent performance for any application where a wall sounder is required.

## VAD wall sounder beacon
**CASB393/CASB393WP**
**CASB383*/CASB383WP***

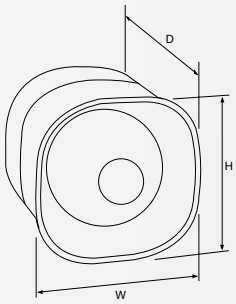



## Typical applications:

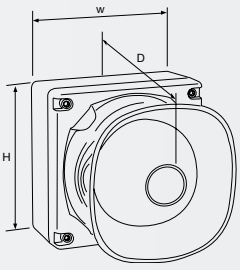
The CASB393 is an addressable open class VAD suitable for all markets where EN54-23 VADs are now a requirement. **White flash only.**

(The CASBB383 wall sounder beacon is also available for indication purposes, where EN 54-23 is not a requirement. **Red flash only.**)

## Dimensions




Internal wall sounder / sounder beacon




Weatherproof wall sounder/ sounder beacon

| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Wall sounder | 105 | 105 | 95 |
| WP wall sounder | 108 | 108 | 103 |
| VAD sounder beacon | 108 | 108 | 96 |
| WP VAD sounder beacon | 110 | 110 | 105 |

## Tones

| Tones | CAS381/ CAS381WP | CASB393/ CASB393WP | CAS381AU/ CAS-381WPAU |
|---|---|---|---|
| Continuous | ✓ | ✓ | ✓ |
| Two tone @ 1Hz cycle | ✓ | ✓ | × |
| Slow whoop 500-1200Hz in 3.5 seconds / 0.5secs gap | ✓ | ✓ | × |
| Pulsed 1Hz (Virtual Tone) | ✓ | ✓ | ✓ |
| Pulsed sweep ISO8201 3x500ms 800-970Hz 1½ Sec Gap | × | × | ✓ |
| Bell tone | × | × | ✓ |

## Sound output

| | CAS381/CAS381WP | CASB393/CASB393WP |
|---|---|---|
| Low volume | 87dB at < 2mA | 87dB at < 8.6mA |
| Medium volume | 93dB at < 3mA | 93dB at < 10mA |
| High volume | 100dB at < 6mA | 100dB at < 11mA |
| **Flash rate** | n/a | 0.5Hz Flash |

| | CAS381/ CASB393/ CASB383 | CAS381WP/ CASB393WP/ CASB383WP |
|---|---|---|
| Ingress protection | IP42 | IP66 |

## Catalogue numbers

| Description | Code |
|---|---|
| Internal wall sounder | CAS381 |
| Weatherproof wall sounder | CAS381WP |
| Vad wall sounder beacon | CASB393 |
| Weatherproof VAD wall sounder beacon | CASB393WP |
| Australian internal wall sounder | CAS381AU |
| Australian weatherproof wall sounder | CAS381WPAU |
| Wall sounder beacon | CASB383 |
| Wall sounder beacon weatherproof | CASB383WP |

# Addressable fire systems

Devices - beam detectors



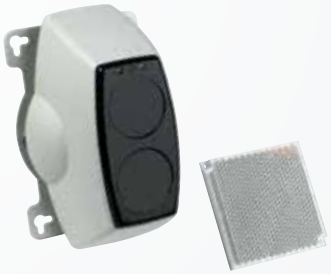

Beam detectors, typically used in large open areas, such as airports, shopping centres and warehouses

# Beam detectors

There are two available loop powered reflective beam detectors in the intelligent addressable range. The MAB50R has a range of up to 50 metres and the MAB100R has a range of up to 100 metres. Neither requires a power supply and are both equipped with a simple set up mode to enable easy and quick alignment during installation.

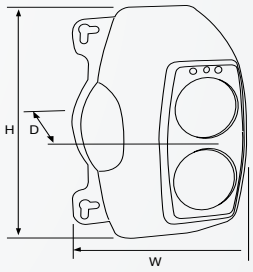
The beam detector is loop powered with one unique address, and has the ability to add address text at the panel. There is a maximum limit of 20 per loop (based on loop loading calculations).

## Addressable reflective beam detector
**MAB50R / MAB100R**



## Dimensions

| H (mm) | W(mm) | D (mm) |
|---|---|---|
| 210 | 130 | 120 |




## Typical applications:

Large open areas such as warehouses, manufacturing plants, shopping centres, airports etc.

Allows access to the automatic gain control data from the detector.

The beam detector will show fire, fault and pre-alarm.

## Features

| | MAB50R | MAB100R |
|---|---|---|
| Operating range | 5 to 50 metres | 50 to 100 metres |
| Tolerance to beam misalignment at 35% | Detector ± 0.8˚, Prism ± 5.0˚ | Detector ± 0.8˚, Prism ± 5.0˚ |
| Fire alarm thresholds | 2.50dB (25%)<br>3.74dB (35%)<br>6.02dB (50%) | 2.50dB (25%)<br>3.74dB (35%)<br>6.02dB (50%) |
| Optical wavelength | 880nm | 880nm |
| Ingress protection | IP40 | IP40 |

Beam detectors have 3 operating modes:

**Prism targeting mode** designed to provide simple initial alignment of beam and reflector assembly.

**Alignment mode** enables accurate fine tuning of beam alignment without the need for additional calibration equipment or a second operator.

**Normal running mode** during standard operation.

# Duct probe mounting kit

The presence of smoke in a ventilation duct is detected by sampling the airflow through the duct via two sampling tubes. A detector and base are mounted within the sampling chamber, which is located on the external skin of the duct, with sample and exhaust probes passing into the duct in an area of low turbulence. The unit requires an addressable optical detector and base and is supplied with full fixing instructions.

## Duct probe unit
**MDP201**





Duct probe unit shown with optical detector fitted

## Typical applications:

Detecting presence of smoke in ventilation ducts.

Requires base and detector to be ordered separately.

## Features

| | |
|---|---|
| Duct width range | 300mm to 1500mm<br>5 to 50 metres |
| Duct air speed range | 1m/s to 20m/s<br>Detector ± 0.8˚<br>Prism ± 5.0˚ |
| Temperature range | -20°C or +60°C |
| Optical wavelength | 880nm |
| Ingress protection | IP67 |

## Catalogue numbers

| Description | Code |
|---|---|
| Reflective beam detector (50m range) | MAB50R |
| Reflective beam detector (100m range) | MAB100R |
| Mounting bracket | MRBFP |
| Spare reflector | MABR |
| Duct probe unit | MDP201 |

# Interfaces

We supply an extensive range of interfaces to support our control panels. Interfaces allow for a wide variety of installations to be simplified without the use of specialist or customised equipment. For assistance deciding which interfaces will benefit you the most, contact our technical support team at firetechsupport@eaton.com

## Zone monitor unit
**CZMU352**



### Typical applications:

The unit connects a zone of suitable conventional detectors (20 detectors per zone) and a separate zone of conventional callpoints (if required) to an addressable panel.

It allows for easier connection to existing conventional detection zones, as long as the devices used are compatible.

## Spur isolator unit
**CSI350**



### Typical applications:

The spur isolator unit enables a spur of intelligent addressable devices to be connected to a main analogue loop. This simplifies the installation of remote parts of buildings or system extensions.

The CSI350 doesn't take an address in the number sequence.

Recommended no more than a zones worth of devices per isolator.

## Shop monitor unit
**MSU840**



### Typical applications:

The shop monitor unit is designed to allow small units with conventional fire systems to be fully integrated with a main intelligent addressable fire system.

It is ideal for connecting individual shop units into a main shopping centre system.

Recommended for use with conventional VADs **(see p72)**. Please note: A PSU **(see p38)** is required to operate conventional sounder circuits.

The MSU840 can have 2 sounder circuits, each with up to 0.3A of power.

## 3 channel I/O unit
**CIO351**

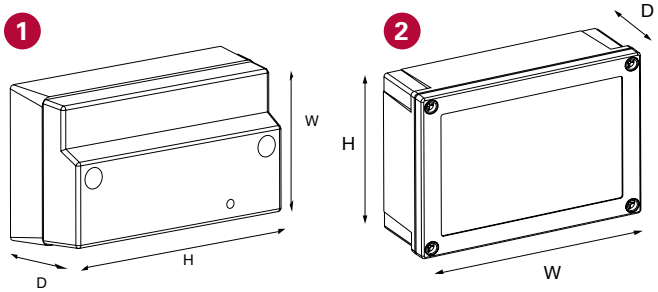


### Typical applications:

The 3 channel input/output unit enables simple interfacing between the fire system and other equipment such as nurse call systems or access control systems. The inputs are fully monitored for open and short circuits.

Relay contacts are rated at 30V dc 1A. See below for further options.

## Dimensions




| Description | | H (mm) | W (mm) | D (mm) |
|---|---|---|---|---|
| Interface style 1 | 1 | 88 | 147 | 60 |
| Interface style 2 | 2 | 129 | 180 | 60 |

## Catalogue numbers

| Description | Code |
|---|---|
| Zone monitor unit | CZMU352 |
| Shop monitor unit | MSU840 |
| Spur isolator unit | CSI350 |
| 3 channel input/output unit resets on reset (recognised as 1 address) | CIO351 |
| 230V ac relay unit | CMIO353 |

## 230V ac relay unit
**CMIO353**



### Typical applications:

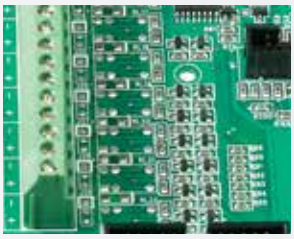
Enables simple interfacing between the fire system and other equipment such as nurse call systems or access control systems.

The ability of the output unit to switch 230V ac mains at 8A makes the unit ideal for plant control or mains powered door holders.

The input is monitored for open and short circuits therefore can be used for fire input applications such as monitoring sprinkler flow switches.

If you require higher current switching (10A) **please see page 76** for MAR724.

## 4 to 20mA interface
**CGI420**



### Typical applications:

Designed to interface with gas detection modules and are compatible with Eaton intelligent addressable control panels.

The supply to the gas detector is taken directly from the interface.



## Features

| | CZMU352/CSI350/ MSU840/CIO351 | CMIO353 |
|---|---|---|
| Ingress protection | IP40 | IP65 |

# Interfaces continued

## 4 way sounder controller unit
**CSC354CPR**



### Typical applications:

The 4 way sounder controller unit (CSC354CPR) adds functionality to your addressable panel by powering up to 4 lines of conventional output devices.

The CSC354CPR gives access to Eaton's extensive range of conventional devices, including EN54-23 certified VADs, beacons, signboards, bells and sounders.

It is ideal in situations where there is a requirement for devices with a high current draw or where conventional sounder circuits are in a remote location away from the fire alarm control panel.

### Dimensions

| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| 4 way sounder controller Unit | 300 | 300 | 74 |

### Catalogue numbers

| Description | Code |
|---|---|
| 4 way sounder controller unit) | CSC354CPR |

## Mimic relay boards
**CIOP4 / CIOP8**




### Typical applications:

These addressable mimic relay boards (CIOP4) and (CIOP8) are 4 and 8 way soft addressing output modules, incorporating integral short circuit isolators.

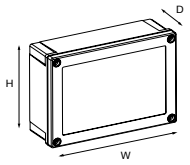
The units are suitable for switching low voltage (24V dc at 1A maximum), via a set of latching relay contacts.

The flexibility of these modules is further enhanced by the fact that each output can be programmed for a range of triggers such as disablement, fault, fire, test panel, test zone prealarm, fire routing equipment, fire protecting equipment and reset with up to 16 different trigger sources per output.

These units have an additional 4 inputs which can initiate a reset, silence, evacuate and test function.

### Dimensions

| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| CIOP4/8 mimic relay board | 180 | 244 | 63 |



Mimic relay

### Features

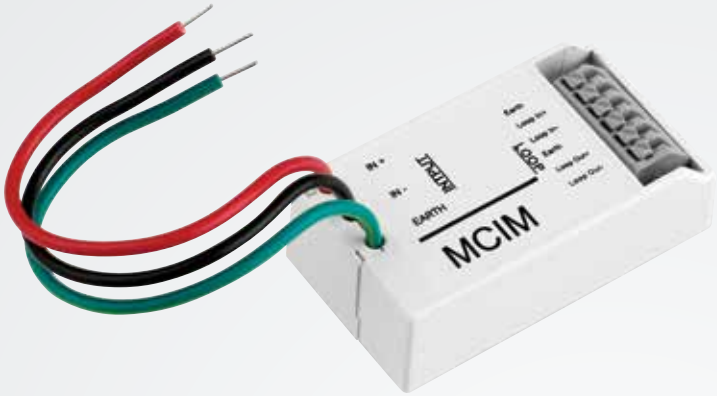
| | CSC354CPR | CIOP4/CIOP8 |
|---|---|---|
| Ingress protection | IP30 | IP65 |

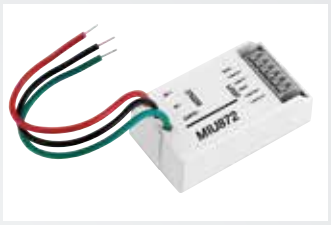
### Catalogue numbers

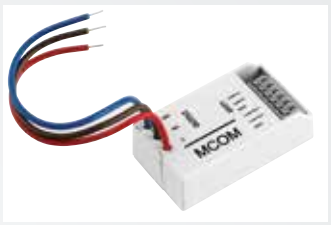
| Description | Code |
|---|---|
| Technical input/output unit | CFC301 |
| 4 way mimic relay board, 4 inputs, 4 outputs | CIOP4 |
| 8 way mimic relay board, 8 inputs, 8 outputs | CIOP8 |
| 4 to 20mA interface | CGI420 |

# Micro interfaces

Whereas our standard interfaces are designed to be installed in the position required on the loop, our range of micro interfaces are compact enough to sit within a panels' enclosure, or in our dedicated mini module enclosure (ULBU) which can house up to 3 mini modules.




## Micro zone monitor unit
**MIU872**

### Typical applications:

The micro zone monitor unit (MIU872) is suitable for interfacing a zone of up to 20 conventional detectors onto an intelligent addressable control panel.

It will operate with any conventional detector in configuration with a schottky diode type base (CDBB300).

## Micro single channel input unit
**MCIM**

### Typical applications:

The micro single channel input unit (MCIM) is suitable for monitoring a set of normally open, volt free contacts such as sprinkler system flow switches and auxiliary panel fire/fault signals. Other examples include non-fire input signals such as flow valve open contacts, generator start up, fire door closed etc.

## Micro single channel output unit
**MCOM**

### Typical applications:

The micro single channel output unit (MCOM) is suitable for switching low voltage (24V dc at 1A maximum), via a set of non latching relay contacts.

It is also suitable for switching HVAC control circuits, plant shutdown control circuits, fire door closure etc.

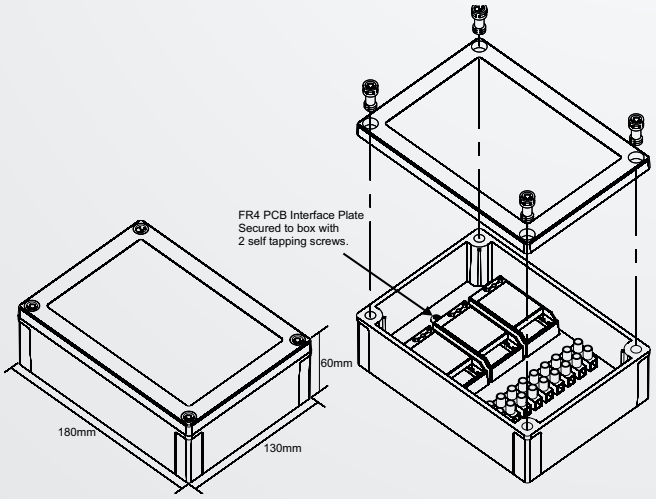
**Variants**

The (MCOM-R) gives a 5 second pulse on reset, and is used for connecting/resetting beam detectors.

The (MCOM-S) is identified by the panel as a sounder and does not reset when put into 'silence' mode, only resets once panel has been reset.

## Installation into mini module box

1. Fit the unit in position in accordance to the mounting diagram below.
2. Connect the unit according to standard connections.
3. Up to 3 units can be fitted inside a micro module box unit




## Features

| | MIU872 | MCOM | MCIM |
|---|---|---|---|
| Soft addressed | ✓ | ✓ | ✓ |
| Short circuit isolators | ✓ | ✓ | ✓ |
| Single address | ✓ | ✓ | ✓ |
| Ingress protection | IP40 | IP40 | IP40 |

## Catalogue numbers

| Description | Code |
|---|---|
| Micro zone monitor unit | MIU872 |
| MCOM Output Module | 400010FIRE-0024X |
| MCOM-S Output Module Sounder | 400012FIRE-0026X |
| MCOM-R Output Module Resettable | 400011FIRE-0025X |
| MCIM Micro single channel input unit | 400008FIRE-0022X |
| Mini module box unit (empty box) | ULBU |

# Network interfaces

Eaton offer multiple network interfaces which allow our panels and devices a wider variety of functionality. These network interfaces allow the connection of the Eaton network system to a computer network, and PC based applications such as site monitor, site graphic and web server.

## Lon to RS232 adaptor
**EC0232**



### Typical applications:

The EC0232 Lon to RS232 adapter allows connection of our system network (LonWorks) devices to PC based applications such as site monitor, site graphics and web server.

In addition to the standard adaptor, Eaton offer 2 variants for use with a HMX PA/VA system - the ECO232PAVA with no handshaking, and the EC0232PAVA3D with a 3 min time delay.

## Dual-channel LonWorks BMS interface
**EC200**




### Typical applications:

The EC200 dual-channel LonWorks BMS interface is an "add-on" to the network which translates the pre-configured network variables to a set of un-configured network variables which can then be bound to a BMS, giving full access to the fire network data.

## TCP/IP interface
**EC400**




### Typical applications:

The EC400 is a high performance, reliable and secure network infrastructure device for accessing Eaton Lon Network of intelligent addressable control panels over intranet or ethernet.

The EC400's built in configuration server manages up to 256 IP devices on 1 IP channel without a dedicated management PC.

Easy to understand diagnostic LEDs allow installers to install and troubleshoot the device without expert knowledge and dedicated troubleshooting tool.

## Lon network booster
**EC540**



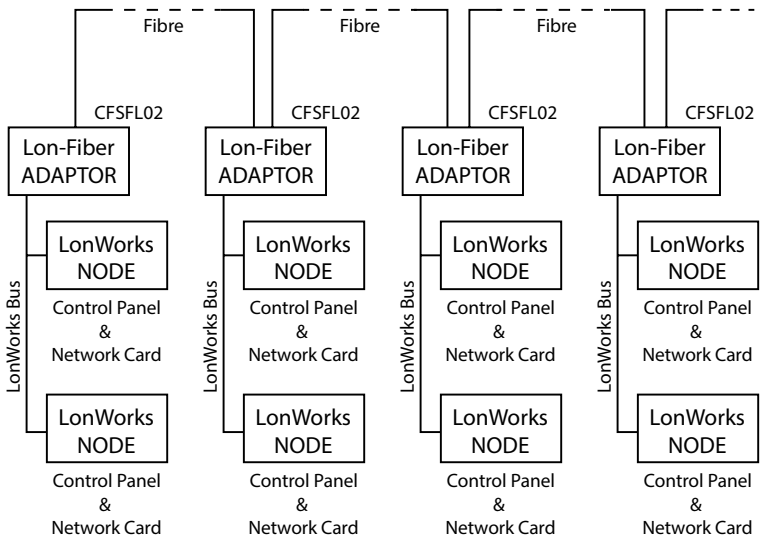

### Typical applications:

The Lon network booster (EC540) is the solution to interconnect multiple EIA-709 channels.

This unit provides up to 5 ports and routes packets between these ports. In spite of its small size the (EC540) provides best class performance and flexibility in use.

In order to provide the optimal router configuration the (EC540) supports 2 to 5 ports as well as the 2 operating modes "smart switch mode" and "configured router mode".

Fibre optic multi-drop link - example network diagram



## BACnet gateway
**EC650B**




### Typical applications:

The BACnet gateway (EC650B) is a CEA- 709/BACnet gateway which maps CEA-709 network variables (NVs) to standard BACnet server objects. When ordered with this part code (EC650B), the LonWorks to BACnet address mapping is pre-loaded and ready for use with the the intelligent addressable CF3000 system interface board.

## Modbus gateway
**EC700**



### Typical applications:

The modbus gateway is part of the InfraLINK range of network infrastructure components from partners.

All of the modbus gateways feature a robust hardware platform with high performance CPU and UART for fast communications without loss of data. The LonWorks to modbus address mapping is pre-loaded and ready for use with the CF3000 fire system interface board.

## Single mode Lon to fibre optic adapter
**CFSFL01**




### Typical applications:

The single mode Lon to fiber optic adapter (CFSFL01) allows connection of the system network (LonWorks) devices through optical fibre, and to allow both point to point or multi drop topology.

## Dual channel Lon to fibre optic adapter
**CFSFL02**




### Typical applications:

The dual channel Lon to fiber optic adapter (CFSFL02) allows connection of the system network (LonWorks) devices through optical fibre, and to allow both point to point or multi drop topology.

## Features

| | EC400/EC540 | EC700 |
|---|---|---|
| Ingress protection | IP40 (IP20 screws) | IP20 |

## Catalogue numbers

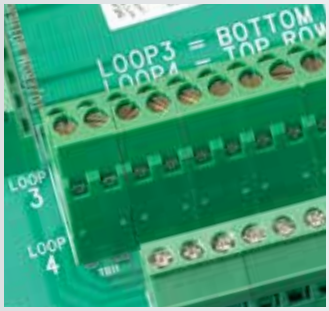
| Description | Code |
|---|---|
| Dual-channel lonworks BMS interface (non handshake) | EC200 |
| Dual-channel lonworks BMS interface (self configuring for use with EC700) | EC200S |
| Lon to RS232 adapter | EC0232 |
| Lon to RS232 adapter (For HMX pa/va system - no handshake) | EC0232PAVA |
| Lon to RS232 adapter (For HMX pa/va system - 3 min time delay) | EC0232PAVA3D |
| TCP/IP interface | EC400 |

| Description | Code |
|---|---|
| Lon network booster | EC540 |
| Bacnet gateway | EC650B |
| Modbus gateway | EC700 |
| Single mode lon to fibre optic adaptor | CFSFL01 |
| Dual channel lon to fibre optic adaptor | CFSFL02 |

# Ancillaries

A range of ancillaries are available to complement and extend the capability of our existing hardware.

## Loop splitter unit
**ZPCB2222**

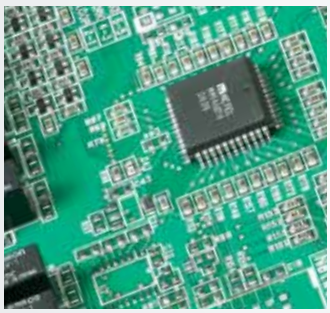



### Typical applications:

Allows expansion of the CF3000 intelligent addressable panel from 4 to 16 loops.

This interface is mainly applicable in countries where the mixing of detectors, sounders, callpoints and interfaces are not permissible on the same loop or the number of devices per loop is limited to a small number.

## Mimic PCB
**ZPCB2252MML / ZPCB2252MSL**



### Typical applications:

Up to 250 outputs can be connected to the mimic PCBs (ZPCB2252MML) and (ZPCB2252MSL). This offers more capability to the extensive options already offered by the CF3000 control panel.

These boards are typical used for geographical LED mimic displays.

## SPS Range -
**SPS-2423**
**SPS-2433**
**SPS-2453**



### Typical applications:

Offers a compact, robust and versatile power solution to installers, allowing them to safely power fire detection and signaling systems in small to large installations.

Compact and discrete design allows for these SPS to be installed in a visible location such as a hotel lobby for instance.

## Features

| | SPS-2423/SPS-2433/SPS-2453 |
|---|---|
| Ingress protection | IP30 |

## Catalogue numbers

| Description | Code |
|---|---|
| Loop splitter unit | ZPCB2222 |
| Mimic PCB (master) | ZPCB2252-MML |
| Mimic PCB (slave) | ZPCB2252-MSL |
| Safety power supply 24V / 1.5A (batteries not supplied) | SPS-2423 |
| Safety power supply 24V / 2.5A (batteries not supplied) | SPS-2433 |
| Safety power supply 24V / 4.5A (batteries not supplied) | SPS-2453 |

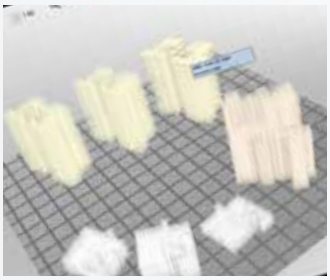

Terminal D,E
Abflug Departures Terminal A,B,C,Z
Terminal D,E
A,B,C,Z

# Software

Eaton offer a number of specialised programs to aid with the installation, maintenance, functionality and servicing of our addressable systems. Installed using the USB analogue systems panel interface **(see p41)** and a PC or laptop, these software programs help to solidify our addressable systems' capabilities and make it easier for users to control and organise the system on their site.



## Graphical visualisation software
**EFGVS**



### Typical applications:

Eaton Fire Graphic Visualisation Software (EFGVS) is a state of the art and powerful supervision management tool for Eaton Fire addressable systems.

Users can monitor, visualise in 2D and 3D, control and interrogate their systems to ensure alarms are located quickly and dealt with efficiently.

Ergonomic and intuitive, EFGVS includes a comprehensive list of advanced features offering the system designer and site supervisor a very efficient tool ensuring all information and controls be available at their fingertips.

## Site monitor
**SITEMONITOR**



### Typical applications:

Site monitor / webserver software is designed to monitor Eaton fire systems and allow quick PC based administration.

Using a simple interface, authorised users can view control panel event history, event status, device properties and other information depending on access permissions defined by the system administrator.

## Catalogue numbers

| Description | Code |
|---|---|
| Graphical Visualisation Software license 1-2 panels including an EC0232 interface | EFGVS1-2 |
| Graphical Visualisation Software license up to 6 panels including an EC0232 interface | EFGVS3-6 |
| Graphical Visualisation Software license up to 10 panels including an EC0232 interface | EFGVS7-10 |
| Graphical Visualisation Software license above 10 panels including an EC0232 interface | EFGVS11-PLUS |
| Graphical Visualisation Software license up to 10 panels with TCP/IP interlink | EFGVS7-10-TCPIP |
| Graphical Visualisation Software license above 10 panels with TCP/IP interlink | EFGVS11-PLUS-TC |
| Graphical Visualisation Designer Software license - no panel connectivity | EFGVS-DESIGN |

| Description | Code |
|---|---|
| Graphical Visualisation Premium Designer Software license including an EC0232 interface | EFGVS-PREMIUM |
| Interface to connect panel network (LONWorks) to PC (RS232) | EC0322 |
| Site monitor / webserver software | SITEMONITOR |

All software products except SITEMONITOR include EC0232 (p36) as standard

# Testing equipment

As well as offering complete fire systems, Eaton can also provide testing equipment to ease the process of installation, commissioning, maintenance and fault finding.

## Loop tester kit
**LP800KIT**



### Typical applications:

The loop tester kit is a hardware/software combination that can be used to test, commission and fault find a loop of up to 200 intelligent addressable devices (sensors, sounders, ancillary devices) without having to connect the loop to the intelligent addressable control panel.

The loop tester is connected between the loop and PC, and allows the engineer to quickly identify and locate any loop device that is operating outside its operating conditions.

## USB analogue systems panel interface
**USBINT2**



### Typical applications:

The analogue systems panel interface is a universal serial bus converter that provides conversions from RS232 to USB, TTL to USB or TTL to RS232.

These options provide the connectivity required between a PC and intelligent addressable control panels, wireless control panels, and wireless survey tools including our range of software solutions (**see page 40**).

## Addressable device programmer
**CF800PROG**



### Typical applications:

The addressable device programmer is a versatile tool to aid the installation, commissioning, maintenance and servicing of current intelligent addressable devices and fire systems.

This unit is light, robust and easy to operate using a user friendly menu structure on 2 x 40 character LCD display. It is powered from a single PP3 size, heavy duty battery or an external supply.

CF800PROG can:

Program sensor modes **(see p24).**

Change address details

Change heat detector settings

Read analogue levels

## Catalogue numbers

| Description | Code |
|---|---|
| Loop tester kit | LP800KIT |
| Addressable device programmer | CF800PROG |
| USB panel interface | USBINT2 |



# UL Systems

Underwriters Laboratories Inc. (UL) is an independent product safety certification organisation, established in 1894, to develop standards and test procedures for products, materials, components, assemblies, tools and equipment. Chiefly dealing with product safety it also evaluates and certifies the efficiency of a company's business processes through its magnificent system registration programs.

Since the launch of our UL Listed fire product range, several prestigious projects worldwide have been supplied including Hyatt Resort and Spa, Shangri-la at the Fort and Times Square projects in South East Asia and several major projects in the Middle East including a major projects within the prestigious Riyadh Financial District in the Kingdom of Saudi Arabia.

The Eaton UL range is designed to provide a solution for all sizes of project, from the simple small stand alone system to the large multi panel networked system with PA/VA and BMS integration.



# Contents

## UL listed fire systems range

### Panels

ULCF3000 series panels **44**



### Devices

Addressable sensors **46**



Conventional detectors **48**



Horns and strobes **50**




Pull stations **52**




Interfaces **54**




Micro interfaces **55**




SIGNALING
LISTED
4AC5
FIRE ALARM
EQUIPMENT

# ULCF3000 series
## UL listed control panels




ULCF3000RM (wall mount red metal)



ULCF3000 (wall mount graphite)

The ULCF3000 series panels are UL listed, high specification, wall or rack mounted fire panels. Combining sophisticated functionality with simple operation and aesthetically pleasing design, the panels are available in a number of loop configurations. Each panel is networkable with up to 126 other Eaton UL fire panels.

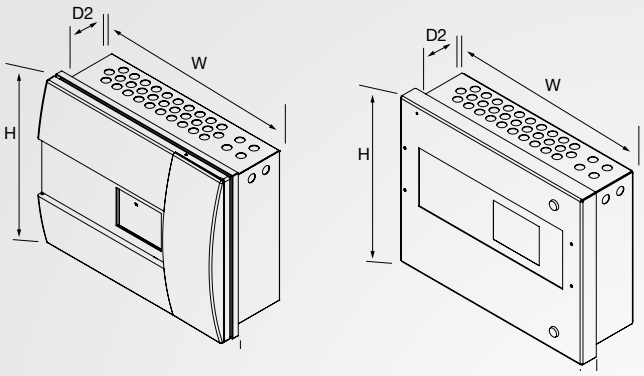
The control panel has the ability to support complex cause and effect programming. A wide range of user controllable functions make the system ideal for a diverse range of projects, from industrial applications through to large multi-site commercial developments.

### Benefits

- Soft addressing
- Large versatile touchscreen user interface
- Integral printer (optional)
- Integral battery and power supply
- 2 x 12Ah batteries included
- Flexible distributed network capability
- Full range of compatible devices
- 4 notification appliance circuits (NACs) outputs
- 2 or 4 class A style 7 SLC loops
- PAS (Positive Alarm Sequence)

SIGNALING
LISTED
4AC5
FIRE ALARM
EQUIPMENT

## Dimensions




| Description | H (mm) | W (mm) | D1 (mm) | D2 (mm) |
|---|---|---|---|---|
| ULCF3000 | 397 | 497 | 75 | 130 |
| ULCF3000RM | 398 | 505 | 48 | 118 |






## Compatible repeater panels

The ULCF3000 has both a standard and a touchscreen repeater panel available. Ideal for larger sites, the repeater allows you to display the system information from multiple locations.





## Features

| | ULCF3000PRG | ULCTPR3000 |
|---|---|---|
| Active or passive option | × | ✓ |
| No programming required | ✓* | ✓ |
| Multi language capability | × | ✓ |
| Allows networking with other Eaton fire panels | × | ✓ |
| Integral power supply | ✓ | ✓ |
| Ingress protection | IP30 | IP40 |

*Except local text information



## Catalogue numbers

| Description | Code |
|---|---|
| 2 loop panel | ULCF30002G |
| 4 loop panel | ULCF30004G |
| 2 loop panel, integral printer | ULCF30002GP |
| 4 loop panel, integral printer | ULCF30004GP |
| 2 loop panel, network card | ULCF30002GNC |
| 4 loop panel, network card | ULCF30004GNC |
| 2 loop panel, integral printer, network card | ULCF30002GPNC |
| 4 loop panel, integral printer, network card | ULCF30004GPNC |
| 2 loop panel, red metal box | ULCF30002GRM |
| 4 loop panel, red metal box | ULCF30004GRM |
| 2 loop panel, integral printer, red metal box | ULCF30002GPRM |

| Description | Code |
|---|---|
| 4 loop panel, integral printer, red metal box | ULCF30004GPRM |
| 2 loop panel, network card, red metal box | ULCF30002GNCRM |
| 4 loop panel, network card, red metal box | ULCF30004GNCRM |
| 2 loop panel, integral printer, network card, red metal box | ULCF30002GPNCRM |
| 4 loop panel, integral printer, network card, red metal box | ULCF30004GPNCRM |
| Rack mounted 2 loop panel | ULR3000L2 |
| Rack mounted 4 loop panel | ULR3000L4 |
| Rack mounted 2 loop panel c/w network card | ULR3000L2NC |
| Rack mounted 4 loop panel c/w network card | ULR3000L4NC |
| Loop connected repeater panel | ULCF3000PRG |
| Touchscreen network repeater panel | ULCTPR3000 |

# Sensors

Our UL range has multiple options for intelligent addressable sensors. All sensors are designed for optimum functionality in mid-large sized builds. They are all soft addressed and have integral short circuit isolators.

## Addressable sensor base
**UCAB300**



### Typical applications:

Specifically designed for use with all of our UL addressable sensors, the UCAB base will be used in all builds.

## Optical smoke sensor
**ULCAP320**



### Typical applications:

Suitable for most applications.

Fastest response to slow burning or smouldering fires which give rise to large visible smoke particles.

## Photo-thermal sensor
**ULCAPT340**



### Typical applications:

Responds quickly to fast clean burning fires.

Maintains the advantage of optical sensors when detecting smouldering fires.

## Heat sensor
**ULCAH330**



### Typical applications:

Environments where the ambient conditions might cause false alarms with smoke detectors.

Examples include areas with high levels of dust or fumes.



Sensor detail



Addressable base detail

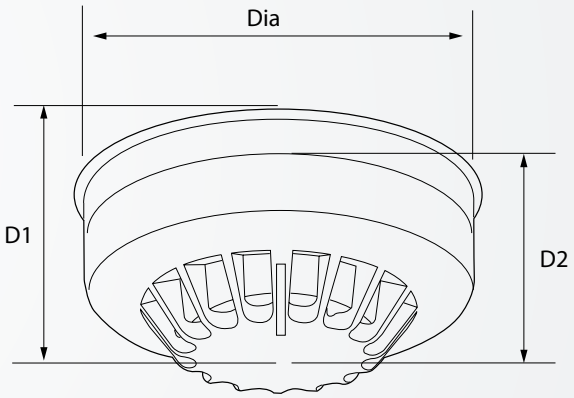


SIGNALING UL LISTED

## Performance

| Heat Class | ULCAP320 | ULCAPT340 | ULCAH330 |
|---|---|---|---|
| Heat element rating | N/A | 135°F | ROR + Fixed 135°F, Fixed 135°, Fixed 194°F |
| Heat detector spacing | N/A | 50ft (heat alone operation) | 50ft |
| Heat class | N/A | A2S | A2R |

## Dimensions




| Description | Diameter (mm) (incl base) | Depth (mm) (excl base) | Depth (mm) (incl base) |
|---|---|---|---|
| Optical | 104 | 33 | 45 |
| Photo-thermal | 104 | 43 | 55 |
| Heat | 104 | 43 | 55 |




## Features

| | ULCAP320 | ULCAPT340 | ULCAH330 |
|---|---|---|---|
| Ingress protection | IP30 | IP30 | IP30 |

## Catalogue numbers

| Description | Code |
|---|---|
| ULCAP320 Optical smoke sensor | 400005FIRE-0011X |
| ULCAPT340 Photo-thermal sensor | 400006FIRE-0012X |
| ULCAH330 Heat sensor | 400007FIRE-0013X |
| Addressable sensor base | UCAB300 |

# Detectors

Our UL range has multiple options for conventional detectors. All detectors have a removable detector chamber and drift compensation. The range of detectors for different applications allow for all build requirements to be met.

As there is no UL certified conventional panel a ULMIU872 micro interface (p55) is required in conjunction with a UL intelligent addressable panel to use conventional detectors.

## Optical smoke detector
**UCPD-2W**



### Typical applications:

Suitable for most applications.

Fastest response to slow burning or smouldering fires which give rise to large visible smoke particles.

## Photo-thermal detector
**UCPT-2W**



### Typical applications:

Responds quickly to fast clean burning fires.

Maintains the advantage of optical sensors when detecting smouldering fires.

## Fixed heat detector (135°F)
**UCHT-2W**



### Typical applications:

Environments where the ambient conditions might cause false alarms with smoke detectors.

Examples include areas with high levels of dust or fumes.

## Performance

| Heat class | UCPD-2W | UCPT-2W | UCHT-2W |
|---|---|---|---|
| Heat element rating | N/A | 135°F | 135°F |
| Heat detector spacing | N/A | 50ft (heat alone operation) | 50ft |
| Mounting position | Ceiling in open areas | Ceiling in open areas | Ceiling in open areas |

## Features

| | UCPD-2W | UCPT-2W | UCHT-2W |
|---|---|---|---|
| Ingress protection | IP40 | IP40 | IP40 |



SIGNALING UL LISTED

## Conventional detector base
**CB2E**

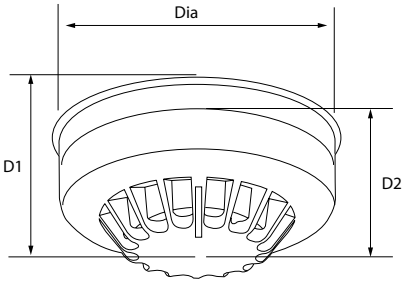


## Typical applications:

The CB2E has been specifically designed for compatibility with our UL range of conventional detectors. It can be be used in all builds with conventional detectors.



## Dimensions




| Description | Diameter (mm) (incl base) | Depth (mm) (incl base) | Depth (mm) (excl base) |
|---|---|---|---|
| Optical | 104 | 45 | 33 |
| Photo-thermal | 104 | 55 | 43 |
| Heat | 104 | 55 | 43 |

## Catalogue numbers

| Description | Code |
|---|---|
| 2 wire detector, optical | UCPD-2W |
| 2 wire detector, opto-heat | UCPT-2W |
| 2 wire detector, fixed heat 135°f | UCHT-2W |
| Standard detector base | CB2E |

# Horns and strobes

Our UL range incorporates a variety of audio and visual notification devices. Each device has up to 48% savings in current draw compared to similar products. The whole range is easy to install and has voltage test points for quick troubleshooting and easy spot checking, saving time on both installation and maintenance.

## Wall mount horn
**HNR**



### Typical applications:

The horns are ideal for retrofit jobs, limited space environments and pre-existing wire configurations.

## Ceiling mount horn
**CN128972**



### Typical applications:

The horns are ideal for retrofit jobs, limited space environments and pre-existing wire configurations.

## Wall mount horn strobe/synchronised strobe
**CN127249/STR**




### Typical applications:

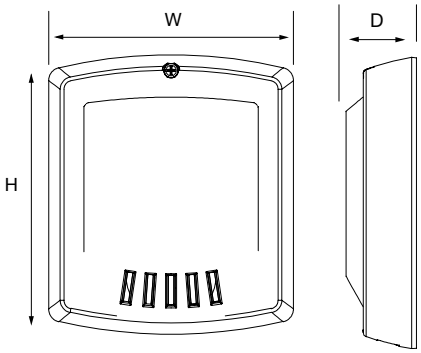
With the range of settings for both audio and visual purposes, these products are effectively 9 models in 1 appliance. With this functionality, and both ceiling and wall mount options available, it will meet almost any build requirements.

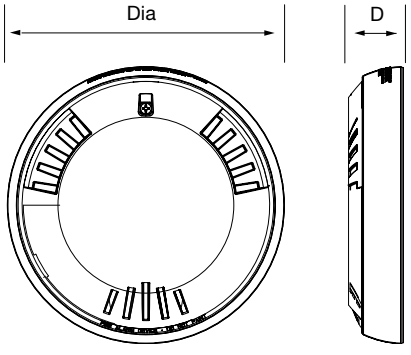
The synchronised option enhances both the sound and light output by keeping the outputs of multiple devices in sync.

## Ceiling mount horn strobe/synchronised strobe
**CN127464/CN127488**




## Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Wall mount horn HNR | 133 | 116 | 56 |
| Wall mount horn strobe/ synchronised strobe CN127249/STR | 131 | 131 | 110 |

| Description | Diameter (mm) | Depth (mm) |
|---|---|---|
| Ceiling mount horn CN128972 | 166 | 34 |
| Ceiling mount horn/ synchronised strobe CN127464/CN127488 | 166 | 34 |



SIGNALING UL LISTED

## Wall mount outdoor synchronised strobe
**CN129013**




## Ceiling mount outdoor synchronised strobe
**CN124338**



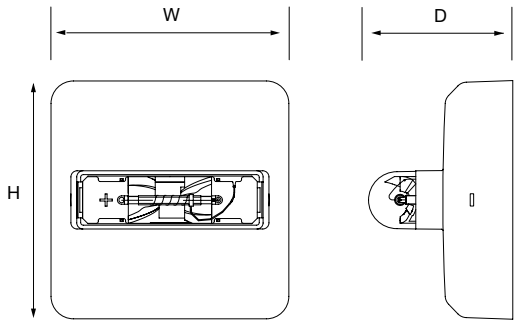
## Typical applications:

The outdoor synchronised strobes are UL certified to meet adverse weather conditions. They are perfect for builds where outdoor indication is required.

These units use a universal, common mounting base making them ideal for retrofit jobs, limited space environments and pre-existing wire configurations.




## Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| RSSWP* | 131 | 131 | 110 |

*Both wall mount and ceiling mount variants

## Catalogue Numbers

| Description | Code |
|---|---|
| Wall mount horn | HNR |
| Ceiling mount horn | CN128972 |
| Wall mount horn strobe | CN127249 |
| Ceiling mount horn strobe | CN127464 |
| Wall mount synchronised strobe | STR |
| Ceiling mounted synchronised strobe | CN127488 |
| Wall mount outdoor synchronised strobe | CN129013 |
| Ceiling mount outdoor synchronised strobe | CN124338 |
| WPSBB -R Exposed conduit, surface mount back box (RED) | CN109751 |
| WPSBB-R + WP-KIT Concealed conduit surface mount back box (RED) | CN109751 + CN104486 |

# Pull stations

The addressable pull stations are constructed of high quality, die cast metal for long lasting performance. The range consists of the UL listed MPS range of pull stations and the UL listed fast response input initiating module (ULMCIM-C).

## Single action addressable pull station
**UMPS-100/ UMPS-100WP**




### Typical applications:

Indoor/weatherproof pull station for use with addressable systems (UMPS-100/UMPS-100WP).

A dual action model is also available (UMPS-200, not shown), where the push bar rotates inward allowing the pull handle to be grasped in a one handed motion.

## Single action conventional pull station
**SG42BK2**



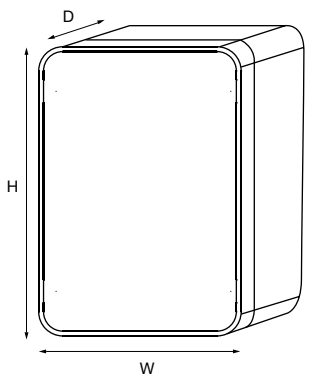

### Typical applications:

Cost effective conventional version of the single action pull station, must be used in conjunction with ULMIU872. **Back box ordered seperately.**




Pull station detail

## Dimensions




| H (mm) | W (mm) | D (mm) |
|---|---|---|
| 118 | 80 | 80 |

## Catalogue numbers

| Description | Code |
|---|---|
| Single action pull station, supplied with back box (addressable) | UMPS-100 |
| Weatherpoof single action pull station | UMPS-100WP |
| Double action pull station | UMPS-200 |
| Weatherproof double action pull station | UMPS-200WP |
| Micro zone monitor unit | ULMIU872 |
| Micro single channel input unit (recognised as callpoint) | ULMCIM-C |
| Conventional single action pull station (back box ordered seperately) | SG42BK2 |
| Conventional double action pull station (back box ordered seperately) | SG42BK1 |
| Back box for conventional, surface mounting | SGB32S |
| Back box for conventional, weatherproof | SGB-32C |



SIGNALING UL LISTED



# Interfaces

We supply an extensive range of interfaces to support our UL control panels. Interfaces allow for a wide variety of installations to be simplified without the use of specialist or customised equipment. For assistance deciding which interfaces will benefit you the most, contact our technical support team; **firetechsupport@eatoncom**

## 4 Way Sounder Controller Unit
**ULCSC354**



### Typical applications:

The unit connects 4 lines of conventional output devices on a single address to an addressable panel. Ideal for when specialist devices with a high current draw are required, such as Eaton's UL ceiling and wall horns/strobes. Or where conventional sounder circuits are in a remote location away from the fire alarm control panel.

## Shop monitor unit
**ULCSUM355**



### Typical applications:

The shop monitor unit is designed to allow small units with conventional fire systems to be fully integrated with a main intelligent addressable fire system.

It is ideal for connecting individual shop units into a main shopping centre system.

## Spur isolator unit
**ULCSI350**



### Typical applications:

The spur isolator unit enables a spur of intelligent addressable devices to be connected to a main analogue loop. This simplifies the installation of remote parts of buildings or system extensions.

## 3 channel I/O unit
**ULCIO351**



### Typical applications:

The 3 channel input/output unit enables simple interfacing between the fire system and other equipment such as nurse call systems or access control systems. The inputs are fully monitored for open and short circuits.

## 230V ac relay unit
**ULCMIO353**



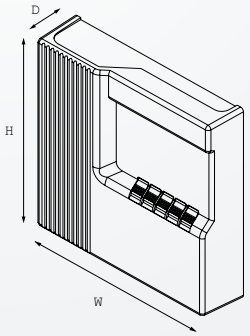
### Typical applications:

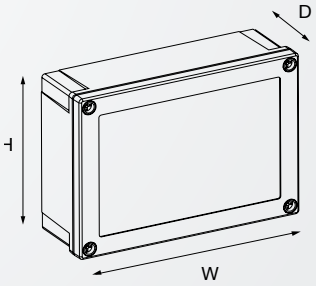
Enables simple interfacing between the fire system and other equipment such as nurse call systems or access control systems.

The ability of the output unit to switch mains also makes the unit ideal for plant control or mains powered door holders.

The input is monitored for open and short circuits so can be used for fire input applications such as monitoring sprinkler flow switches.

## Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Interface units | 129 | 180 | 60 |
| 4 way sounder controller unit | 300 | 300 | 74 |

## Features

| | ULCSC354 | ULCSUM355 /ULCSI350/ ULCIO351/ULCMIO353 |
|---|---|---|
| Ingress protection | IP30 | IP40 |



SIGNALING UL LISTED

# Micro interfaces

Whilst our standard UL interfaces are designed to be installed in the position required on the loop, our range of micro interfaces can sit within a panels' enclosure.

## Micro single channel output units
**ULMCOM/ULMCOM-S**




### Typical applications:

The Micro Single Channel Output Unit (ULMCOM) is suitable for switching low voltage (24V dc at 1A maximum), via a set of non latching relay contacts.

It is also suitable for switching HVAC control circuits, plant shutdown control circuits, fire door closure etc.

The ULMCOM-S is identified by the panel as a sounder.

## Micro single channel input units
**ULMCIM/ULMCIM-C**




### Typical applications:

The Micro Single Channel Input Unit (ULMCIM) is suitable for monitoring a set of normally open, volt free contacts such as sprinkler system flow switches and auxiliary panel fire/fault signals. Other examples include non-fire input signals such as flow valve open contacts, generator start up, fire door closed etc.

The ULMCIM-C is identified by the panel as a call point and is designed for use with pull stations.

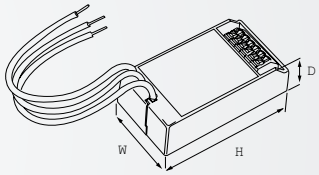
## Micro zone monitor unit
**ULMIU872**




### Typical applications:

The Micro Zone Monitor Unit (ULMIU872) is suitable for monitoring a zone of up to 20 UL approved conventional detectors.

## Dimensions




| H (mm) | W (mm) | D (mm) |
|---|---|---|
| 65 | 35 | 18.5 |

Please be aware, we offer an enclosure for our micro interfaces, **see p35.**

## Features

| | ULMCOM/ ULMCOM-S | ULMCIM/ ULMCIM-C | ULMIU872 | ULMIU872 | ULBU |
|---|---|---|---|---|---|
| Ingress protection | IP40 | IP40 | IP40 | IP40 | IP40 |

## Catalogue numbers

| Description | Code |
|---|---|
| 4 way sounder controller unit | ULCSC354 |
| Shop monitor unit | ULCSUM355 |
| Spur isolator unit | ULCSI350 |
| 3 Channel input/output unit resets on reset | ULCIO351 |
| 3 Channel input/output unit rests on silence alarms | ULCIO351S |
| 120V/230V ac relay unit | ULCMIO353 |
| Micro zone monitor unit | ULMIU872 |

| Description | Code |
|---|---|
| ULMCOM Micro single channel output unit (recognised as output unit) | 400015FIRE-0029X |
| ULMCOM-S Micro single channel output unit (recognised as sounder) | 400016FIRE-0030X |
| ULMCIM Micro single channel input unit (recognised as input unit) | 400013FIRE-0027X |
| ULMCIM-C Micro single channel input unit (recognised as callpoint) | 400014FIRE-0028X |
| Mini module box unit (empty box) | ULBU |

SIGNALING UL LISTED







# Contents

## Conventional fire systems

### Conventional fire system panels

EFCV8 series panel 58



FXP2200 series panel 60



FXP5000 series panel 62



### Conventional devices

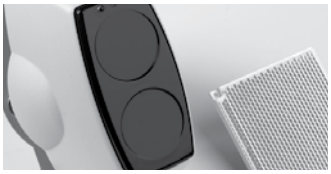
Detectors and indicators 64



Bases 66



Beam detectors 66



Duct probe detector 67



Callpoints 68



Bells 69




Sounders 70



Visual alarm devices 72



Indicators 74



Sounder indicators 75



Door retainers 76



Auxiliary power supply 77



# EFCV8Z
## Conventional control panel



Eaton's 8 zone conventional fire system panel delivers a straightforward, intuitive interface that makes programming and maintenance simple.

Approved to EN54-2&4, it offers a comprehensive set of functionalities in a modern, robust and discrete enclosure. It's appearance and performance makes the panel well suited for life safety notification in a wide variety of small to medium sized buildings, particularly schools, warehouses, retail stores and office buildings.

With the addition of an isolator barrier the panel has the additional flexibility to monitor standard or intrinsically safe conventional zone circuits, making it suitable for industrial applications.

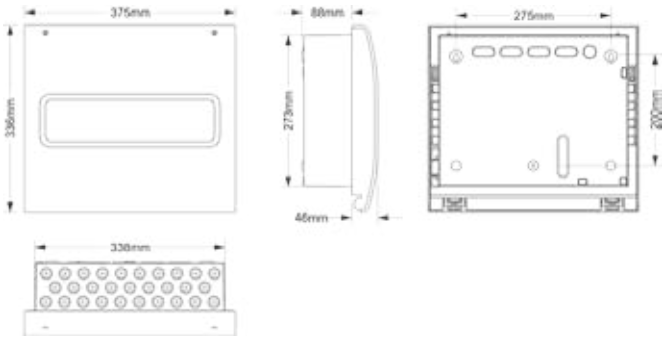
| | EFCV8ZONE |
|---|---|
| No. of zones | 8 |
| Detectors per zone | 32 |
| Maximum loading per zone | 32mA |
| Repeater Port | ✓ |
| No. of sounder circuits | 4 |
| Maximum loading per sounder circuit | 250mA |
| Ingress protection | IP30 |

### Benefits

- Zones switchable between standard conventional and intrinsically safe zones (using isolator barrier)
- One man test facility
- Class change input
- Interlink relay functionality for connecting 2 panels together
- Interlink relay allows forgreater system flexibility
- Supports an expansion card for Fire Routing Equipment, Fire Protection Equipment and fire relays per zone
- Modern and discreet enclosure



## Dimensions




| | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Complete Panel | 336 | 375 | 134 |
| Back Box | 273 | 338 | 88 |

## Catalogue numbers

| Description | Code |
|---|---|
| Eaton 8 Zone Conventional Panel | EFCV8Z |
| End of Line Module | EOLM-1 |
| 8 Zone Relays + FRE/FPE | BW0B8Z |

# FX2200CPD series
## Conventional control panel



"A flexible conventional solution that ensures ease of use and high reliability"

The FX2200CPD range of conventional control panels provide a solution to any conventional system requirement. The advanced features include a simple "one-shot" user test facility, class change contacts, battery voltage alarms and charger temperature compensation, all included as standard to ensure ease of use and high reliability.

Attention to detail is emphasised by the neat log book holder feature, allowing essential records to be stored close to hand, ready for quick reference. For larger installations, custom configuration of the panels offers even greater flexibility, allowing project specific requirements to be easily met, in a competitive and cost effective package.

### Benefits

- Compact design
- Surface or semi-flush mounting
- Numerical access code (no lost keys)
- 2 or 4 zones panels
- Flexible, high specification system
- Simple "one-shot" auto-reset user test facility
- Maintenance free poly switch circuit protection, with auto reset

| | FX2202 | FX2204 |
|---|---|---|
| No. of zones | 2 | 4 |
| Detectors per zone | 32 | 32 |
| No. of alarm circuits | 2 (4 on FX2202CR) | 2 (4 on FX2204CR) |

| | FX2202 | FX2204 | FXRP2200 |
|---|---|---|---|
| Ingress protection | IP30 | IP30 | IP30 |

## Compatible Repeater Panel

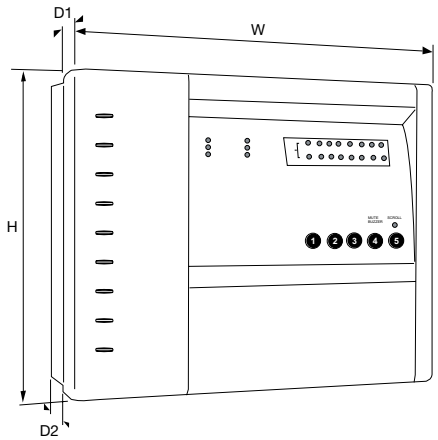
To complement the FX2200 range a repeater panel is available for connection to the 4 zone control panel. Specifically designed for ease of installation, it requires only 2 interconnecting wires from the main panel, saving material cost and labour time. Further repeater panels can be cascaded which does not affect standby time as each has its own mains supply and standby battery. The repeater displays all the same functions as the main panel and includes an indicator test facility.



## Features

- Charger with built in temperature compensation
- Displays essential information at other key locations in a large building/site
- Zone fire and fault conditions
- Test mode in operation
- Zones or alarm lines in disabled mode

## Dimensions




| | H (mm) | W (mm) | D1 (mm) | D2 (mm) |
|---|---|---|---|---|
| 2 / 4 zone panel | 270 | 332 | 45 | 47 |
| Cut-out | 265 | 327 | - | - |

**Note:** If surface mounting add D1 and D2 to obtain depth dimension

## Catalogue numbers

| Description | Code |
|---|---|
| Conventional 2 Zone Panel | FX2202CPD |
| Conventional 4 Zone Panel | FX2204CPD |
| Conventional Repeater Panel | FXRP2200 |
| Steel Back Box (for use with FX2202/4/8) | FX22003300 MB |
| Fire Alarm System Log Book | MFALOG |

# CF5000 series
## Conventional control panel




NEW PRODUCT

"Contemporary and compact panel design that provides a solution to any conventional system requirement"

The new FXP5000 conventional control panel is currently available in a 16 zone version. The panel features an array of user friendly features and are available at very competitive prices. The attractive flush or surface mountable plastic enclosure, with metal back box, has been designed through intensive voice of the customer research to provide ample space for termination of cables.

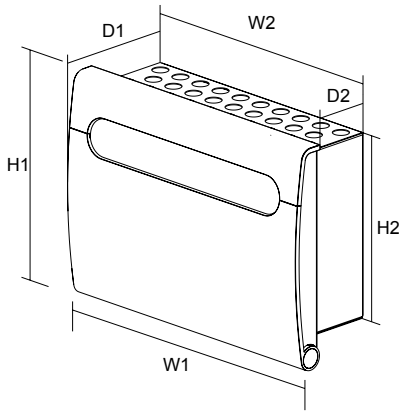
### Benefits

- Zonal relay card as standard
- One man test facility
- Non latching zone feature
- Class change input
- Fire and fault relays
- Discreet enclosure
- Supplied complete with battery for 24 hour standby

| | CF50016 |
|---|---|
| No. of zones | 16 |
| Detectors per zone | 30 |
| No. of alarm circuits | 4 |
| Zonal relay card | ✓ |
| Ingress protection | IP30 |



## Dimensions




| Description | H1 (mm) | W1 (mm) | D1 (mm) | H2 (mm) | W2 (mm) | D2 (mm) |
|---|---|---|---|---|---|---|
| | Total height | Total width | Total depth | Back box height | Back box width | Back box depth |
| 16 Zone | 276 | 375 | 136 | 232 | 335 | 96 |

## Catalogue numbers

| Description | Code |
|---|---|
| 16 zone control panel | CF50016 |
| Fire alarm system log book | MFALOG |

# Detectors and remote indicator

The conventional range offers a multi-mode, 5 in 1 detector (FXN922), covering many building needs. It's quick and simple to install with a stylish low profile design. The detector is mounted on our standard conventional base (FXN520) but can also be used in conjunction with our relay base (FXN520R) for local switching. Each detector is fitted with a 360˚ viewable LED for indication.

This multi-mode detector can be configured to operate as either an optical detector, photo-thermal detector or 1 of 3 heat detector modes (A1R, BS, CS) using the four position switches located at the back of the detector. The FXN922 is certified for use in all 5 modes.

## Multimode detector
**FXN922**



Base not included. See p66 for compatible bases.

### Optical smoke detector mode

**Typical applications:**

Suitable for most applications.

Fastest response to slow burning or smouldering fires which give rise to large visible smoke particles.

### Photo-thermal detector mode

**Typical applications:**

Responds quickly to fast clean burning fires.

Maintains the advantage of optical sensors when detecting smouldering fires.

### Rate of rise heat detector mode

**Typical applications:**

Environments where the ambient conditions might cause false alarms with smoke detectors.

Examples include areas with high levels of dust or fumes.

### Fixed heat detector (77°) mode

**Typical applications:**

Environments where a change in temperature is a likely occurrence. Using a fixed heat negates false alarms from insignificant temperature rises.

### Fixed heat detector (92°) mode

**Typical applications:**

Environments where the ambient heat levels are likely to be above normal temperatures, such as restaurant kitchens.

**Note:**

We can also supply separate detectors for each individual mode if they are required. These are displayed in the catalogue numbers in the table over the page.

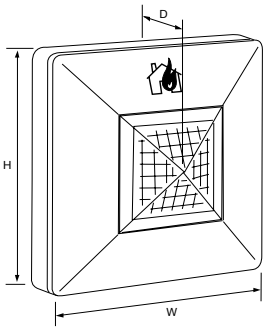
## Remote indicator
**CIR301**



### Typical applications:

The remote indicator is ideal for applications such as void spaces or outside locked or inaccessible rooms to provide indication of the activation of an automatic detector.

## Dimensions

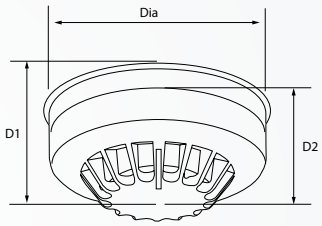



| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Remote indicator | 87 | 87 | 49 |

## Performance

| Feature | Optical smoke mode | Photo-thermal mode | Rate of rise mode | Fixed heat 77 ˚C mode | Fixed heat 92 ˚C mode |
|---|---|---|---|---|---|
| Area coverage (subject to local standards) | 100m$^2$ | 100m$^2$ | 50m$^2$ | 50m$^2$ | 50m$^2$ |
| Heat class | N/A | A2S | A1R | BS | CS |
| Alarm temperature | N/A | 60 ˚C | 60 ˚C | 77 ˚C | 92 ˚C |

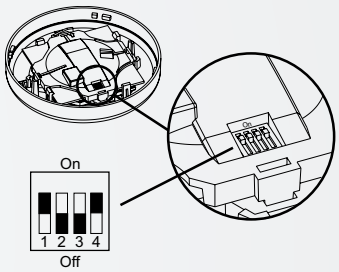
## Dimensions




| Description | Diameter (mm) (incl base) | Depth (mm) (incl base) | Depth (mm) (excl base) |
|---|---|---|---|
| Multimode detector* | 104 | 42 | 55 |
| Optical smoke detector | 104 | 33 | 45 |

* All other conventional detectors share same dimensions

## Switch settings




| Description | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|
| Optical mode | - | OFF | OFF | OFF |
| Photo-thermal mode | - | OFF | OFF | ON |
| Rate of rise mode | - | ON | OFF | OFF |
| Fixed heat 77° mode | - | OFF | OFF | ON |
| Fixed heat 92° mode | - | ON | ON | OFF |

| | FXN922/CPD321/ CPT341/CFR330/ CMT360/CMT390 | CIR301/CIR301WP |
|---|---|---|
| Ingress protection | IP40 | IP30 |



## Catalogue numbers

| Description | Code |
|---|---|
| 5 in 1 Multi-Mode Detector | FXN922 |
| Optical Smoke Detector | CPD321 |
| Photo-Thermal Detector | CPT341 |
| Rate of Rise Heat detector | CFR330 |
| Fixed Heat Detector 77 ˚C | CMT360 |
| Fixed Heat Detector 92 ˚C | CMT390 |
| Remote Indicator | CIR301 |
| Weatherproof Remote Indicator | CIR301WP |

# Bases

There are two types of conventional detector bases, compatible with our range of detector heads to provide a wide functionality for different applications. The standard base (FXN520) is a general use product, providing a foundation for our conventional detectors, whereas the relay base (FXN520R) provides a local relay signal in the event of its host detector being triggered, making it ideal for instigating a local response.

# Beam detectors

There are two zone powered reflective beam detectors designed to be fully compatible with our conventional control panels. The MBD50R has a range of up to 50 meters and the MBD100R has a range of up to 100 metres. Neither require a power supply and both are equipped with a simple set up mode to enable easy and quick alignment during installation.

## Standard base
**CDBB300**



### Typical applications:

General use product, suitable for use in most indoor applications.

## Relay base
**FXN520R**



### Typical applications:

Areas where a local response is required.

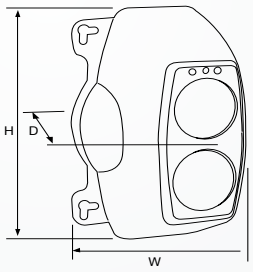
## Conventional reflective beam detector
**MBD50R / MBD100R**



### Typical applications:

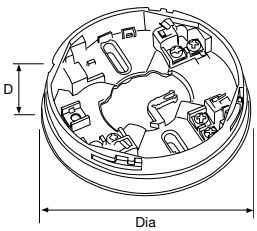
Large open areas such as warehouses, manufacturing plants, shopping centres, airports etc.

## Dimensions

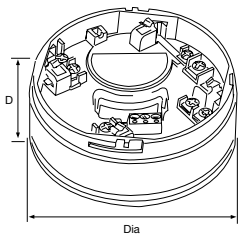



| H (mm) | W(mm) | D (mm) |
|---|---|---|
| 210 | 130 | 120 |

## Dimensions




Standard base




Relay base

| Description | Dia (mm) | D (mm) |
|---|---|---|
| Standard base | 104 | 22 |
| Relay base | 102 | 40 |

## Features

| | MBD50R | MBD100R |
|---|---|---|
| Operating range | 5 to 50 metres | 50 to 100 metres |
| Tolerance to beam misalignment at 35% | Detector ± 0.8˚, prism ± 5.0˚ | Detector ± 0.8˚, prism ± 5.0˚ |
| Fire alarm thresholds | 2.50dB (25%)<br>3.74dB (35%)<br>6.02dB (50%) | 2.50dB (25%)<br>3.74dB (35%)<br>6.02dB (50%) |
| Optical wavelength | 880nm | 880nm |
| Ingress protection | IP40 | IP40 |

Beam detectors have 3 operating modes:

**Prism targeting mode** designed to provide simple initial alignment of beam and reflector assembly.

**Alignment mode** enables accurate fine tuning of beam alignment without the need for additional calibration equipment or a second operator.

**Normal running mode** during standard operation.

# Duct probe detector

The presence of smoke in a ventilation duct is detected by sampling the airflow through the duct via two sampling tubes. An optical detector and base are mounted within the sampling chamber, which is located on the external skin of the duct, with sample and exhaust probes passing into the duct in an area of low turbulence.

## Duct probe unit
**MDP201**





Duct probe unit shown with optical detector - **detector and base must be ordered separately.**

## Typical applications:

Detecting presence of smoke in ventilation ducts.



Duct probe units can be used to detect the presence of smoke in a ventilation duct

## Features

| | |
|---|---|
| Duct width range | 300mm to 1500mm<br>5 to 50 metres |
| Duct air speed range | 1m/s to 20m/s<br>Detector ± 0.8˚<br>Prism ± 5.0˚ |
| Temperature range | -20°C or +60°C |
| Ingress protection | IP67 |

## Catalogue numbers

| Description | Code |
|---|---|
| Standard base | FXN520 |
| Relay base | FXN520R |
| Reflective beam detector (50m range) | MBD50R |
| Reflective beam detector (100m range) | MBD100R |
| Mounting bracket | MRBFP |
| Duct probe unit | MDP201 |

# Callpoints

Two versions of the conventional callpoint are available, the surface or flush mounted FX201 or the weatherproof FX203. Both have an integral short circuit isolator and are very simple to install. The callpoints are packaged with 2 frangible glass elements and test key, with a comprehensive range of further devices available.

## Surface/flush mounted callpoint
**CX201**



### Typical applications:

General use product, suitable for use in most indoor applications.

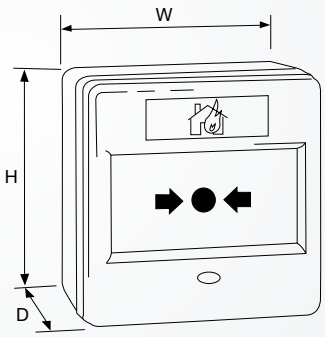
## Weatherproof callpoint
**CX203**



### Typical applications:

Builds requiring a callpoint in harsh conditions. For example, outside or in a wash down area.

## Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Surface mounted | 87 | 87 | 57 |
| Flush mounted | 87 | 87 | 36 |
| Weatherproof | 87 | 87 | 59 |

## Features

| | FX201 | FX203 |
|---|---|---|
| Fast fit clip | ✓ | ✓ |
| Heavy duty terminals | ✓ | ✓ |
| Ingress protection | IP42 | IP65 |

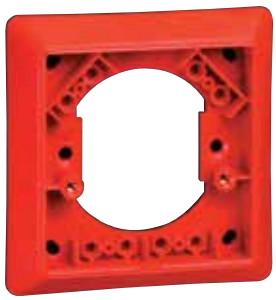
## Catalogue Numbers

| Description | Code |
|---|---|
| Surface/flush callpoint | FX201 |
| Weatherproof callpoint | FX203 |
| CXPC Protective hinged cover (pack of 10) | 4990001FUL-0022 |
| Spacer plates (pack of 10) | MBGSP |
| MBGBEZ Recessing bezels (pack of 10) | 4990005FUL-0194 |
| MBGREKIT Resettable element kit (pack of 10) | 4990010FUL-0045 |
| FX5G Spare break glasses (pack of 10) | 516200FULL-5017 |
| Earth continuity links (pack of 5) | MBG119 |
| MFBGKEY3 Callpoint keys (pack of 10) | 4990009FUL-0040 |

## Further accessories:



Callpoint shown with protective hinged cover



Callpoint recessing bezel

# Bells

Bells still remain a popular choice for many applications where they can sometimes be used as a signal for non-fire purposes, such as class change in a school.


Bells can be used for non fire applications such as class change in a school

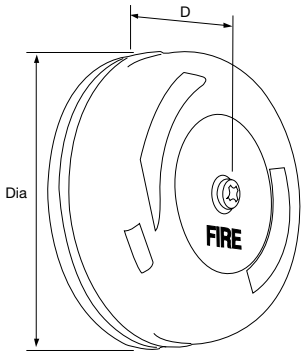
## Internal 6 inch bell
**FX006**




### Typical applications:

Can be used for non-fire applications, such as class change in a school.

## Dimensions




Internal 6 inch bell

| Description | Dia (mm) | D (mm) |
|---|---|---|
| 6 inch internal bell | 152 | 63 |

## Sound output

| | FX006 | MWB824 |
|---|---|---|
| Sound Output | 93-95dB(A) at 24V dc | 95dB(A) (+/-2) |

## Features

| | FX006 |
|---|---|
| Ingress protection | IP21C |

## Catalogue numbers

| Description | Code |
|---|---|
| FX006 Internal 6 inch bell | 521601FULL-1601 |

# Sounders

We have an extensive range of conventional sounders, designed to meet every specification's functional and aesthetic needs. Completely EN54 Pt. 3 certified, each sounder offers a unique solution to your conventional system requirements.

## Flush sounder
**FX003**



### Typical applications:

Ideal for retail, hotel and residential applications such as sheltered housing.

## Surface sounder
**FX002SB**



### Typical applications:

This all-purpose sounder has been designed to be both robust and aesthetically pleasing to meet many build requirements.

## Weatherproof surface sounder
**FX002DB**



### Typical applications:

The weatherproof sounder is perfect for harsh weather conditions where a sounder is needed. With selectable tones a high volume can be easily achieved meaning this sounder functions well in outdoor settings.

## High output wall sounder
**FX007**



### Typical applications:

With a maximum output of 120dB(a), this sounder is ideal for areas with high ambient noise levels like warehouses.

## Low current wall sounder
**MLC624**



### Typical applications:

Designed to provide a high sound output with a low current consumption the MLC624 is perfect for areas where high sound levels need to be achieved but sounder circuit capacity is limited.

## Base mountable sounder
**FXN824**



### Typical applications:

With a slim and aesthetically pleasing design this base sounder is ideal for applications such as hotel bedrooms where a detector/sounder or a detector/sounder-beacon is required.

Please note a detector base is still required when used in conjunction with a detector

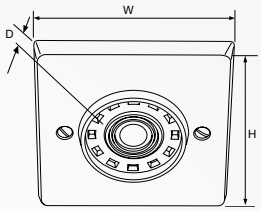


Wall sounder detail

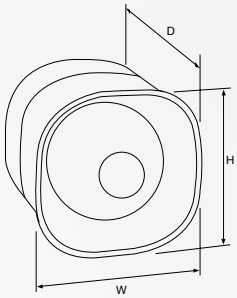
## Sound output

| | FX003 | FX002 | FX007 | MLC624 | FXN824 |
|---|---|---|---|---|---|
| Sound output | 98dB(a) at 1 Metre (+/-2) | 105dB(a) max (+/-2) at 24V dc | 120dB(a) (+/-2) Max at 1m (tone 5)<br>114dB(a) (+/-2) Max at 1m (tone3) | 100dB(a) at 24V dc | 80/90dB(a) (+/-3) @ 1 Metre |
| Tones | 32 | 32 | 32 | 3 | 8 |

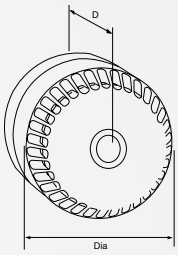
## Dimensions



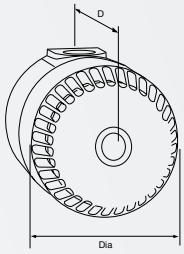

Flush sounder



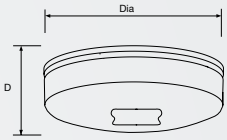

Wall sounder




Surface sounder




Weatherproof surface sounder




Base mountable sounder

| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Flush sounder | 86 | 86 | 36 |
| High output wall sounder | 105 | 105 | 95 |
| Low current wall sounder | 105 | 105 | 95 |

| Description | Dia (mm) | D (mm) |
|---|---|---|
| Surface sounder | 93 | 63 |
| Weatherproof surface sounder | 93 | 93 |
| Base mountable sounder | 111 | 26 |

## Features

| | FX003/ FX003W | FX002SB | FX002DB |
|---|---|---|---|
| Ingress protection | IP20 | IP54 | IP65 |

| | FX007 | MLC624 | FXN824 |
|---|---|---|---|
| Ingress protection | IP42 | IP30 | IP65 |



## Catalogue Numbers

| Description | Code |
|---|---|
| FX003 Flush sounder, red | 550001FULL-0001X |
| FX003W Flush sounder, white | 550015FULL-0017X |
| MFSSBB Back box for FX003, red | 591001FULL-0016 |
| FX002SB Low profile surface sounder, red | 540501FULL-0389X |
| FX002DB Weatherproof deep base surface sounder back box, red (IP65) | 540503FULL-0403X |
| FX007 High output wall sounder | 651004FULL-0009X |
| MLC624 Low current wall sounder | 650001FULL-0003X |
| FXN824 Base mountable sounder | 666058FULL-0098X |
| MDS824COV Blanking plate for FXN824 (pack of 5) | 590037FULL-0305 |

# Visual alarm devices (VADs)

From 31st December 2013 a new beacon standard, EN 54-23 became mandatory throughout the EU where Construction Product Regulation (CPR) applies. It directly affects the use of visual alarm devices (VADs) in fire detection and alarm systems for non-domestic premises. Its purpose is to standardise the requirements, test methods and functional criteria of VADs to ensure that their visual performance is measured and presented in a uniform manner.

Eaton's LX range has been designed to comply with the new EN 54-23 standard. With current consumption as low as 10mA, the range has been developed to provide the lowest current consumption with the highest possible coverage. Three years in the making, the LX range, available for wall and ceiling applications, features a number of patented technologies including an innovative lens and flash pattern.

## Solista LX wall
**FXSOLWRS**




### Typical applications:

With both a shallow base and deep base option the Solista meets requirements of a large range of builds.

## Solista LX ceiling
**FXSOLCWS**




### Typical applications:

The ceiling option Solista helps to cover different types of room sizes to meet the requirements of the CoP 0001 design guidelines.

## RoLP LX wall
**FXROLPWR**




### Typical applications:

The RoLP LX Wall is ideal for dual use applications where a visual alarm device is required in addition to an audible alarm.

The RoLP LX Wall is available to use with any standard RoLP sounder.

## Symphoni LX wall
**FXSYG1WR**




### Typical applications:

The Symphoni LX Wall base can be used in combination with any standard Symphoni sounder.

Its high sound output makes it suitable for open areas or areas where there is higher than normal background noise.

## Symphoni LX WP wall (weatherproof)
**FXSYG1WR-WP**




### Typical applications:

The Symphoni LX WP Wall device offers a weatherproof alternative to the Symphoni LX Wall device. With an ingress protection rating of IP66, it is suited for wet and outdoor environments.

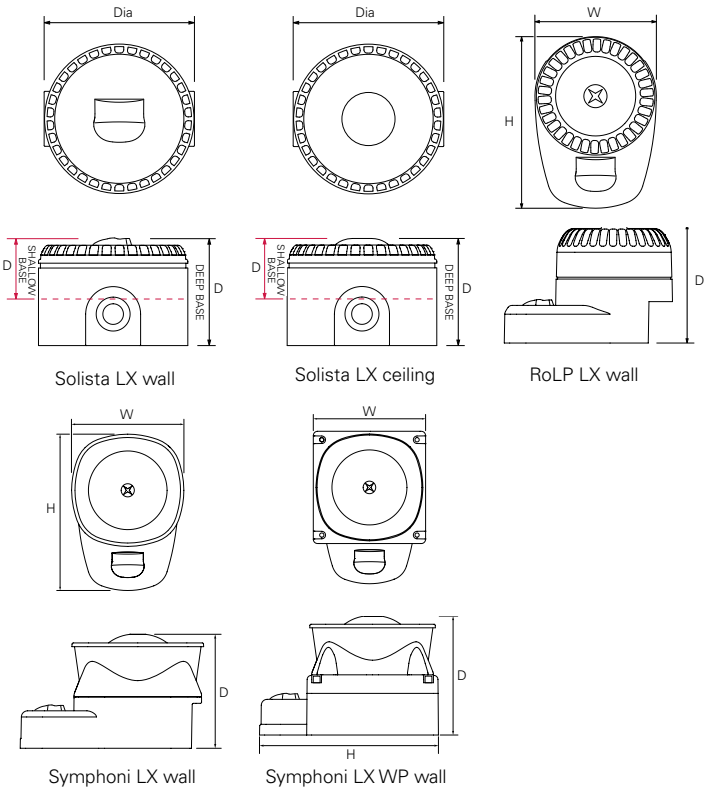
These products are all **red flash**, for more options please contact:

firetechsupport@eaton.com

## Performance

| | Solista LX wall | Solista LX ceiling | RoLP LX wall | Symphoni LX wall | Symphoni LX WP wall |
|---|---|---|---|---|---|
| Sound output | N/A | N/A | 102dB(A) (Typical tone 3 - RoLP) | 100dB(A) (Typical tone 3 - Symphoni) | 100dB(A) (Typical tone 3 - Symphoni) |
| Minimum current consumption | 10mA | 10mA | 22mA | 15mA | 15mA |
| EN54-23 coverage reference | W-2.4-7.5 | C-3-7.5 | W-2.4-7.5 | W-2.4-7.5 | W-2.4-7.5 |
| Coverage volume | 135m$^3$ (15m$^3$) | 132m$^3$ (21m$^3$) | 135m$^3$ (15m$^3$) | 135m$^3$ (15m$^3$) | 135m$^3$ (15m$^3$) |
| Flash rate | 1Hz (switchable to 0.5Hz) | 1Hz (switchable to 0.5Hz) | 1Hz (switchable to 0.5Hz) | 1Hz (switchable to 0.5Hz) | 1Hz (switchable to 0.5Hz) |
| Ingress protection | IP33C | IP33C | IP65 | IP21C | IP66 |

## Dimensions




| Description | Dia (mm) | D (mm) | W (mm) | H (mm) |
|---|---|---|---|---|
| Solista LX wall deep base | 93 | 66 | - | - |
| Solista LX wall shallow base | 93 | 38 | - | - |
| Solista LX ceiling shallow base | 93 | 37 | | |
| RoLP LX wall | - | 95 | 95 | 135 |
| Symphoni LX wall | - | 92 | 106 | 147 |
| Symphoni LX WP wall | - | 92 | 106 | 147 |



## Catalogue numbers

| Description | Code |
|---|---|
| FXSOLWRS Solista wall red body shallow base | 812013FULL-0237X |
| FXSOLWRD Solista wall red body deep base | 812005FULL-0107X |
| FXSOLCWS Solista LX ceiling | 812022FULL-0123X |
| FXROLPWR RoLP wall red body base and sounder | 8500025FULL-0025X |
| FXROLPWR-B RoLP wall red body base only | 8500040FULL-0219X |
| FXSYG1WR Symphoni LX wall red body | 8500045FULL-0233X |
| FXSYR-B Symphoni LX wall base red body | 8500095FULL-0231X |
| FXSYG1WR-WP Symphoni LX wall weatherproof red body | 8500050FULL-0249X |
| FXSYR-B-WP Symphoni LX wall weatherproof base red body | 8500100FULL-0247X |

For more guidance on EN-54-23 and placement of VADs, refer to our Fire Installer's Mate pocket guide.

(Part code CFS-CC2478-FIM)



# Indicators

In areas which do not have to meet the new regulations regarding EN54-23 visual alarm devices, our range of indicators can still provide reliable light indication.

## Low profile LED indicator
**MLB124SB**



### Typical applications:

In regions where the EN54-23 VADs standard is not a requirement, the LED indicator can be used as an indicating device.

## Weatherproof LED indicator
**MLB124DB**

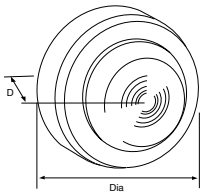


### Typical applications:

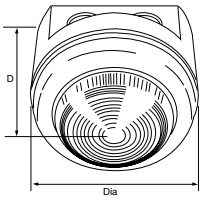
The weatherproof version of the LED indicator provides an IP65 option ideal for outdoor use.



## Dimensions




Low profile LED indicator




Weatherproof LED indicator

| Description | W (mm) | D (mm) |
|---|---|---|
| Low profile LED indicator | 95 | 53 |
| Weatherproof LED indicator | 95 | 80 |

**Note:** From 31st December 2013 a new beacon standard, EN 54-23 became mandatory across Europe where Construction Product Regulation (CPR) applies. If you are in a region where this standard applies please understand that these indicators do not meet the requirements of the new standards - **see p72 for compliant beacons and sounder beacons**

## Features

| | MLB124SB | MLB124DB |
|---|---|---|
| Ingress protection | IP54 | IP65 |

## Catalogue numbers

| Description | Code |
|---|---|
| MLB124SB Low profile LED beacon | 811012FULL-0006 |
| MLB124DB Weatherproof LED beacon | 811013FULL-0007 |

# Sounder indicators

In areas which do not have to meet the new regulations regarding EN54-23 visual alarm devices, our range of sounder indicators can still provide excellent sound quality and light indication.

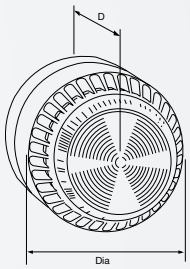
## Xenon sounder indicator
**FL-RL-R-S**



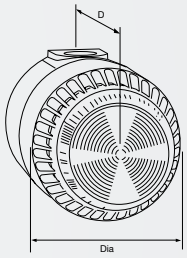
## Weatherproof Xenon sounder indicator
**FL-RL-R-D**



## Dimensions



Xenon sounder indicator



Weatherproof xenon sounder indicator

| Description | Dia (mm) | D (mm) |
|---|---|---|
| Xenon sounder indicator | 93 | 92 |
| Weatherproof xenon sounder indicator | 93 | 121 |

## Typical applications:

In regions where the EN54-23 VADs standard is not a requirement, the xenon sounder indicator provides an alternative option to the xenon indicator - where an audible warning is required in addition to light indication.

## Typical applications:

The weatherproof version of the sounder indicator is IP65 rated which allows for installation in harsher environments.

## Sound output

| | XENON sounder indicator, FL-RL-R-S/FL-RL-R-D |
|---|---|
| Sound output | 101dB(a) at 24V dc (typical tone 3) |
| Tones | 32 |

**Note:** From 31st December 2013 a new beacon standard, EN 54-23 became mandatory across Europe where Construction Product Regulation (CPR) applies. If you are in a region where this standard applies please understand that these indicators do not meet the requirements of the new standards - **see p72 for compliant beacons and sounder beacons**

## Features

| | FL-RL-R-S | FL-RL-R-D |
|---|---|---|
| Ingress protection | IP54 | IP65 |

## Catalogue numbers

| Description | Code |
|---|---|
| FL-RL-R-S Conventional xenon sounder indicator | 640001FULL-0003X |
| FL-RL-R-D Weatherproof IP65 xenon sounder indicator | 640031FULL-0111X |

# Door retainers and relay unit

Door retainers enable doors to be held open under normal conditions but automatically be released in the event of fire alarm activation.

Eaton have a range of door retainers which are robust and simple to install. Both floor and wall mounted retainers, with either mains or 24V dc power supplied variations, are available.

## Heavy duty door retainer
**MDR240/MDR24L**



### Typical applications:

Robust and simple to install, the heavy duty door retainer is ideal for a wide range of applications, such as nursing homes, hospitals, schools and industrial premises.

## Compact door retainer
**FX021240LC/ FX02124VLC**



### Typical applications:

Equally as reliable, the compact door retainer is also a good choice for nursing homes, hospitals and also busy corridors.

## Heavy duty relay unit
**MAR724**



### Typical applications:

Designed for interfacing heavy loads such as door release units or plant shut down equipment with fire alarm systems.

This unit is simple to fix and install and the neat unobtrusive design makes it suitable for use in a wide range of areas.

The heavy duty relay unit is powered by 24V dc external supply and is provided with 2 separate sets of changeover contacts.

Can switch 230V ac mains at 10A

## Performance

| | MDR240 | MDR24L | FX021240LC | FX02124VLC |
|---|---|---|---|---|
| Holding force | 40kg | 40kg | 45kg | 40kg |
| Power consumption | 1.2VA | 40mA | 1.2VA | 40mA |
| Ingress protection | IP40 | IP40 | IP42 | IP40 |

## Catalogue numbers

| Description | Code |
|---|---|
| Mains powered heavy duty door retainer | MDR240 |
| 24V dc heavy duty door retainer | MDR24L |
| Floor mounting bracket for heavy duty door retainers | ZMDRFBB |
| Mains powered compact door retainer | FX021240LC |
| 24V dc compact door retainer | FX02124VLC |
| Floor mounting bracket for compact door retainers | FX021LCFB |
| Spare striker plate for either magnet | ZMDRSWIV |
| Heavy duty relay unit | MAR724 |

# Power supply

Specifically recommended as an auxiliary power supply unit for fire detection system components such as electromagnets, notification devices, etc.

Using the unit in large systems eliminates the problem of long power cable runs which simplifies installation.

## EN54 pt.4 approved power supply unit
**SPS Range**



## Typical applications:

The new range of EN 54-4 certified safety power supplies offer a compact, robust and versatile power solution to installers, allowing them to safely power fire detection and signaling systems in small to large installations.

Compact and discrete design allows for these SPS to be installed in a visible location such as a hotel lobby for instance. Comprehensive yet simple status indicators on the front of the unit help installers, commissioners and maintainers assess status of the unit.

## Features

| | SPSS-2423/2433/2453 |
|---|---|
| Ingress protection | IP30 |

## Catalogue numbers

| Description | Code |
|---|---|
| Safety power supply 24V / 1.5A (batteries not supplied) | SPS-2423 |
| Safety power supply 24V / 2.5A (batteries not supplied) | SPS-2433 |
| Safety power supply 24V / 4.5A (batteries not supplied) | SPS-2453 |



Door retainers enable doors to be held open under normal conditions but automatically be released in the event of fire alarm activation.

CE





# Contents

## Emergency voice communications

### Panels

Network exchange units **80**




Non network exchange units **82**



### Devices

Outstations **84**




Emergency assist alarm **86**



# Network exchange units

Our range of EVCS control units cover functionality for all builds, whether small and basic or larger and more complex. All parts are designed to fully comply with BS5839 part 9 2011 with EN54-4-A2 compliant power supplies and chargers.

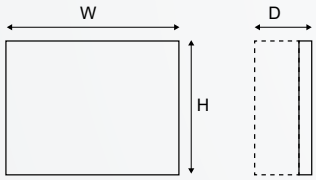
## Network master handset
**CFVCWM**




### Features

| | |
|---|---|
| Up to 8 network master handsets per system | ✓ |
| Controls up to 128 lines (16 x 8 line exchange units) | ✓ |
| Monitored handset | ✓ |
| Large high contrast display (4 x 20 character) | ✓ |
| Dual network ports | ✓ |
| Remote powered handsets, no mains required | ✓ |
| Full system event log (fault & configuration) | ✓ |

### Dimensions




| Description | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| VoCALL Network Master Handset | 300 | 300 | 65 |

*Please check with our technical team if dimensions are critical as they may have changed from time of print

Each system can have up to 8 VoCALL Network Master Handsets which gives great flexibility to larger installations allowing all calls to be monitored from various control points. As an example, an installation may have security offices, reception and numerous entrances that need to be monitored by master handsets.

- Wall or desk mount
- Graphical display
- Calls can be made by dialling or selecting the outstation name

## 8 line network exchange unit
**CFVCX8**



The VoCALL Network 8 Line Exchange Unit is a small wall mounted unit which can be distributed throughout a site and concealed from view in convenient locations such as risers, stairwells and cupboards.

- Greatly reduces cabling requirement
- Less equipment 'on view' in key places such as reception areas
- Aesthetically pleasing system with minimal equipment

Up to 8 lines can be connected to each distributed exchange, and each cable is fully monitored for open, short or earth faults. Up to 168 outstation Exchange Units can be attached to a VoCALL Network master system giving a maximum system size of 128 independent lines.

## VoCALL Compact 9 Line Master and 10 Line Slave Exchange Unit
**CFVCCM9*/ CFVCCS10***




*See website for further details

## Catalogue numbers

| Description | Code |
|---|---|
| VoCALL 8 line network master handset | CFVCWM |
| VoCALL 8 line network exchange unit | CFVCX8 |
| VoCALL Compact 9 Line Master Unit | CFVCCM9 |
| VoCALL 10 Line Slave Exchange Unit | CFVCCS10 |

# Standalone master exchange units (non networkable)

Our range of EVCS control units cover functionality for all builds, whether small and basic or larger and more complex. All units are fully certified to EN54-4:A2 with compliant power supplies and chargers. The EFVCC5 and EFVCM10 are our non-networkable standalone options for small and medium sized builds.

## VoCALL Compact 5
**EFVCC5**




### Typical applications:

The VoCALL Compact 5 Line Unit is ideal for smaller installations which require just a limited number of outstations and Emergency Assist Alarms.

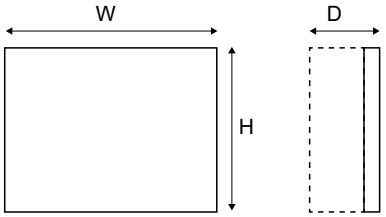
The EFVCC5 is a standalone unit containing the systems master handset, EN54-4 approved power supply and connectivity for the 5 outstations. 20mm knockouts are provided for all system cabling and the housing is of ample size to support 2x 3.2Ah backup batteries.

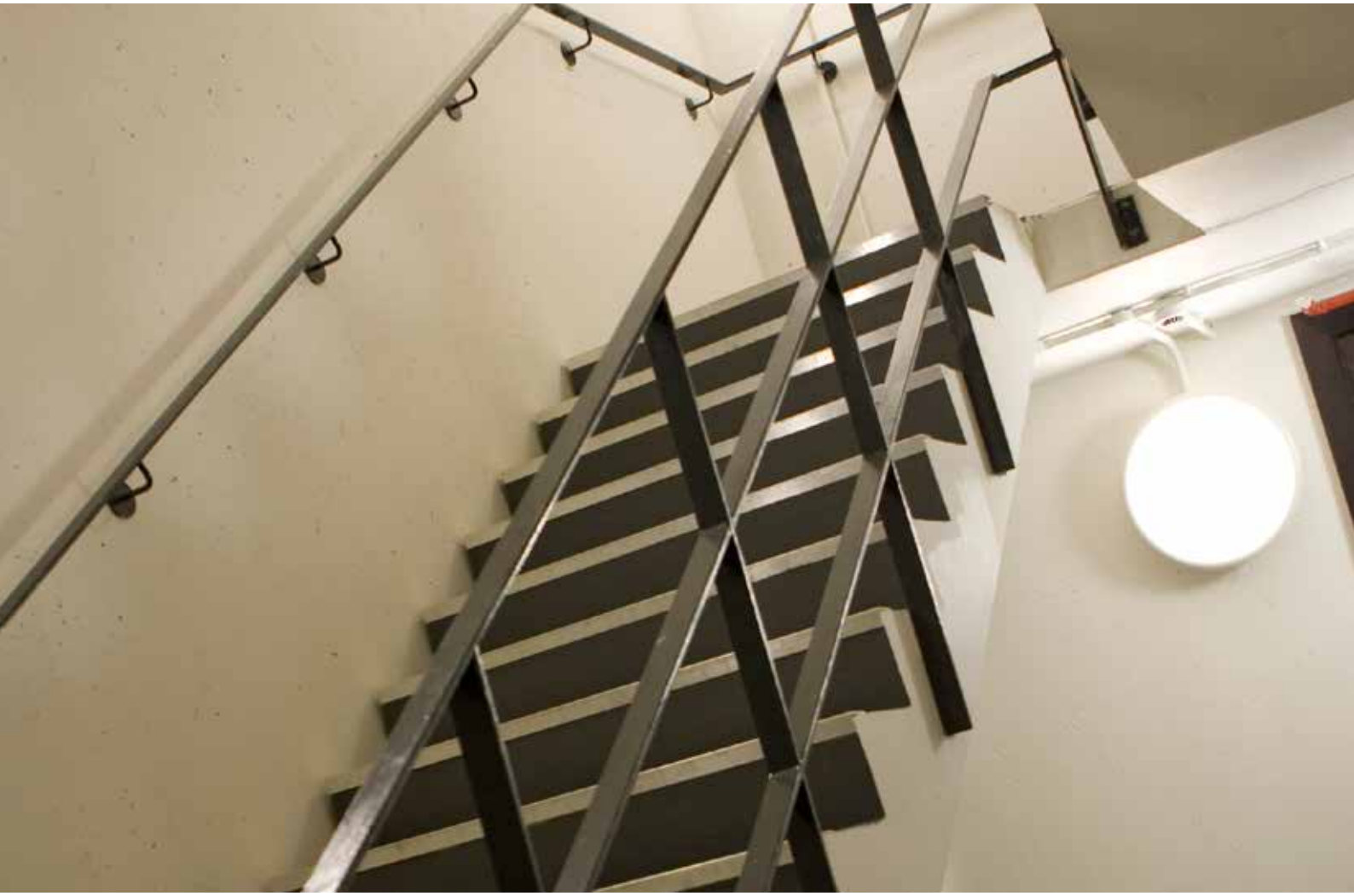
## Features

| | Compact 5 |
|---|---|
| Bs5839 pt9 2011 compliant | ✓ |
| Monitored handset | ✓ |
| Monitored supply and charger | ✓ |
| Relay outputs | ✓ |
| No programming | ✓ |
| Functional with emergency assist alarms | ✓ |

## Dimensions

| Dimensions | H1 (mm) | H2 (mm) | W1 (mm) | W2 (mm) | D1 (mm) | D2 (mm) |
|---|---|---|---|---|---|---|
| VoCALL Compact 5 surface mounted | 280 | - | 397 | - | 77 | - |
| VoCALL Compact 5 flush mounted | 280 | 309 | 397 | 427 | 77 | 16 |





## Catalogue numbers

| Description | Code |
|---|---|
| VoCALL compact 5 line master exchange unit, non-network, surface mount, graphite | EFVCC5 |
| VoCALL compact 5 line master exchange unit, non-network, flush mount, stainless steel | EFVCC5SS |

# Outstations

For disabled refuge systems we offer a number of devices for call functions. Outstations can offer functionality as a fire telephone or disabled refuge call point. All outstations are available as a wall mountable unit, or with an optional bezel to allow the product to be flush mounted.

## Type A outstation
**CFVCSHP**




### Typical applications:

All builds which require a disabled refuge EVC system.

The Type A should be used for evacuation or firefighting use.

**Note:**

There is a weatherproof, IP65 rated version of the Type A outstation available with a lockable door. Please enquire for more information.

## Type B outstation
**CFVCSHF**




### Typical applications:

Type B outstations can only be used where the background noise is below 40dBA (therefore there can be no sounder or voice alarm coverage in the area).

## Roaming handset and jack plate
**CFVCRJP/CFVCRHS**

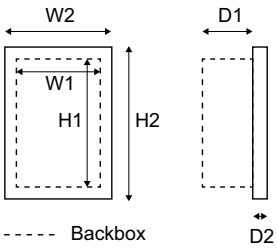


### Typical applications:

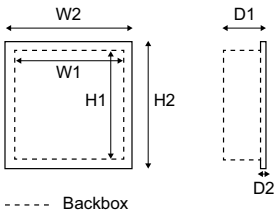
When used together, the roaming handset and jack plate form a Type A outstation. This can be used in countries whose fire codes allow for roaming handsets.

(These units are not suitable for installation in the UK under BS5839 Pt9.)

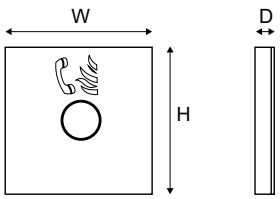
## Dimensions




Type A outstation




Type B outstation




Jack plate

| Description | H1 (mm) | H2 (mm) | W1 (mm) | W2 (mm) | D1 (mm) | D2 (mm) |
|---|---|---|---|---|---|---|
| Type A outstation backbox | 320 | - | 152 | - | 85 | - |
| Type A outstation flush mounted | 320 | 334 | 152 | 191 | 85 | 2 |
| Type B outstation backbox | 135 | - | 135 | - | 45 | - |
| Type B outstation flush mounted | 135 | 154 | 135 | 154 | 45 | 2 |
| Jack plate | 86 | - | 86 | - | 25 | - |




## Catalogue numbers

| Description | Code |
|---|---|
| VoCALL Type A outstation, surface mount, red | CFVCSHP |
| VoCALL Type A outstation, flush mount, red | CFVCFHP |
| VoCALL Type A outstation, flush mount stainless | CFVCFHPSS |
| VoCALL Type A outstation, IP65 lockable, surface mount, red | CFVCIPA |
| VoCALL Type B outstation, surface mount, red | CFVCSHF |
| VoCALL Type B outstation, surface mount, green | CFVCSHFG |

| Description | Code |
|---|---|
| VoCALL Type B outstation, surface mount, stainless steel | CFVCSHFSS |
| VoCALL flush mounting bezel for use with any Type B outstation, stainless steel | CFVCFHB |
| VoCALL jack plate | CFVCRJP |
| VoCALL roaming handset | CFVCRHS |

# Emergency assist alarm equipment

Emergency assist alarms are required by building regulation document M.

We offer either a stand-alone kit or a kit which integrates the Emergency Assist equipment with our VoCALL products.




Our emergency assist alarm kits supply everything you need to install a fully compliant system.

## VoCALL kit

This Emergency Assist Alarm - VoCALL kit has been specifically designed to integrate disabled call functions into the VoCALL network or VoCALL compact ranges.

It is fully monitored and battery backed by the VoCALL system. The Emergency Assist Alarm shows up as a call on the VoCALL system, but has no speech path so a conversation cannot be had with the occupant, use of the Type B Outstations would allow this.

## Stand alone kit

The Emergency Assist Alarm - stand alone kit provides the perfect solution for conformity with the building regulations document M and Equality Act 2010.

The Emergency Assist Alarm - stand alone kit comprises of all the components needed to install a fully compliant system, with additional parts available separately.

## 4 Way Splitter

The 4 Way Splitter unit allows up to 4 stand alone disabled toilets to be monitored in one specific area. Staff can then, at the designated area such as a reception or security desk, react to an alarm swiftly and efficiently.

## EAA VoCALL kit
**CFVCEA**




### Typical applications:

Disabled Toilets.

Includes:

- Over door indicator
- Cancel button
- Pull cord unit
- Disabled sticker pack

Does not include PSU as the kit is powered by a master unit **(the Compact 5, see p82)**

## EAA standalone kit
**CFEAPULLKIT**




### Typical applications:

Disabled Toilets.

Includes:

- Power supply unit
- Over door indicator
- Cancel button
- Pull cord unit
- Disabled sticker pack

### Accessories:




Pull cord unit




4 way splitter

## Catalogue numbers

| Description | Code |
|---|---|
| Emergency assist alarm - vocall kit | CFVCEA |
| Emergency assist alarm - stand alone kit | CFEAPULLKIT |
| 4 way splitter | CFEASL4 |
| Pull cord unit | CFEAPULL |



Emergency assist alarm stand alone kit, basic usage schematic





# Contents

## Voice alarm system

### Panels

Distributed amplifier unit **90**



Emergency mic all call **90**




### Devices

Speakers **92**



# VoCALL emergency evacuation systems

The VoCALL Voice series of public address and voice alarm systems are scalable, so can be used in any sized installation.

## Voice distributed amplifier unit (DAU)
**EESDAU100**




NEW PRODUCT

The Emergency Evacuation System Distributed Amplifier Unit (DAU) is a complete VA system, which has been developed to replace talking sounders in many voice alarm applications.

It is supplied in a single wall mount box which is complete with messages, contacts, dual 50W monitored amplifiers, EN54-4 approved power supply, monitored battery charger and the ability to connect non-monitored paging and music sources directly.

The boxes can be connected together using the network ports so a system with up-to 128 nodes is achievable. The system can be paged from the All Call EESEMA fire microphones.

- Can function as a stand alone or networked system
- EN54-16 and EN54-4 LPCB certified for CPR
- BS5839 part 8, 2008 compliant
- Dual 50W 100V line outputs
- 3 Messages 130 second total
- Wall mounted
- Common fault out
- Paging input
- Full fault monitoring
- EN54-4 battery charging and monitoring
- Direct music input
- Music ramping
- Up to 128 units per network

## Emergency microphone all call (EMA)
**EESEMA**




NEW PRODUCT

The Emergency Evacuation System Emergency Microphone All Call (EMA) is designed to provide an All Call emergency microphone as the top priority of the network.

All connections are fully monitored for open, short and earth faults and the microphone capsule is also monitored for open and short conditions.

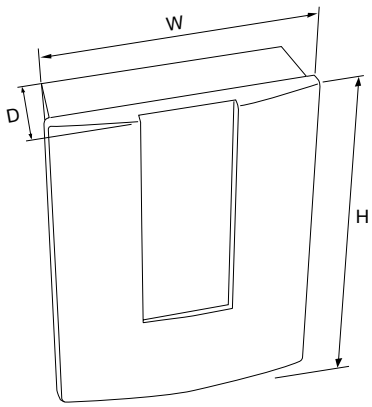
The pre-amplifier is a high quality compressor limiter, which prevents the system from being overdriven by poor microphone use, it also corrects for quiet speakers. Tone controls allow the microphone to be equalised for maximum clarity and the chime is selectable (1,2 or 3 note) and volume controlled independently of the voice level.

- EN54-16 CPR certified by LPCB
- Fully monitored
- Close coupled noise cancelling fist microphone
- Studio quality compressor limiter
- Wall mounted enclosure
- Bass and treble controls
- Selectable message chime
- Secure controls inside panel
- Three message trigger buttons and cancel button
- Compliant high visibility signage
- BS5839 part 8, 2008 compliant
- Network powered






## Dimensions




| | H (mm) | W (mm) | D (mm) |
|---|---|---|---|
| Voice DAU panel | 400 | 320 | 180 |
| EMA panel | 400 | 320 | 180 |

## Catalogue numbers

| Description | Code |
|---|---|
| 100W addressable DAU | EESDAU100 |
| Emergency microphone all call | EESEMA |

# Speakers

Whether the call is for discreet ceiling speakers in a hotel or for vandal resistant weatherproof columns on a station, there is a suitable model within the range to match the most demanding environments. Where the speakers are required to operate in a highly secure life safety Voice Alarm system then versions are available which are fire rated and have been designed to fully comply with BS5839-Pt8 and EN54-24.

## Vandal resistant loudspeaker
**SENTRY6ST-ENC**



### Typical applications:

Recommended for voice evacuation systems, these units are ideally suited for use in shopping centres, prisons, schools, railway stations etc.

## Sound projector
**CAD10T-ENC**



### Typical applications:

With rugged construction, these units are ideally suited for use in corridors, passageways, shopping centres, prisons, car parks, railway stations and other public places.

The CAD10T/ENC projector speaker has a fitted U-bracket.

## Weatherproof horn
**APH10T-ENC**



### Typical applications:

Designed for installation in outdoor or ambient temperature areas where a wide angle of coverage is required, these weatherproof horns are a practical solution for car parks, courtyards and warehouses.

## Ceiling loudspeaker
**MC range**



### Typical applications:

Ideal for general public address, background music and voice evacuation systems.

These 10W speakers come in sizes from 5" to 6" in diameter, disignated by the part codes MC5-EN and MC6-EN.

## Performance

| Feature | SENTRY6ST-ENC | CADIOT-ENC | APHIOT-ENC | MC5-EN | MC6-EN |
|---|---|---|---|---|---|
| Output | 100dB at 10W | 104dB at 20W | 101db at 20W | 103dB at 10W | 103dB at 10W |
| Sensitivity | 90dB at 1W | 92dB at 1W | 88dB at 1W | 93dB at 1W | 93dB at 1W |
| IP rating | IP66 | IP33 | IP66 | NA | N/A |

## Catalogue numbers

| Description | Code |
|---|---|
| Vandal resistant loudspeaker | SENTRY6ST-ENC |
| Projector speaker | CAD10T-ENC |
| Weatherproof horn | APH10T-ENC |
| 5" ceiling loudspeaker | MC5-EN |
| 6" ceiling loudspeaker | MC6-EN |



# Notes

# Notes



**Spring Mews**
London, UK



## Contact

**Eaton**

Eaton Electrical Systems Ltd
Wheatley Hall Road
Doncaster
South Yorkshire
DN2 4NB
United Kingdom
www.cooperfire.com
www.uk.eaton.com

**Sales**

T: +44 (0)1633 628 566
F: +44 (0)1302 367 155
E: FireCustomerService@eaton.com

**Technical**

T: +44 (0)1302 303 350
F: +44 (0)1302 303 332
E: FireTechSupport@eaton.com

**Service**

T: +44 (0)1302 303 352
F: +44 (0)1302 303 332
E: FireService@eaton.com

**Export**

T: +44 (0)1302 303 344
F: +44 (0)1302 303 345
E: FireExport@eaton.com

**Online Resources**

Visit www.uk.eaton.com for the following resources:

- 24/7 online product support
- Catalogue and literature
- Product profiles
- Datasheets, installation and user manuals

At Eaton, we're energized by the challenge of powering a world that demands more. With over 100 years experience in electrical power management, we have the expertise to see beyond today. From groundbreaking products to turnkey design and engineering services, critical industries around the globe count on Eaton.

We power businesses with reliable, efficient and safe electrical power management solutions. Combined with our personal service, support and bold thinking, we are answering tomorrow's needs today.

Follow the charge with Eaton, visit eaton.eu


UAE
**Middle East Headquarters**
Techno Park, Jebel Ali (South)
P.O Box 261768
Dubai, United Arab Emirates
Tel: +971 4 8066100
Fax:+971 4 8894813

**Kuwait**
Shayma Tower, Mezzanine Floor
Omar Bin al Khattab Street Sharq
Kuwait
Tel: +965 22253606
Fax:+965 22253608

**Saudi Arabia**
King Abdullah Street (Ex. Dhahran St.)
Dhahran Centre, 1st Floor Office 101
P.O Box 620
Al-Khobar 31952, Saudi Arabia
Tel: +966 1 38825424 / 8825680
Fax:+966 1 38825732

**Saudi Arabia**
Saad Al-Ajlan Trade Centre 1st Floor
Office 9, Olaya Main Stret
P.O Box 19651
Riyadh 11445, Saudi Arabia
Tel: +966 1 4602275 / 288-6238
Fax:+966 1 14602291

**Lebanon**
Sin El Fil, Saydet Al Wardiyeh Street
Beirut Symposium Building
2nd Floor, Office 2A
Tel/Fax: +961 1 494711

**Qatar**
Greedco 1 Building, Office no 4303
PO Box 91357, C Ring Road
Doha, Qatar
Tel: +974 4467273
Fax: +974 44667134

**Jordan**
Amman-Mekkia & Madina Streets Intersection
Al-Haramien intersection.
Al Hajar Al Aswad Cplx, 3rd floor - Office 306
Tel: +962 6 5542538

**Oman**
Maktabi building, Office No 208
Near Zakher Mall, Al Khuwair
PO Box 1982, PC 111 CPO
Oman
Tel: +968 24391973
Fax:+968 24483801

**Egypt**
Building No. 289 Off 90th Street
Apartment 4B, 4th Street
5th District, New Cario, Egypt
Tel: +202 261 357 47
+202 261 357 46

**Iraq**
Burosan Bldg, 4th Floor, Office 10
60m Street, Kouran Intersection
Erbil, Iraq

**Eaton**
Electrical Sector EMEA
Route de la Longeraie 7
1110 Morges, Switzerland

**Eaton**
Eaton Electrical Systems Ltd.
Wheatley Hall Road
Doncaster
South Yorkshire
DN2 4NB
United Kingdom

**Tel:** +44 (0)1302 303 999
**Fax:** +44 (0)1302 303 333
**Email:** FireSales@eaton.com
**Web:** www.cooperfire.com
www.uk.eaton.com



© 2017 Eaton
All Rights Reserved


Pub Reference: CF-CC2556
June 2017


Powering Business Worldwide

EQUIPMENT, DESIGN & SERVICE MANUAL

# NAFFCO CLEAN AGENT SYSTEM
# W/ IMPULSE TECHNOLOGY
# HFC-227ea AGENT
# DOT / TC CONTAINERS

## UL LISTED
## FM APPROVED
## NFPA 2001 STANDARD

Equipment, Design & Service Manual, P/N: NF-06-433 (Rev. 1 / March, 2014) UL Listed / FM Approved.

*This page intentionally left blank*

ORIGINAL RELEASE DATE: ..... October, 2010

REVISION / DESCRIPTION OF CHANGE — REVISION DATE

Revision 1 ..... March, 2014

1) Changes to the Equipment Section – HFC-227ea EQUIPMENT INFORMATION / DATA SHEETS
2) Changes to the Design Section – HFC-227ea DESIGN INFORMATION
3) Formatting change to Service Information Section

**INTRODUCTION**

**SECTION 1**
EQUIPMENT INFORMATION / COMPONENT SHEETS

**SECTION 2**
DESIGN INFORMATION

**SECTION 3**
SERVICE INFORMATION

**ANNEX MATERIAL**
MATERIAL SAFETY DATA SHEETS

NAFFCO's Equipment, Design and Service Manuals for Clean Agent Fire Suppression Systems incorporates the latest design requirements found in NFPA Standard 2001, as well as the most up-to-date information available for our products.

This manual has been provides the information necessary for the design, installation, and/or maintenance of NAFFCO hardware and systems.

NAFFCO utilizes two types of systems:

"Pre-Engineered System" concept – minimizes the engineering effort required to design an effective system. As long as nozzle selection, pipe size and pipe length limitations are adhered to, hydraulic flow calculations are not required.

"Engineered System" concept – These systems are designed within the basic parameters outlined in this manual, and their performance is evaluated with the assistance of the NAFFCO Flow Calculation Program.

Tests have shown that the NAFFCO Flow Calculation Program can accurately determine the expected performance of the system when it is discharged. This provides the system designer with the maximum degree of flexibility possible as it pertains to flow imbalance, tee splits, piping configurations, etc.

NAFFCO Clean Agent Fire Suppression systems must be installed and maintained in accordance with the limitations established NFPA Standard no. 2001, Clean Agent Extinguishing Systems, as well as the limitations set forth by Underwriters Laboratories Inc. and FM Approvals. The information contained within this manual defines these limitations in detail.

Enough information is incorporated into this manual to allow those responsible for designing NAFFCO Clean Agent Fire Suppression systems to properly do so, and for the parties responsible for verifying the system design to determine if the design parameters have in deed been met.

Any questions concerning the information presented in this manual should be addressed to:

**NAFFCO FZCO**
**WORLD HEAD QUARTERS**
DUBAI, United Arab Emirates
Email: info@naffco.com
www.naffco.com

## COPYRIGHT INFORMATION

This document may not be reproduced, in whole or in part, by any means without the prior express written permission of the copyright owner. All NAFFCO documentation and hardware are copyrighted with all rights reserved.

## DISCLAIMERS

The information contained in this manual is as accurate as possible. NAFFCO does not guarantee that this manual is technically correct, complete, or free from writing problems or that this product is free from minor flaws.

In accordance with our policy of continuing product and system improvement, NAFFCO reserves the right to change designs or specifications without obligation and without further notice.

## READER RESPONSES

NAFFCO encourages input from our distributors and end users on how we can improve this manual and even the product itself. Please direct all calls of this nature to NAFFCO's Systems Sales Department at +971 4 815 1111

Any communication received becomes the property of NAFFCO.

## WARRANTIES

NAFFCO provides a one-year limited manufacturer's warranty on this product. The standard warranty is printed in each Marketing Price List. All warranty returns must be returned from an authorized NAFFCO Distributor. Contact NAFFCO's Marketing Department for further warranty information. NAFFCO maintains a repair department that is available to repair and return existing electronic components or exchange/purchase previously repaired inventory component (advance replacement). All returns must be approved prior to return. A Material Return Authorization (MRA) number should be indicated on the box of the item being returned. Contact the appropriate Regional Sales Manager for further information regarding Return Material Procedures.

## LIMITATION OF LIABILITY

NAFFCO cannot be held liable for any damages resulting from the use or misuse of this product.

## QUALITY NOTICE

NAFFCO has maintained ISO 9001 certification since 1999. Prior to shipment, we thoroughly test our products and review our documentation to assure the highest quality in all respects.

# NAFFCO CLEAN AGENT HARDWARE w/ IMPULSE TECHNOLOGY HFC-227ea AGENT DOT / TC CONTAINERS

ORIGINAL RELEASE DATE ..... October 2010,

REVISION / DESCRIPTION OF CHANGE REVISION DATE

Revision 1 ..... March, 2014

1) Add information on 5 and 10 lb. containers on: AGENT STORAGE CONTAINER –
HFC-227ea COMPONENT SHEET
MOUNTING STRAPS & BRACKET S – COMPONENT SHEET
PIPE AND FITTINGS – COMPONENT SHEET

| PART NUMBER | REVISION LEVEL | DESCRIPTION OF COMPONENT SHEET |
|---|---|---|
| NF-06-433-1-1 | 0 | AGENT – HFC-227ea |
| NF-06-433-1-2 | 0 | AGENT STORAGE CONTAINER – HFC-227ea |
| NF-06-432-1-1 | 0 | IMPULSE VALVE |
| NF-06-433-1-3 | 0 | PRESSURE GAUGE– HFC-227ea |
| NF-06-432-1-2 | 0 | LIQUID LEVEL INDICATOR (LLI) |
| NF-06-432-1-3 | 0 | LOW PRESSURE SWITCH |
| NF-06-432-1-4 | 0 | MOUNTING STRAPS & BRACKETS |
| NF-06-432-1-5 | 0 | IMPULSE VALVE OPERATOR (IVO) |
| NF-06-432-1-6 | 0 | IMPULSE VALVE PNEUMATIC OPERATOR (IVPO) |
| NF-06-432-1-7 | 0 | PIPE AND FITTINGS |
| NF-06-432-1-8 | 0 | DISCHARGE PRESSURE SWITCH |
| NF-06-433-1-4 | 0 | DISCHARGE NOZZLES – HFC-227ea |
| NF-06-432-1-9 | 0 | CHECK VALVE |
| NF-06-433-1-5 | 0 | CAUTION / ADVISORY SIGNS – HFC-227ea |

## CLEAN AGENT

| | |
|---|---|
| Chemical Name | Heptafluoropropane |
| ASHRAE Designation | HFC-227ea |
| Listings and Approvals | UL Listed / FM Approved |
| FEATURES AND BENEFITS | Colorless, odorless, liquefied compressed gas |
| | Stored as a liquid |
| | Electrically-nonconductive |
| | Discharges as a gaseous vapor (due to its relatively low boiling point) |
| | Zero ozone depleting potential |
| | Low global warming potential |
| | Included on the U.S. EPA Significant New Alternative Policy (SNAP) rules |

## EXTINGUISHING METHOD

HFC-227ea extinguishes a fire primarily through Heat Absorption that occurs as the agent changes from a liquid to a vapor during discharge. In addition, HFC-227ea also disrupts the combustion reaction which aids in the extinguishment of a fire. It is important to note, HFC-227ea does not use the depletion of oxygen to extinguish a fire.

## USE AND LIMITATIONS

| **HFC-227ea system shall be used on the following Class of Hazards:** | **HFC-227ea systems shall "NOT" be used on fires involving the following materials:** |
|---|---|
| Class A & C:<br>Electrical and Electronic Hazards<br>Telecommunications Facilities<br>High value assets, where the associated down-time would be costly | Chemicals or mixtures of chemicals that are capable of rapid oxidation in the absence of air.<br>(Examples include: Cellulose Nitrate and Gunpowder) |
| | Reactive metals such as Lithium, Sodium, Potassium, Magnesium, Titanium, Zirconium, Uranium, and Plutonium |
| Class B:<br>Flammable liquids and gases | Metal hydrides such as Sodium Hydride and Lithium Aluminum Hydride |
| | Chemicals capable of undergoing auto-thermal decomposition.<br>(Examples: Organic Peroxides and Hydrazine) |

## EXPOSURE LIMITATIONS

| Hazard Type | Design Concentration | Maximum Human Expose Time |
|---|---|---|
| Normally Occupied Space | 6.25% to 10.5% | 5 minutes |
| Not Normally Occupied Space | 11.0% to 12.0% | 30 seconds |

**NOTE:** NAFFCO does not recommend HFC-227ea systems to be used in any normally occupied spaces where the design concentration required is above **10.5%.**

**WARNING:** The discharge of clean agent systems to extinguish a fire can result in potential hazard to personnel from the natural form of the clean agent or from the products of combustion that result from exposure of the agent to the fire or hot surfaces. Unnecessary exposure of personnel either to the natural agent or to the products of decomposition shall be avoided.

## PHYSICAL PROPERTIES OF HFC-227ea

| | |
|---|---|
| Chemical Name | 1,1,1,2,3,3,3-Heptafluoropropane |
| Chemical Formula | $CF_3$ $CHFCF_3$ |
| CAS No. | 431-89-0 |
| Molecular Wt. | 170.03 |
| Boiling Point, 1 atm, °C (°F) | -16.4 (2.5) |
| Melting Point, °C (°F) | -131 (-204) |
| Critical Temperature, °C (°F) | 101.6 (214.9) |
| Critical Pressure, kPa (psia) | 2930 (424.7) |
| Critical Density, kg/m³ (lb/ft³) | 621 (38.77) |
| Liquid Density @ 25 °C (77°F), kg/m³ (lb/ft³ ) | 1386 (86.53) |
| Vapor Density @ 25 °C (77°F) and 1atm, kg/m³ (lb/ft³ ) | 7.148 (0.4462) |
| Specific Heat, Liquid (Cp) @ 25°C (77°F), kJ/kg- °C (Btu/lb °F) | 1.247 (0.2979) |
| Specific Heat, Vapor (Cp) @ 25°C (77°F), kJ/kg- °C (Btu/lb °F) and 1 ATM | 0.8136 (0.1945) |
| Vapor Pressure, Saturated @ 25°C (77°F), kPa (psia) | 453.3 (65.7) |
| Heat of Vaporization @ B.P., kJ/kg (Btu/lb) | 132.6 (56.7) |
| Thermal Conductivity, Liquid @ 25°C (77°F),W/m- °C (Btu/hr-ft °F) | 0.0533 (0.0308) |
| Thermal Conductivity, Vapor @ 25°C (77°F),W/m- °C (Btu/hr-ft °F) | 0.0127 (0.0073) |
| Viscosity, Liquid (lb/ft-hr) @ @ 25°C (77°F), cP (lb/ft-hr) | 0.2442 (0.5907) |
| Relative dielectric strength @ 1atm, 25 °C ($N_2$ =1) | 2.00 |
| Solubility of Water in HFC-227ea @ 20 °C (68 °C ), ppm | 600 |
| Ozone Depletion Potential | 0.0 |
| Global Warming Potential, GWP (100 yr. ITH. For CO2, GWP = 1) | 2900 |

## CONTAINER DATA / SPECIFICATIONS

| | | |
|---|---|---|
| Purpose | Pressure Vessel to hold agent until activated | |
| Listings and Approvals | UL Listed / FM Approved | |
| Container Super – Pressurization Level | 360 psig at 70°F (24.8 bar at 21°C) after filling with dry nitrogen | |
| Container Storage Temperature Limitation | 32°F (0°C) Minimum | 130°F (54.4°C) Maximum |
| Container Rating | DOT 4BW500 | TC 4BWM534 |
| Container Actuation Methods | Electric / Pneumatic / Manual | |
| NOTE: If container temperatures exceeding 130°F (54.4°C), valve will open automatically, this also fulfills the pressure relief valve requirements in accordance with DOT regulations. | | |
| Container Color Options | White (Default) | Red |
| Fill Increments | 1.0 lbs. | 0.5 kg |
| Fill Range | 40 to 70 lbs/ft³ | 630 to 1121 kg/m³ |



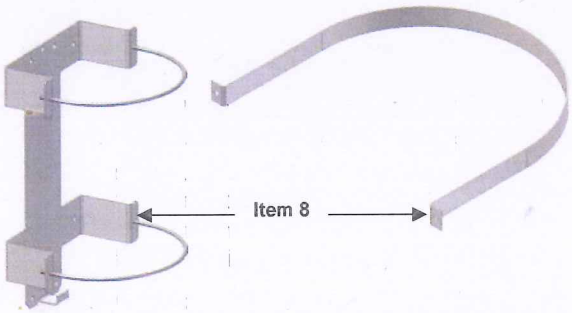
| Container | | Fill Range | | Valve Size | Tare Weight | Dimensions (approximate) | | Mounting Position |
|---|---|---|---|---|---|---|---|---|
| Size | P/N | Minimum | Maximum | | | Diameter | Height | |
| Lb. (L) | | lbs. (kg) | lbs. (kg) | in. (mm) | lbs. (kg) | in. (mm) | in. (mm) | |
| 5 (2) | NF-70-272 | 3 (2.0) | 5 (2.5) | 1 (25) | 11 (5.0) | 4.2 (102) | 16.2 (411.5) | Upright (Valve Up) |
| 10 (4) | NF-70-273 | 6 (3.0) | 10 (4.5) | 1 (25) | 15 (6.8) | 4.2 (102) | 27.24 (691.9) | Upright (Valve Up) |
| 20 (8.5) | NF-70-263 | 12 (5.5) | 21 (9.5) | 1 (25) | 21 (9.5) | 7.0 (178) | 22.50 (571.5) | Upright – Horizontal |
| 35 (15) | NF-70-264 | 22 (10.0) | 38 (17.0) | 1 (25) | 31 (14.1) | 7.0 (178) | 33.75 (857.3) | Upright – Horizontal |
| 60 (27) | NF-70-265 | 39 (18.0) | 68 (30.5) | 1 (25) | 52 (23.6) | 10.75 (273) | 28.13 (714.4) | Upright – Horizontal |
| 100 (44) | NF-70-266 | 63 (28.5) | 108 (49.0) | 1 (25) | 77 (34.9) | 10.75 (273) | 39.63 (1006.5) | Upright (Valve Up) |
| 150 / 150i (61) | NF-70-267 | 87 (39.5) | 150 (68.0) | 3 (80) | 150 (68.0) | 20.0 (508) | 24.25 (616.0)) | Upright – Inverted |
| 215 (88) | NF-70-268 | 124 (56.5) | 216 (98.0) | 3 (80) | 155 (70.3) | 20.0 (508) | 30.13 (765.2) | Upright (Valve Up) |
| 375 (153) | NF-70-269 | 217 (98.5) | 378 (171.5) | 3 (80) | 225 (102.1) | 20.0 (508) | 43.38 (1101.7) | Upright (Valve Up) |
| 650 (267) | NF-70-270 | 378 (171.5) | 660 (299.0) | 3 (80) | 385 (174.6) | 24.0 (610) | 50.50 (1282.7) | Upright (Valve Up) |
| 1000 (423) | NF-70-271 | 598 (271.5) | 1045 (474.0) | 3 (80) | 550 (249.5) | 24.0 (610) | 71.88 (1825.6) | Upright (Valve Up) |

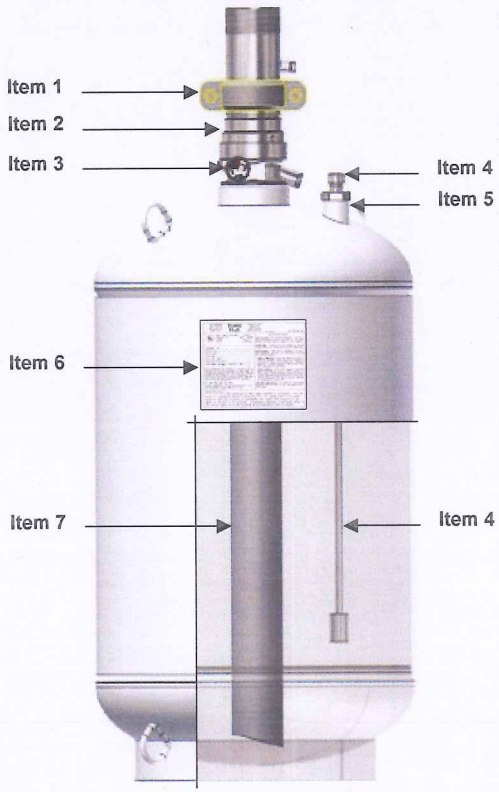
## ITEMS SUPPLIED WITH CONTAINER ASSEMBLY

| Item Number | Description | Component Sheet |
|---|---|---|
| 1 | Victaulic Coupling & Nipple | NF-06-432-1-7 |
| 2 | Impulse Valve | NF-06-432-1-1 |
| 3 | Pressure Gauge | NF-06-433-1-3 |
| 4 | Liquid Level Indictor (LLi) | NF-06-432-1-2 |
| 5 | LLi Boss (see note 1) | n/a |
| 6 | Nameplate (see note 2) | n/a |
| 7 | Siphon Tube (see note 3) | n/a |
| 8 | Mounting Straps & Brackets | NF-06-432-1-4 |

**NOTES:**

1) 100 thru 1000 lb. (44 thru 423 L) containers are equipped with a LLi Boss.
2) NAFFCO nameplate provides the information that is specific to each container:
   Assembly and serial number of the container, Weight information: tare, gross and agent and Installation, operation and safety information.
   All containers filled either by the factory or by an Approved Initial Fill Station are provided with a nameplate bearing the UL & FM markings.
3) NAFFCO Clean Agent containers [except the 150i (Inverted)] are equipped with a siphon tube. The 20, 35 & 60 lb. containers have bent siphon tubes and the 5, 10 & 100 – 1000 lb. containers have straight siphon tubes. All containers with siphon tubes can be mounted upright. The 20, 35 & 60 lb containers can also be mounted horizontally. The 150 container can only be mounted upright and the 150i can only be mounted inverted.



## OPTIONAL ITEMS FOR CONTAINER

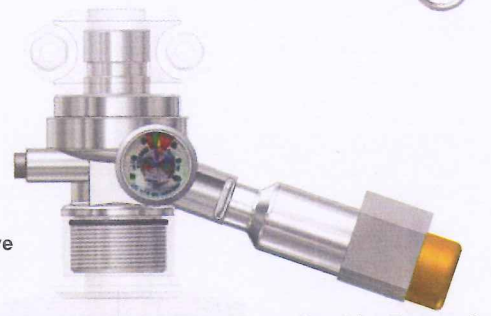
The following container accessory items must be ordered separately.

## ACTUATION COMPONENTS

- Electric / Manual Actuation – Impulse Valve Operator (IVO) (For detailed information, refer to the IVO Component Sheet p/n NF-06-432-1-5)




- Pneumatic Actuation – Impulse Valve Pneumatic Operator (IVPO) (For detailed information, refer to the IVPO Component Sheet p/n NF-06-432-1-6)




## ACTUATION METHODS

Clean Agent containers with an Impulse Valve can be actuated by the following methods:

- Method 1 – Electric Actuation – Single Container System w/ IVO & IRM
- Method 2 – Electric Actuation – Multi-Containers System w / IVO & IRM
- Method 3 – Electric & Pneumatic Actuation – Two Container System w/ IVO & IVPO
- Method 4 – Electric & Pneumatic Actuation – Multi Container System w/ IVO & IVPO

For detailed information on actuation methods, refer to the Impulse Valve Operator (IVO) Component Sheet (p/n NF-06-432-1-5).

These devices provide the force required to extend a pin that will open the rupture disc, allowing the agent to be released from the container.

## LOW PRESSURE SWITCH




The Low Pressure Switch provides a means to continuously monitoring the container pressure for a low-pressure condition.

If the pressure inside the container drops below 288 psig (1986 kPa), the switch contacts will transfer and invoke a "trouble" indication on the control panel.

The Low Pressure Switch (P/N 02-12533) has a single pole, double-throw switch that can be wired for normally open or normally closed.

For detailed information, refer to the Low Pressure Switch Component Sheet (p/n NF-06-432-1-3).

## INSTALLATION

The system installation must comply with the requirements of this manual; NFPA 2001, latest edition; all applicable local codes, regulations, and standards and the authority having jurisdiction (AHJ).

**WARNING:** **DO NOT** start system installation until the final design of the total system has been verified using NAFFCO's Engineered Flow Calculation.

**WARNING:** The Actuator shall **always** be the last component installed on a NAFFCO Clean Agent Fire Suppression system to avoid accidental discharge.

## FACTORS TO CONSIDER – CONTAINER LOCATION

| FACTOR | CONSIDERATION |
|---|---|
| **MOUNTING SURFACE** | Container brackets must be mounted securely to solid load-bearing surfaces that will support the container load.<br>Some installations may require additional mounting support not supplied by NAFFCO. |
| **ENVIRONMENTAL EFFECTS** | Container(s) should be located in clean, dry, and relatively vibration-free areas.<br>Avoid aisle ways and other high traffic areas where physical damage or tampering is more likely.<br>Container(s) should never be mounted where the container could potentially be splashed with, or submerged in any liquid.<br>Do not locate containers where they would be subject to physical damage, exposure to corrosive chemicals, or harsh weather conditions. |
| **TEMPERATURE RANGE** | Container locations must be between 32°F (0°C) to 130°F (54.4°C)<br>Temperatures outside of this range may result in the system not supplying the desired quantity of agent or accidental discharge. |
| **SERVICEABILITY** | In general, the larger the container, the more difficult it will be to remove it from the system for maintenance and service.<br>However, smaller containers that are located in a sub-floor space, under a computer bank, or above the ceiling over the same computer bank can be difficult as well. |
| **FLOOR SPACE** | Consideration should be given to the space available to install the container(s).<br>For example, a 900 lb. (408 kg) system could be stored in (2) 650 lb. (267 L) containers located on the floor.<br>However, if floor space is a problem, the system could be designed to utilize (6) 150i lb. (61 L) Inverted Containers mounted on the wall(s). |

| FACTOR | CONSIDERATION |
|---|---|
| FLOOR LOADING | Floor loading must be considered when selecting a container location.<br>The floor must be able to support the total weight of the NAFFCO container(s) as they are moved into position. Consult raised floor manufacturer for floor loading limitation.<br>The following guidelines are recommended:<br>Raised floor loading is a function of the manufacturer's load specification and the positioning of the container(s) on the raised floor grid.<br>**NOTE:** NAFFCO cannot assume responsibility for determining the suitability of a particular raised floor system; the following does provide information to help determine installation requirements.<br>When clean agent containers are located on a raised floor, floor integrity must be considered to determine if the type of tile and vertical floor support can handle the increased load. If necessary additional floor supports can be added.<br>**Option:**<br>To help distribute the container weight over a greater area, a ¼" steel plate can be placed under the container(s), sized to span multiple floor supports. If container spans multiple floor tiles, add additional floor supports (Minimum of 4 floor supports, 1 per corner, must be used). Excessive floor loading may require relocating the container(s) to a more suitable location.<br>For floor loading information refer to Table 1 or to Flow Calculation program for container size and actual fill weight being supplied. |

**TABLE 1 – FLOOR LOADING / AREA BY CONTAINER SIZE**

| Container Size lb. (L) | Total Container Weight lbs. (kg) (See Note 1) | Container Floor Area ft² (m²) | Container Floor Loading lbs/ft² (kg/m²) | Container Floor Area w/ Plate 1/4" x 2' x 2' plate (6.4mm x 0.6m x 0.6m plate) ft² (m²) | Container w/ Plate Floor Loading lbs/ft² (kg/m²) (See Note 2) |
|---|---|---|---|---|---|
| 1000 (423) | 1386 (628) | 3.14 (0.29) | **508 (2493)** | 4.0 (0.36) | **404 (2037)** |
| 650 (267) | 913 (41) | 3.14 (0.29) | **333 (1636)** | 4.0 (0.36) | **267 (1467)** |
| 375 (153) | 527 (239) | 2.18 (0.20) | **277 (1368)** | 4.0 (0.36) | **156 (788)** |
| 215 (88) | 328 (148) | 2.18 (0.20) | **170 (840)** | 4.0 (0.36) | **98 (495)** |
| 150 (61) | 283 (128) | 2.18 (0.20) | **138 (680)** | 4.0 (0.36) | **81 (406)** |
| 100(44) | 164 (74) | 0.63 (0.06) | **294 (1400)** | 4.0 (0.36) | **52 (262)** |
| 60 (27) | 106 (48) | 0.63 (0.06) | **190 (908)** | 4.0 (0.36) | **36 (180)** |
| 35 (15) | 51 (23) | 0.27 (0.03) | **256 (115)** | 4.0 (0.36) | **23 (114)** |
| 20 (8.5) | 37 (17) | 0.27 (0.03) | **156 (72)** | 4.0 (0.36) | **16 (83)** |
| 10 (4) | 23 (11) | 0.10 (0.009) | **250 (1278)** | 4.0 (0.36) | **12 (60)** |
| 5 (2) | 15 (7) | 0.10 (0.009) | **160 (833)** | 4.0 (0.36) | **10 (49)** |

**NOTES:**

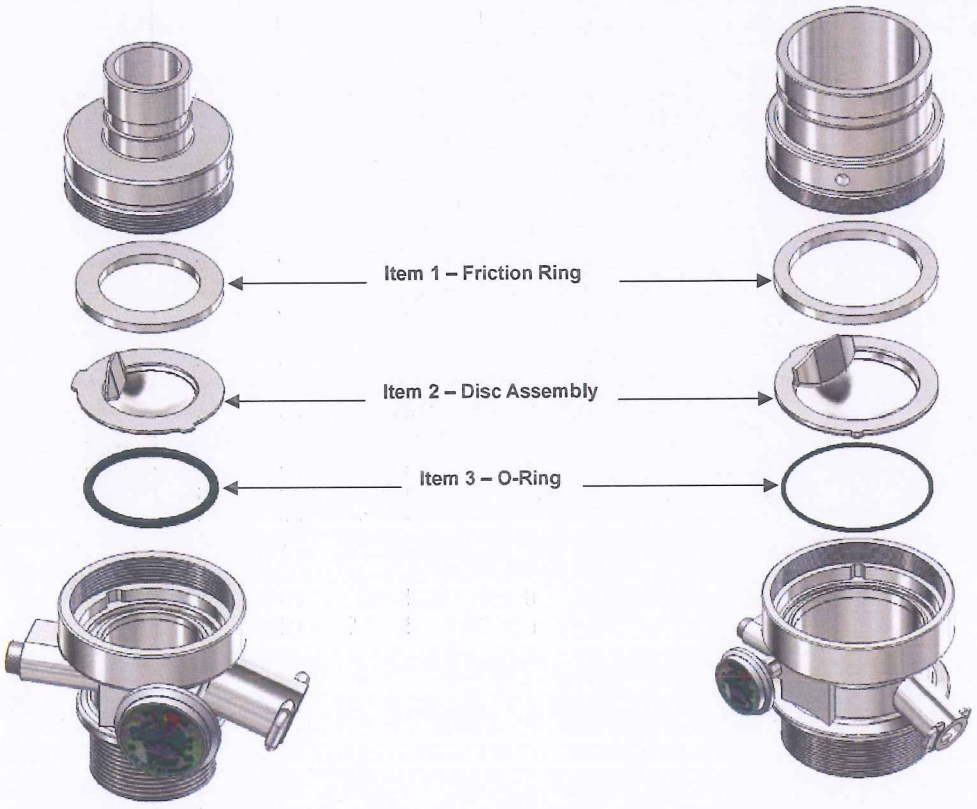
1) Total Container weight is based on container tare weight + maximum fill weight.
2) Total Container weight + 22.5 lbs. (10.2 kg) added for 1/4" x 2' x 2' (6.4mm x 0.6m x 0.6m) plate used to calculate Container w/ plate floor loading.

**RECHARGE ITEMS – 1" (25) & 3" (80) VALVE** (Must Order Separate)

After a system has been discharged, the following items must be replaced before a container can be recharged. For a detailed procedure on recharging a NAFFCO container w/ an Impulse Valve refer to NAFFCO's Recharge Manual.

| Item | Description | 1" (25mm) Recharge Kit (p/n 85-047) includes the following: | 3" (80mm) Recharge Kit (p/n 85-048) includes the following: |
|---|---|---|---|
| | | Part Number | Part Number |
| 1 | Friction Ring | 70-2060 | 70-2063 |
| 2 | Disc Assembly | 70-247 | 70-248 |
| 3 | O-Ring | 02-11987 | 02-11989 |
| 4 | Valve Core-Fill Port (not shown) | 02-4161 | 02-4161 |
| 5 | Reconditioning Instructions (not shown) | 06-567 | |

**NOTE:** 1" Recharge Kit is used on 5, 10, 20, 35, 60 & 100 lb. (2, 4, 8, 15, 27 & 44 L) containers 3" Recharge Kit is used on 150, 150i, 215, 375, 650 & 1000 lb. (61, 61i, 88, 153, 267 & 423 L) containers




**1" (25 mm) Impulse Valve** **3" (80 mm) Impulse Valve**

The 1" & 3" Impulse Valves are a rupture disc (metal diaphragm), pressure operated device that allows the agent to be released from the container and into the protected enclosure via the associated piping network and discharge nozzle(s).



NAFFCO Impulse Valves are equipped with four ports:

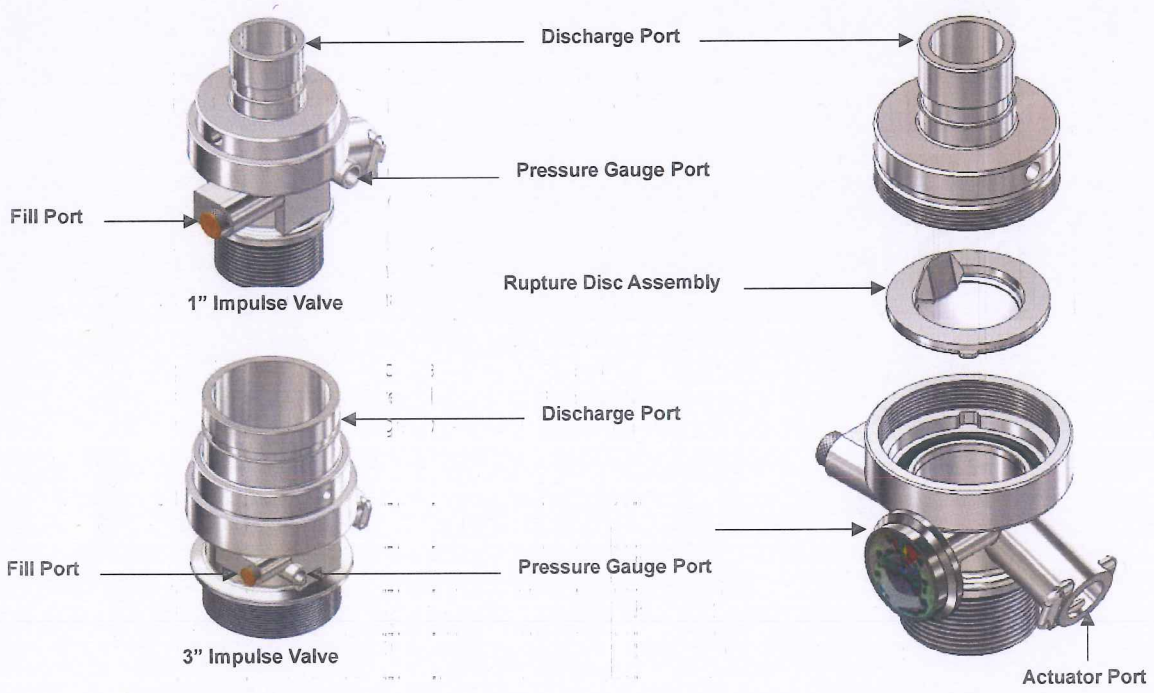
Agent Discharge Port allows agent release from container and also fulfills the pressure relief valve requirements in accordance with DOT regulations.

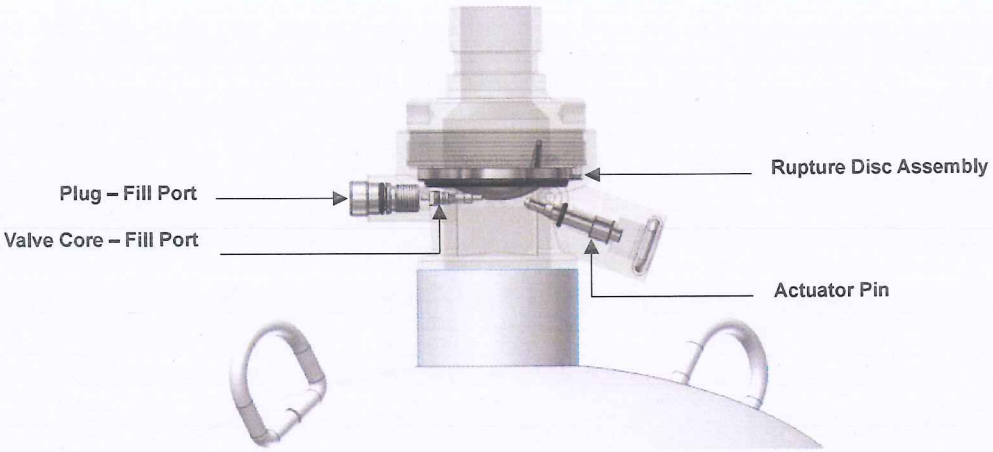
Agent Fill Port used to fill (refill) and pressurize the container and also used for the Low Pressure Switch.

Actuator Port used to connect an Impulse Valve Operator (IVO) with Manual Strike Button for electric and manual actuation of the container or an Impulse Valve Pneumatic Operator (IVPO) for pneumatic operation.

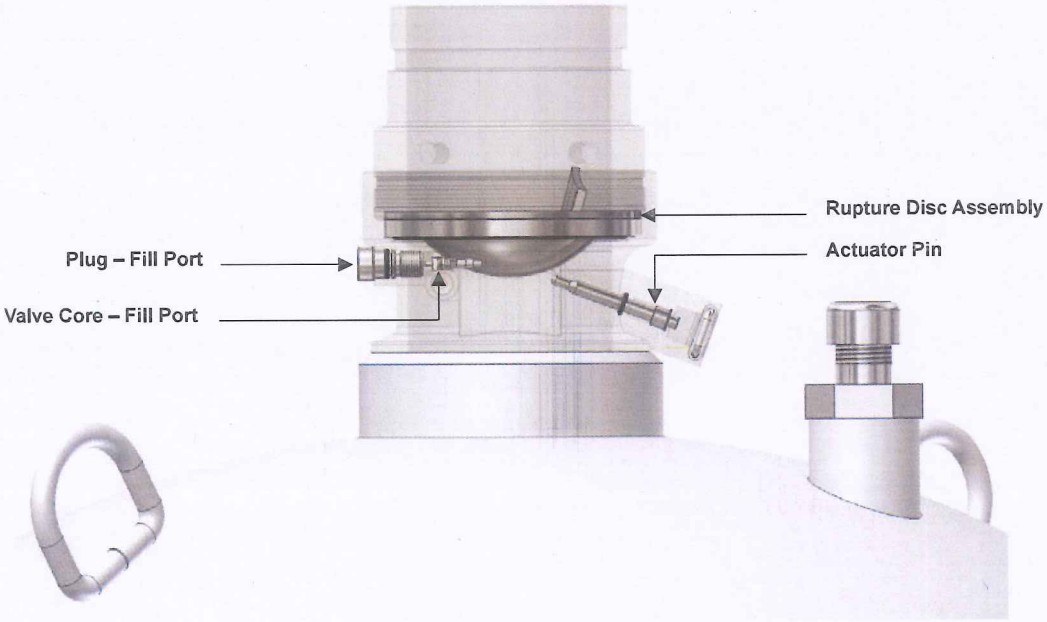
Pressure Gauge Port is used to connect a Pressure Gauge that will monitor internal container pressure, also equipped with an orifice plug that allows the pressure gauge to be removed safely when the container is pressurized.

| COMPONENT | MATERIAL |
|---|---|
| Valve Body | Brass |
| Rupture Disc Assembly | Hastelloy C276/ 316SST |
| Listings and Approvals | UL Listed & FM Approved |






Internal View – 1" Impulse Valve




Internal View – 3" Impulse Valve

All NAFFCO Clean Agent Fire Suppression containers with HFC-227ea agent are provided with a pressure gauge to indicate the internal container pressure.

The pressure gauge scale is calibrated to show the actual pressure and is color-coded to show operating range, under-pressure range, and over-pressure range.

This gauge can be removed/replaced on a charged container without removing the agent first. This port works by allowing a small controlled amount of leakage past its internal threads. This provides enough flow to operate the pressure gauge while being small enough to allow the gauge to be removed safety.



**Listings and Approvals** UL Listed / FM Approved **INSTALLATION**

The pressure gauge is installed on the container at the factory before the container is filled / shipped.

The container pressure needs to be checked as a part of the installation procedure. They should read 360 PSIG at 70°F (24.8 bar at 21°C). For temperatures other than 70°F (21°C), reference Figure 1 – Temperature vs. Pressure Chart.

**Figure 1 – Temperature vs. Pressure Chart**

| US Standard | Metric | |
|---|---|---|
| **Temperature** (°F)<br>**Pressure** (psig) | **Temperature** (°C) | **Pressure** (bar) |
| 32<br>288 | 0 | 19.9 |
| 40<br>303 | 4 | 20.9 |
| 50<br>321 | 10 | 22.1 |
| 60<br>340 | 16 | 23.4 |
| 70<br>360 | 21 | 24.8 |
| 80<br>381 | 27 | 26.2 |
| 90<br>402 | 32 | 27.7 |
| 100<br>425 | 38 | 29.3 |
| 110<br>449 | 43 | 31.0 |
| 120<br>475 | 49 | 32.8 |
| 130<br>502 | 54 | 34.6 |

## REPLACEMENT PROCEDURE

The following procedure is used to replace the pressure gauge on a charged container.

**CAUTION:** When replacing a pressure gauge, do not allow the pressure port to remain open (disconnected) for an extended period of time. A significant quantity of agent could be lost from the container.

| Step | Procedure |
|---|---|
| 1 | Place Teflon tape on the male thread connection of the replacement pressure gauge(s). **DO NOT** overlap the end of the connection – the first thread should be uncovered. |
| 2 | Remove the old pressure gauge. |
| 3 | Install the new pressure gauge. |
| 4 | Check the assembly for leaks using a suitable leak test device. |

**NOTE:** Refer to the Recharge Manual for recommendations and leak test procedures.



# LIQUID LEVEL INDICATOR (LLi) COMPONENT SHEET

The Liquid Level Indicator (LLi) provides a means of verifying the weight of agent in a container without having to remove the container and weigh it on a calibrated scale.

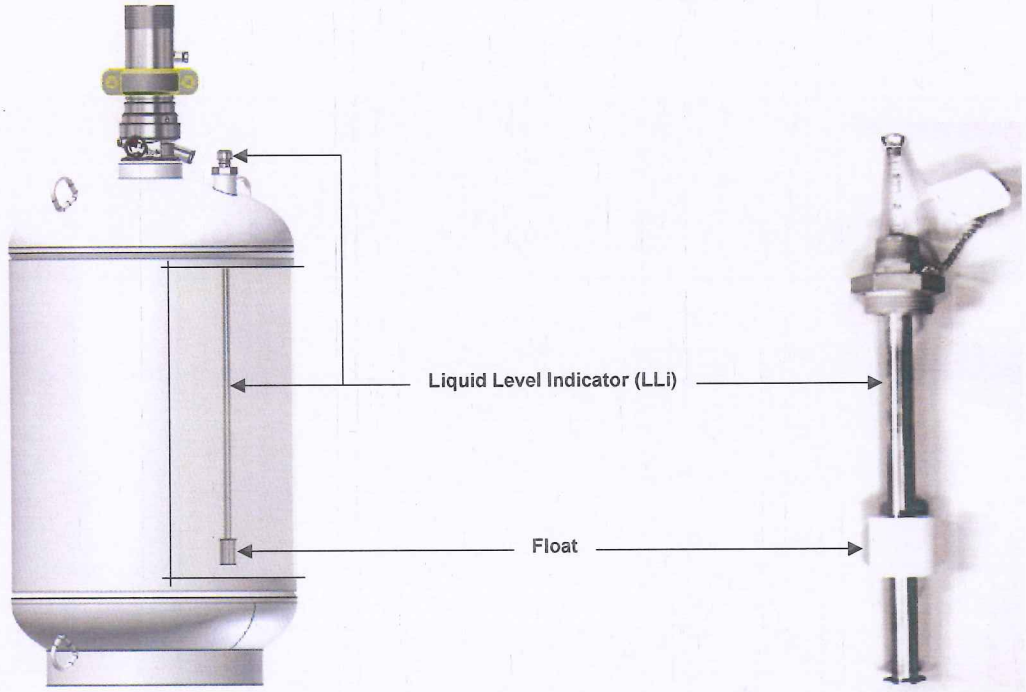
This device enables the inspector to determine the weight of agent with the container safely secured in its installed position.

LLi's are furnished on the 100, 150, 215, 375, 650 and 1000 lb. (44, 61, 88, 153, 267 and 423 L) containers. Refer to the following Liquid Level Indicator Manuals for additional information concerning its installation and use:

P/N NF-06-548 LLi Manual for ECARO-25 containers

P/N NF-06-549 LLi Manual for FM-200 containers

**WARNING:** The Liquid Level Indicator (LLi) **MUST** be installed while the Container is **EMPTY.**




| CONTAINER SIZE lb. (L) | LLi PART NUMBER |
|---|---|
| 100 (44) | 70-1353-27 |
| 150 (61) | 70-1353-14 |
| 215 (88) | 70-1353-18 |
| 375 (153) | 70-1353-27 |
| 650 (267) | 70-1353-38 |
| 1000 (423) | 70-1353-49 |
| Listings and Approvals | UL Listed & FM Approved |

# LOW PRESSURE SWITCH

## COMPONENT SHEET

NAFFCO offers an optional Low Pressure Switch (LPS) for the purpose of continuously monitoring the container pressure for a low-pressure condition.

If the pressure inside the container drops below 288 psig (1986 kPa), the switch contacts will transfer and invoke a "supervisory" indication on the control panel.

The LPS is an optional item and must be ordered separately. This device is installed in the fill port on the container with an Impulse Valve.

The LPS can be installed when the container is charged without the concern of agent / pressure loss.



Low Pressure Switch



Container w/ Impulse Valve

| SPECIFICATIONS – LOW PRESSURE SWITCH | |
|---|---|
| Part Number | 02-12533 |
| Temperature Limits | +32 to +130°F (0 to 54.4°C) |
| Enclosure Classification | NEMA 4 |
| Contact Rating | Single pole, double throw; 5 amps resistive, 3 amps inductive @ 30VDC (can be wired for normally open or normally closed operation) |
| Body Material | Aluminum with irridite finish |
| Weight | 6.5 ounces |
| Pressure Connection | M10 x 1-6G |
| Electrical Connection | 1/2" NPT (15 mm) |
| LPS Length (approximate) | 4 3/8" (111 mm) Long (including both connectors) |
| Wire Leads | (3) 18 gauge x 4.0 ft. (1.2m) long Violet (Common), Blue (N.O.), Black (N.C.) |
| Pressure Setting | 288 psig (20 bar) (decreasing) |
| Listings and Approvals | UL Listed & FM Approved |

## INSTALLATION

The LPS is an optional item and must be ordered separately. This device can be installed in the Fill Port on a container that is charged by using the following steps:

Step 1: Prior to Assembly; lubricate the LPS O-Ring with Molycoat 55 or equal. Use care not to get lubricant into pressure port.

**NOTES: DO NOT** apply Teflon Tape to LPS threads. **DO NOT** cross thread the LPS during installation.

Step 2: Remove and retain Plug from Fill Port. (see Figure 1)

Step 3: Remove rubber cap and screw in the LPS (Hand Tight) until the switch bottoms out. Screwing the switch in to this point will open an internal check valve and applies pressure the switch.

**NOTE: "NO TOOLS"** are required to install LPS.

Step 4: Leak check around the pressure gauge port using Snoop leak test fluid or equivalent.

If a leak is detected; remove the LPS from the fill port and remove the lubricant and contaminants from the O-Ring, threads and valve port using isopropyl alcohol and a soft clean cloth. Lubricate the O-Ring with Molycoat 55 or equal and reinstall. Leak test around the fill port.

If a leak is detected; remove the LPS from the fill port, remove the O-Ring, install a new O-Ring, lubricate the O-ring with Molycoat 55 or equal, install the LPS in the fill port, and leak test around the fill port. **NOTE:** When installing conduct connector to LPS secure "Hand Tight". Over tightening may cause damage to the LPS or to the Impulse valve fill port threads.

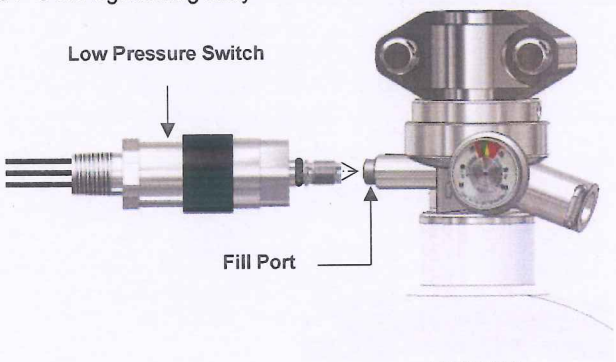



FIGURE 1

## WIRING DIAGRAM – LOW PRESSURE SWITCH

The LPS should be wired into a supervised circuit in the control panel used to provide a supervisory signal if the container pressure drops below 288 psig (1986 kPa). The switch is wired as a normally closed contact (open under pressure). (see Figure 2)

**NOTE:** Refer to the Installation, Operation & Maintenance for the control panel being used for specific wiring criteria.

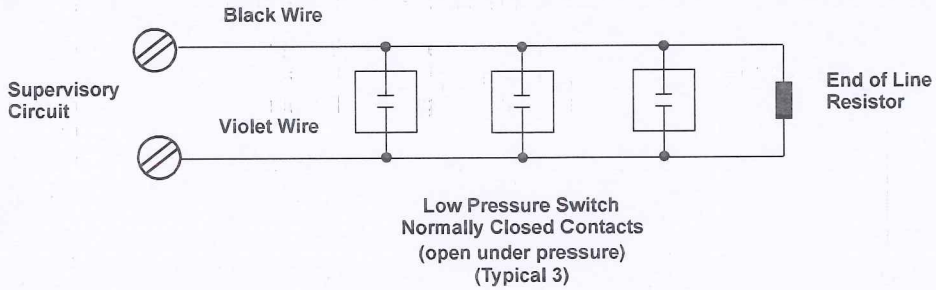



FIGURE 2

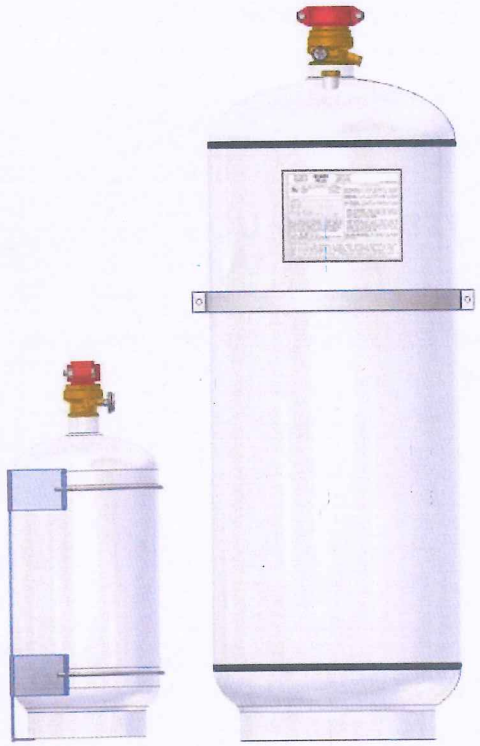
# MOUNTING STRAPS & BRACKETS

## COMPONENT SHEET

Mounting Straps / Brackets are used to secure containers to a wall or other suitable mounting surface. These devices are supplied with each container purchased in accordance with the information shown below.

Mounting hardware is supplied by system installer.

**CAUTION:** Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable.



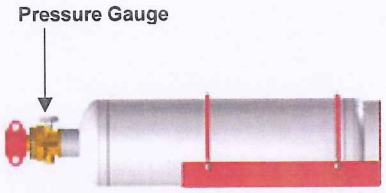
| CONTAINER SIZE lb. (L) | BRACKET PART NUMBER |
|---|---|
| 5 (2) | 70-2135-X |
| 10 (4) | 70-2135-X |
| 20 (8.5) | 70-1372-X |
| 35 (15) | 70-1372-X |
| 60 (27) | 70-1070-X |
| 100 (44) | 70-1345-X |
| 150 (61) | 70-2146-X |
| 150i (61) | 70-2147-X |
| 215 (88) | 70-1310-X |
| 375 (153) | 70-1310-X |
| 650 (267) | 70-1384-X |
| 1000 (423) | 70-1384-X |
| **Material** | Carbon Steel |
| **Bracket Color** (see note) | White (Standard) |
| | Red |
| **Listings and Approvals** | UL Listed & FM Approved |

**NOTE:** Container brackets have 2 paint options (White or Red). When ordering a container bracket the paint option must be specified. For a bracket painted white enter part number – W and for bracket painted red enter part number – R.

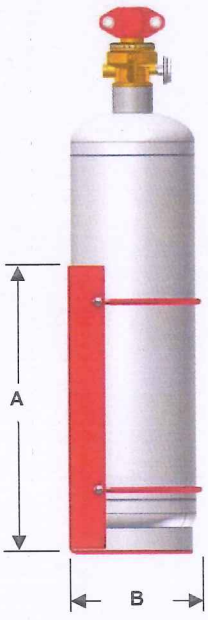
**Example:** 20 lb. container bracket painted white, the part number is NF-70-1372-W.

## MOUNTING DETAILS – 5, 10, 20 & 35 LB. (2L, 4L, 8.5L & 15L) CONTAINERS

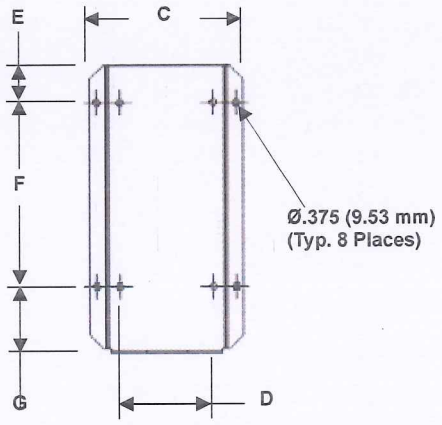
| DIMENSION | CONTAINER SIZE | | | | NOTES |
|---|---|---|---|---|---|
| | **5 lb. (2L)** in. (mm) | **10 lb. (4L)** in. (mm) | **20 lb. (8.5L)** in. (mm) | **35 lb. (15L)** in. (mm) | |
| A | 12.3 (313) | 12.3 (313) | 16.3 (414) | 16.3 (414) | When mounting the 20 & 35 lb. (8.5L to 15L) containers in the horizontal position (wall mount or sub-floor mount), the container valve "Pressure Gage" **MUST** point up. Failure to comply with this requirement will result in an incomplete discharge. |
| B | 4.2 (102) | 4.2 (102) | 7.0 (178) | 7.0 (178) | |
| C | 5.7 (145) | 5.7 (145) | 8.2 (209) | 8.2 (209) | |
| D | 3.0 (76) | 3.0 (76) | 5.0 (127) | 5.0 (127) | |
| E | 2.5 (63.5) | 2.5 (63.5) | 3.0 (76) | 3.0 (76) | |
| F | 8.0 (203) | 8.0 (203) | 9.7 (246) | 9.7 (246) | |
| G | n/a | n/a | 3.6 (91) | 3.6 (91) | |
| **NOTE:** All dimensions are approximate. | | | | | |
| **MOUNTING POSITION** | Upright (Valve Up) | Upright (Valve Up) | Upright – Horizontal | Upright – Horizontal | |




**IMPORTANT NOTE:** The 5 & 10 lb. (2 & 4L) containers must be mounted in the vertical (valve up) position; they can NOT be mounted in the horizontal position. If mounted in horizontal position will result in an incomplete discharge.




Side View



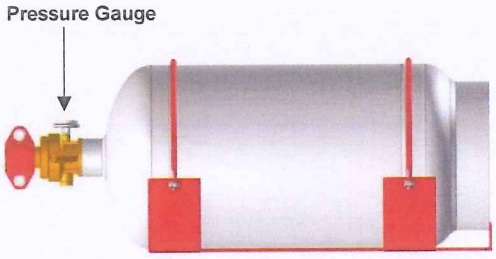

Front View

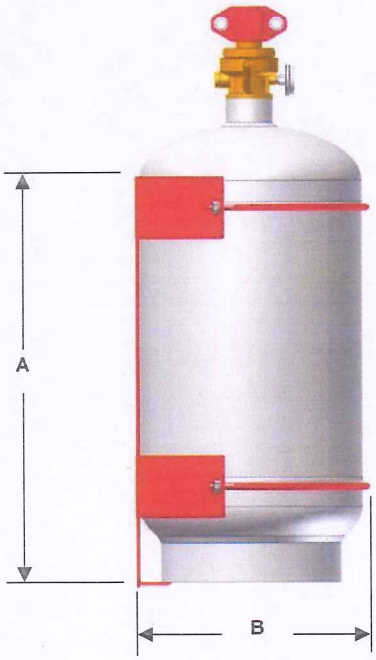
## MOUNTING DETAILS – 60 LB. (27L) CONTAINERS

| DIMENSION | in. (mm) |
|---|---|
| A | 20.00 (508) |
| B | 10.75 (273) |
| C | 13.19 (335) |
| D | 9.00 (229) |
| E | 1.50 (38) |
| F | 0.75 (19) |
| G | 3.50 (89) |
| H | 4.88 (124) |
| **NOTE:** All dimensions are approximate. | |
| **MOUNTING POSITION** | Upright – Horizontal |

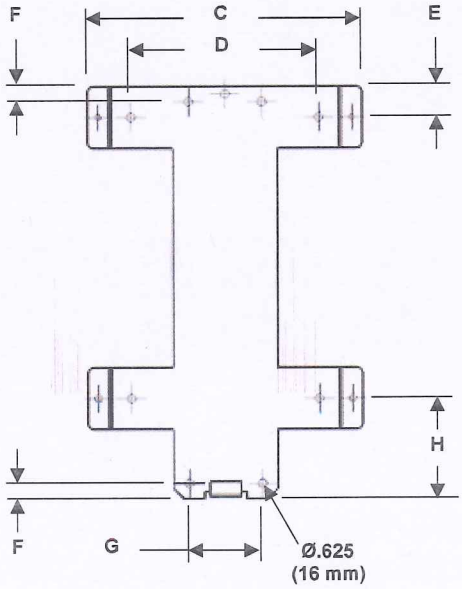
**NOTES**

When mounting the 60 lb. (27L) container in the horizontal position (wall mount or sub-floor mount), the container valve "Pressure Gage" **MUST** point up. Failure to comply with this requirement will result in an incomplete discharge.



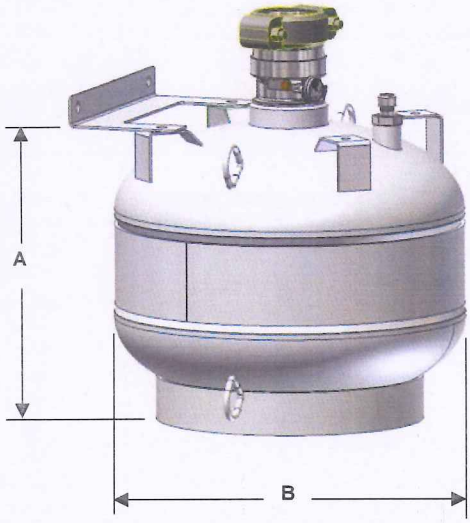

Side View

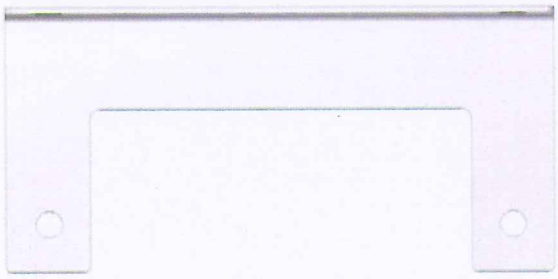



Front View

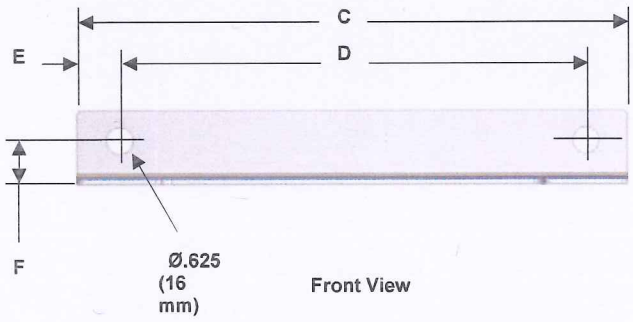
## MOUNTING DETAILS – 150 LB. (61L) CONTAINERS

| DIMENSION | in. (mm) | NOTES |
|---|---|---|
| A | 17.125 (435) | The 150 lb. container is equipped with a siphon tube and **MUST** be mounted in the upright (valve up) position. Failure to comply with this requirement will result in an incomplete discharge. |
| B | 20.00 (508) | |
| C | 13.20 (335) | |
| D | 11.20 (284) | |
| E | 1.00 (25) | |
| F | 1.07 (27) | |
| **NOTE:** All dimensions are approximate. | | |
| **MOUNTING POSITION** | Upright | |



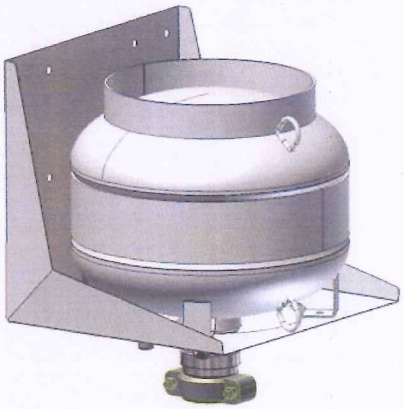
Top View

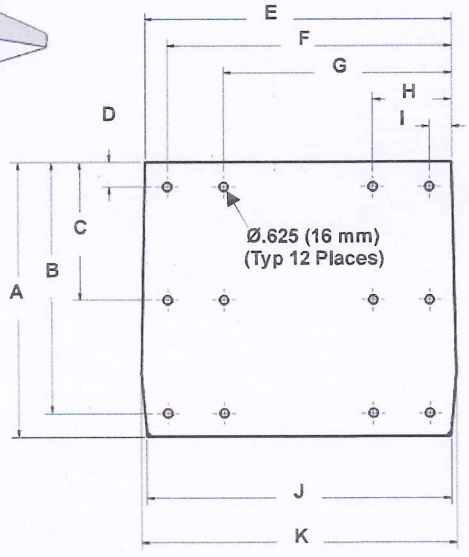



Front View

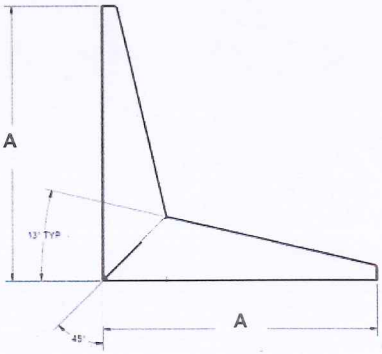
## MOUNTING DETAILS – 150i LB. (61L) CONTAINERS

| DIMENSION | in. (mm) | NOTES |
|---|---|---|
| A | 19.42 (493) | The 150i lb. container is NOT equipped with a siphon tube and **MUST** be mounted in the inverted (valve down) position. Failure to comply with this requirement will result in an incomplete discharge.<br><br>**NOTE:** All dimensions are approximate. |
| B | 17.75 (451) | |
| C | 9.75 (248) | |
| D | 1.75 (44) | |
| E | 21.62 (549) | |
| F | 18.81 (478) | |
| G | 14.81 (376) | |
| H | 6.81 (173) | |
| I | 2.81 (71) | |
| J | 21.50 (546) | |
| K | 22.27 (566) | |
| **MOUNTING POSITION** | Inverted (Valve Down) | |






Front View

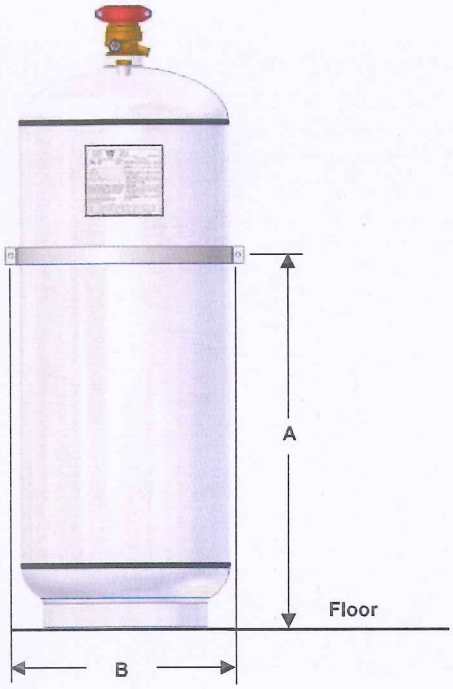



Side View

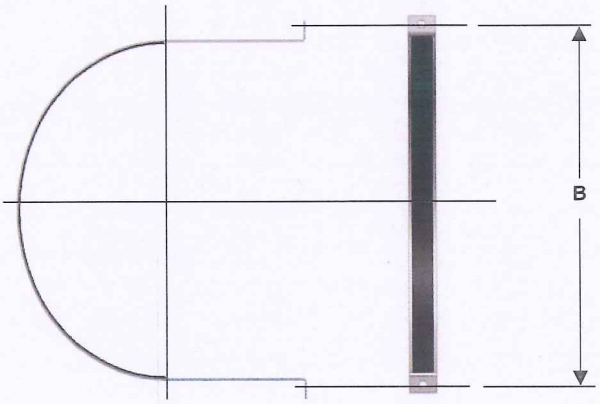
## MOUNTING DETAILS – 100, 215, 375, 650 & 1000 LB. (44, 88, 153, 267, 423 L) CONTAINERS

| PART NUMBER | CONTAINER SIZE | DIMENSION | | MOUNTING POSITION |
|---|---|---|---|---|
| | | A in. (mm) | B in. (mm) | |
| NF-70-266 | 100 lb. (44L) | 20.00 (508) | 12.25 (311) | Upright (Valve Up) |
| NF-70-268 | 215 lb. (88L) | 11.00 (279) | 21.75 (552) | Upright (Valve Up) |
| NF-70-269 | 375 lb. (153L) | 24.00 (610) | 21.75 (552) | Upright (Valve Up) |
| NF-70-270 | 650 lb. (267L) | 28.00 (711) | 26.00 (661) | Upright (Valve Up) |
| NF-70-271 | 1000 lb. (423L) | 40.00 (1016) | 26.00 (661) | Upright (Valve Up) |

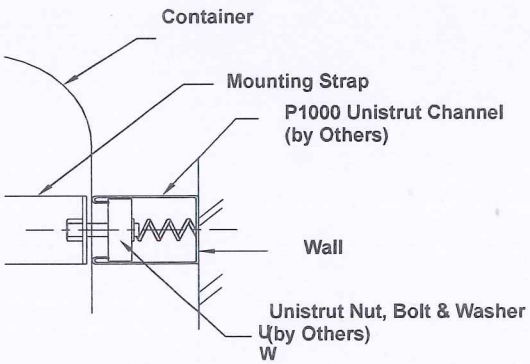
**NOTES:** Mounting Strap can be fastened to the Unistrut Channel with a Unistrut Spring Nut and Bolt.
All dimensions are approximate.




Front View




Top View




MOUNTING STRAP DETAIL

# IMPULSE VALVE OPERATOR (IVO) KIT

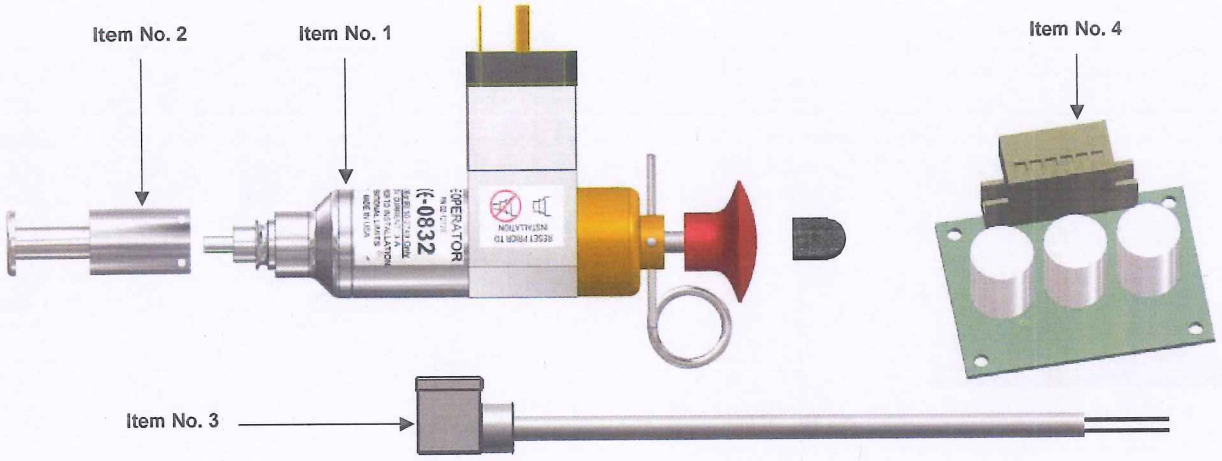
## COMPONENT SHEET

The Impulse Valve Operator (IVO) provides means to electrically or manually activate the NAFFCO Impulse Valve clean agent container by providing the force required to extend a piston that will open the rupture disc, allowing the agent to be released from the container.

The IVO can be activated electrically via a signal from NAFFCO control panel or manually by depressing red strike buttom.

NAFFCO Clean Agent Containers with Impulse Valve **must** use an Impulse Releasing Module (IRM) to supervise the agent release circuit wiring (for open and ground fault conditions) from the container to the control panel.





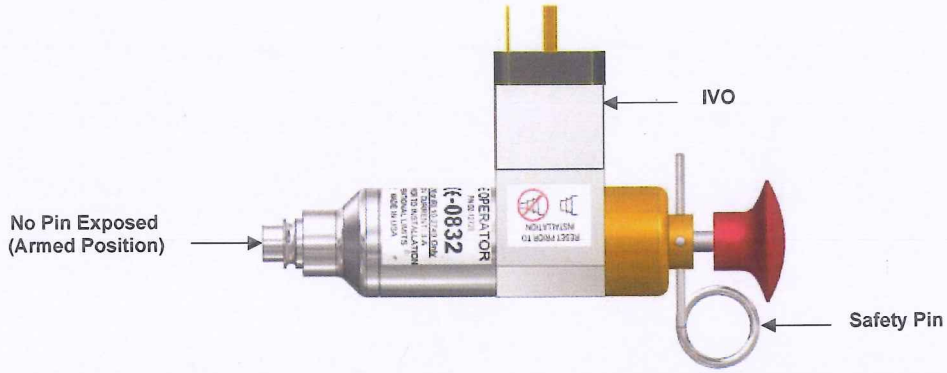

| SPECIFCATIONS – IMPULSE VALVE OPERATOR (IVO) KIT | | |
|---|---|---|
| **Item No.** | **Part Number** | **Description** |
| 1 | NF-02-12728 | Impulse Valve Operator (IVO) |
| 2 | 70-286 | Reset Tool |
| 3 | 02-12755 | Wire Lead (5' lg.) w/ Connector |
| 4 | NF-10-2748 | Impulse Releasing Module Assembly (IRM) |
| Normal Supply Voltage | | 24 VDC |
| Current Consumption | | 0 Amps (for Battery Calculation) |
| Electrical Connection | | DIN Connector w/ Cable & ½" NPT for conduit connection |
| IVO Material | | Stainless Steel (Body) / Brass (End Cap) |
| Temperature Range | | 32°F to 130°F (0°C to 54.4°C) |
| Listings & Approvals | | UL Listed & FM Approved |

## INSTALLATION

After the electrical / control system has been checked out and no trouble / ground faults are present; proceed with the Actuation System installation.

**NOTE:** This should be the last items completed before the system is placed into operation.

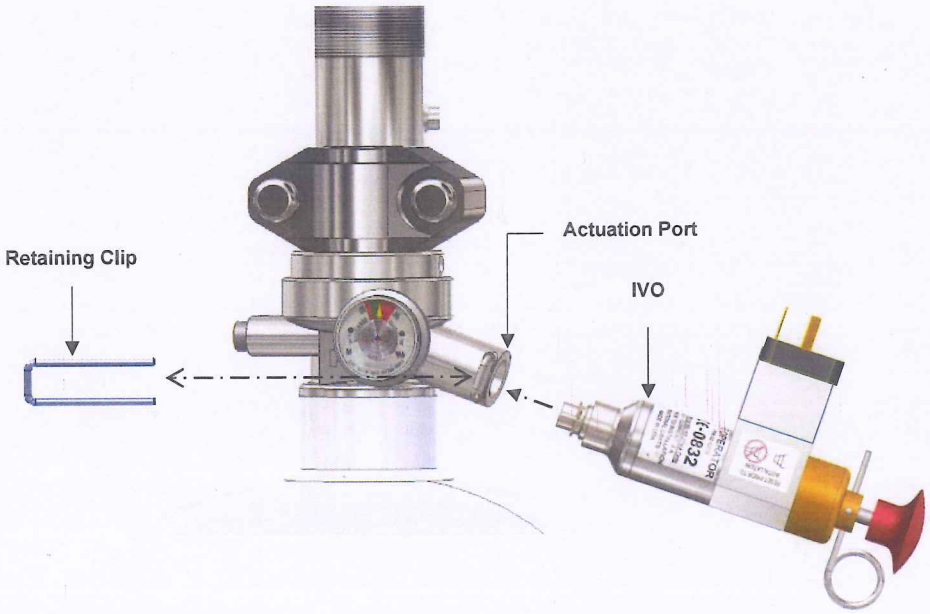
**IMPORTANT NOTE:** Check to ensure IVO is armed (Firing Pin retracted) and Safety Pin is place before installing to the Impulse Valve on the container.




Install the wire lead w/ connector (Item no. 3) to the IVO (Item no. 1) connector and secure with set screw.

Install IVO; remove Retaining Clip and Plastic Plug from Impulse Valve Actuation Port.

Insert IVO into Impulse Valve Actuation Port and re-insert Retaining Clip.



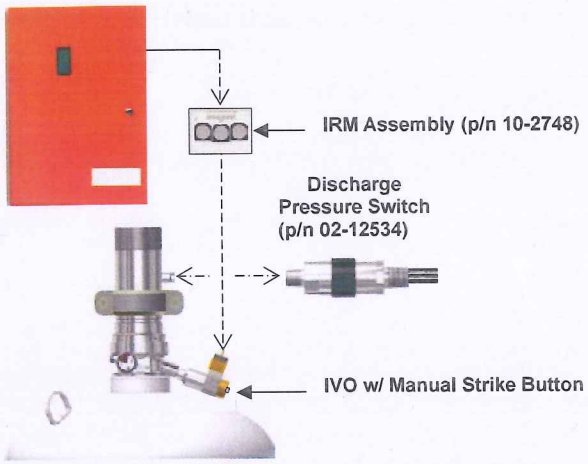

The container is **"NOW ARMED"**.

## ELECTRIC ACTUATION – SINGLE CONTAINER SYSTEM W/ IVO

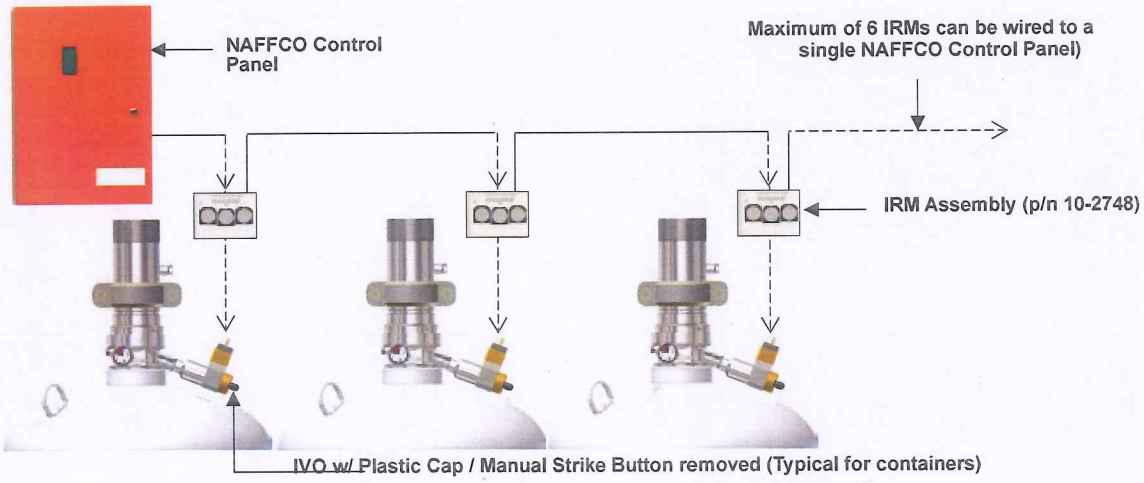
For wiring installation details between NAFFCO Control Panel, IRM and the IVO, reference the Impulse Release Module Product Manual (p/n NF-06-552).

At this point the IVO can be installed to the Clean Agent Container Impulse Valve. The Discharge Pressure Switch (p/n 02-12534) is required and is wired to the manual release contact in SHP PRO or to a monitor module in Cheetah Xi or Xi50.

**WARNING:** Do not attempt to install the IVO with the firing pin in the extended position.




## ELECTRIC ACTUATION – MULTI- CONTAINER SYSTEM W/ IVO




**IMPORTANT NOTE:** When utilizing electric actuation (IRM) with multiple containers with IVO, the manual strike button on each IVO must be removed and plastic cap installed. The Discharge Pressure Switch is **NOT** used. This is to prevent a single container from being discharged in a multiple container system.

For wiring installation details between NAFFCO Control Panel, IRM and the IVO, reference the Impulse Release Module (IRM) Product Manual (p/n NF-06-552).

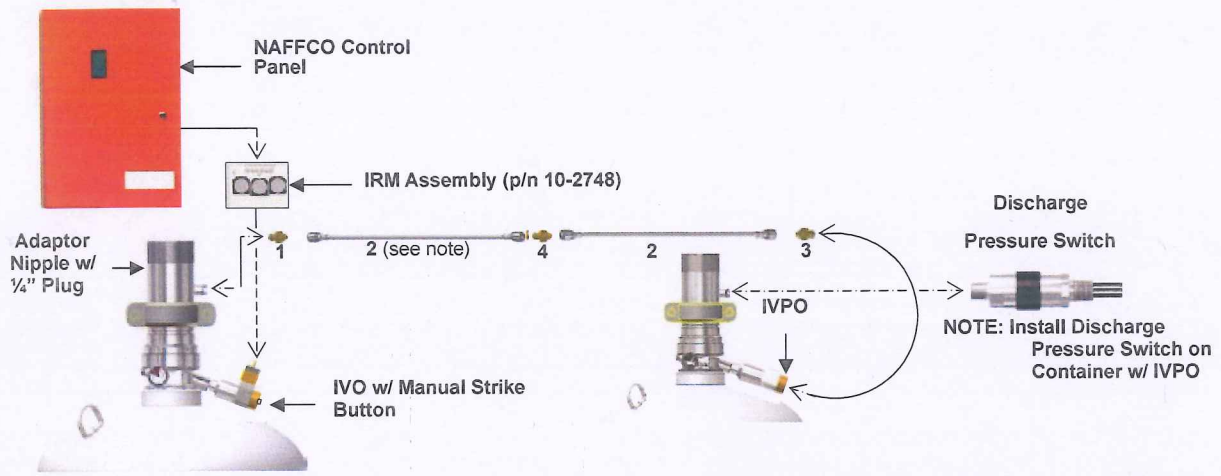
At this point the IVO can be installed to the Clean Agent Container Impulse Valve.

Reference detailed installation instructions on page 2 of this component sheet

## ELECTRIC & PNEUMATIC ACTUATION – TWO CONTAINER SYSTEM W/ IVO & IVPO

| ITEM | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 02-4530 | ¼" NPT x ¼" JIC Adaptor (must be ordered separately) |
| 2 | 02-4977 | ¼" JIC x 3.0' lg. Actuation Hose (supplied w/ IVPO)(see note) |
| 3 | 02-4535 | 1/8" NPT x ¼" JIC Adaptor (supplied w/ IVPO) |
| 4 | 02-12926 | ¼" JIC Male Adaptor (must be ordered separately) |

**NOTE:** This actuation method requires 2 – ¼" JIC x 3.0' lg. Actuation Hoses, 1 hose supplied w/ IVPO assembly, the 2nd Actuation Hose must be ordered separately.



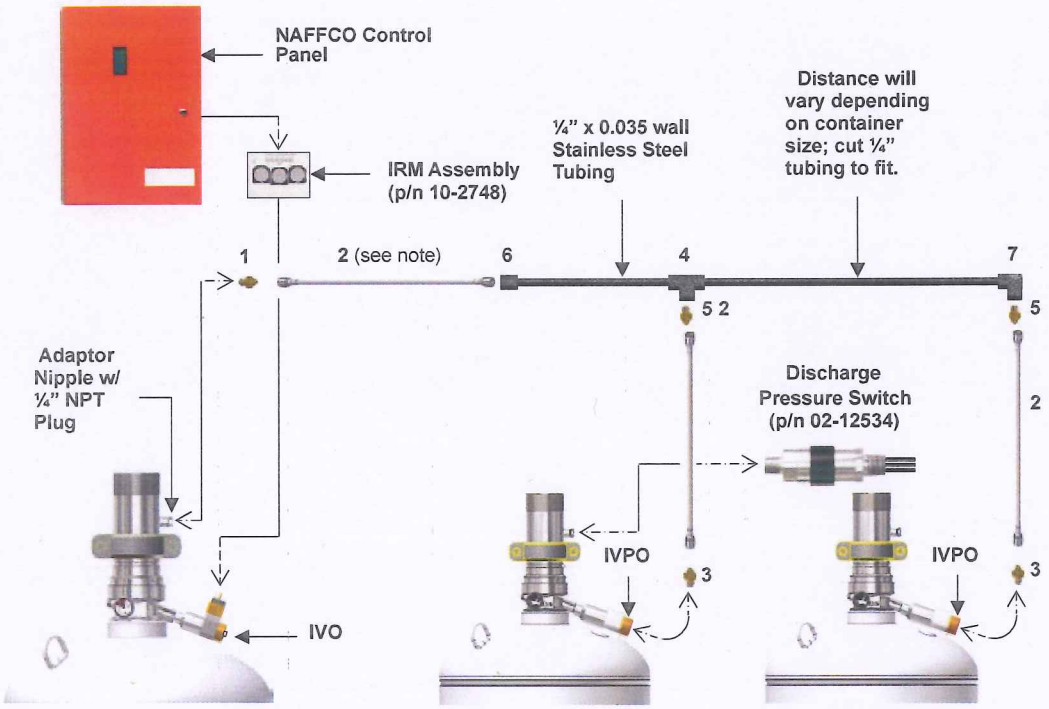

1st remove the ¼" NPT Plug from Adaptor Nipple, then install Actuation System as shown above. Secure Actuation tubing to a solid surface. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable. For additional information regarding the installation and resetting of the IVPO, refer to the IVPO Component Sheet (p/n NF-06-432-1-6).

The Discharge Pressure Switch (p/n 02-12534) is required and is wired to the manual release contact in SHP PRO or to a monitor module in Cheetah Xi or Xi50.

## ELECTRIC & PNEUMATIC ACTUATION – MULTI CONTAINER SYSTEM W/ IVO & IVPO

| ITEM | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 02-4530 | ¼" NPT x ¼" JIC Adaptor (must be ordered separately) |
| 2 | 02-4977 | ¼" JIC x 3.0' lg. Actuation Hose (supplied w/ IVPO) (see note) |
| 3 | 02-4535 | 1/8" NPT x ¼" JIC Adaptor (supplied w/ IVPO) |
| 4 | C02-1359 | ¼" Tube Tee (must be ordered separately) |
| 5 | C02-1356 | ¼" Male JIC x ¼" Male Tube Adaptor (must be ordered separately) |
| 6 | 02-12695 | ¼" Tube x ¼" JIC Adaptor (must be ordered separately) |
| 7 | 02-12696 | ¼" Tube Elbow-90° (must be ordered separately) |
| 8 | 02-12697 | ¼" Tube Coupler (not shown) (must be ordered separately) |

**NOTE:** The Actuation Hose required to connect the 1st container w/ IVO to the Actuation Tubing must be ordered separately.




The illustration above shows the items required to make the proper connection between the Container equipped w/ an IVO and the Container(s) equipped w/ an IVPO. The maximum length of pneumatic actuation line (including Hoses) can not exceed 50 ft. (15.2 m) and up to 6 containers equipped w/ an IVPO.

1st remove the ¼" NPT Plug from Adaptor Nipple, then install Actuation System as shown above. Secure Actuation tubing to a solid surface. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable.

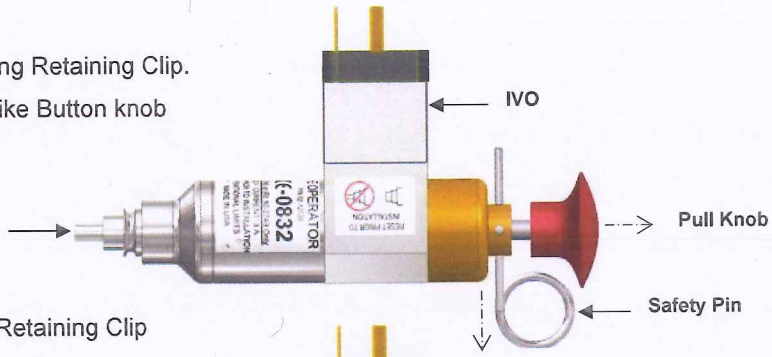
The Discharge Pressure Switch (p/n 02-12534) is required and is wired to the manual release contact in SHP PRO or to a monitor module in Cheetah Xi or Xi50.

For additional information regarding the installation and resetting of the IVPO, refer to the IVPO Component Sheet (p/n NF-06-432-1-6).

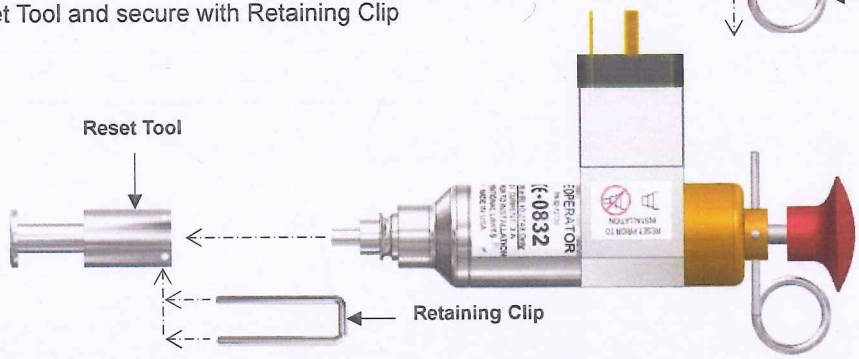
## RESET INSTRUCTIONS

Remove IVO from Impulse Valve by removing Retaining Clip.

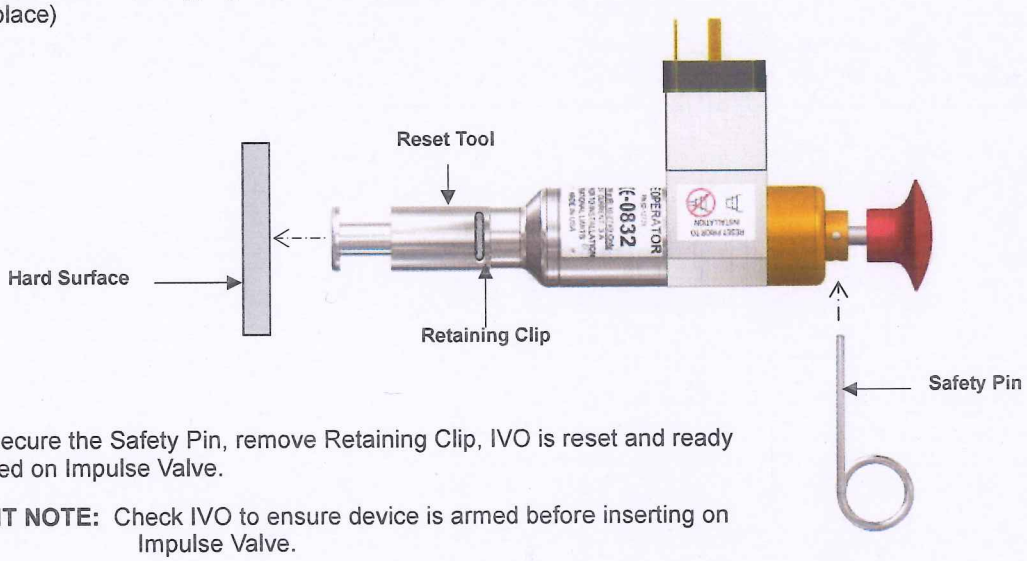
Remove Safety Pin and pull the Manual Strike Button knob until it resets (clicks into place)




Insert IVO into Reset Tool and secure with Retaining Clip

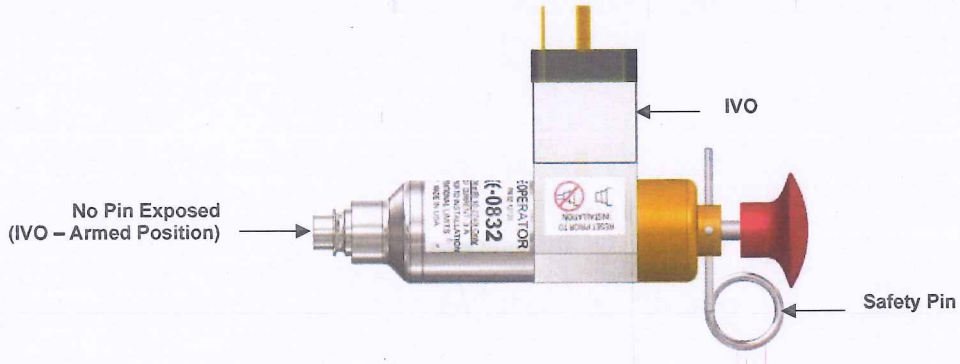



Push Reset Tool button (firmly) against a hard surface until IVO Pin resets (clicks into place)




Insert and secure the Safety Pin, remove Retaining Clip, IVO is reset and ready to be installed on Impulse Valve.

**IMPORTANT NOTE:** Check IVO to ensure device is armed before inserting on Impulse Valve.



# IMPULSE VALVE PNEUMATIC OPERATOR (IVPO) KIT

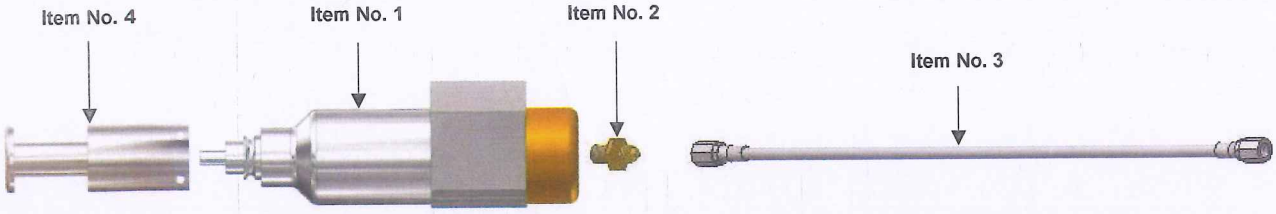
## COMPONENT SHEET

The Impulse Valve Pneumatic Operator (IVPO) provides the means to pneumatically activate the NAFFCO Impulse Valve clean agent container by providing the force required to extend a piston that will open the rupture disc, allowing the agent to be released from the container.

The IVPO is installed in systems utilizing multiple clean agent containers.

NAFFCO Clean Agent Containers with IVPO are operated by pneumatic pressure from Container with Impulse Valve Operator (IVO). For detailed information, refer to the Impulse Valve Operator Component Sheet (p/n NF-06-432-1-5).






| SPECIFICATIONS – IMPULSE VALVE PNEUMATIC OPERATOR (IVPO) KIT | | |
|---|---|---|
| **Item No.** | **Part Number** | **Description** |
| 1 | NF-02-12729 | Impulse Valve Pneumatic Operator (IVPO) |
| 2 | 02-4543 | 1/8" x ¼" JIC Adaptor |
| 3 | 02-4977 | ¼" JIC x 3.0' lg. Actuation Hose |
| 4 | 70-286 | Reset Tool |
| IVPO Material | | Stainless Steel (Body) / Brass (End Cap) |
| Pneumatic Connection | | 1/8" NPT |
| Temperature Range | | 32°F to 130°F (0°C to 54.4°C) |
| Listings and Approvals | | UL Listed & FM Approved |

### INSTALLATION

After the electrical / control system has been checked out and not trouble / ground faults are present; proceed with the IVO and IVPO installation.

**NOTE:** The IVO should be the last items completed before the system is placed into operation.

- Remove the Retaining Clip from the actuation port of the Impulse Valve. (see Figure 1)
- Remove the Plastic Plug from the actuation port of the Impulse Valve. Retain the plug for future use when the container has to be re-filled/serviced.
- Insert the IVPO into the actuation port of the Impulse Valve and secure by inserting the Retaining Clip provided. (see Figure 1)

**IMPORTANT NOTE:** Check IVPO to ensure device is armed before inserting on Impulse Valve.

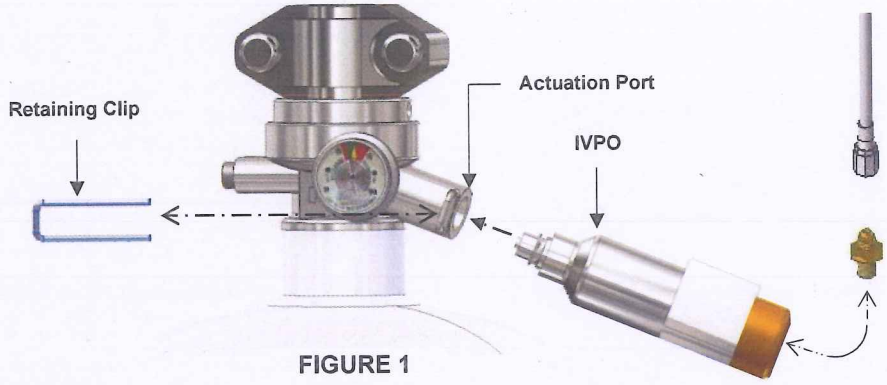
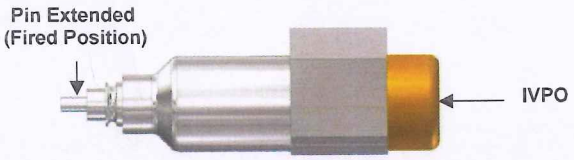



FIGURE 1

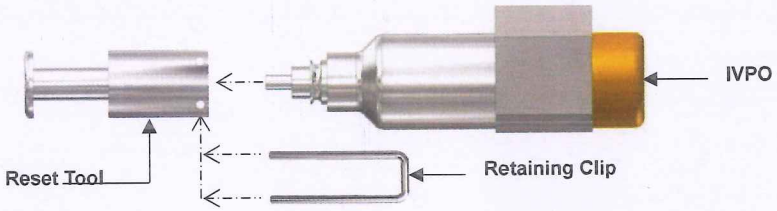
## RESET INSTRUCTIONS

Remove IVPO from Impulse Valve by removing Retaining Clip.

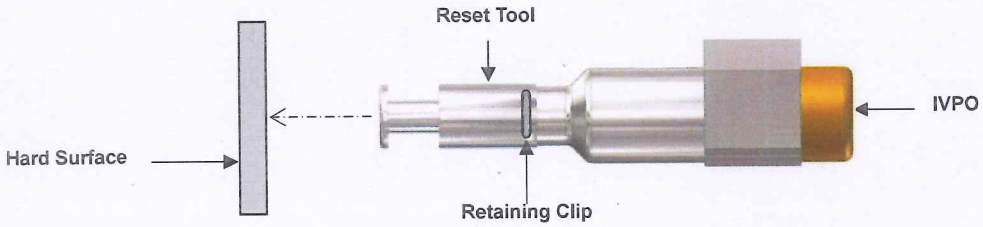



IVPO – Fired Position

Insert IVPO into Reset Tool and secure with Retaining Clip




Push Reset Tool button (firmly) against a hard surface until IVPO Pin resets (clicks into place)




Remove Retaining Clip, IVPO is reset and ready to be installed on Impulse Valve.

**IMPORTANT NOTE:** Check IVPO to ensure device is armed before inserting on Impulse Valve.




IVPO – Armed Position

Pipe and fittings used in Clean Agent System piping network must conform to the requirements as outlined in NFPA 2001, latest edition.



## PIPING MATERIALS

Piping materials must conform to the requirements as outlined in NFPA 2001, latest edition. The thickness of the piping wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For NAFFCO Clean Agent System, w/ 360 psig (24.8 bar) working pressure, use a minimum piping design pressure of 500 psig (34.4 bar) at 70°F (21°C).

| | |
|---|---|
| **CAUTION:** | Cast iron pipe, steel pipe conforming to ASTM A120, or nonmetallic pipe **shall not** be used. |
| The following piping materials and configurations are acceptable: | Schedule 40 Threaded, Welded & Grooved |
| | Schedule 80 Threaded & Welded |

The following piping types and grades are acceptable for pipe configurations utilizing threaded, welded or grooved end connections:

| Pipe Schedule | NPS Pipe Size | Wall Thickness | Grade / Type | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | A-106C | A-53B A-106B | A-53B | A-53A A-106A | A-53A | A-53F |
| | | | Seamless | Seamless | ERW | Seamless | ERW | Furnace |
| 40 | 3/8 | 0.091 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 1/2 | 0.109 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 3/4 | 0.113 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 1 | 0.133 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 1 1/4 | 0.140 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 1 1/2 | 0.145 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 2 | 0.154 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 2 1/2 | 0.203 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 3 | 0.216 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 4 | 0.237 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 6 | 0.280 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## FITTING MATERIALS

Fitting materials **MUST** conform to the requirements outlined in NFPA 2001, latest edition.

| FITTINGS SIZE | FITTING CLASS |
|---|---|
| Up to 3" NPT | Class 300 malleable or ductile iron |
| Over 3" NPT | 1000 lb. ductile or forged steel |
| All pipe sizes | Class 300 flanged |

**NOTE:** All grooved fittings must be UL Listed and conform to the pressure requirements outlined in NFPA 2001, latest edition. Cast Iron fittings are **NOT** acceptable.

## PIPE SIZE CHANGE

Pipe size changes, to increase or decrease the size, can be done at three different locations in the piping network:

| | |
|---|---|
| Pipe Size Change at a Tee | When the change in pipe size is done at a tee, this is accomplished by using either a reducing tee or a standard tee and reducing fittings. All reducers must be concentric bell reducers or concentric reducing couplings. |
| Pipe Size Change at an Elbow | When the change in pipe size is done at an elbow, this is accomplished by using either reducing elbows or a standard elbow with concentric bell reducers or concentric reducing couplings. |
| Pipe Size Change at a Coupling | When the change in pipe size accomplished at a coupling, only concentric bell reducers or concentric reducing couplings can be used. |

**NOTE:** Reducing bushings, weld-o-let, and hole-cut fittings **"ARE NOT"** acceptable.

## INSTALLATION

The piping system should be securely supported with due allowance for agent thrust forces, thermal expansion, and contraction, and should not be subject to mechanical, chemical, vibration, or other type of damage. The maximum horizontal spacing for screwed, welded or grooved pipe are as indicated on the following table:

| Pipe Size (in.) | Distance Between Supports (feet) | Rod Diameter (in.) |
|---|---|---|
| 3/8 | 7 | 3/8 |
| 1/2 | 7 | 3/8 |
| 3/4 | 7 | 3/8 |
| 1 | 7 | 3/8 |
| 1 1/4 | 7 | 3/8 |
| 1 1/2 | 9 | 3/8 |
| 2 | 10 | 3/8 |
| 2 1/2 | 11 | 1/2 |
| 3 | 12 | 1/2 |
| 4 | 14 | 5/8 |
| 6 | 17 | 3/4 |

**NOTE:**

- Each pipe section shall be cleaned internally before installation with a non-flammable cleaner such as Perchlorethylene in accordance with NFPA 2001, latest edition.
- Teflon tape or joint compound shall be used on all threaded joints. All grooved coupling gaskets shall be lubricated per the manufacturer's specifications.
- "C" Clamps are not acceptable to support rod hangers.
- Rigid pipe supports are required to support the "live load" of the pipe system during discharge. Rigid bracing is required at each directional change, fitting, tee and nozzle. All drops to 180° nozzles require back bracing in the opposite direction of the discharge. Earthquake bracing **shall** be used where required by local code. (Refer to ANSI B31.1 *Power Piping Code* for additional information)
- For additional information on pressure rating of pipe and fittings, plus recommended pipe supports and hangers, refer to FSSA's Pipe Design Handbook, FSSA PDH-01.
- All system piping shall be installed in strict accordance to system plans. If piping changes are necessary, they must be recalculated on NAFFCO's Flow Calculation Program.

## CONNECTION – CONTAINER TO PIPING NETWORK

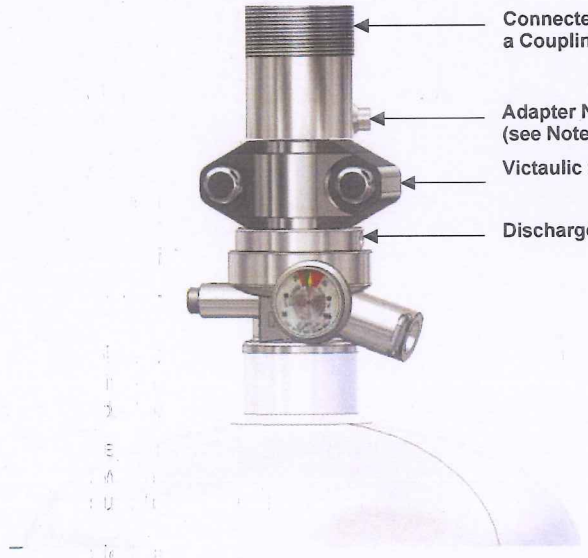
The container discharge valve outlet is connected to the piping network using the following items:

| Discharge Valve Size | Fittings Required | Comments |
|---|---|---|
| 1" Discharge Valve | 1" Victaulic Coupling | Supplied w/ Container (5, 10, 20, 35, 60 & 100 lb.) |
| | 1" Adapter Nipple x 3" (76 mm) lg. | |
| | 1" Coupling or Union (not shown) | Supplied by Others |
| 3" Discharge Valve | 3" Victaulic Coupling | Supplied w/ Container (150, 150i, 215, 375, 650 & 1000) |
| | 3" Adapter Nipple<br>NPT to Victaulic x 4" (114 mm) lg. | Standard Item – Supplied w/ Container (150, 150i, 215, 375, 650 & 1000) |
| | 3" Adapter Nipple<br>Victaulic to Victaulic x 4" (114 mm) lg. (not shown) | Optional Item |
| | 3" Coupling or Union (not shown) | Supplied by Others |

**NOTES:** 1) It is not necessary to supply a pipe union after the grooved coupling to facilitate removal of the container for service or maintenance purposes. The container can be removed by removing the grooved coupling provided with each container.

2) Adapter Nipple is supplied with 1/4" NPT female threads (plugged) to connect to:
- Discharge Pressure Switch
- Used to provide pressure to activate slave container(s)

**IMPORTANT NOTE:** Remove the Baffle Plate located inside the grooved coupling before connecting the discharge piping to the container. The Baffle Plate is an anti-recoil device that must be installed whenever transporting or handling pressurized containers that are not connected to the discharge piping.




Front View

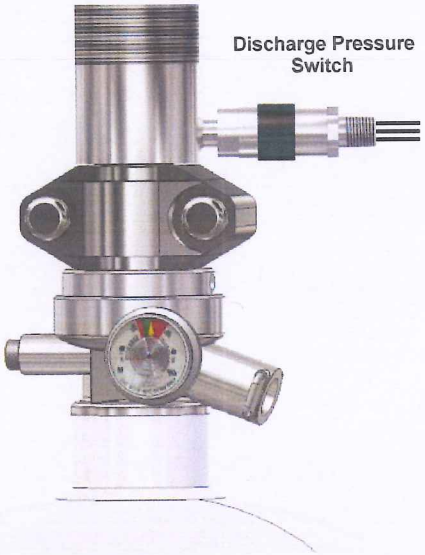
# DISCHARGE PRESSURE SWITCH

## COMPONENT SHEET

Discharge Pressure Switch (DPS) is used to provide a positive pneumatic confirmation to the control system that the NAFFCO Fire Suppression system has been discharged.

When a system is discharged manually (by Impulse Valve Operator (IVO) with Strike Button), the discharge pressure switch is required to provide the input to the control system needed to activate various audio/visual warning devices and auxiliary relays.

The switch is operated pneumatically using the agent pressure in the discharge piping network.




Container w/ Impulse Valve

| SPECIFICATIONS – DISCHARGE PRESSURE SWITCH | |
|---|---|
| Part Number | 02-12534 |
| Temperature Limits | +32 to +130°F (0 to 54.4°C) |
| Enclosure Classification | NEMA 4 |
| Contact Rating | Single pole, double throw; 5 amps resistive, 3 amps inductive @ 30VDC (can be wired for normally open or normally closed operation) |
| Body Material | Aluminum with irridite finish |
| Weight | 6.5 ounces |
| Pressure Connection | 1/4" NPT (6 mm) |
| DPS Length (approximate) | 4 1/8" (105 mm) Long (including both connectors) |
| Electrical Connection | 1/2" NPT (15 mm) |
| Wire Leads | (3) 18 gauge x 20" (508 mm) long Violet (Common), Blue (N.O.), Black (N.C.) |
| Pressure Setting | 40 psig (3 bar) (Increasing) |
| Listings and Approvals | UL Listed & FM Approved |

## INSTALLATION

Discharge Pressure Switch is installed in the 1/4" NPT (female threads) port machined into the Adapter Nipple as shown in the illustration below. (see Figure 1)

Step 1: Remove rubber cap and apply Teflon Tape to the male threads of the Discharge Pressure Switch.

Step 2: Remove ¼" pipe plug from Adapter Nipple.

Step 3: Thread Discharge Pressure Switch into ¼" NPT port on Adaptor Nipple (Wrench tight).

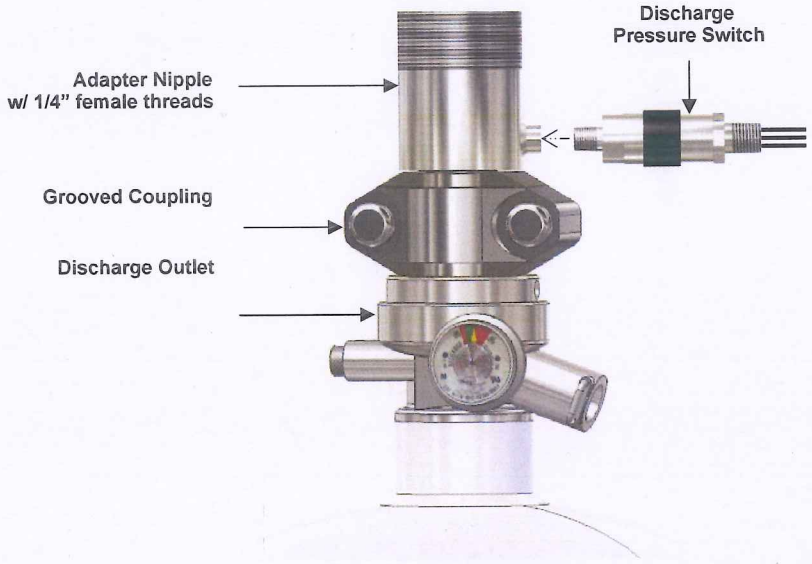



FIGURE 1

## WIRING DIAGRAM

Following is a typical wiring diagram showing how the discharge pressure switch is wired to the manual release input of the NAFFCO SHP PRO control panel. (see Figure 2) For control panel wiring details, refer to the SHP PRO manual.

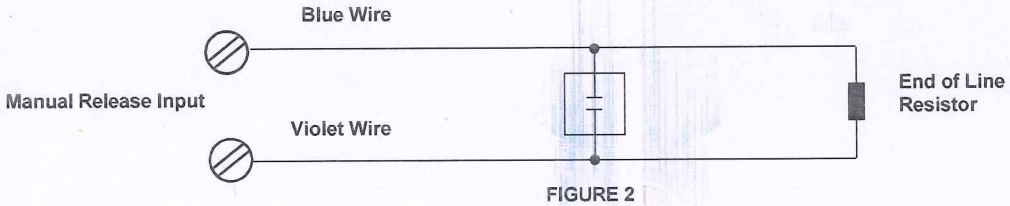



FIGURE 2

Discharge Pressure Switch
Normally Open Contacts
(closes when pressure applied)

When the Cheetah Xi or Xi50 is used, the switch can connect to a monitor module (MM) programmed for latching manual release. For control panel wiring details, refer to the Cheetah Xi manual (p/n 06-356) or Cheetah Xi50 manual (p/n 06-369).

# DISCHARGE NOZZLES – HFC-227ea

## COMPONENT SHEET

The function of the NAFFCO discharge nozzle is to control the agent flow and distribute the agent throughout the protected enclosure in a uniform, predetermined pattern and concentration.

The discharge nozzle size refers to the size of schedule 40 or 80 pipe that it can be connected to.

The discharge nozzle is mounted to allow the agent to be discharge on a horizontal axis.

The nozzle orifice area is determined be performing a hydraulic calculation using the NAFFCO Engineered Flow Calculation program.

Nozzle should not be ordered until the clean agent system pipe network is installed and an "As Built" hydraulic calculation is performed.

Nozzle orifice drilling must be done at NAFFCO factory, or at a UL listed nozzle drill station.



360° Nozzle



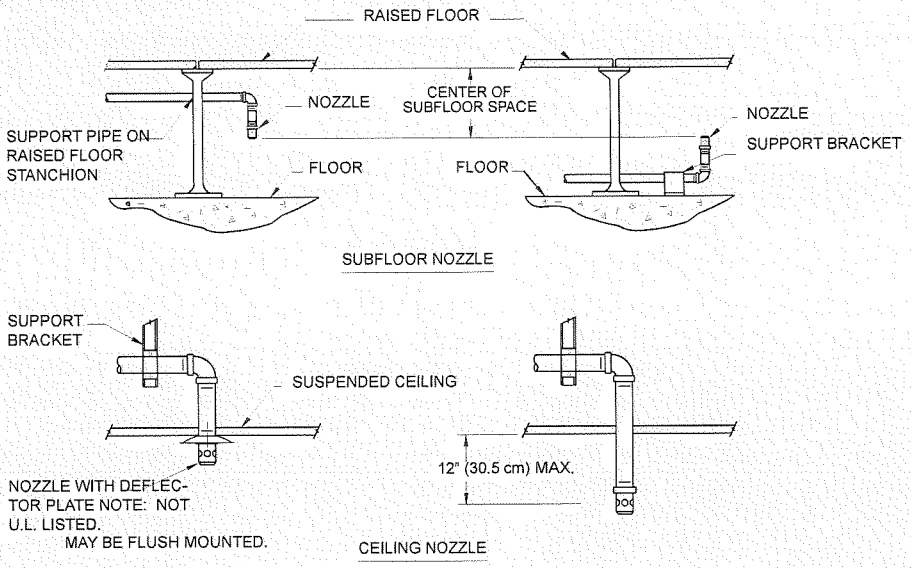
180° Nozzle

| Nozzle Size in. (mm) | 360° Engineered Nozzles (12 Orifices) | | | 180° Engineered Nozzles (11 Orifices) | | | Nozzle Length (Approx.) in. (mm) |
|---|---|---|---|---|---|---|---|
| | Part Number | Drill Diameter (in) | | Part Number | Drill Diameter (in) | | |
| | | Minimum | Maximum | | Minimum | Maximum | |
| 3/8 (10) | 80-052-XXXX | 0.0670 | 0.1250 | 80-060-XXXX | 0.0670 | 0.1285 | 1.56 (40) |
| 1/2 (15) | 80-053-XXXX | 0.0810 | 0.1590 | 80-061-XXXX | 0.0860 | 0.1660 | 1.88 (48) |
| 3/4 (20) | 80-054-XXXX | 0.1065 | 0.2090 | 80-062-XXXX | 0.1130 | 0.2210 | 2.19 (56) |
| 1" (25) | 80-055-XXXX | 0.1360 | 0.2660 | 80-063-XXXX | 0.1440 | 0.2812 | 2.50 (64) |
| 1 1/4 (32) | 80-056-XXXX | 0.1820 | 0.3480 | 80-064-XXXX | 0.1875 | 0.3680 | 3.13 (79) |
| 1 1/2" (40) | 80-057-XXXX | 0.2090 | 0.4130 | 80-065-XXXX | 0.2188 | 0.4219 | 3.38 (86) |
| 2 (50) | 80-058-XXXX | 0.2720 | 0.5312 | 80-066-XXXX | 0.2812 | 0.5469 | 3.75 (95) |
| Material | Aluminum (anodized with a dull gray finish to prevent corrosion) | | | | | | |
| Listings and Approvals | UL Listed / FM Approved | | | | | | |

## INSTALLATION

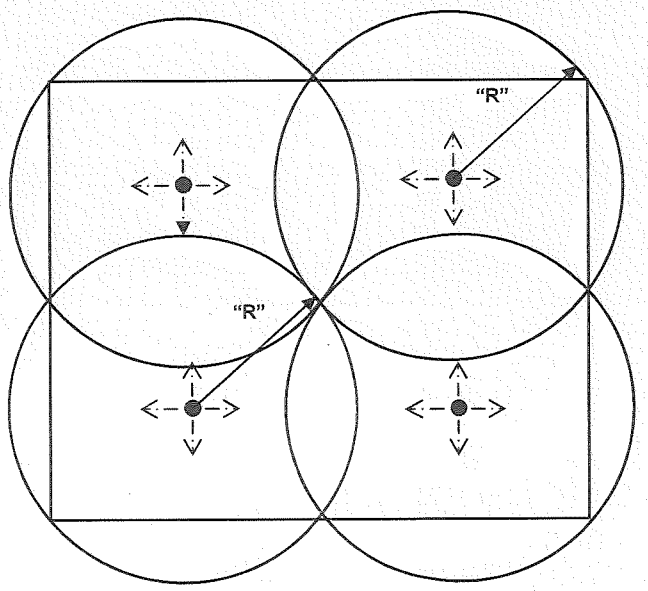
Always verify the nozzle identification number (stamped on the closed end of the nozzle) matches the nozzle part number listed on the system installation plans. All nozzle locations should be within 1'- 0" (0.3m) of their intended locations on the system plans. Discharge Nozzles must be mounted in the vertical position and can face either up or down.

**CAUTION:** The piping should be blown clear to remove chips, mill scale, or metal shavings before the nozzles are installed.



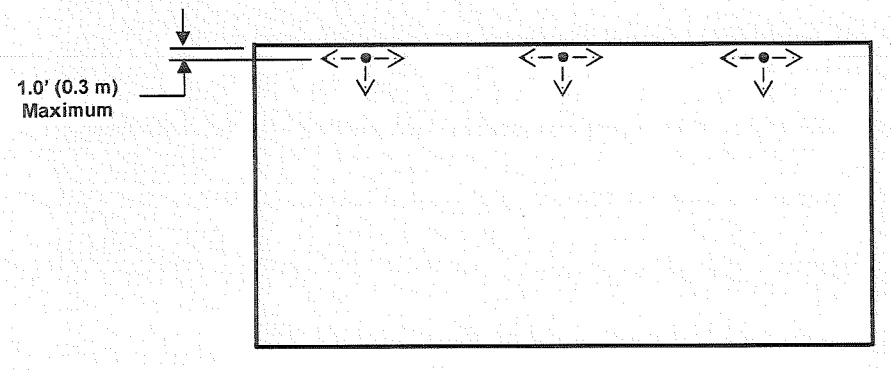

## 360° NOZZLES

360° Nozzles should be located in a symmetrical, or near symmetrical, pattern within the protected area. Nozzle patterns need to overlap, to adequately cover the area without any "blind spots" due to nozzle locations. Apply to all Nozzle types.



### 180° NOZZLES

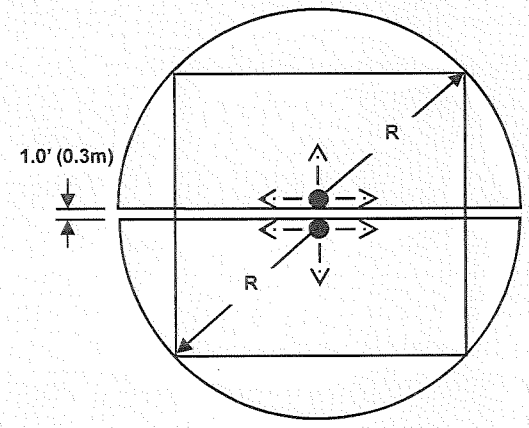
180° Nozzles should be located in a symmetrical, or near symmetrical, pattern within the protected area. 180° Nozzles should be located along the perimeter of the area – discharging along the perimeter and toward the opposite side. These nozzles can be located a maximum of 1'-0" (0.3 m) out from the wall.




### 180° NOZZLES – BACK to BACK APPLICATION

180° Nozzles can be installed in a back to back arrangement within the following limitations:

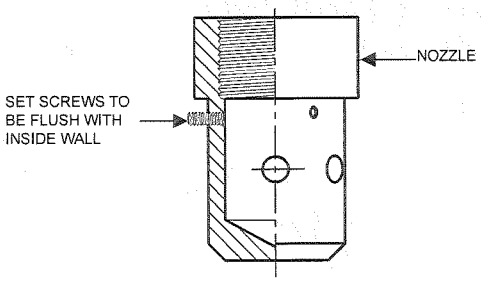
- Maximum distance between nozzles = 1.0' (0.3 m)
- Agent supplied and flow rate from both nozzles are the same.
- Pipe size from tee to both nozzles is the same.
- Pipe lengths from tee to each nozzle are within 10% of each other.




### NOZZLE SET SCREW

Verify the Set Screws found on the side of the nozzle are in place after system installation.

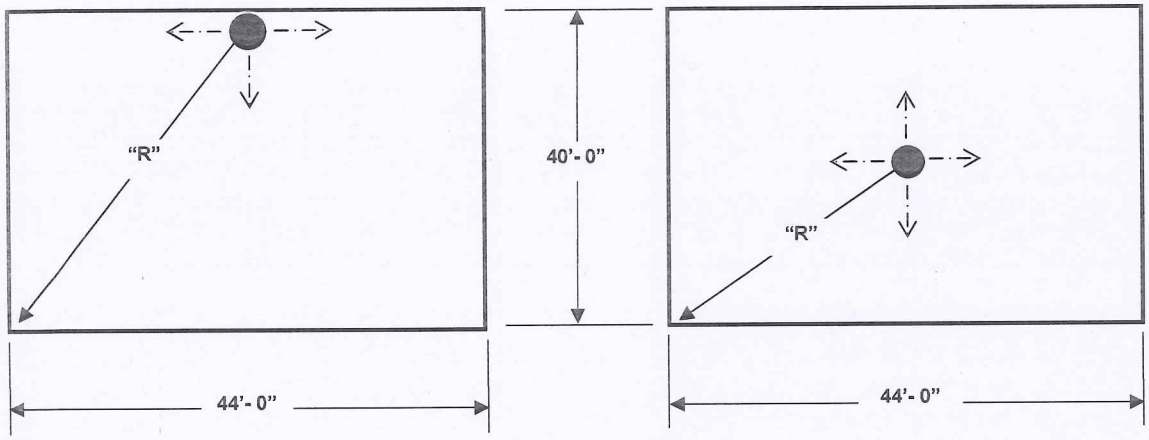
**WARNING:** Failure to have the setscrews in place will affect agent distribution and possibly the system's ability to suppress the fire.



## NOZZLE AREA COVERAGE

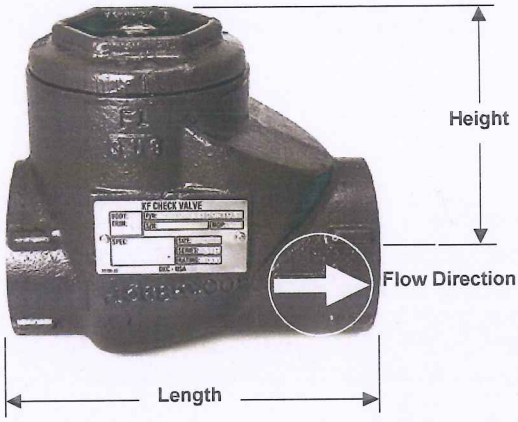
| Nozzle Size – 3/8" – 2" (10 – 50 mm) | | |
|---|---|---|
| **Nozzle Type** | **Radius "R" Dimension** ft. (m) | **Ceiling Height Range** ft. (m) |
| 180° | 45.67 (14) | 1.0 to 16.0 (0.3 to 4.9) |
| 360° | 29.67 (9) | 1.0 to 16.0 (0.3 to 4.9) |

| Maximum Distance | 180° Nozzle | 360° Nozzle | Note |
|---|---|---|---|
| Below Ceiling | 1.0 (0.3 m) | 1.0 (0.3 m) | Maximum distance above highest point of protection when stacking nozzles. |
| Away from Sidewall | 1.0 (0.3 m) | | |



Check Valves are used prevent agent loss from the open end of a manifold and/or piping system in the event that one or more containers are removed for servicing / maintenance.

Check Valves are required for multiple containers connected in a manifold arrangement and for containers used in a main / reserve system, without the need for redundant piping systems, to prevent agent loss and to ensure personnel safety if the system is operated when any containers are removed for maintenance. All containers must be the same size & same weight.




| CHECK VALVE DATA | | DIMENSIONS | | APPROXIMATE WEIGHT | EQUIVALENT LENGTH |
|---|---|---|---|---|---|
| PART NO. | DESCRIPTION | HEIGHT | LENGTH | | |
| 02-2980 | 1" (25 mm) Check Valve | 3.75" (95 mm) (maximum) | 4.25" (108 mm) | 9 lbs. (4.1 kg) | 2.0' (0.61 m) |
| 02-4158 | 2" (50 mm) Check Valve | 4.5 (144 mm) (maximum) | 6" (152 mm) | 12 lbs. (5.4 kg) | 4.0' (1.22 m) |
| 02-4157 | 3" (80 mm) Check Valve | 6" (152 mm) | 8" (203 mm) | 31 lbs. (14.1 kg) | 4.0' (1.22 m) |
| Material | | Carbon Steel | | | |
| Working Pressure | | 750 psi (50 bar) | | | |
| Thread Type | | Female NPT (Both Ends) | | | |
| Listings and Approvals | | UL Listed & FM Approved | | | |

**NOTE:** Check Valves have threaded female connections on both ends; therefore piping leading into and exiting from must be threaded.

**IMPORTANT NOTE:** The Check Valves **must** be installed with the flow arrow pointing in the direction of discharge. If reversed, the system will not discharge.

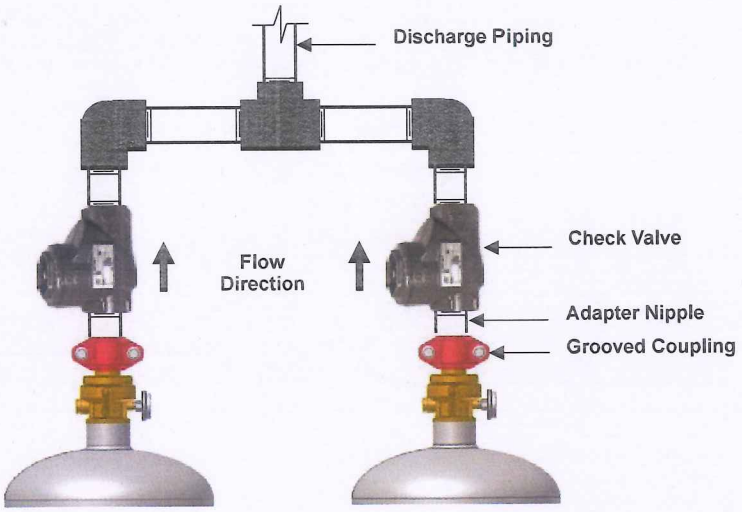
## INSTALLATION

Once the pipe / manifold is assembled and the containers connected, the pipe / manifold should not be supported by the containers. The piping should be secured with pipe hangers or brackets to support the manifold when the containers are removed for service.

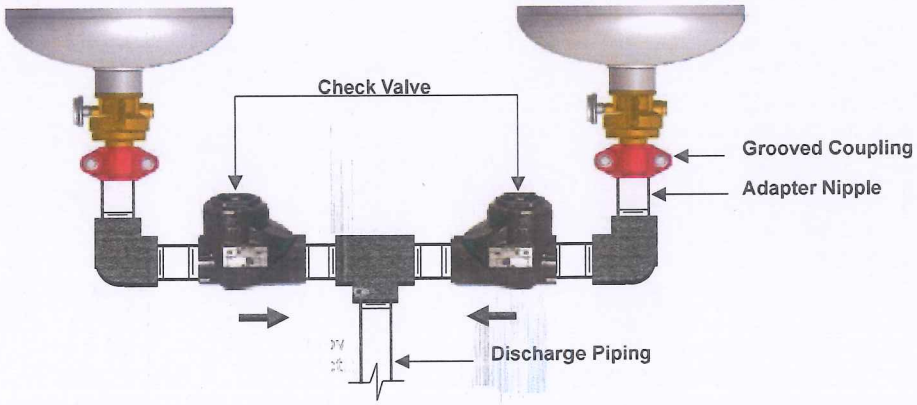
If grooved couplings are used, the gaskets must be lubricated with a non-petroleum base lubricant as recommended by the fitting manufacturer.

Manifolds are commonly assembled using grooved fittings, however threaded; welded or flanged fittings can also be used. Teflon tape or joint compound shall be used on all threaded joints.

### EXAMPLE 1 – CENTER EXIT MANIFOLD / MAIN & RESERVE SYSTEM




### EXAMPLE 2 – CENTER EXIT MANIFOLD / MAIN & RESERVE SYSTEM FOR 150i (INVERTED) CONTAINERS




**IMPORTANT NOTE:** When used with 150i (Inverted) containers, the check valve must be installed in the Horizontal position. Do NOT install check valve in the Vertical down position, check valve flipper will be left in the open position and will NOT function as intended.

# CAUTION / ADVISORY SIGNS FOR HFC-227ea

## COMPONENT SHEET

Caution / Advisory Signs are used to provide the necessary information to personnel in the area and to comply with NFPA 2001 requirements.

The caution lettering and backgrounds meet the requirements of ANSI Z535.

The signs are made from flame retardant, Lexan™ polycarbonate material. Each sign has an adhesive backing for mounting purposes.

**Listings and Approvals** UL Listed / FM Approved Optional

Item – Caution / Advisory signs must be ordered separately




**CAUTION – AREA PROTECTED BY HFC-227ea SIGN – p/n 02-10139**

Provided to alert personnel that the room is protected with an HFC-227ea system and that they should not enter the area during or after discharge.

The sign also indicates the requirement that all doors serving the protected area must be kept closed at all times.

The sign is 13.0" (330 mm) x 10.0" (254 mm), with black lettering

**CAUTION – SYSTEM DISCHARGE ALARM SIGN – p/n 02-10138**

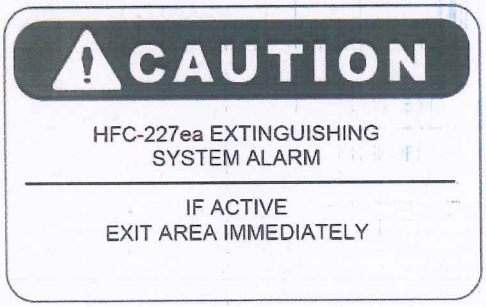



Provided to alert personnel that the room is protected with an HFC-227ea system and to evacuate the area when t he alarms sound.

This sign is provided to alert personnel that the room is protected with an HFC-227ea system and that they should not enter the area when the alarm sounds.

The sign is 9.0" (229 mm) x 6.0" (154 mm), with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

**CAUTION – EXIT AREA SIGN – p/n 02-10105**



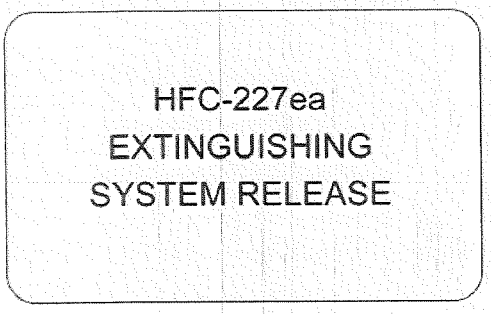

Provided to explain the presence of notification devices that are located inside the protected space.

This sign explains that the HFC-227ea system will soon be discharged if the strobe light is flashing, and appropriate actions should be taken.

This sign should be placed at each strobe light location.

The sign is 9.0" (229 mm) x 6.0" (154 mm), with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

**SYSTEM RELEASE SIGN – p/n 02-10137**

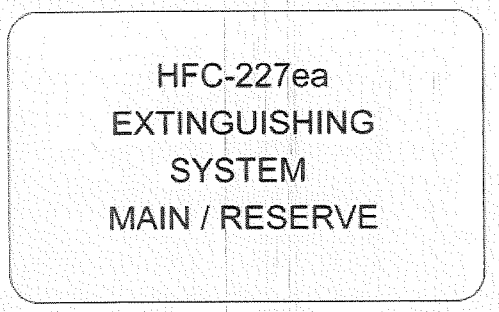



Provided to identify each system release station associated with the HFC-227ea system.

This reduces the risk of a manual discharge station being mistaken for a fire alarm pull station.

This sign should be placed at each manual release station location for positive identification. This sign is 4.0" (102 mm) x 2.25" (57 mm), with black lettering on a white background.

**MAIN / RESERVE SIGN – p/n 02-10107**



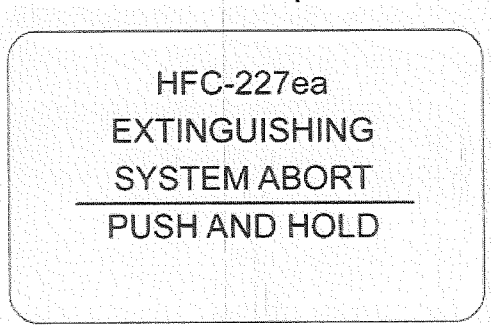

Provided to identify each system main/reserve station associated with the HFC-227ea system.

This sign clearly identifies the purpose of the switch.

This sign should be placed at each main/reserve station location for positive identification.

This sign is 4.0" (102 mm) x 2.25" (57 mm), with black lettering on a white background.

**SYSTEM ABORT SIGN – p/n 02-10106**




Provided to identify each system abort station associated with the HFC-227ea system.

This reduces the risk of an abort station being mistaken for a manual release or fire alarm pull station.

This sign should be placed at each abort station location for positive identification.

The sign is 4.0" (102 mm) x 2.25" (57 mm).

# NAFFCO CLEAN AGENT SYTEM w/ IMPULSE TECHNOLOGY HFC-227ea AGENT

ORIGINAL RELEASE DATE: ..... October, 2010

REVISION / DESCRIPTION OF CHANGE REVISION DATE

Revision 1 .....March, 2014

1) Added information on 5 & 10 lb. containers on pages 6 & 28.
2) Added pre-engineering piping limitations for 5 & 10 lb. containers on pages 29 & 30.

HAZARD CLASSIFICATION
MINIMUM DESIGN CONCENTRATION
MAXIMUM DESIGN CONCENTRATION
ENCLOSURE VOLUME
AGENT REQUIRED
FLOODING FACTORS – AGENT VS TEMPERATURE CHART (ENGLISH UNITS)
FLOODING FACTORS – AGENT VS TEMPERATURE CHART (METRIC UNITS)
TEE DESIGN FACTOR
ALTITUDE CORRECTION FACTORS
CONCENTRATION AT MINIMUM TEMPERATURE
SYSTEM DESIGN CONCEPTS
CONTAINER SIZE AND FILL RANGE
TEMPERATURE LIMITATION
SYSTEM DISCHARGE TIME
NOZZLE FLOW RATE LIMITATION
NOZZLE AREA COVERAGE
NOZZLE PLACEMENT
CEILING HEIGHT VS LEVELS OF NOZZLES
MAXIMUM ELEVATION DIFFERENCES IN PIPE RUNS LIMITATION
NOZZLE DISCHARGE OBSTRUCTIONS
TEE SPLIT RATIOS
TEE CONFIGURATION – BULLHEAD
TEE CONFIGURATION – SIDE-THRU
TEE ORIENTATION
ESTIMATING PIPE SIZE
MINIMUM PIPING DISTANCE
EQUIVALENT LENGTH VALUES
PIPE NETWORK LIMITATIONS
PERCENT OF AGENT IN PIPE
LOCATION OF 1ST TEE
LIQUID ARRIVAL TIME
LIQUID RUNOUT TIME
NOZZLE ORIFICE AREA LIMITATION
MANIFOLD OPTIONS

SAMPLE PROBLEM
HAZARD INFORMATION
INPUTS – NAFFCO HFC-227ea FLOW CALCULATION PROGRAM
OUTPUTS – NAFFCO HFC-227ea FLOW CALCULATION PROGRAM
PRE-ENGINEERED PIPING LIMITATIONS
NOZZLE TYPES – PRE-ENGINEERED
PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS
PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS

# DESIGN INFORMATION – HFC-227ea

The following information details the steps necessary to design a NAFFCO Clean Agent Fire Suppression System w/ HFC-227ea agent within the limitations established by NAFFCO's UL listing, FM approval and in compliance with NFPA 2001.

## HAZARD CLASSIFICATION

| Class of Hazard | Definitions of Fire Class (definitions per NFPA 2001) |
|---|---|
| Class A | A fire in ordinary combustible materials, such as wood, cloth, paper, rubber and many plastics (anything that leaves an ash residue after combustion). |
| Class B | A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases. |
| Class C | A fire that involves energized electrical equipment. |

## MINIMUM DESIGN CONCENTRATION

| Hazard Classification | Minimum Design Concentration | NOTES |
|---|---|---|
| Class A | 6.7% | Clean Agent System incorporates Detection & Control System to automatically discharge agent. |
| Class A | 6.9% | Recommendation, when protecting multiple hazards w/ single agent supply. |
| Class C | 7.0% | When energized electrical hazard remains powered during/after agent discharge and Clean Agent System incorporates Detection & Control System to automatically discharge agent. |
| Class C | 7.2% | Recommendation, when protecting multiple hazards w/ single agent supply. |
| Class B (Heptane) | 8.7% | For design concentrations of other Class B (flammable liquids), consult NAFFCO's Product Support group. |

## MAXIMUM DESIGN CONCENTRATION

| Space Type | Maximum Concentration Allowed |
|---|---|
| Occupiable (See Note below) | 10.5% |
| Not Occupiable | No Limit |

**NOTE:** Occupiable space is defined as a space that can be "Normally Occupied" or that can be "Not Normally Occupied.

Maximum human exposure time shall not exceed 5 minutes for HFC-227ea systems utilized in any occupiable spaces.

## ENCLOSURE VOLUME

| FORMULA | NOTES |
|---|---|
| Protected Volume = | As a general rule, Hazard Volume should be based on the empty (gross) volume. |
| Base Volume | Length x Width x Height |
| + Added Volume | Volume that is open to the space being protected (i.e. non-dampered ductwork, un-closeable openings, etc.) |
| - Removed Volume | Volume for items that are solid, non-permeable, and non-removable objects can be deducted from the protected volume |
| **IMPORTANT NOTE:** | Any object that can be removed from the protected space **CANNOT** be deducted from the volume |

## AGENT REQUIRED

| **Calculation Based on:** | Lowest Expected Ambient Temperature | Minimum Design Concentration Required (to protect this type of hazard) |
|---|---|---|

The agent quantity needed can be determined by the following formula:

$$W = \frac{V}{S}\left(\frac{C}{100 - C}\right)$$

**Where:** W = Agent Weight in lbs. (kg)

V = Hazard Volume / $ft^3$ ($m^3$)

C = Design Concentration, % by volume

S = Specific Vapor in $ft^3/lb$ ($m^3/kg$)

S = k1 + k2 (t)

**Where:** k1 = 1.8850, k2 = 0.0046(t), t = temperature (°F)

or k1 = 0.1269, k2 = 0.0005(t), t = temperature (°C)

**NOTE**: The equation to calculate S is an approximation.

## FLOODING FACTORS – Agent vs. Temperature Charts (English Units)

| Temp. | Specific Vapor Volume | Weight Requirements of Hazard Volume, W/V (lb/ft³)[b] (English Units) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T (°F)[c] | s (ft³/kg)[d] | HFC-227ea Design Concentration (% by Volume)[e] | | | | | | |
| | | 6.25 | 6.5 | 6.7 | 7.0 | 8.0 | 9.0 | 10.0 |
| 30 | 2.0210 | 0.0330 | 0.0344 | 0.0355 | 0.0372 | 0.0430 | 0.0489 | 0.0550 |
| 40 | 2.0678 | 0.0322 | 0.0336 | 0.0347 | 0.0364 | 0.0421 | 0.0478 | 0.0537 |
| 50 | 2.1146 | 0.0315 | 0.0329 | 0.0340 | 0.0356 | 0.0411 | 0.0468 | 0.0525 |
| 60 | 2.1612 | 0.0308 | 0.0322 | 0.0332 | 0.0348 | 0.0402 | 0.0458 | 0.0514 |
| 70 | 2.2075 | 0.0302 | 0.0315 | **0.0325** | **0.0341** | 0.0394 | 0.0448 | 0.0503 |
| 80 | 2.2538 | 0.0296 | 0.0308 | 0.0319 | 0.0334 | 0.0386 | 0.0439 | 0.0493 |
| 90 | 2.2994 | 0.0290 | 0.0302 | 0.0312 | 0.0327 | 0.0378 | 0.0430 | 0.0483 |
| 100 | 2.3452 | 0.0284 | 0.0296 | 0.0306 | 0.0321 | 0.0371 | 0.0422 | 0.0474 |
| 110 | 2.3912 | 0.0279 | 0.0291 | 0.0300 | 0.0315 | 0.0364 | 0.0414 | 0.0465 |
| 120 | 2.4366 | 0.0274 | 0.0285 | 0.0295 | 0.0309 | 0.0357 | 0.0406 | 0.0456 |
| 130 | 2.0210 | 0.0330 | 0.0344 | 0.0355 | 0.0372 | 0.0430 | 0.0489 | 0.0550 |

## FLOODING FACTORS – Agent vs. Temperature Charts (Metric Units)

| Temp. | Specific Vapor Volume | Weight Requirements of Hazard Volume, W/V (kg/m³)[b] (Metric Units) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T (°C)[c] | s (m³/kg)[d] | HFC-227ea Design Concentration (% by Volume)[e] | | | | | | |
| | | 6.25 | 6.5 | 6.7 | 7.0 | 8.0 | 9.0 | 10.0 |
| 0 | 0.1268 | 0.5258 | 0.5483 | 0.5659 | 0.5936 | 0.6858 | 0.7800 | 0.8763 |
| 5 | 0.1294 | 0.5152 | 0.5372 | 0.5550 | 0.5816 | 0.6719 | 0.7642 | 0.8586 |
| 10 | 0.1320 | 0.5051 | 0.5267 | 0.5444 | 0.5700 | 0.6585 | 0.7490 | 0.8414 |
| 15 | 0.1347 | 0.4949 | 0.5161 | 0.5343 | 0.5589 | 0.6457 | 0.7344 | 0.8251 |
| 20 | 0.1373 | 0.4856 | 0.5063 | **0.5246** | **0.5483** | 0.6335 | 0.7205 | 0.8094 |
| 25 | 0.1399 | 0.4765 | 0.4969 | 0.5151 | 0.5382 | 0.6217 | 0.7071 | 0.7944 |
| 30 | 0.1425 | 0.4678 | 0.4879 | 0.5061 | 0.5284 | 0.6104 | 0.6943 | 0.7800 |
| 35 | 0.1450 | 0.4598 | 0.4794 | 0.4973 | 0.5190 | 0.5996 | 0.6819 | 0.7661 |
| 40 | 0.1476 | 0.4517 | 0.4710 | 0.4888 | 0.5099 | 0.5891 | 0.6701 | 0.7528 |
| 45 | 0.1502 | 0.4439 | 0.4628 | 0.4807 | 0.5012 | 0.5790 | 0.6586 | 0.7399 |
| 50 | 0.1527 | 0.4366 | 0.4553 | 0.4728 | 0.4929 | 0.5694 | 0.6476 | 0.7276 |

[a] The manufacturer's listing specifies the temperature range for operation.

[b] W/V [agent weight requirements (lb/ft³) or (kg/m³)] = pounds of agent required per ft³ (m³) of protected volume needed to produce the indicated concentration at the temperature specified.
t [temperature (°F) or (°C)] = the design temperature in the hazard area.

[c] s [specific volume (ft³/lb)] = specific volume of superheated HFC-227ea vapor as approximated by the formula: $s = 1.885 + 0.0046(t)$

[d] s [specific volume (m³/kg)] = specific volume of superheated HFC- 227ea vapor as approximated by the formula: $s = 0.1269 + 0.0005(t)$

[e] c [concentration (%)] = volumetric concentration of HFC-227ea in air at the temperature indicated.

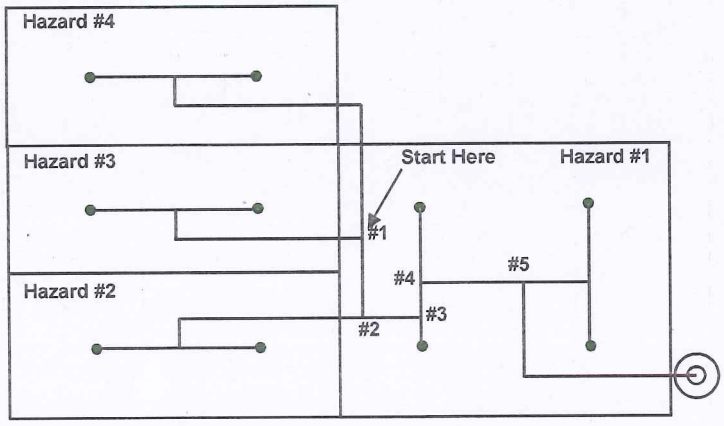
## TEE DESIGN FACTOR

| Definition: | When a single agent supply is being used to protect multiple hazards, a tee design factor is applied when more than 4 tees are used in multiple hazard applications. |
|---|---|

| Steps: | | Tee Count | Design Factor |
|---|---|---|---|
| 1 | Starting from the point where the piping enters the hazard that is located farthest (hydraulically) from the agent container(s), count the number of tees in the direct flow path as it returns to the agent container(s). **Do Not** include the tees that are used in the manifold (if applicable). | 0 – 4 | 0.00 |
| | | 5 | 0.01 |
| | | 6 | 0.02 |
| | | 7 | 0.03 |
| | | 8 | 0.04 |
| 2 | Any tee within the hazard that supplies agent to another hazard shall be included in the tee count. | 9 | 0.05 |
| | | 10 | 0.06 |
| 3 | After counting the tees, compare that number to the chart above to determine the Tee Design Factor | 11 - 12 | 0.07 |
| | | 13 | 0.08 |
| | | 14 - 15 | 0.09 |
| 4 | Apply the Tee Design Factor to the Agent Quantity calculations by multiplying the Tee Design Factor by the amount of agent previously determined in the volumetric calculations | 16 | 0.10 |
| | | 17 - 18 | 0.11 |
| | | 19 | 0.12 |

**EXAMPLE:**

This example shows a multi-hazard area arrangement. Starting at the point where the piping enters the hazard farthest away, count the number of tees leading back to the agent container. With a tee count of five (5), an additional 1% (0.01) of agent is required. Therefore, the base quantity of agent is multiplied by 1.01 (1%) to determine the adjusted quantity of agent required




**NOTE:** NAFFCO recommends increasing the design concentration to 6.9% when protecting multiple hazards w/ single agent supply. This will satisfy the tee design factor requirement.

## ALTITUDE CORRECTION FACTORS

| Definition | Where compensation is made when pressure varies from standard sea level pressure due to elevation change. | | |
|---|---|---|---|
| Altitude | Enclosure Pressure | | Correction Factor |
| Feet<br>Kilometers | psia | mm Hg | |
| -3,000<br>-0.92 | 16.25 | 840 | 1.11 |
| -2,000<br>-0.61 | 15.71 | 812 | 1.07 |
| -1,000<br>-0.30 | 15.23 | 787 | 1.04 |
| 0<br>0.00 | 14.71 | 760 | 1.00 |
| 1,000<br>0.30 | 14.18 | 733 | 0.96 |
| 2,000<br>0.61 | 13.64 | 705 | 0.93 |
| 3,000<br>0.91 | 13.12 | 679 | 0.89 |
| 4,000<br>1.22 | 12.58 | 650 | 0.86 |
| 5,000<br>1.52 | 12.04 | 622 | 0.82 |
| 6,000<br>1.83 | 11.53 | 596 | 0.78 |
| 7,000<br>2.13 | 11.03 | 570 | 0.75 |
| 8,000<br>2.45 | 10.64 | 550 | 0.72 |
| 9,000<br>2.74 | 10.22 | 528 | 0.69 |
| 10,000<br>3.05 | 9.77 | 505 | 0.66 |

**NOTE:** The HFC-227ea flow calculation program will automatically calculate the agent required based altitude correction factor entered

## CONCENTRATION AT MAXIMUM TEMPERATURE

The expected concentration at maximum temperature can be determined by following formula:

$$C = \frac{100WS}{V + WS}$$

**Where:**

W = Agent Weight in lbs. (kg)

V = Hazard Volume / $ft^3$ ($m^3$)

C = Design Concentration, % by volume

S = Specific Vapor in $ft^3/lb$ ($m^3/kg$)

Refer to Flooding Factor Table on page 3 to determine the S value

**NOTE:** This is a necessary step to properly evaluate the exposure and egress time limitations discussed in the beginning of this section. The HFC-227ea flow calculation program will automat ically calculate concen tration at the maximum temperature entered.

## SYSTEM DESIGN CONCEPTS

Systems can be designed with the containers arranged in modular, central storage or manifolded arrangements as described below:

| | |
|---|---|
| Modular System | Where the containers are located throughout or around the protected area(s) to keep the discharge piping requirements down to a minimum, but increases the electrical materials necessary to reach each individual container location. |
| Central Storage System | Where the containers are located in one location, and piped to the protected space(s) from this location. This concept often requires more discharge piping, but it decreases the electrical materials necessary to reach the singular container(s) location. This concept may be more difficult to design due to the increased piping runs involved, and the installation labor will tend to be more costly. |

## CONTAINER SIZE AND FILL RANGE

| Container Size (lb. – L) | Container Part Number | Minimum Fill Range (40 lbs/ft³ – 640 kg/m³) (lbs. – kg) | Maximum Fill Range (70 lbs/ft³–1121 kg/m³) (lbs. – kg) | Fill Increments (lbs. – kg) | Mounting Position (see Important Note) | Valve Size | Approx. Tare Weight (lbs. – kg) |
|---|---|---|---|---|---|---|---|
| 5 (2) | NF-70-272 | 3 (2.0) | 5 (2.5) | 1 lb. (0.5 kg) | Upright (Valve Up) | 1 (25) | 11 (5.0) |
| 10 (4) | NF-70-273 | 6 (3.0) | 10 (4.5) | 1 lb. (0.5 kg) | Upright (Valve Up) | 1 (25) | 15 (6.8) |
| 20 (8.5) | NF-70-263 | 12 (5.5) | 21 (9.5) | 1 lb. (0.5 kg) | Upright – Horizontal | 1" (25) | 21 (10) |
| 35 (15) | NF-70-264 | 22 (10.0) | 38 (17.0) | 1 lb. (0.5 kg) | Upright – Horizontal | 1" (25) | 31 (14) |
| 60 (27) | NF-70-265 | 39 (18.0) | 68 (30.5) | 1 lb. (0.5 kg) | Upright – Horizontal | 1" (25) | 52 (24) |
| 100 (44) | NF-70-266 | 63 (28.5) | 108 (49.0) | 1 lb. (0.5 kg) | Upright (Valve Up) | 1" (25) | 77 (35) |
| 150 (61) | NF-70-267 | 87 (39.5) | 150 (68.0) | 1 lb. (0.5 kg) | Upright – Inverted | 3" (80) | 150 (68) |
| 215 (88) | NF-70-268 | 124 (56.5) | 216 (98.0) | 1 lb. (0.5 kg) | Upright (Valve Up) | 3" (80) | 155 (70) |
| 375 (153) | NF-70-269 | 217 (98.5) | 378 (171.5) | 1 lb. (0.5 kg) | Upright (Valve Up) | 3" (80) | 225 (102) |
| 650 (267) | NF-70-270 | 378 (171.5) | 660 (299.5) | 1 lb. (0.5 kg) | Upright (Valve Up) | 3" (80) | 385 (175) |
| 1000 (423) | NF-70-271 | 598 (271.5) | 1045 (474.0) | 1 lb. (0.5 kg) | Upright (Valve Up) | 3" (80) | 550 (249) |

## TEMPERATURE LIMITATION

| Description | Minimum | Maximum | Note |
|---|---|---|---|
| Container Storage / Location | 32°F (0°C) | 130°F (54.4°C) | At temperatures outside of this range, the system may not supply the desired quantity of agent or discharge due to over-pressure. |
| Flow Calculation Program | 60°F (16°C) | 80°F (27°C) | |

## SYSTEM DISCHARGE TIME

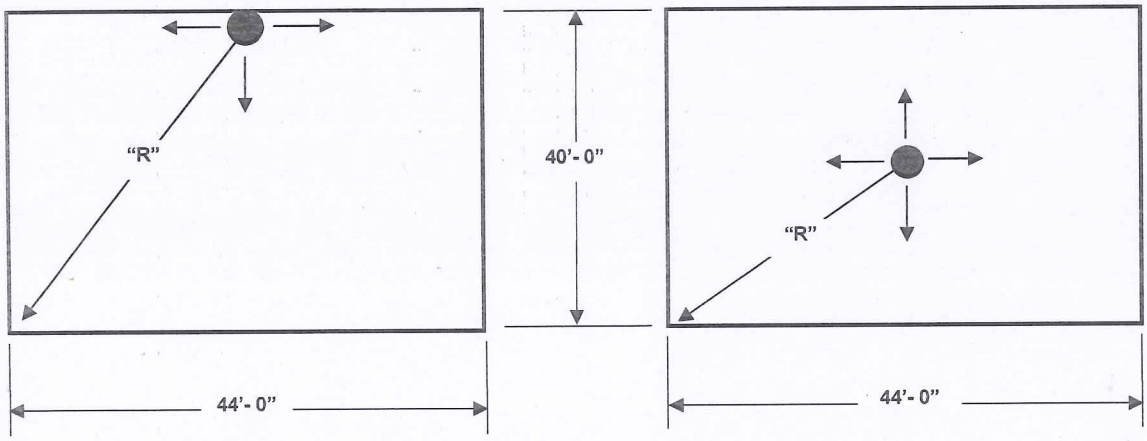
| Discharge Time Limits | |
|---|---|
| **Minimum** | **Maximum** |
| 6 seconds | 10 seconds |

## NOZZLE FLOW RATE LIMITATION

| **Nominal Pipe Size** NPT-(mm) | **Minimum Design Flow Rate** (System Limitation) lbs./sec (kg/sec) | **Maximum Design Flow Rate** (Estimate Only) lbs./sec (kg/sec) | **Notes** |
|---|---|---|---|
| 3/8" (10) | 0.7 (0.32) | 2.0 (0.91) | A maximum nozzle flow rate of 17 lbs./sec. (7.7 kg/sec.) is recommended for all areas with false ceilings or delicate operations where a higher flow rate may dislodge objects or affect a process.<br>This information is provided for estimation purposes only. The final system design MUST be verified using the NAFFCO Flow Calculation Program. |
| 1/2" (15) | 1.0 (0.45) | 3.4 (1.54) | |
| 3/4" (20) | 2.0 (0.91) | 6.0 (2.72) | |
| 1" (25) | 3.4 (1.54) | 8.5 (3.86) | |
| 1 ¼" (32) | 5.8 (2.63) | 13.0 (5.90) | |
| 1 ½" (40) | 8.4 (3.81) | 19.5 (8.85) | |
| 2" (50) | 13.0 (5.90) | 33.0 (14.97) | |

## NOZZLE AREA COVERAGE

| Nozzle Size – 3/8" – 2" (10 – 50 mm) | | | |
|---|---|---|---|
| **Maximum Distance** | **180° Nozzle** ft. (m) | **360° Nozzle** ft. (m) | **Note** |
| Below Ceiling | 1.0 (0.3) | 1.0 (0.3) | Maximum distance above highest point of protection when stacking nozzles. |
| Away from Sidewall | 1.0 (0.3) | --- | |



## NOZZLE PLACEMENT

| TYPE OF NOZZLE | PLACEMENT RECOMMENDATION | NOTES |
|---|---|---|
| 360° Nozzle(s) | Located on, or near, the centerline of the protected area, discharging toward the perimeter of the area being covered. | Nozzle patterns need to overlap, to adequately cover the area without any "blind spots" due to nozzle locations. Apply to all Nozzle types. Refer to Figure 1 |

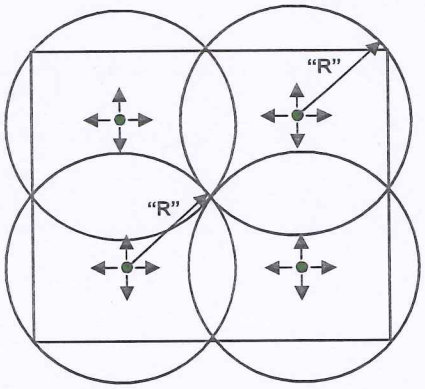



Figure 1

| | | |
|---|---|---|
| 180° Nozzle(s) | Located along the perimeter of the area, discharging toward the opposite side. | Refer to Figure 2 |

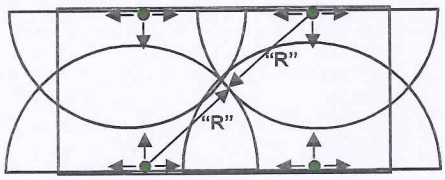



Figure 2

| | | |
|---|---|---|
| 180° Nozzles – Back to Back Application | Maximum distance between nozzles is 1'-0" (0.3 m) | Refer to Figure 3 |

**IMPORTANT NOTE:**

The Minimum Piping Distance Rule outlined on page 12 **does not** apply when using back-to-back 180° nozzles as long as:

1) Agent supplied and flow rate from both nozzles are the same.
2) Pipe size from tee to both nozzles is the same.
3) Pipe lengths from tee to each nozzle are within 10% of each other.

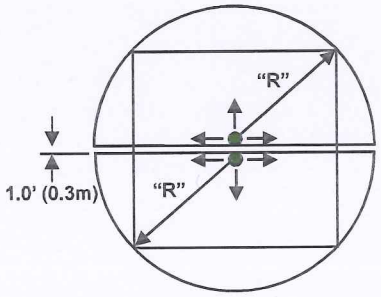
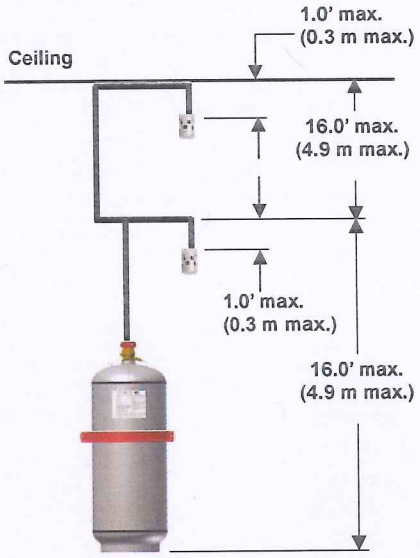



Figure 3

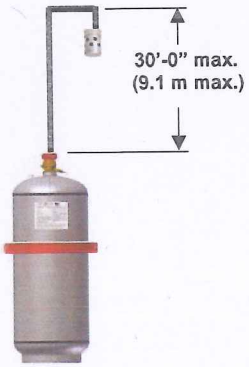
## CEILING HEIGHT vs. LEVELS OF NOZZLES

| Ceiling Height | Levels of Nozzles Required |
|---|---|
| 1.0' (0.3 m) to 16.0' (4.9 m) | 1 |
| Over 16.0' (4.9 m) to 32.0' (9.75 m) | 2<br>(See Maximum Elevation Differences in Pipe Runs Limitation) |

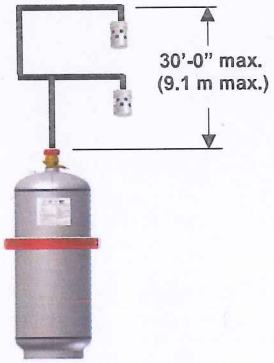



## MAXIMUM ELEVATION DIFFERENCES IN PIPE RUNS LIMITATION

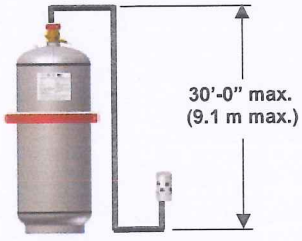
| Nozzle(s) Location | Maximum Elevation Difference |
|---|---|
| Nozzle(s) "Only" above Container Outlet | 30 feet (9.1 m) (See Examples 1 & 2) |
| Nozzle(s) "Only" below Container Outlet | 30 feet (9.1 m) (See Examples 3) |
| Nozzle(s) above & below Container Outlet | 30 feet (9.1 m) (See Examples 4) |



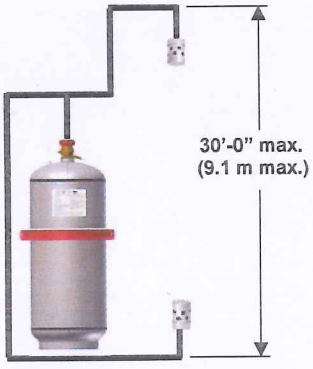

**Example 1**
System with a single level of Nozzle(s) above above Container outlet




**Example 2**
System with multiple levels of Nozzle(s) Container outlet



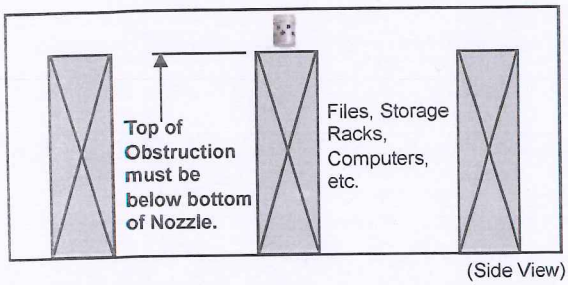

**Example 3**
System with a single level of Nozzle(s) below Container outlet



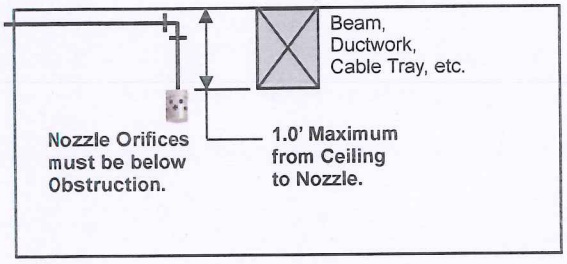

**Example 4**
System with levels of Nozzle(s) above & below Container outlet

## NOZZLE DISCHARGE OBSTRUCTIONS

When solid obstructions (walls, partitions, equipment racks, and tall equipment) interfere with the nozzle discharge path, they should be treated as separate areas. All nozzles should be located in a manner that will provide a clear discharge path that reaches all of the outer extremes for the protected space.



(Side View)

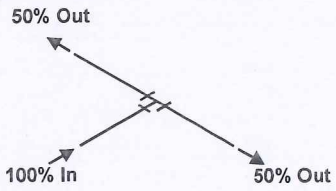


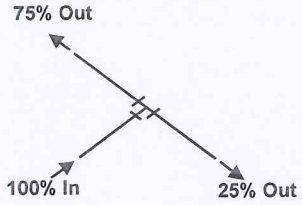

## TEE SPLIT RATIOS

| Type of Tee | Major-Flow Outlet | | Minor-Flow Outlet | |
|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum |
| Bullhead | 50% | 75% | 25% | 50% |
| Side-Thru | 75% | 90% | 10% | 25% |

## TEE CONFIGURATION – BULLHEAD

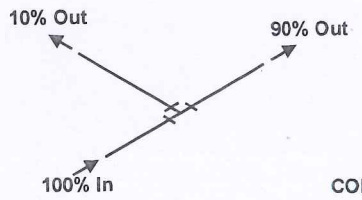
Definition: Where the two-outlet branches change direction from the incoming piping inlet.



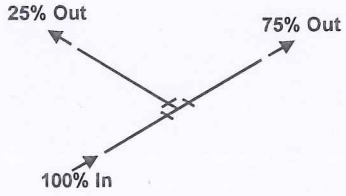



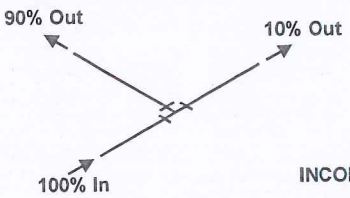

## TEE CONFIGURATION – SIDE-THRU

Definition: Where one outlet branch changes direction from the inlet and the other continues straight through in the same direction as the inlet.

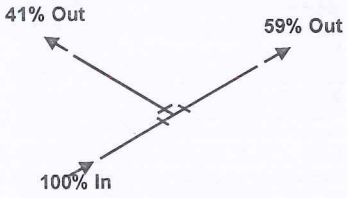



CORRECT



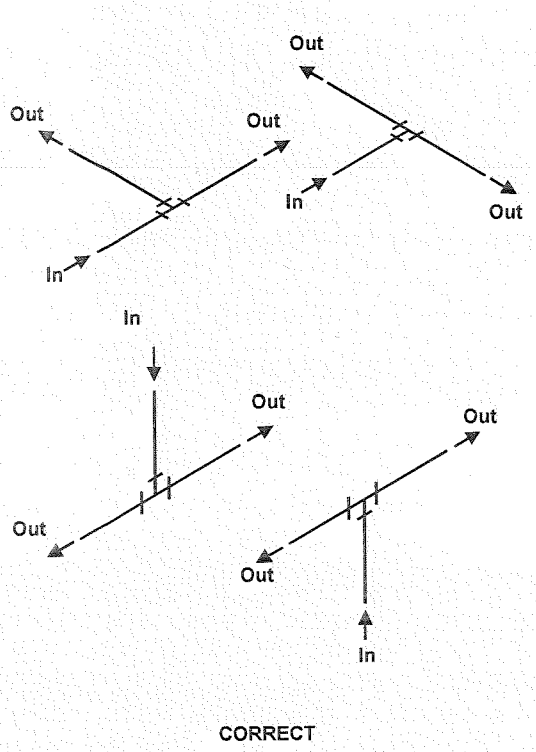




INCORRECT

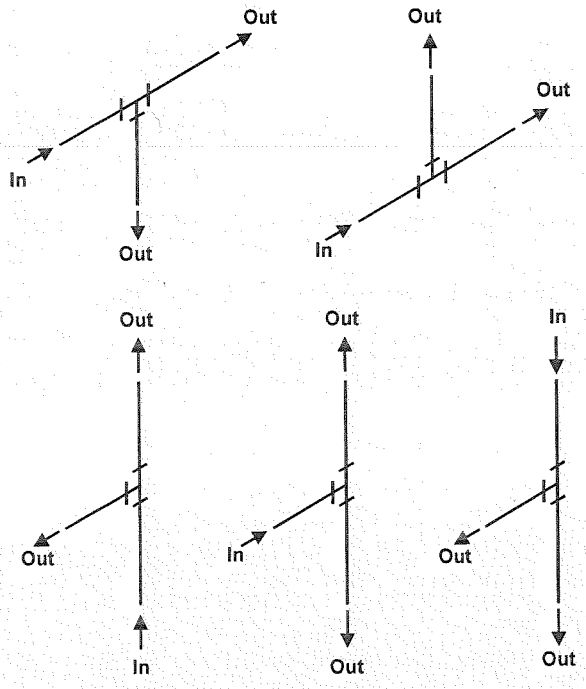


## TEE ORIENTATION

**IMPORTANT NOTE:** EVERY OUTLET of every tee MUST be orientated in the horizontal plane.




CORRECT




INCORRECT

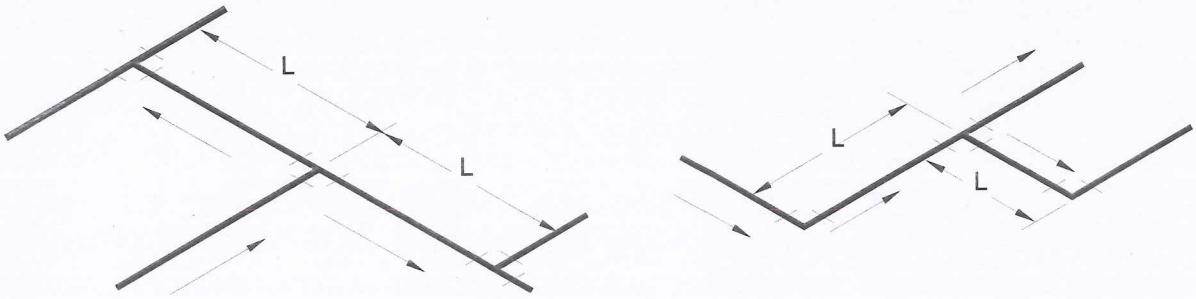
## ESTIMATING PIPE SIZE

| Factor | Definition | |
|---|---|---|
| Minimum Flow Rate | A two phase flow (liquid and vapor) that creates a turbulent flow effect forming a homogenous mixture of liquid and vapor. If the pipe size is too large, phase separation will occur and the flow cannot be predicted. | |
| **Pipe Size** NPT (mm) | **Minimum Design Flow Rate** lbs/sec (kg/sec) **(System Limitation)** | **Maximum Design Flow Rate** lbs/sec (kg/sec) **(Estimate)** |
| 3/8 (10) | 0.7 (0.32) | 2.0 (0.91) |
| 1/2 (15) | 1.0 (0.45) | 3.4 (1.54) |
| 3/4 (20) | 2.0 (0.91) | 6.0 (2.72) |
| 1 (25) | 3.4 (1.54) | 8.5 (3.86) |
| 1 ¼ (32) | 5.8 (2.63) | 13.0 (5.90) |
| 1 ½ (40) | 8.4 (3.81) | 19.5 (8.85) |
| 2 (50) | 13.0 (5.90) | 33.0 (14.97) |
| 2 ½ (65) | 19.5 (8.85) | 58.0 (26.31) |
| 3 (80) | 33.0 (15.00) | 95.0 (43.10) |
| 4 (100) | 58.0 (26.31) | 127 (57.61) |
| 6 (150) | 95 (43.10) | 222 (100.70) |

**NOTE:** To determine the flow rate of a pipe section, divide the amount of agent flowing through that section by the discharge time (10 seconds).

## MINIMUM PIPING DISTANCE

| |
|---|
| A minimum of ten (10) pipe diameters must be maintained between fittings to stabilize the flow and maintain the accuracy of the splits occurring at the tees. |
| The (10) pipe diameter rule applies to the following configurations: |
| |
| Configuration 2: Distance from an Elbow to a Tee |



| 10 PIPE DIAMETERS VS. PIPE SIZE | | | |
|---|---|---|---|
| **Pipe Size** | **Minimum Length** | **Pipe Size** | **Minimum Length** |
| 3/8" NPT | 4" | 10 mm | 102 mm |
| 1/2" NPT | 5" | 15 mm | 127 mm |
| 3/4" NPT | 8" | 20 mm | 204 mm |
| 1" NPT | 10" | 25 mm | 254 mm |
| 1-1/4" NPT | 12" | 32 mm | 305 mm |
| 1-1/2" NPT | 15" | 40 mm | 381 mm |
| 2" NPT | 20" | 50 mm | 508 mm |
| 2-1/2" NPT | 25" | 65 mm | 635 mm |
| 3" NPT | 30" | 80 mm | 762 mm |
| 4" NPT | 40" | 100 mm | 1016 mm |
| 6" NPT | 60" | 150 mm | 1524 mm |

**NOTE**: The ten (10) pipe diameter rule does **not** apply:

- between an Elbow and another Elbow.
- when using back-to-back 180° nozzles as long as:
  1) Agent supplied and flow rate from both nozzles are the same.
  2) Pipe size from tee to both nozzles is the same.
  3) Pipe lengths from tee to each nozzle are within 10% of each other.

**EQUIVALENT LENGTH VALUES** (Schedule 40 pipe)

| **Pipe Size** NPT (mm) | **Union** ft (m) | **45° Elbow** ft (m) | **90° Elbow** ft (m) | **Thru Tee** ft (m) | **Side Tee** ft (m) | **Check Valve** ft (m) |
|---|---|---|---|---|---|---|
| 3/8" (10) | 0.3 (0.09) | 0.6 (0.18) | 1.3 (0.40) | 0.8 (0.24) | 2.7 (0.82) | - - - |
| 1/2" (15) | 0.4 (0.12) | 0.8 (0.24) | 1.7 (0.52) | 1.0 (0.30) | 3.4 (1.04) | - - - |
| 3/4" (20) | 0.5 (0.15) | 1.0 (0.30) | 2.2 (0.67) | 1.4 (0.43) | 4.5 (1.37) | - - - |
| 1" (25) | 0.6 (0.18) | 1.3 (0.40) | 2.8 (0.85) | 1.8 (0.55) | 5.7 (1.74) | 2.0 (0.61) |
| 1-1/4" (32) | 0.8 (0.24) | 1.7 (0.52) | 3.7 (1.13) | 2.3 (0.70) | 7.5 (2.29) | - - - |
| 1-1/2" (40) | 0.9 (0.27) | 2.0 (0.61) | 4.3 (1.31) | 2.7 (0.82) | 8.7 (2.65) | - - - |
| 2" (50) | 1.2 (0.37) | 2.6 (0.79) | 5.5 (1.68) | 3.5 (1.07) | 11.2 (3.41) | 4.0 (1.22) |
| 2-1/2" (65) | 1.4 (0.43) | 3.1 (0.94) | 6.6 (2.01) | 4.1 (1.25) | 13.4 (4.08) | - - - |
| 3" (80) | 1.8 (0.55) | 3.8 (1.16) | 8.2 (2.50) | 5.1 (1.55) | 16.6 (5.06) | 4.0 (1.22) |
| 4" (100) | 2.4 (0.73) | 5.0 (1.52) | 10.7 (3.26) | 6.7 (2.04) | 21.8 (6.64) | - - - |
| 6" (150) | 3.5 (1.07) | 7.6 (2.32) | 16.2 (4.94) | 10.1 (3.08) | 32.8 (10.0) | - - - |

| **Impulse Valve Size** | 1" | 3" | 3" (Inverted 150i) |
|---|---|---|---|
| **Equivalent Length** | 6.03 ft. (1.84m) | 30.90 ft. (9.42m) | 35.93 ft. (10.95m) |

**PIPE NETWORK LIMITATIONS** (Verified by the NAFFCO Flow Calculation

| Description of Limit | Definition | Limitation |
|---|---|---|
| **Percent of Agent in Pipe** | The total agent weight (liquid) that may reside in the piping network during discharge. | **70%** maximum |
| Location of 1st Tee | The distance from the cylinder to the first tee of the piping system. | 1 – Percent of agent in pipe network = 39% or less: No Restriction applies to the location of the 1st tee. |
| | | 2 – Percent of agent in pipe network = 40% or higher: 1st tee must be located a minimum of 10% to 30% away from the container<br>See Figure 1 for details |

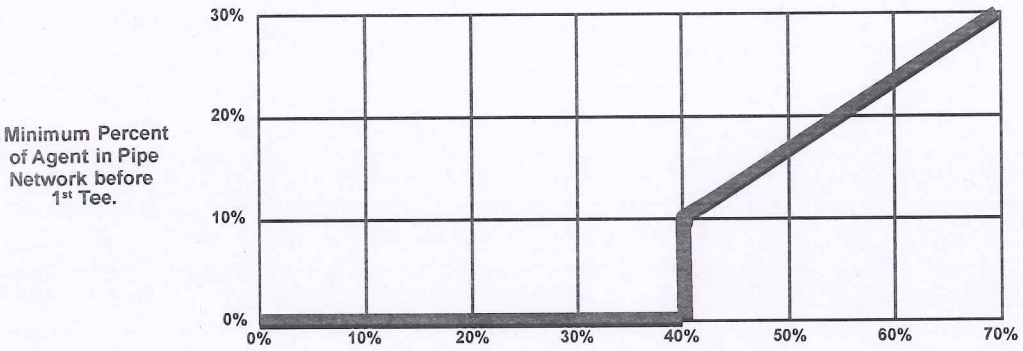
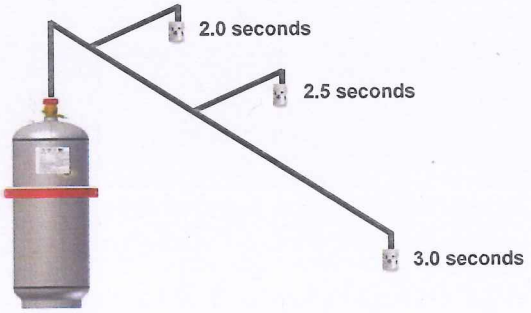


Figure 1

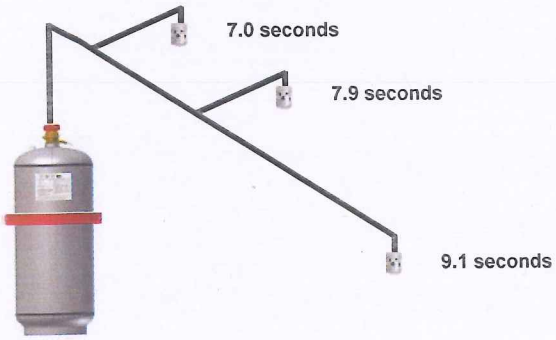
| | | |
|---|---|---|
| **Liquid Arrival Time** | The time necessary for liquid agent to arrive at each nozzle. | Liquid agent must "Arrive" at each nozzle within **1 second** of each other. (See Example 5) |




**Example 5:**

If liquid agent takes 2.0 seconds to arrive at the 1st nozzle, (the closest nozzle to the container); liquid arrival time for remaining nozzles cannot exceed 1 second.

| | | |
|---|---|---|
| **Liquid Runout Time** | The time necessary for the liquid agent to discharge (runout) of each nozzle. | Each nozzle must "Runout" within **2.1 seconds** of each other. (See Example 6) |




**Example 6:**

If liquid runout time for the 1st nozzle takes 7.0 seconds, the runout time for remaining nozzles must not exceed 9.1 seconds.

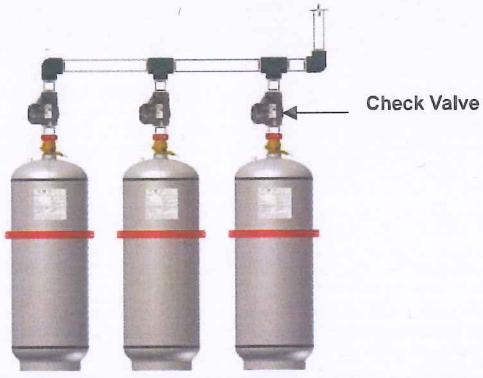
## NOZZLE ORIFICE AREA LIMITATION – 180° & 360°

| Minimum Orifice Area | Maximum Orifice Area | Minimum Pressure |
|---|---|---|
| 20% – Pipe cross sectional area | 80% – Pipe cross sectional area | 55 psig (3.8 bar) |

**CAUTION:** It is important to use pipe & fittings that are approved (for details, refer to the Pipe and Fittings component sheet (p/n 06-495) and not to exceed system limitations in a clean agent fire suppression system design, failure to do so may cause the system not to supply the quantity of extinguishing agent required to suppress the fire.

## MANIFOLD OPTIONS

| Configurations | Notes |
|---|---|
| Center Exit Manifold | Used for multiple container applications. |
| End Exit Manifold | Check Valves are required for **EACH** container being connected to a manifold. |
| Center Exit Manifold / Main and Reserve | Every container must be the same type, same size, and identical fill weight. |
| End Exit Manifold / Main and Reserve | Refer to Check Valve Component sheet (p/n 06-497) for installation information. |




**Typical End Exit Manifold**

## SAMPLE PROBLEM

The following is a NAFFCO Clean Agent Fire Suppression system designed within the limitations established by NAFFCO's UL listing and FM approval, and in compliance with NFPA 2001 using NAFFCO Flow Calculation Program reflecting the inputs required and showing the computer program output information.

## HAZARD INFORMATION

Design Concentration: 7.0% (Minimum)

Temperature Range: 70° F. to 85° F.

Enclosure Elevation: 0 Feet (Sea Level)

Room Height: 8.0'

Unclosable Openings: None

No. of Nozzles:

- Control Room: 2 - 360° Nozzles
- Office / Storage Room: 1 - 180° Nozzles

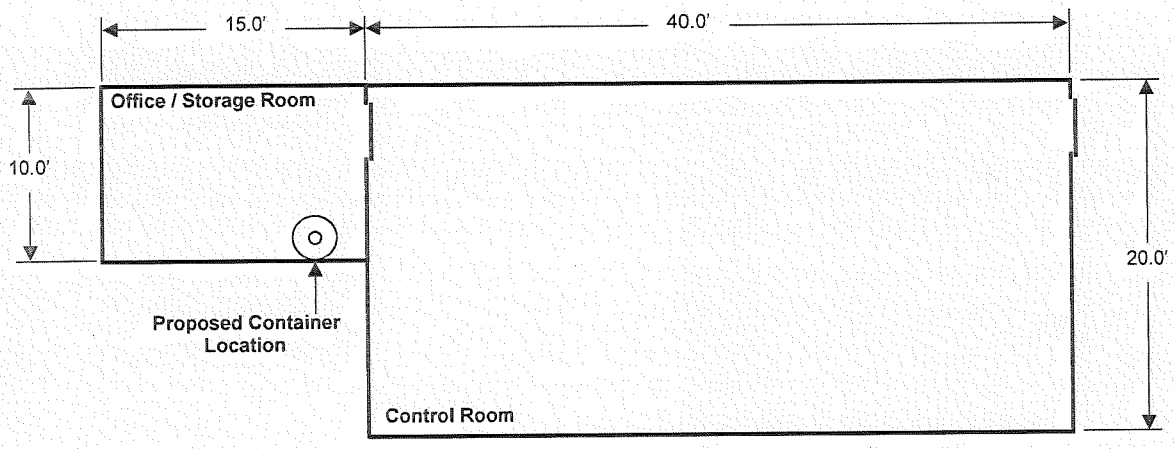
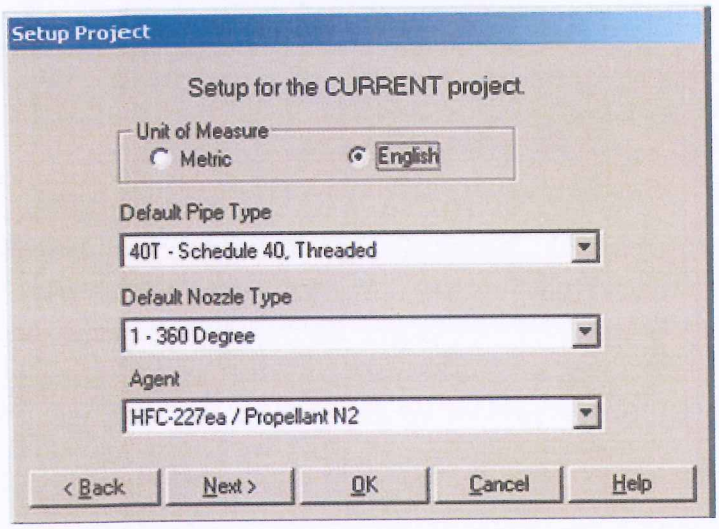
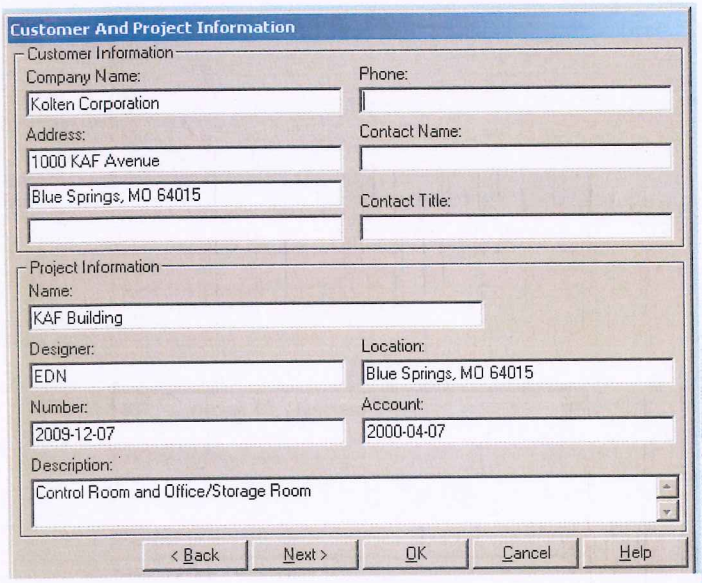
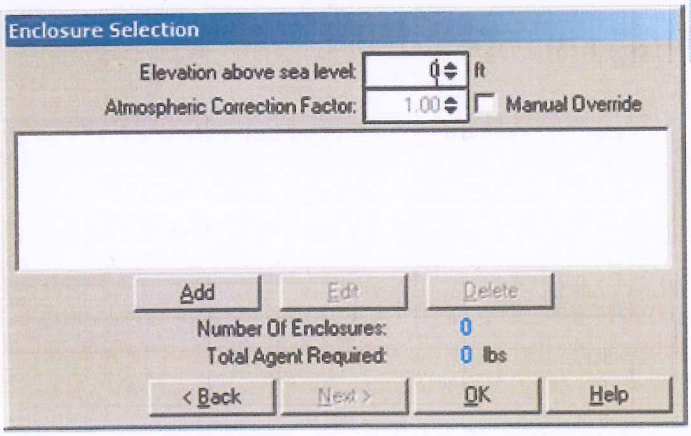


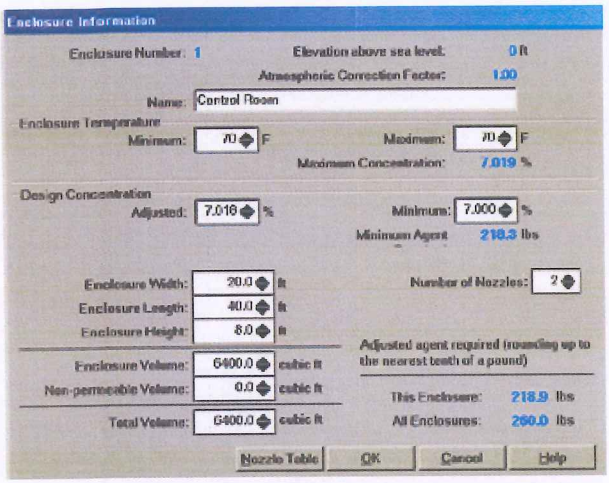

**FIGURE 1 – Floor Plan**

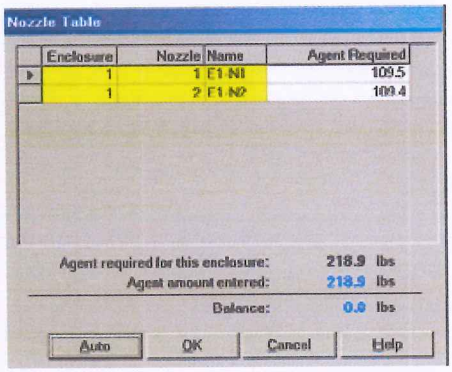
## INPUTS – FLOW CALCULATION PROGRAM

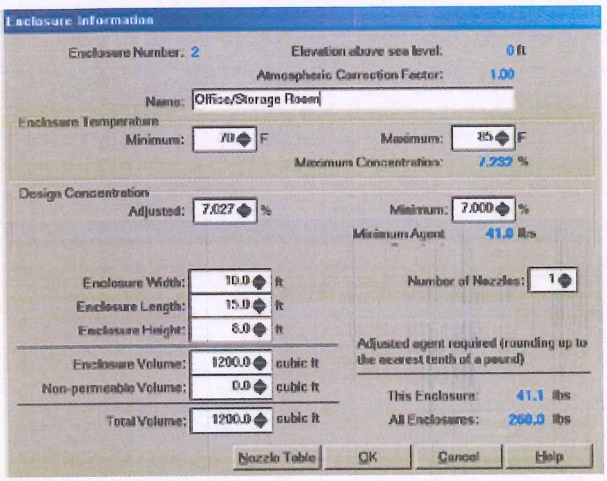


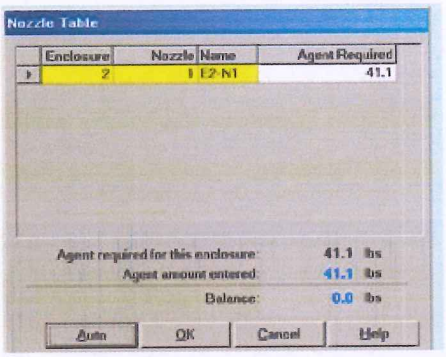



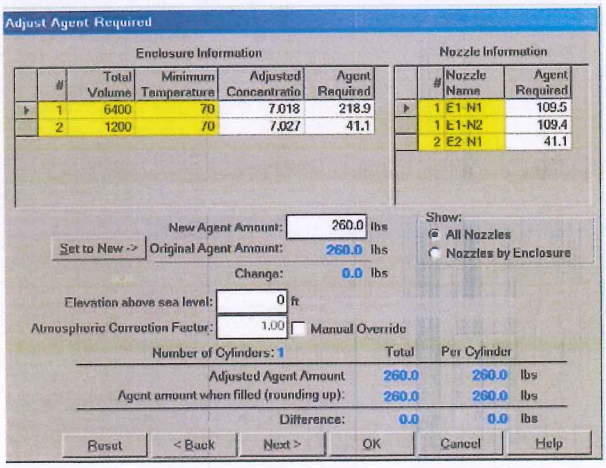



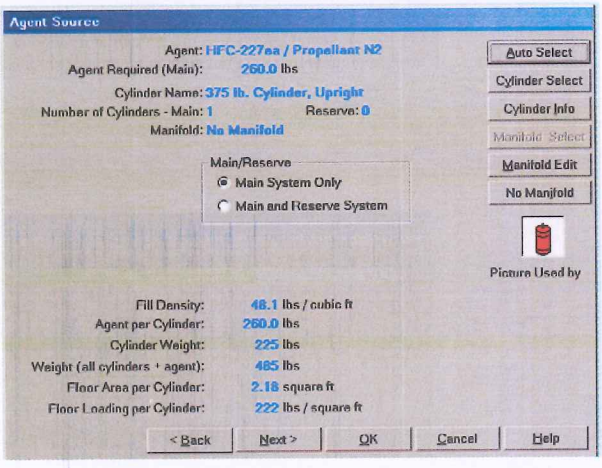

Enclosure Information
Enclosure Number: 1
Elevation above sea level: 0 ft
Atmospheric Correction Factor: 1.00
Name: Control Room
Enclosure Temperature
Minimum: 70 F
Maximum: 70 F
Maximum Concentration: 7.019 %
Design Concentration
Adjusted: 7.018 %
Minimum: 7.000 %
Minimum Agent 218.3 lbs
Enclosure Width: 20.0 ft
Enclosure Length: 40.0 ft
Enclosure Height: 8.0 ft
Number of Nozzles: 2
Enclosure Volume: 6400.0 cubic ft
Non-permeable Volume: 0.0 cubic ft
Total Volume: 6400.0 cubic ft
Adjusted agent required (rounding up to the nearest tenth of a pound)
This Enclosure: 218.9 lbs
All Enclosures: 260.0 lbs
Nozzle Table
OK
Cancel
Help


Nozzle Table
Enclosure
Nozzle
Name
Agent Required
1 1 E1-N1 109.5
1 2 E1-N2 109.4
Agent required for this enclosure: 218.9 lbs
Agent amount entered: 218.9 lbs
Balance: 0.0 lbs
Auto
OK
Cancel
Help


Enclosure Information
Enclosure Number: 2
Elevation above sea level: 0 ft
Atmospheric Correction Factor: 1.00
Name: Office/Storage Room
Enclosure Temperature
Minimum: 70 F
Maximum: 85 F
Maximum Concentration: 7.232 %
Design Concentration
Adjusted: 7.027 %
Minimum: 7.000 %
Minimum Agent 41.0 lbs
Enclosure Width: 10.0 ft
Enclosure Length: 15.0 ft
Enclosure Height: 8.0 ft
Number of Nozzles: 1
Enclosure Volume: 1200.0 cubic ft
Non-permeable Volume: 0.0 cubic ft
Total Volume: 1200.0 cubic ft
Adjusted agent required (rounding up to the nearest tenth of a pound)
This Enclosure: 41.1 lbs
All Enclosures: 260.0 lbs
Nozzle Table
OK
Cancel
Help


Nozzle Table
Enclosure
Nozzle
Name
Agent Required
2 1 E2-N1 41.1
Agent required for this enclosure: 41.1 lbs
Agent amount entered: 41.1 lbs
Balance: 0.0 lbs
Auto
OK
Cancel
Help


Adjust Agent Required
Enclosure Information
# Total Volume Minimum Temperature Adjusted Concentratio Agent Required
1 6400 70 7.018 218.9
2 1200 70 7.027 41.1
Nozzle Information
# Nozzle Name Agent Required
1 E1-N1 109.5
1 E1-N2 109.4
2 E2-N1 41.1
New Agent Amount: 260.0 lbs
Set to New ->
Original Agent Amount: 260.0 lbs
Change: 0.0 lbs
Show:
All Nozzles
Nozzles by Enclosure
Elevation above sea level: 0 ft
Atmospheric Correction Factor: 1.00
Manual Override
Number of Cylinders: 1
Total
Per Cylinder
Adjusted Agent Amount 260.0 260.0 lbs
Agent amount when filled (rounding up): 260.0 260.0 lbs
Difference: 0.0 0.0 lbs
Reset
< Back
Next >
OK
Cancel
Help


Agent Source
Agent: HFC-227ea / Propellant N2
Agent Required (Main): 260.0 lbs
Cylinder Name: 375 lb. Cylinder, Upright
Number of Cylinders - Main: 1
Reserve: 0
Manifold: No Manifold
Main/Reserve
Main System Only
Main and Reserve System
Auto Select
Cylinder Select
Cylinder Info
Manifold Select
Manifold Edit
No Manifold
Picture Used by
Fill Density: 48.1 lbs / cubic ft
Agent per Cylinder: 260.0 lbs
Cylinder Weight: 225 lbs
Weight (all cylinders + agent): 485 lbs
Floor Area per Cylinder: 2.18 square ft
Floor Loading per Cylinder: 222 lbs / square ft
< Back
Next >
OK
Cancel
Help

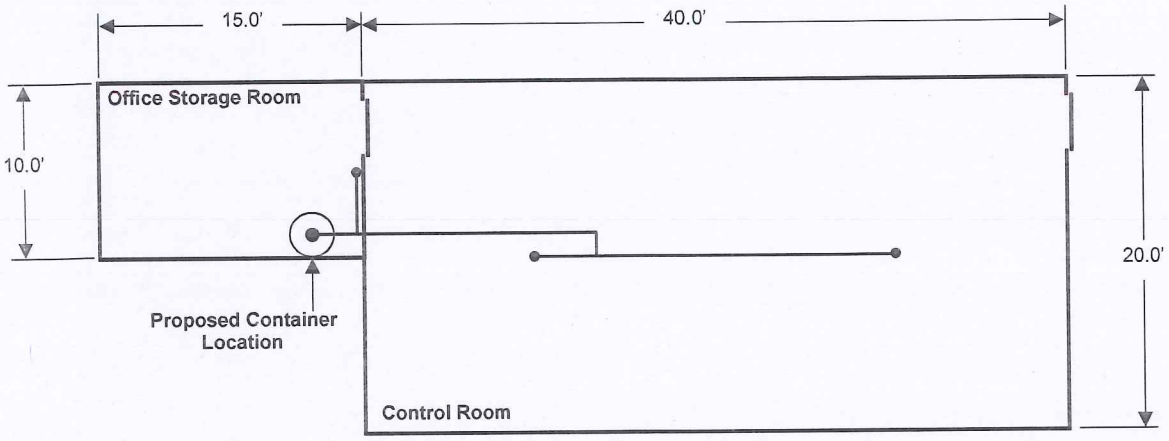
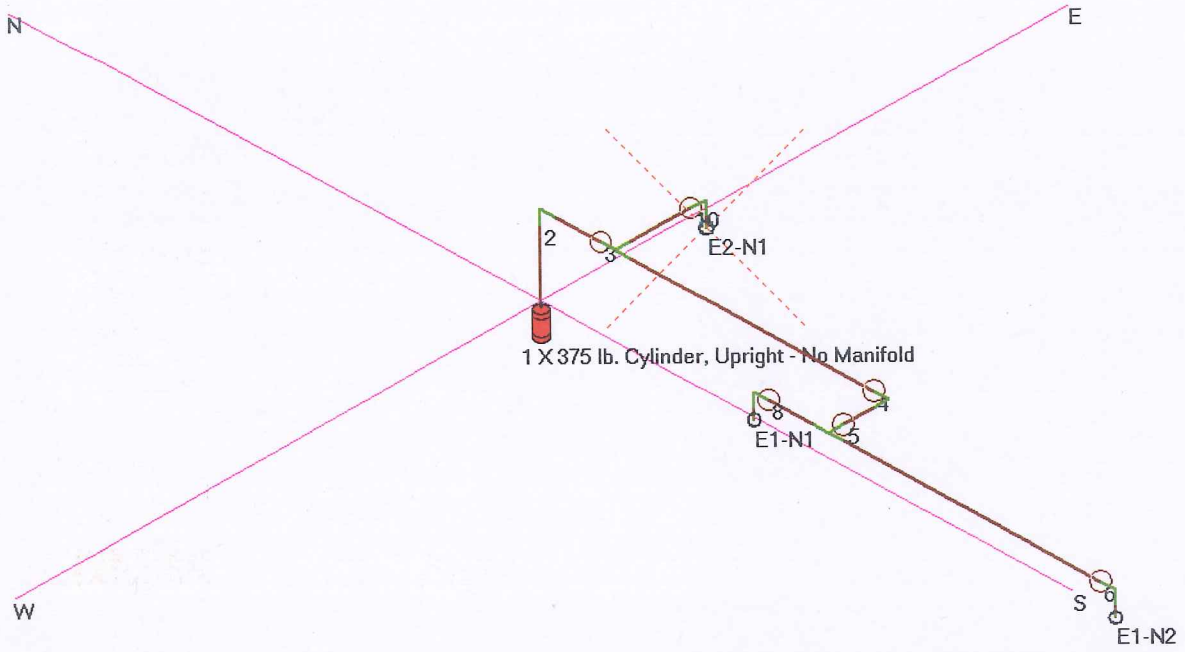



**FIGURE 2 – Pipe and Nozzle Layout**




Fike HFC 227ea FlowCalc FIK3.02 - FM-200 Example Problem.FLC - [Pipe Network]

File Edit Input Calculate Reports Tables Window Help

Def. D. Dup. T. Dup. D. Test < Back OK

Desc. PipeType 45 Union Other E.L.

| Description | Start | End | Type | Diameter | Lock Pipe | Length | Elev. | 90 | Thru | Side | Union | EL Added | EL Total | Flow | Nozzle | Nozzle Type | Nozzle Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Main Cyl. X 1 | 0 | 1 | | 3 in | Yes | 3.54 | 3.54 | | | | | 0.0 | 30.9 | 260.0 | | | |
| Pipe | 1 | 2 | 40T | 1-1/2 in | No | 4.50 | 4.50 | | | | | 0.0 | 4.5 | 260.0 | | | |
| Pipe | 2 | 3 | 40T | 1-1/2 in | No | 3.00 | 0.00 | 1 | | | | 0.0 | 7.3 | 260.0 | | | |
| Pipe | 3 | 4 | 40T | 1-1/2 in | No | 16.00 | 0.00 | | 1 | | | 0.0 | 18.7 | 218.9 | | | |
| Pipe | 4 | 5 | 40T | 1-1/2 in | No | 2.00 | 0.00 | 1 | | | | 0.0 | 6.3 | 218.9 | | | |
| Pipe | 5 | 6 | 40T | 1-1/2 in | No | 17.00 | 0.00 | | | 1 | | 0.0 | 25.7 | 109.4 | | | |
| Pipe/E1-N2 | 6 | 7 | 40T | 1-1/2 in | No | 0.50 | -0.50 | 1 | | | | 0.0 | 4.8 | 109.4 | E1-N2 | 360 Degree | 0.5161 |
| Pipe | 5 | 8 | 40T | 1-1/4 in | No | 3.00 | 0.00 | | | 1 | | 0.0 | 10.5 | 109.5 | | | |
| Pipe/E1-N1 | 8 | 9 | 40T | 1-1/4 in | No | 0.50 | -0.50 | 1 | | | | 0.0 | 4.2 | 109.5 | E1-N1 | 360 Degree | 0.5161 |
| Pipe | 3 | 10 | 40T | 3/4 in | No | 4.00 | 0.00 | | | 1 | | 0.0 | 8.5 | 41.1 | | | |
| Pipe/E2-N1 | 10 | 11 | 40T | 3/4 in | No | 0.50 | -0.50 | 1 | | | | 0.0 | 2.7 | 41.1 | E2-N1 | 180 Degree | 0.2184 |

## Consolidated Report
## Customer Information

Company Name:
Address:

Phone:
Contact:
Title:

## Project Data

Project Name:
Designer: EDN
Number: 04-07-2011
Account: 2000-04-07
Location:
Description: Control Room and Office/Storage Room


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report
## Enclosure Information

| | |
|---|---|
| Elevation: | 0 ft (relative to sea level) |
| Atmospheric Correction Factor: | 1 |

| | |
|---|---|
| Enclosure Number: | 1 |
| Name: | Control Room |
| Enclosure Temperature... | |
| Minimum: | 70 F |
| Maximum: | 70 F |
| Maximum Concentration: | 7.019 % |
| Design Concentration... | |
| Adjusted: | 7.018 % |
| Minimum: | 7.000 % |
| Minimum Agent Required: | 218.3 lbs |
| Width: | 20.0 ft |
| Length: | 40.0 ft |
| Height: | 8.0 ft |
| Volume: | 6400.0 cubic ft |
| Non-permeable: | 0.0 cubic ft |
| Total Volume: | 6400.0 cubic ft |
| Adjusted Agent Required: | 218.9 lbs |
| Number of Nozzles: | 2 |


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report
## Enclosure Information

| | |
|---|---|
| Elevation: | 0 ft (relative to sea level) |
| Atmospheric Correction Factor: | 1 |

| | |
|---|---|
| Enclosure Number: | 2 |
| Name: | Office/Storage Room |
| Enclosure Temperature... | |
| Minimum: | 70 F |
| Maximum: | 85 F |
| Maximum Concentration: | 7.232 % |
| Design Concentration... | |
| Adjusted: | 7.027 % |
| Minimum: | 7.000 % |
| Minimum Agent Required: | 41.0 lbs |
| Width: | 10.0 ft |
| Length: | 15.0 ft |
| Height: | 8.0 ft |
| Volume: | 1200.0 cubic ft |
| Non-permeable: | 0.0 cubic ft |
| Total Volume: | 1200.0 cubic ft |
| Adjusted Agent Required: | 41.1 lbs |
| Number of Nozzles: | 1 |


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report
## Agent Information

Agent: HFC-227ea / Propellant N2

| | |
|---|---|
| Adjusted Agent Required: | 260.0 lbs |
| Cylinder Name: | 375 lb. Cylinder, Upright |
| Cylinder Part Number: | 70-269 |
| Number of Main Cylinders: | 1 |
| Number of Reserve Cylinders: | 0 |
| Manifold: | No Manifold |
| Pipe Take Off Direction: | Up |
| Agent Per Cylinder: | 260.0 lbs |
| Fill Density: | 48.1 lbs / cubic ft |
| Cylinder Empty Weight: | 225.0 lbs |
| Weight, All Cylinders + Agent: | 485.0 lbs |
| Floor Area Per Cylinder: | 2.18 square ft |
| Floor Loading Per Cylinder: | 222 lbs / square ft |

### Pipe Network

Part 1 - Pipe

| | | | Pipe | | | |
|---|---|---|---|---|---|---|
| Description | Start | End | Type | Diameter | Length | Elevation |
| Main Cyl. X 1 | 0 | 1 | | 3 in | 3.54 ft | 3.54 ft |
| Pipe | 1 | 2 | 40T | 1-1/2 in | 4.50 ft | 4.50 ft |
| Pipe | 2 | 3 | 40T | 1-1/2 in | 3.00 ft | 0.00 ft |
| Pipe | 3 | 4 | 40T | 1-1/2 in | 16.00 ft | 0.00 ft |
| Pipe | 4 | 5 | 40T | 1-1/2 in | 2.00 ft | 0.00 ft |
| Pipe | 5 | 6 | 40T | 1-1/2 in | 17.00 ft | 0.00 ft |
| Pipe/E1-N2 | 6 | 7 | 40T | 1-1/2 in | 0.50 ft | -0.50 ft |
| Pipe | 5 | 8 | 40T | 1-1/4 in | 3.00 ft | 0.00 ft |
| Pipe/E1-N1 | 8 | 9 | 40T | 1-1/4 in | 0.50 ft | -0.50 ft |
| Pipe | 3 | 10 | 40T | 3/4 in | 4.00 ft | 0.00 ft |
| Pipe/E2-N1 | 10 | 11 | 40T | 3/4 in | 0.50 ft | -0.50 ft |



Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM

Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report

### Part 2 - Equivalent Length

| Start | End | 90 | 45 | Thru | Side | Union | Other | Added | Total |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | | 0.00 ft | 30.9 ft |
| 1 | 2 | 0 | 0 | 0 | 0 | 0 | | 0.00 ft | 4.5 ft |
| 2 | 3 | 1 | 0 | 0 | 0 | 0 | | 0.00 ft | 7.3 ft |
| 3 | 4 | 0 | 0 | 1 | 0 | 0 | | 0.00 ft | 18.7 ft |
| 4 | 5 | 1 | 0 | 0 | 0 | 0 | | 0.00 ft | 6.3 ft |
| 5 | 6 | 0 | 0 | 0 | 1 | 0 | | 0.00 ft | 25.7 ft |
| 6 | 7 | 1 | 0 | 0 | 0 | 0 | | 0.00 ft | 4.8 ft |
| 5 | 8 | 0 | 0 | 0 | 1 | 0 | | 0.00 ft | 10.5 ft |
| 8 | 9 | 1 | 0 | 0 | 0 | 0 | | 0.00 ft | 4.2 ft |
| 3 | 10 | 0 | 0 | 0 | 1 | 0 | | 0.00 ft | 8.5 ft |
| 10 | 11 | 1 | 0 | 0 | 0 | 0 | | 0.00 ft | 2.7 ft |

### Part 3 - Nozzles

| Start | End | Flow | Name | Size | Type | Nozzle Area |
|---|---|---|---|---|---|---|
| 0 | 1 | 260.0 lbs | | | | |
| 1 | 2 | 260.0 lbs | | | | |
| 2 | 3 | 260.0 lbs | | | | |
| 3 | 4 | 218.9 lbs | | | | |
| 4 | 5 | 218.9 lbs | | | | |
| 5 | 6 | 109.4 lbs | | | | |
| 6 | 7 | 109.4 lbs | E1-N2 | 1-1/2 in | 360 Degree | 0.5161 square in |
| 5 | 8 | 109.5 lbs | | | | |
| 8 | 9 | 109.5 lbs | E1-N1 | 1-1/4 in | 360 Degree | 0.5161 square in |
| 3 | 10 | 41.1 lbs | | | | |
| 10 | 11 | 41.1 lbs | E2-N1 | 3/4 in | 180 Degree | 0.2381 square in |

## Parts Information

Total Agent Required: 260.0 lbs
Cylinder Name: 375 lb. Cylinder, Upright (Part: 70-269)
Number Of Cylinders: 1
Field1


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report

| Nozzle | Type | Diameter | Nozzle Area | Part Number |
|---|---|---|---|---|
| E1-N1 | 360 Degree | 1-1/4 in | 0.5161 square in | 80-056-2340 |
| E1-N2 | 360 Degree | 1-1/2 in | 0.5161 square in | 80-057-2340 |
| E2-N1 | 180 Degree | 3/4 in | 0.2381 square in | 80-062-1660 |

| Nozzle | Drill Diameter | Drill Size |
|---|---|---|
| E1-N1 | 0.2340 inches | A |
| E1-N2 | 0.2340 inches | A |
| E2-N1 | 0.1660 inches | 19 |

| Pipe: | Type | Diameter | Length |
|---|---|---|---|
| | 40T | 3/4 in | 4.50 ft |
| | 40T | 1-1/4 in | 3.50 ft |
| | 40T | 1-1/2 in | 43.00 ft |

List of 90 degree elbows:
3 - 1-1/2 in
1 - 1-1/4 in
1 - 3/4 in

List of Tees:
2 - 1-1/2 in

## System Acceptance

System Discharge Time: 8.6 seconds
Percent Agent In Pipe: 22.3%
Percent Agent Before First Tee: 3.6%

Enclosure Number: 1
Enclosure Name: Control Room

Minimum Design Concentration: 7.000%
Adjusted Design Concentration: 7.018%
Predicted Concentration: 7.000%
Maximum Expected Agent Concentration: 7.000% (At 70 F)


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## Consolidated Report

| Nozzle | Minimum Agent Required | Adjusted Agent Required | Predicted Agent Delivered | Nozzle Pressure (Average) |
|---|---|---|---|---|
| E1-N1 | 109.2 lbs | 109.5 lbs | 105.2 lbs | 153 psig |
| E1-N2 | 109.1 lbs | 109.4 lbs | 113.1 lbs | 146 psig |

Enclosure Number: 2
Enclosure Name: Office/Storage Room

Minimum Design Concentration: 7.000%
Adjusted Design Concentration: 7.027%
Predicted Concentration: 7.127%
Maximum Expected Agent Concentration: 7.333% (At 85 F)

| Nozzle | Minimum Agent Required | Adjusted Agent Required | Predicted Agent Delivered | Nozzle Pressure (Average) |
|---|---|---|---|---|
| E2-N1 | 41.0 lbs | 41.1 lbs | 41.7 lbs | 170 psig |


Calculation Date/Time: Tuesday, October 25, 2011, 3:56:20 PM
Copyright (c) Hughes Associates, Inc. Licensed to: Fike Protection Systems

## PRE-ENGINEERED PIPING LIMITATIONS

The following information details the steps necessary to design a pre-engineered piping network for a NAFFCO HFC-227ea Clean Agent Fire Suppression System within the limitations established by NAFFCO's UL listing and FM approval.

Pipe sizes have been pre-determined based on container size and the number of nozzles needed. Refer to one of the following tables:

- Table 1 – Single Nozzle Piping Limitations
- Table 2 – Two Nozzle Piping Limitations

The Pre-Engineered concept minimizes the engineering effort required to design an effective system. As long as nozzle selection, pipe size and pipe length limitations are adhered to, hydraulic flow calculations are not required.

The designer will need to perform a simple hand calculation to determine the following:

For 1 Nozzle Systems:

Determine the length of pipe and the number of elbows from the container to the nozzle, refer to Table 1, if pipe length and number of elbows is equal to or less than values for the container and pipe size being used, the pipe network is acceptable.

For 2 Nozzle Systems:

When designing a two nozzle Pre-Engineered System, the nozzle and piping layout **MUST** be installed in a balanced configuration. To accomplish this, the flow path from the container to each nozzle must be the same length, using the same pipe sizes, the same quantity and type of fittings, and the nozzles must discharge the same amount of agent from each nozzle. A piping network is considered to be balanced if the total length from the container to each nozzle is within 10% of each other.

In addition, all tee splits **MUST** be made using a Bullhead Tee configuration, and each outlet must be oriented in the horizontal plane.

Pipe sizes have already been pre-determined for Pre-Engineered Systems depending upon the size of the container and the number of nozzles needed for each system. Refer to one of the following tables.

- HFC-227ea Pre-Engineered Pipe Network Limitations – 1 Nozzle Systems
- HFC-227ea Pre-Engineered Pipe Network Limitations – 2 Nozzle Systems

## CONTAINER SIZE AND FILL RANGE

| **Container Size** lb. (L) | **Container Part Number** | **Minimum Fill Range** (40 lbs/ft³–630 kg/m³) lbs. (kg) | **Maximum Fill Range** (70 lbs/ft³–1121 kg/m³) lbs. (kg) | **Fill Increments** lbs. (kg) | **Mounting Position** (see Important Note) | **Valve Size** in. (mm) |
|---|---|---|---|---|---|---|
| 5 (2) | NF-70-272 | 4 (2.0) | 5 (2.5) | 1 (0.5) | Upright (Valve Up) | 1 (25) |
| 10 (4) | NF-70-273 | 6 (3.0) | 10 (4.5) | 1 (0.5) | Upright (Valve Up) | 1 (25) |
| 20 (8.5) | NF-70-263 | 12 (5.5) | 21 (9.5) | 1 (0.5) | Upright – Horizontal | 1 (25) |
| 35 (15) | NF-70-264 | 22 (10.0) | 38 (17.0) | 1 (0.5) | Upright – Horizontal | 1 (25) |
| 60 (27) | NF-70-265 | 39 (18.0) | 68 (30.5) | 1 (0.5) | Upright – Horizontal | 1 (25) |
| 100 (44) | NF-70-266 | 63 (28.5) | 108 (49.0) | 1 (0.5) | Upright (Valve Up) | 1 (25) |

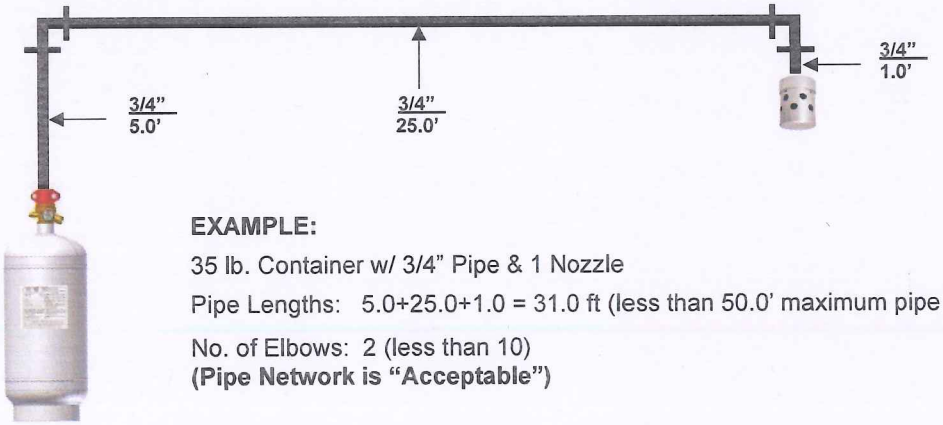
## NOZZLE TYPES – PRE-ENGINEERED

The 180° and 360° nozzles can be used on a pre-engineered NAFFCO HFC-227ea Clean Agent Fire Suppression System: For design limitations for the 180° and 360°Nozzles, refer to pages 7 and 8.

## PIPING NETWORK LIMITATIONS – SINGLE NOZZLE SYSTEMS

**TABLE 1 – HFC-227ea Pre-Engineered Pipe Network Limitations – Single Nozzle Systems**

| Container Size & Fill Range lb. (L) | Pipe Size | Maximum Pipe Length ft. | Elbows included in Maximum Pipe Length | Deduct for each additional Elbow over 8 | Nozzle Type | |
|---|---|---|---|---|---|---|
| | | | | | 360° Nozzle | 180° Nozzle |
| 5 lb. (4-5) | 3/8 | 45 | 8 | 1.3 | 80-052-1110 | 80-060-1160 |
| 10 lb.(6-10) | 3/8 | 45 | 8 | 1.3 | 80-052-1200 | 80-060-1285 |
| 20 lb. (12-21) | 1/2 | 35 | 8 | 1.7 | 80-053-1590 | 80-061-1660 |
| 35 lb. (22-38) | 3/4 | 45 | 8 | 2.2 | 80-054-2090 | 80-062-2210 |
| 60 lb.(39-68) | 1 | 45 | 8 | 2.8 | 80-055-2660 | 80-063-2812 |
| 100 lb. (63-108) | 1 1/2 | 60 | 8 | 4.3 | 80-057-3020 | 80-065-3160 |




**EXAMPLE:**

35 lb. Container w/ 3/4" Pipe & 1 Nozzle

Pipe Lengths: 5.0+25.0+1.0 = 31.0 ft (less than 50.0' maximum pipe length)

No. of Elbows: 2 (less than 10)

**(Pipe Network is "Acceptable")**

## PIPING NETWORK LIMITATIONS – TWO NOZZLE SYSTEMS

| TABLE 2 – HFC-227ea Pre-Engineered Pipe Network Limitations – Two Nozzle Systems | | | | | | | |
|---|---|---|---|---|---|---|---|
| Container Size | Total Pressure Drop (TPD) | Section A | | Section B (see Note 1) | | Nozzle Type | |
| | | Pipe Size | Deduct for each Elbow over 4 | Pipe Size | Deduct for each Elbow over 4 | 360° Nozzle | 180° Nozzle |
| 10 lb. (6-10) | 23 | 3/8 | 1.3 | 3/8 | 1.3 | 80-052-0670 | 80-060-0670 |
| 20 lb. (12-21) | 36 | 1/2 | 1.7 | 3/8 | 1.3 | 80-052-1250 | 80-060-1285 |
| 35 lb. (22-38) | 46 | 3/4 | 2.2 | 1/2 | 1.7 | 80-053-1590 | 80-061-1660 |
| 60 lb.(39-68) | 46 | 1 | 2.8 | 3/4 | 2.2 | 80-054-2090 | 80-062-2210 |
| 100 lb. (63-108) | 60 | 1 1/2 | 4.3 | 1 | 2.8 | 80-055-2660 | 80-063-2812 |

**NOTE:** 1) Maximum actual pipe length of **each** Section B branch line is as follows:
20, 35, 60 & 100 lb. system = 32 10 lb.
system = 16

**EXAMPLE:**

35 lb. Container w/ 3/4" Pipe (Section A) & 1/2" Pipe (Section B w/ 2 Nozzles)

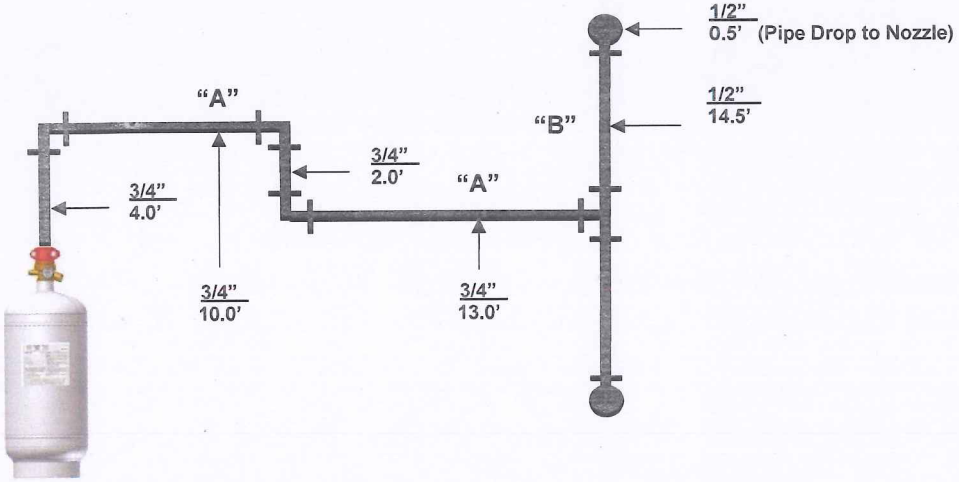
Actual Pipe Lengths + (No. of Elbows x Equivalent Length) = TPD per Section

(Section A) (4.0+10.0+2.0+13.0) 29.0 + (3 elbows[1]) 0 = 29.0
(Section B) (14.5+0.5) 15.0 ft. + (1 elbow[2]) 0 = 15.0

Total TPD = 44.0 (less than 46 maximum TPD)
**(Pipe network is "Acceptable")**

[1] The 3 elbows in Section A is less than 6 therefore no pressure drop compensation required

[2] The 1 elbow in Section B is less than 4 therefore no pressure drop compensation required



# CLEAN AGENT FIRE SUPPRESSION SYSTEM

ORIGINAL RELEASE DATE: ..... October, 2010

| REVISION / DESCRIPTION OF CHANGE | REVISION DATE |
|---|---|
| Revision 1<br>1) Formatting changes | March, 2014 |

**HAZARD ENCLOSURE**

SYSTEM CHECKOUT

MAINTENANCE

**SYSTEM COMPONENTS**

**AGENT STORAGE CONTAINER & ACCESSORIES**

SYSTEM CHECKOUT

MAINTENANCE

**PIPE & FITTINGS .**

SYSTEM CHECKOUT

MAINTENANCE

**DISCHARGE NOZZLE**

SYSTEM CHECKOUT

MAINTENANCE

**DETECTION & CONTROL SYSTEM**

# SERVICE INFORMATION

The following information details the steps necessary to perform system checkout and periodic maintenance on a NAFFCO Clean Agent Fire Suppression System within the limitations established by NAFFCO's UL listing, FM approval and in compliance with NFPA 2001.

The checkout procedures outlined are intended to represent the minimum requirement for the extinguishing portion of the system. Additional procedures may be required by the Authority having Jurisdiction (AHJ)

**IMPORTANT NOTE:** This information **does not** cover service and maintenance procedures for the electrical and control portions of the system. The control portion of the system should be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

## HAZARD ENCLOSURE

### System Checkout

A good review of the hazard area is just as important as the proper operation of system components. The following item shall be checked.

| Factors to Consider | Recommendation |
|---|---|
| Area Configuration | The area dimensions should be checked against those shown on the system plan(s). If the area volume has changed, the agent weight should be recalculated and compared with the agent weight supplied.<br>The area should also be checked for walls or movable partitions, which have been added or changed. If walls or partitions have been added, check to see that all areas within the hazard still receive adequate nozzle coverage and agent distribution. |
| Doors | All perimeter doors should have drop seals on the bottom, weather-stripping around the jambs, latching mechanisms and door closure hardware. Double doors should have a weather-stripped astragal to prevent leakage between the doors, and a coordinator to assure the proper sequence of closure. Normally open doors shall be equipped with door closure hardware and magnetic door holders that will release the door(s) upon a system alarm. |
| Ductwork | All ductwork leading into, or out of, the protected space(s) should be isolated with sealed, "low smoke" dampers. Dampers should be spring-loaded or motor-operated to provide 100% air shutoff upon activation. |
| Air Handling/Ventilation | Unit(s) should be shutdown upon alarm, if unit(s) cannot be shutdown volume of ductwork must be protected. |
| Penetrations | All holes, cracks, gaps or penetrations in perimeter walls must be sealed and floor drains with traps be filled with a non-evaporating liquid. Sub-floor drains must have "P"- traps and be sealed with a non-evaporating liquid, such as anti-freeze or mineral oil. Wall switch and receptacle boxes should be sealed. |
| Walls | All perimeter walls should extend slab-to-slab, and each should be sealed top and bottom on the interior side. Where walls do not extend slab-to-slab, bulkheads will have to be installed to achieve the desired sealing characteristics. Porous block walls must be sealed. |
| Openings | Cable and duct penetrations into the area, joints where walls contact floors or other walls should be permanently sealed. |

| | |
|---|---|
| Enclosure Integrity | An Enclosure Integrity Test shall be performed on all protected enclosures.<br>A Door Fan Test is the accepted method to estimate worst-case room leakage and agent (concentration) hold time. The door fan calculation method makes it possible to predict the timeline for a descending interface to fall to a given height and estimate how long an extinguishing concentration will be maintained within the protected space.<br>Refer to NFPA Standard 2001, latest edition for additional information and door fan test procedures. |
| Auxiliary Functions | Operation of auxiliary functions such as door closures, damper closures, air handling shutdown, etc. should be verified when the control system is activated, both manually and automatically. |
| Caution/ Advisory Signs | Check to ensure that all signs are legible and free of damage. |

**Maintenance**

Certain aspects about the hazard may have changed, or been overlooked, which could affect overall system performance.

| Interval | Factor | Recommendation |
|---|---|---|
| 1 Year | The items described in System Checkout need to be re-checked during system maintenance. If hazard conditions indicate the inability to maintain agent concentration, a Door Fan Test needs to be performed: | |
| | Check Hazard Enclosure | The volume of the hazard enclosure(s) must be checked to determine if agent being supplied will protect the hazard properly.<br>If changes are found, the system needs to be recalculated. |

## SYSTEM COMPONENTS

**IMPORTANT NOTE:** Before starting system checkout or system maintenance, disable the system control panel releasing circuit.

## AGENT STORAGE CONTAINER & ACCESSORIES

**System Checkout**

| Factors to Consider | Recommendation |
|---|---|
| The items described in System Installation, covered in the Equipment Information Section, need to be re-checked during system checkout. | |
| Container Pressure | Pressure should read 360 PSIG at 70°F (24.8 bar at 21°C). For temperatures other than 70°F (21°C), reference Temperature vs. Pressure Chart on the Pressure Gauge Component Sheet in the Equipment Section of this manual. |
| Agent Weight | Amount of agent in the Container(s) must be verified by either weighing the container or by using a Liquid Level Indictor (LLi). This information should be recorded and affixed to the container so it can be used during container maintenance. |

| | |
|---|---|
| Low Pressure Switch | If used, check to ensure device is installed properly to container and wired properly to control panel. |
| Impulse Valve Operator (IVO) | Check to ensure the IVO circuit is free of trouble and ground fault conditions before installing the IVO to the container. |

**Maintenance**

**IMPORTANT NOTE:** These procedures do not preclude those required by NFPA 2001 and the authority having jurisdiction (AHJ).

| Interval | Factor | Recommendation |
|---|---|---|
| 3 Months | Check Container Pressure | The nominal pressure should be 360 PSIG at 70°F (24.8 bar @ 21°C); however, the pressure will vary with temperature. In the range of 50°F to 80°F (10°C to 27°C) the difference is approximately 2 psig (15 kPa) per degree. For temperatures other than 70°F (21°C), reference Temperature vs. Pressure Chart on the Pressure Gauge Component Sheet in the Equipment Section of this manual.<br>If the pressure loss indicated exceeds 10% of the nominal pressure, check the container for leaks and repair as necessary. |
| 6 Months | Verify Agent Weight | Verify the weight of the agent in each container matches the agent weight stamped on the label. If the weight indicates a shortage exceeding five percent of required weight, the container must be removed from service for repair and/or recharge.<br>If the container has a liquid level indicator installed, weight verification can be made without the need for cylinder removal. |
| 5 Years | Container Inspection | Containers shall not be recharged without a retest if more than five years have elapsed since the last test. The retest consists of a complete external and internal visual inspection in accordance with the Code of Federal Regulations, Title 49, Section 173.34(e)(10). The CFR requirements also refer to the Compressed Gas Association (CGA) Pamphlet C-6, Section 3.<br>Cylinders continuously in service without discharging shall receive a complete external [visual] inspection every five years. The cylinder does not need to be emptied for this inspection.<br>All visual inspections must be performed according to the regulations of CFR Title 49 and CGA Pamphlet C-6, Section 3. All inspections are to be done by CGA / DOT approved inspectors only. (Reference: NFPA No. 2001). |

**PIPE NETWORK System Checkout**

| Factors to Consider | Recommendation |
|---|---|
| Discharge Piping | Check to ensure Piping is installed according to the system design drawings. If not, system needs to be recalculated. |
| | Checked piping to see that it is securely supported and free from any lateral movement. All joints should be checked for mechanical tightness. Discharge piping shall be pressure tested in accordance with NFPA 2001, latest edition. |

| | |
|---|---|
| Discharge Pressure Switch | Check to ensure the Discharge Pressure Switch is installed and wired correctly. |
| Check Valves | If used, check to ensure the "Flow Arrow" is pointing in the correct direction. |

**Maintenance**

| Interval | Factor | Recommendation |
|---|---|---|
| 6 Months | Condition of Pipe | Check the system discharge piping for corrosion and damage. |
| | Pipe Supports | Check all piping supports to make sure they are tight and all piping is securely supported. |

## DISCHARGE NOZZLES

**System Checkout**

| Factors to Consider | Recommendation |
|---|---|
| Nozzle Part Number vs Location | Verify that the correct nozzle part number is installed at the proper location in accordance with the system plans. If the piping system was changed from the original system plans, make sure the nozzles were calculated using the "as installed" piping configuration. |
| | Check to ensure the nozzle(s) is aimed / positioned correctly. |
| Set Screws | Make sure all nozzle set screws are in place. |
| Nozzle Orifices | Check to see that nozzle orifices are clear and unobstructed. |

**Maintenance**

| Interval | Factor | Recommendation |
|---|---|---|
| 6 Months | The items described in System Checkout need to be re-checked during system maintenance. | |
| | Corrosion | Verify that the orifices are not showing signs of corrosion. |
| | Obstructions | Check all nozzle orifices for obstructions and make sure large objects have not been placed in front of the nozzles that would block the discharge. |

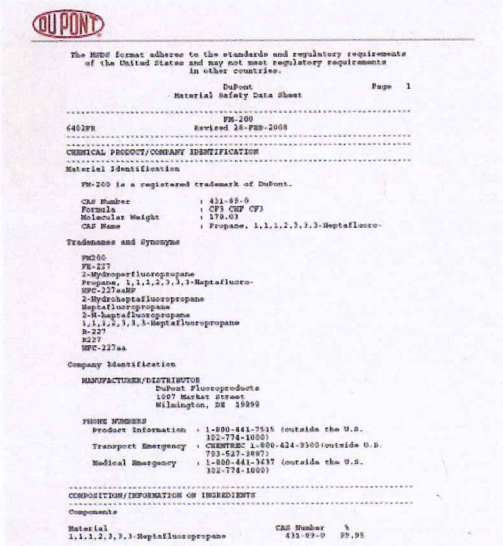
## DETECTION AND CONTROL SYSTEM

The information contained in this document **does not** cover service and maintenance procedures for the Detection and Control System (electrical portion). The electrical portion of the system must be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

**IMPORTANT NOTE:** Do not arm the NAFFCO Clean Agent Fire Suppression system before the Detection and Control System has been checked out and all circuits are free of trouble and ground fault conditions. If control panel checks out, install the Impulse Valve Operator (IVO) to the container(s).

## TABLE OF CONTENTS

MATERIAL SAFETY DATA SHEET – HFC-227ea AGENT (DUPONT FM-200)
MATERIAL SAFETY DATA SHEET – HFC-227ea AGENT (WAYSMOS USA)
MATERIAL SAFETY DATA SHEET – NITROGEN



DUPONT

The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.

DuPont Page 1
Material Safety Data Sheet

FM-200
6402PR Revised 26-FEB-2008

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

FM-200 is a registered trademark of DuPont.

CAS Number : 431-89-0
Formula : CF3 CHF CF3
Molecular Weight : 170.03
CAS Name : Propane, 1,1,1,2,3,3,3-Heptafluoro-

Tradenames and Synonyms

FM200
FE-227
2-Hydroperfluoropropane
Propane, 1,1,1,2,3,3,3-Heptafluoro-
HFC-227eaMF
2-Hydroheptafluoropropane
Heptafluoropropane
2-H-heptafluoropropane
1,1,1,2,3,3,3-Heptafluoropropane
R-227
H227
HFC-227ea

Company Identification

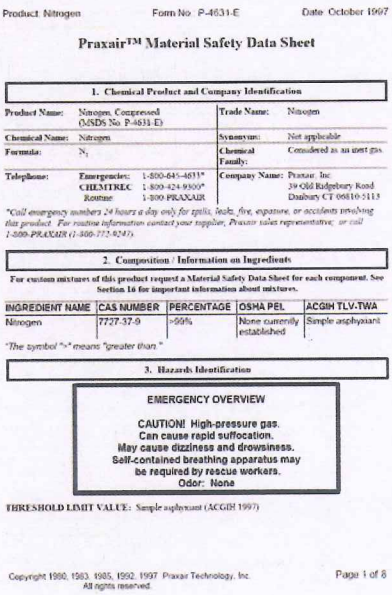
MANUFACTURER/DISTRIBUTOR
DuPont Fluoroproducts
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS
Product Information : 1-800-441-7515 (outside the U.S. 302-774-1000)
Transport Emergency : CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887)
Medical Emergency : 1-800-441-3637 (outside the U.S. 302-774-1000)

COMPOSITION/INFORMATION ON INGREDIENTS

Components

| Material | CAS Number | % |
|---|---|---|
| 1,1,1,2,3,3,3-Heptafluoropropane | 431-89-0 | 99.95 |



Product Nitrogen Form No P-4631-E Date October 1997

**Praxair™ Material Safety Data Sheet**

**1. Chemical Product and Company Identification**

| | | | | |
|---|---|---|---|---|
| Product Name: | Nitrogen, Compressed (MSDS No. P-4631-E) | | Trade Name: | Nitrogen |
| Chemical Name: | Nitrogen | | Synonyms: | Not applicable |
| Formula: | $N_2$ | | Chemical Family: | Considered as an inert gas |
| Telephone: | Emergencies: | 1-800-645-4633* | Company Name: | Praxair, Inc. |
| | CHEMTREC | 1-800-424-9300* | | 39 Old Ridgebury Road |
| | Routine | 1-800-PRAXAIR | | Danbury CT 06810-5113 |

*"Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247)."*

**2. Composition / Information on Ingredients**

For custom mixtures of this product request a Material Safety Data Sheet for each component. See Section 16 for important information about mixtures.

| INGREDIENT NAME | CAS NUMBER | PERCENTAGE | OSHA PEL | ACGIH TLV-TWA |
|---|---|---|---|---|
| Nitrogen | 7727-37-9 | >99% | None currently established | Simple asphyxiant |

*"The symbol ">" means "greater than."*

**3. Hazards Identification**

EMERGENCY OVERVIEW

CAUTION! High-pressure gas.
Can cause rapid suffocation.
May cause dizziness and drowsiness.
Self-contained breathing apparatus may be required by rescue workers.
Odor: None

THRESHOLD LIMIT VALUE: Simple asphyxiant (ACGIH 1997)

Copyright 1980, 1983, 1985, 1992, 1997 Praxair Technology, Inc.
All rights reserved.

Page 1 of 8

The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.



FM-200
6402FR Revised 28-FEB-2008

## CHEMICAL PRODUCT/COMPANY IDENTIFICATION

### Material Identification

FM-200 is a registered trademark of DuPont.

| | |
|---|---|
| CAS Number | : 431-89-0 |
| Formula | : CF3 CHF CF3 |
| Molecular Weight | : 170.03 |
| CAS Name | : Propane, 1,1,1,2,3,3,3-Heptafluoro- |

### Tradenames and Synonyms

FM200
FE-227
2-Hydroperfluoropropane
Propane, 1,1,1,2,3,3,3-Heptafluoro-
HFC-227eaHP
2-Hydroheptafluoropropane
Heptafluoropropane
2-H-heptafluoropropane
1,1,1,2,3,3,3-Heptafluoropropane
R-227
R227
HFC-227ea

### Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont Fluoroproducts
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS

| | |
|---|---|
| Product Information | : 1-800-441-7515 (outside the U.S. 302-774-1000) |
| Transport Emergency | : CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887) |
| Medical Emergency | : 1-800-441-3637 (outside the U.S. 302-774-1000) |

## COMPOSITION/INFORMATION ON INGREDIENTS

### Components

| Material | CAS Number | % |
|---|---|---|
| 1,1,1,2,3,3,3-Heptafluoropropane | 431-89-0 | 99.95 |

## HAZARDS IDENTIFICATION

### Potential Health Effects

Based on animal data, overexposure to FM-200 by inhalation may cause suffocation, if air is displaced by vapors, and irregular heart beat with a strange sensation in the chest, "heart thumping," apprehension, lightheadedness, feeling of fainting, dizziness, weakness, sometimes progressing to loss of consciousness and death.

FM-200 may cause frostbite if liquid or escaping vapor contacts the skin.

FM-200 may cause "frostbite-like" effects if the liquid or escaping vapors contact the eyes.

In one study, human volunteers were selected to inhale FM-200 at a concentration of 6000 ppm but the study was terminated due to a rise in pulse rate that was believed to be unrelated to the chemical. In a subsequent study with human volunteers inhaling concentrations up to 8000 ppm no clinically significant effects were observed for any of the measured laboratory parameters.

Individuals with preexisting diseases of the cardiovascular system or nervous system may have increased susceptibility from excessive exposures.

### Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

## FIRST AID MEASURES

### First Aid

**INHALATION**

If inhaled, immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**SKIN CONTACT**

Treat for frostbite if necessary by gently warming affected area.

**EYE CONTACT**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

(FIRST AID MEASURES - Continued)

INGESTION

Ingestion is not considered a potential route of exposure.

---

## FIRE FIGHTING MEASURES

---

### Flammable Properties

1,1,1,2,3,3,3-Heptafluoropropane is not flammable, however in the presence of a flame or ignition source it may decompose to form toxic hydrogen fluoride or carbonyl fluoride.

Non-flammable.

### Extinguishing Media

Use media appropriate for surrounding material.

### Fire Fighting Instructions

Self-contained breathing apparatus (SCBA) may be required if cylinders rupture or release under fire conditions.

Keep cylinders cool with water spray applied from a safe distance.

---

## ACCIDENTAL RELEASE MEASURES

---

### Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak - evacuate until gas has dispersed.

### Initial Containment

Use forced ventilation to disperse vapors.

## HANDLING AND STORAGE

### Handling (Personnel)

Do not breathe gas. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling. Wash clothing after use.

### Storage

Store in a clean, dry place. Store below 52 C (126 F).

## EXPOSURE CONTROLS/PERSONAL PROTECTION

### Engineering Controls

Use only with adequate ventilation. Keep container tightly closed.

### Personal Protective Equipment

**EYE/FACE PROTECTION**

Wear safety glasses or coverall chemical splash goggles.

**RESPIRATORS**

Wear NIOSH approved respiratory protection, as appropriate.

**PROTECTIVE CLOTHING**

Where there is potential for skin contact have available and wear as appropriate impervious gloves, apron, pants, and jacket.

### Exposure Guidelines

Exposure Limits
FM-200
AEL * (DuPont) : 1000 ppm, 8 & 12 Hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

## PHYSICAL AND CHEMICAL PROPERTIES

### Physical Data

| | |
|---|---|
| Boiling Point | : -16.4 C (2.5 F) |
| Melting Point | : -131 C (-204 F) |
| Vapor Pressure | : 65.7 psia @ 25 C (77 F) (453.3 kPa) |
| Liquid Density | : 1.386 g/cm3 @ 25 C (77 F) (86.53 lb/ft3) |
| Critical temperature | : 101.6 C (214.9 F) |
| Critical pressure | : 424.7 psia (2930 kPa) |
| Odor | : None. |

(PHYSICAL AND CHEMICAL PROPERTIES - Continued)

Form : Liquified Gas

---

## STABILITY AND REACTIVITY

---

### Chemical Stability

Stable at normal temperatures and storage conditions.

Avoid sources of heat or open flame.

### Incompatibility with Other Materials

Incompatible with strong reducing agents such as alkali metals (e.g., sodium, potassium), alkali-earth metals (e.g., magnesium, calcium), and powdered aluminum or zinc.

### Decomposition

Decomposes by reaction with high temperature (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid, carbonyl fluorides, carbon monoxide and carbon dioxide.

### Polymerization

Polymerization will not occur.

---

## TOXICOLOGICAL INFORMATION

---

### Animal Data

FM-200:

Inhalation 4 hour LC50: > 788,698 ppm in rats

Repeated exposure of rats by inhalation for 4 weeks at concentrations up to 50,000 ppm revealed no toxicologically significants effects. The NOEL for this study was 50,000 ppm. A 90-day inhalation study in rats did not find any exposure related effects at 105,000 ppm. The NOEL for this study was 105,000 ppm.

Cardiac sensitization, a potentially fatal disturbance of heart rhythm associated with a heightened sensitivity to the action of epinephrine, occurred in dogs at 105,000 ppm. The NOAEL for cardiac sensitization was 90,000 ppm. In a different study to evaluate cardiac sensitization in dogs, concentrations of 90,000, 105,000, and 140,000 ppm caused a dose-related increase in incidence and severity; at 90,000 ppm efffects were minimal or mild in nature.

Inhalation studies in rabbits and rats do not suggest developmental toxicity at concentrations up to

(TOXICOLOGICAL INFORMATION - Continued)

105,000 ppm. Tests have shown that FM-200 does not cause genetic damage in bacterial or mammalian cell cultures. Tests in animals for carcinogenicity or reproductive toxicity have not been conducted.

## DISPOSAL CONSIDERATIONS

Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Incinerate material in accordance with Federal, State/Provincial and Local requirements.

## TRANSPORTATION INFORMATION

Shipping Information

DOT

| | |
|---|---|
| Proper Shipping Name | : Heptafluoropropane |
| Hazard Class | : 2.2 |
| I.D. No. (UN/NA) | : UN 3296 |
| DOT Label(s) | : Nonflammable Gas |

## REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Listed.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

| | |
|---|---|
| Acute | : Yes |
| Chronic | : No |
| Fire | : No |
| Reactivity | : No |
| Pressure | : No |

## OTHER INFORMATION

NFPA, NPCA-HMIS

NFPA Rating

| | |
|---|---|
| Health | : 1 |
| Flammability | : 0 |
| Reactivity | : 1 |

NPCA-HMIS Rating

| | |
|---|---|
| Health | : 1 |
| Flammability | : 0 |

(Continued)

Reactivity : 0

Personal Protection rating to be supplied by user depending on use conditions.

---

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS : MSDS Coordinator
> : DuPont Fluoroproducts
Address : Wilmington, DE 19898
Telephone : (800) 441-7515

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience is gained.

End of MSDS

# MATERIAL SAFETY DATA SHEET

## HEPTAFLUOROPROPANE

### SECTION I – PRODUCT AND MANUFACTURER INFORMATION

| | |
|---|---|
| TRADE NAME / LABEL NAME | MH227 , HFC-227ea |
| CAS NUMBER | 431890 |
| CHEMICAL FAMILY | Halogenated alkane; Hydrofluorocarbon |
| CHEMICAL NAME | 1,1,1,2,3,3,3-Heptafluoropropane |
| SYNONYMS | 2H-Heptafluoropropane; HFC-227ea; |
| MANUFACTURER'S NAME | WAYSMOS USA |
| MANUFACTURER'S ADDRESS | 11709 Fruehauf Dr, Charlotte NC, 28273 |
| PHONE | 800-633-8253, If outside USA call +1 801-629-0667 |
| FACSIMILE | +86-21-58162299 |
| DATE OF PREPARATION | June 16, 2010 |
| PRODUCT USE | Fire/explosion extinguishing, suppression and prevention (inerting) agent for use in total flooding systems or portable extinguishers. **THIS PRODUCT IS NOT SUITABLE FOR USE AS AN ACTIVE PHARMACEUTICAL INGREDIENT, PHARMACEUTICAL EXCIPIENT OR DOSAGE AGENT.** |

### SECTION II – COMPOSITION AND INGREDIENT INFORMATION

| | |
|---|---|
| CHEMICAL NAME | 1,1,1,2,3,3,3-Heptafluoropropane |
| CAS Number | 431890 |
| % w/w | > 99.9 |
| OSHA PEL TWA $mg/m^3$ | Not established |
| OSHA PEL STEL $mg/m^3$ | Not established |
| OSHA PEL CEIL $mg/m^3$ | Not established |
| ACGIH TLV TWA $mg/m^3$ | Not established |
| ACGIH TLV STEL $mg/m^3$ | Not established |
| ACGIH TLV CEIL $mg/m^3$ | Not established |
| TOXICITY DATA | N/A |

[Remainder of page intentionally blank.]

## SECTION III – PHYSICAL AND CHEMICAL CHARACTERISTICS

| | |
|---|---|
| GENERAL | Colorless, odorless gas |
| BOILING POINT | -16.4°C / 3°F |
| VAPOR PRESSURE (@ 21°C / 70°F) | 58.8 psia |
| VAPOR DENSITY (AIR =1) | 6.04 |
| WATER REACTIVE | NO |
| SPECIFIC GRAVITY (H2O =1) | 1.46 |
| PERCENT VOLATILE (by volume) | N/A |
| EVAPORATION RATE (Butyl acetate = 1) | N/A |
| VISCOSITY (@ 20°C / 68°F) | N/A |
| MELTING POINT | -131°C / -204°F |
| WATER SOLUBILITY (v/v @ 20°C / 68°F) | 260 mg/L |

## SECTION IV – FIRE AND EXPLOSION HAZARDS

| | |
|---|---|
| FLASH POINT | N/A |
| FLAMMABLE LIMIT (in air; % by volume) | N/A |
| AUTO-IGNITION TEMPERATURE | N/A |
| EXTINGUISHING MEDIA | All are suitable. While product is non-flammable and extinguishes fires at sufficient concentration, can undergo thermal decomposition if involved in fires where quantity of product is insufficient to extinguish. Thermal decomposition products may be toxic or corrosive. |
| UNUSUAL FIRE AND EXPLOSION HAZARDS | Container rupture possible if pressure and temperature relief valves should fail. |
| SPECIAL FIRE FIGHTING PROCEDURES | Employ water spray from a safe distance to prevent container rupture. If containers should rupture, use self contained breathing apparatus. Product is non-flammable, but denser than air, posing asphyxiation risk. Thoroughly ventilate affected area to remove product and any decomposition products before allowing re-entry. |

## SECTION V – REACTIVITY DATA

| | |
|---|---|
| STABILITY | Stable |
| CONDITIONS TO AVOID | N/A |
| HAZARDOUS POLYMERIZATION | N/A |
| INCOMPATIBLE MATERIALS | Powdered metals such as aluminum, magnesium or zinc; strong alkaline agents; oxidizing agents' reducing agents. |
| HAZARDOUS DECOMPOSTION PRODUCTS | Thermal decomposition products may include hydrogen fluoride, carbon monoxide and carbon dioxide. |

## SECTION VI – HEALTH HAZARD DATA

| | |
|---|---|
| THRESHOLD LIMIT VALUE | N/A |
| POTENTIAL EXPOSURE ROUTES | Inhalation – Yes<br>Eye contact – Yes<br>Skin contact - Yes<br>Ingestion – No |
| SIGNS AND SYMPTOMS OF OVEREXPOSURE | Inhalation of excessive concentrations in air may induce symptoms of hypoxia (headache, nausea, dizziness, loss of consciousness) or cardiac sensitization (irregular pulse or arrhythmia). Product is a cryogenic gas.<br>Direct skin contact at point of release may cause symptoms of frostbite due to evaporative cooling (cold, white, discolored skin that, in severe cases, may exhibit blistering). |
| MEDICAL CONDITIONS POTENTIALLY AGGRAVATED BY EXPOSURE | Pre-existing cardiac, respiratory or CNS disorders may be exacerbated by |

| | |
|---|---|
| | overexposure. Epinephrine or sympathomemetic drugs may increase susceptibility to cardiac irregularities upon overexposure. |
| CARCINOGENICITY | NTP Program – No<br>IARC Monographs – No<br>OSHA – No<br>ACGIH – No<br>Other – No |
| MUTAGENICITY | S. typhimurium assay – No<br>Mouse lymphoma assay – No<br>Mouse micronuclei assay – No |
| LC50 | > c. 800,000 ppm |
| EMERGENCY AND FIRST AID PROCEDURES | Inhalation – Move to fresh air. Artificial respiration if not breathing. Administer oxygen if breathing is labored. Seek medical attention.<br><br>Eye contact – Flush/irrigate with fresh water. Seek medical attention.<br><br>Skin contact – Flush/irrigate (spray) with water. Apply sterile dressing as necessary.. Seek medical treatment for symptoms of frostbite.<br><br>Ingestion – N/A<br><br>***NOTE TO PHYSICIANS:***<br>In treating cases of overexposure through inhalation, use of epinephrine, sympathomemetics or other stimulants is contraindicated as such compounds increase susceptibility to cardiac sensitization (irregular pulse or arrhythmia). |

## SECTION VII – SPILL/LEAK PROCEDURES AND SPECIAL PRECAUTIONS

| | |
|---|---|
| HANDLING AND STORAGE PRECAUTIONS | Store in a cool, dry, well-ventilated area separate from incompatible materials. Protect containers from mechanical damage. Follow fire equipment manufacturer's instructions for operation, inspecti maintenance and repair of portable extinguishers and fixed extinguishing systems. |
| OTHER PRECAUTIONS | Prohibit backfeed into containers. |
| RELEASE OR SPILL PROCEDURES | Evacuate and ventilate the affected area. Prohibit general entry into areas where high concentrations may exist, particularly confined or poorly ventilated areas. Keep in mind that this product is denser than air and that concentrations will be higher at lower levels (sewers, basements or pits). Trained personnel should use self-contained breathing apparatus when entering areas where high concentrations may exist. |
| WASTE DISPOSAL | Product can be reclaimed unless contaminated. Contact distributor to arrange reclamation. Otherwise, disposal should be in accordance with applicable law, generally by incineration at a qualified facility with an appropriate scrubber and other emission control technology. |

## SECTION VIII – SPECIAL PROTECTION INFORMATION

| | |
|---|---|
| RESPIRATORY PROTECTION | NIOSH/MSHA approved self-contained breathing apparatus for entry into areas where high concentrations may exist. |
| VENTILATION | Passive ventilation (windows, doors, etc.) generally adequate for small areas. Mechanical ventilation for control of large areas and storage or filling facilities. |
| DERMAL PROTECTION | Lined, neoprene gloves for handling liquid product. |
| EYE PROTECTION | Shatterproof chemical splash goggles when handling liquid or working on pressurized containers. |
| OTHER PROTECTIVE EQUIPMENT | Clothing to minimize contact with liquid product or at potential points of release. |
| OTHER PROTECTIVE PRACTICES | Employ prudent confined space entry and related procedures (confirm equipment is free of product and has been ventilated, etc.). As with all chemical products, wash thoroughly after handling and wash contaminated clothing before re-use. |

## HAZARDOUS MATERIAL IDENTIFICATION SYSTEM RATINGS

| HEALTH = 1 | FLAMMABILITY = 0 | REACTIVITY = 0 |
|---|---|---|

*HAZARD INDEX:*

*0 = MINIMAL HAZARD, 1 = SLIGHT HAZARD, 2 = MODERATE HAZARD,*

*3 = SERIOUS HAZARD AND 4 = SEVERE HAZARD*

## SHIPPING INFORMATION – U.S. DOT GENERAL

| | |
|---|---|
| DOT SHIPPING NAME | HEPTAFLUOROPROPANE |
| DOT ID NUMBER | UN3296 |
| DOT HAZARD CLASS | 2.2 NON-FLAMMABLE, COMPRESSED GAS |
| PACKING GROUP | N/A |
| PACKAGING INSTRUCTIONS | 200 |
| SPECIAL PROVISIONS | T50 |
| NON-BULK PACKAGING | 304 |
| PASSENGER AIR/RAIL LIMIT | 75 kg/package |
| AIR CARGO LIMIT | 150 kg/package |
| VESSEL STOWAGE | A |
| REPORTABLE QUANTITY | None specified |
| LABEL | NON-FLAMMABLE GAS |
| PACKAGING EXCEPTIONS | 306 |
| BULK PACKAGING | 314/315 |
| OTHER STOWAGE | N/A |

| | |
|---|---|
| PROPER SHIPPING NAME | HEPTAFLUOROPROPANE |
| ID NUMBER | UN3296 |
| HAZARD CLASS | 2.2 NON-FLAMMABLE, COMPRESSED GAS |
| SUBSIDIARY RISK | N/A |
| PACKING GROUP | N/A |
| PACKAGING INSTRUCTIONS | 200 |
| PACKAGING INSTRUCTIONS – CARGO | 200 |
| SPECIAL PROVISIONS | N/A |
| AIR PASSENGER LIMIT | 75 kg/package |
| AIR CARGO LIMIT | 150 kg/package |
| LABEL | NON-FLAMMABLE GAS |

| | |
|---|---|
| PROPER SHIPPING NAME | HEPTAFLUOROPROPANE |
| ID NUMBER | UN3296 |
| HAZARD CLASS | 2.2 NON-FLAMMABLE, COMPRESSED GAS |
| SUBSIDIARY RISK | N/A |
| PACKING GROUP | N/A |
| MEDICAL/FIRST AID GUIDE | N/A |

# Praxair™ Material Safety Data Sheet

## 1. Chemical Product and Company Identification

| | | | | |
|---|---|---|---|---|
| **Product Name:** Nitrogen, Compressed (MSDS No. P-4631-E) | | | **Trade Name:** | Nitrogen |
| **Chemical Name:** Nitrogen | | | **Synonyms:** | Not applicable |
| **Formula:** | $N_2$ | | **Chemical Family:** | Considered as an inert gas. |
| **Telephone:** | **Emergencies:** | 1-800-645-4633* | **Company Name:** | Praxair, Inc. |
| | **CHEMTREC** | 1-800-424-9300* | | 39 Old Ridgebury Road |
| | Routine: | 1-800-PRAXAIR | | Danbury CT 06810-5113 |

**Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).*

## 2. Composition / Information on Ingredients

**For custom mixtures of this product request a Material Safety Data Sheet for each component. See Section 16 for important information about mixtures.**

| INGREDIENT NAME | CAS NUMBER | PERCENTAGE | OSHA PEL | ACGIH TLV-TWA |
|---|---|---|---|---|
| Nitrogen | 7727-37-9 | >99% | None currently-established | Simple asphyxiant |

**The symbol ">" means "greater than."*

## 3. Hazards Identification

**EMERGENCY OVERVIEW**

**CAUTION! High-pressure gas. Can cause rapid suffocation. May cause dizziness and drowsiness. Self-contained breathing apparatus may be required by rescue workers. Odor: None**

**THRESHOLD LIMIT VALUE:** Simple asphyxiant (ACGIH 1997)

Copyright 1980, 1983, 1985, 1992, 1997 Praxair Technology, Inc.
All rights reserved.

**EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:**

**INHALATION**–Asphyxiant. Effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill.
**SKIN CONTACT**–No harm expected.
**SWALLOWING**–This product is a gas at normal temperature and pressure.
**EYE CONTACT**–No harm expected.

**EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:** No harm expected.

**OTHER EFFECTS OF OVEREXPOSURE:** Nitrogen is an asphyxiant. Lack of oxygen can kill.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** The toxicology and the physical and chemical properties of nitrogen suggest that overexposure is unlikely to aggravate existing medical conditions.

**SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:** None known.

**CARCINOGENICITY:** Nitrogen is not listed by NTP, OSHA, or IARC.

## 4. First Aid Measures

**INHALATION:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician. **SKIN CONTACT:** Flush with water.

**SWALLOWING:** This product is a gas at normal temperature and pressure.

**EYE CONTACT:** Flush eyes with warm water. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly.

***NOTES TO PHYSICIAN:*** *There is no specific antidote. This product is nearly inert. Treatment of overexposure should be directed at the control of symptoms and the clinical condition. Refer to section 16.*

## 5. Fire Fighting Measures

| | | | | |
|---|---|---|---|---|
| **FLASH POINT (test method)** | Not applicable | **AUTOIGNITION TEMPERATURE** | Not applicable | |
| **FLAMMABLE LIMITS IN AIR, % by volume** | **LOWER** | Not applicable | **UPPER** | Not applicable |

**EXTINGUISHING MEDIA:** Nitrogen cannot catch fire. Use media appropriate for surrounding fire.

**SPECIAL FIRE FIGHTING PROCEDURES:**

**CAUTION! High-pressure gas.** Evacuate all personnel from danger area. Immediately deluge cylinders with water from maximum distance until cool, then move them away from fire area if without risk. Self-contained breathing apparatus may be required by rescue workers. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Nitrogen cannot catch fire. Heat of fire can build pressure in cylinder and cause it to rupture. No part of cylinder should be subjected to a temperature

higher than 125°F (52°C). Nitrogen cylinders are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.)

**HAZARDOUS COMBUSTION PRODUCTS:** None known.

## 6. Accidental Release Measures

**STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:**

**CAUTION! High-pressure gas.** Immediately evacuate all personnel from danger area. Nitrogen is an asphyxiant. Lack of oxygen can kill. Use self-contained breathing apparatus where needed. Shut off flow if you can do so without risk. Ventilate area or move cylinder to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces, before allowing reentry.

**WASTE DISPOSAL METHOD:** Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

## 7. Handling and Storage

**PRECAUTIONS TO BE TAKEN IN STORAGE:** Store and use with adequate ventilation. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

**PRECAUTIONS TO BE TAKEN IN HANDLING:** Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier. For other precautions in using nitrogen, see section 16.

For additional information on storage and handling, refer to Compressed Gas Association (CGA) pamphlet P-1, "Safe Handling of Compressed Gases in Containers," available from the CGA. Refer to section 16 for the address and phone number along with a list of other available publications.

## 8. Exposure Controls/Personal Protection

**VENTILATION/ENGINEERING CONTROLS:**

**LOCAL EXHAUST**–Use a local exhaust system, if necessary, to prevent oxygen deficiency.

**MECHANICAL (general)**–General exhaust ventilation may be acceptable if it can maintain an adequate supply of air. **SPECIAL**–None **OTHER**–None

**RESPIRATORY PROTECTION:** None required under normal use. However, air supplied respirators are required while working in confined spaces with this product. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

**SKIN PROTECTION:** Wear work gloves when handling cylinders.

**EYE PROTECTION:** Wear safety glasses when handling cylinders.

**OTHER PROTECTIVE EQUIPMENT:** Metatarsal shoes for cylinder handling. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

## 9. Physical and Chemical Properties

| | |
|---|---|
| **MOLECULAR WEIGHT:** 28.01 | **EXPANSION RATIO:** Not applicable |
| **SPECIFIC GRAVITY (air=1):** At 70°F (21.1°C) and 1 atm: 0.967 | **SOLUBILITY IN WATER**: % by wt:, vol/vol at 32°F (0°C): 0.023 |
| **GAS DENSITY:** At 70°F (21.1°C) and 1 atm:0.072 lbs/ft$^3$(1.153 kg/m$^3$) | **VAPOR PRESSURE:** AT 68°F (20°C): Notapplicable |
| **PERCENT VOLATILES BY VOLUME:** 100 | **EVAPORATION RATE (Butyl Acetate=1):** Gas, not applicable |
| **BOILING POINT (1 atm):** -320.4°F (-195.8°C) | **pH:** Not applicable |
| **MELTING POINT (1 atm):** -345.8°F (-209.9°C) | |

**APPEARANCE, ODOR, AND STATE:** Colorless, odorless, tasteless gas at normal temperature and pressure.

## 10. Stability and Reactivity

| | | | | |
|---|---|---|---|---|
| **STABILITY:** | **Unstable** | | **Stable** | **X** |

**INCOMPATIBILITY (materials to avoid):** None currently known. Nitrogen is chemically inert.

**HAZARDOUS DECOMPOSITION PRODUCTS:** None

| | | | | |
|---|---|---|---|---|
| **HAZARDOUS POLYMERIZATION:** | **May Occur** | | **Will Not Occur** | **X** |

**CONDITIONS TO AVOID:** Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium, and magnesium to form nitrides. At high temperature it can also combine with oxygen and hydrogen.

## 11. Toxicological Information

Nitrogen is a simple asphyxiant.

## 12. Ecological Information

No adverse ecological effects expected. Nitrogen does not contain any Class I or Class II ozone-depleting chemicals. Nitrogen is not listed as a marine pollutant by DOT.

## 13. Disposal Considerations

**WASTE DISPOSAL METHOD:** Do not attempt to dispose of residual or unused quantities. Return

cylinder to supplier. For emergency disposal, secure cylinder in a well-ventilated area or outdoors, then slowly discharge gas to the atmosphere.

## 14. Transport Information

| | |
|---|---|
| **DOT/IMO SHIPPING NAME:** Nitrogen, compressed | **HAZARD CLASS:** 2.2 |
| **IDENTIFICATION NUMBER:** UN 1066 | **PRODUCT RQ:** Not applicable |
| **SHIPPING LABEL(s):** NONFLAMMABLE GAS | **PLACARD (When required):** NONFLAMMABLE GAS |

**SPECIAL SHIPPING INFORMATION:** Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of

## 15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

**U.S. FEDERAL REGULATIONS:**

**EPA (Environmental Protection Agency)**

**CERCLA:** Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (40 CFR Parts 117 and 302):

**Reportable Quantity (RQ):** None

**SARA:** Superfund Amendment and Reauthorization Act:
**SECTIONS 302/304:** Require emergency planning based on Threshold Planning Quantity

- (TPQ) and release reporting based on Reportable Quantities (RQ) of extremely hazardous substances (40 CFR Part 355):

**Threshold Planning Quantity (TPQ):** None.
**Extremely Hazardous Substances (40 CFR 355):** None.

- **SECTIONS 311/312:** Require submission of Material Safety Data Sheets (MSDSs) and chemical inventory reporting with identification of EPA hazard categories. The hazard categories for this products are as follows: IMMEDIATE: No PRESSURE: Yes
  DELAYED: No REACTIVITY: No
  FIRE: No

- **SECTION 313:** Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

  Nitrogen does not require reporting under Section 313.

**40 CFR 68:** Risk Management Program for Chemical Accidental Release Prevention: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Nitrogen is not listed as a regulated substance.

**TSCA:** Toxic Substances Control Act: Nitrogen is listed on the TSCA inventory.

**OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION):**

**29 CFR 1910.119 :** Process Safety Management of Highly Hazardous Chemicals: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Nitrogen is not listed in Appendix A as a highly hazardous chemical.

**STATE REGULATIONS:**

**CALIFORNIA:** This product is not listed by California under the Safe Drinking Water Toxic Enforcement Act of 1986 (Proposition 65).

**PENNSYLVANIA:** This product is subject to the Pennsylvania Worker and Community Right-To-Know Act (35 P.S. Sections 7301-7320).

## 16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

**OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE:** ***High-pressure gas.*** Use piping and equipment adequately designed to withstand pressures to be encountered. Never work on a pressurized system. ***Gas can cause rapid suffocation due to oxygen deficiency.*** Store and use with adequate ventilation. Close valve after each use; keep closed even when empty. ***Prevent reverse flow.*** Reverse flow into cylinder may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder. ***Never work on a pressurized system.*** If there is a leak, close the cylinder valve. Blow the system down in a safe and environmentally sound manner in compliance with all federal, state and local laws; then repair the leak. ***Never ground a compressed gas cylinder or allow it to become part of an electrical circuit.***

**MIXTURES:** When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist, or other trained person when you evaluate the end product.

**HAZARD RATING SYSTEMS:**

| **NFPA RATINGS:** | | **HMIS RATINGS:** | |
|---|---|---|---|
| HEALTH | = 0 | HEALTH | = 0 |
| FLAMMABILITY = 0 | | FLAMMABILITY = 0 | |
| REACTIVITY | = 0 | REACTIVITY | = 0 |

SPECIAL SA (CGA recommends this rating to designate Simple Asphyxiant.)

**STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:**

| | | |
|---|---|---|
| **THREADED**: | 0-3000 psig | CGA-580 |
| | 3001-5500 psig | CGA-680 |
| | 5001-7500 psig | CGA-677 |
| **PIN-INDEXED YOKE:** | 0-3000 psig | CGA-960 (Medical |
| Use) **ULTRA-HIGH-INTEGRITY CONNECTION:** | 0-3000 psig | CGA-718 |

Use the proper CGA connections. **DO NOT USE ADAPTERS.**

Ask your supplier about free Praxair safety literature as referenced on the label for this product; you may also obtain copies by calling 1-800-PRAXAIR. Further information about nitrogen can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Arlington, VA 22202-4102, Telephone (703) 412-0900. G-10.1 *Commodity Specification for Nitrogen*

P-1 *Safe Handling of Compressed Gases in Containers*
P-9 *Inert Gases— Argon, Nitrogen, and Helium*
P-14 *Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres*
SB-2 *Oxygen-Deficient Atmospheres*
AV-1 *Safe Handling and Storage of Compressed Gases*
V-1 *Compressed Gas Cylinder Valve Inlet and Outlet Connections*
*Handbook of Compressed Gases, Third Edition*

Praxair asks users of this product to study this Material Safety Data Sheet (MSDS) and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents and contractors of the information on this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

suppliers who package and sell our products. To obtain current Praxair MSDSs for these products, Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14150-7891).

Praxair is a trademark of Praxair Technology, Inc.

Praxair, Inc.
39 Old Ridgebury Road Danbury CT 06810-5113

PRAXAIR

Printed in USA

*This page intentionally left blank*

NAFFCO FZCO
WORLD HEAD QUARTERS
DUBAI, United Arab Emirates
Email: info@naffco.com
www.naffco.com

## Technical Specification For Water And Sludge Vacuum Tanker Vehicle

### 1.0 – GENERAL:

a. This specification describes a truck mounted Flooded water/clean water and sludge vacuum tanker ideally designed to offer effective and user-friendly solution for Town/City Solid Waste Management with a vacuum tank capacity of useable not less then 9000 Ltrs made of mild steel sheets fitted with a High-Capacity Vacuum Pump and mounted on truck.

b. The Flooded water/clean water and Sludge Vacuum Tanker should be built on atleast 18-ton GVW Truck (IZUSO/FAW or equivelant) classified as a medium weight class vehicle with minimum horsepower of 210 PS @ 2600 RPM with an engine displacement of minimum 5193 cc

### 1.1 – Quality Standards

General: The engineering and construction of the Flooded water/clean water and Sludge Vacuum Tanker must be conducted in an environment that follows procedures of the following standards of ISO 9001, ISO 14001, and ISO 45001

### 2.0 – WEIGHTS

### 2.1 – Permissible weight:

a. Gross Vehicle (GVW): ≥18,000 kg.
b. Front Axle (FAW): ≥6000 kg.
c. Rear Axle: ≥12000 kg.

The weights of the vehicle offered will be verified from Engineering Development Board, Pakistan certificate issued to manufacturer of the chassis.

### 3.0 – ENGINE:

The engine for the vacuum tanker must be a water cooled 4-cylinder diesel engine installed with turbo and an intercooler with the engine emissions of Euro-2. The engine must be a Common Rail Direct Injection with electronic unit injection pumps. Single block head, four valves per cylinder, light alloy pistons with a total displacement of 5193 cc minimum giving an output of 210 PS @ 2600 RPM and minimum torque output of 706 nm @ 1600 RPM.

### 4.0 – SUSPENSION:

Front: Semi-elliptical alloy steel leaf springs shackle type with hydraulic double acting telescopic shock absorber

Rear: Semi-elliptical alloy steel leaf springs

### 5.0 – TIRES:

Front and rear tires should be suitable for road driving conditions.
1 x Spare tire to be provided loose.

Tire size: 11.00 x 20 - 16 PR with 10 studs

**6.0 – BRAKES:**

Service: Air over hydraulic brake

Parking: Drum brake

Auxiliary: Exhaust brake with pneumatic control

**7.0 – ELECTRICAL SYSTEM:**

Voltage: 24 V Alternator generator 50 A.
Starter motor: 24 V

**8.0 – Fuel Tank:** 200 Liters

**10.0 – DRIVER CABIN**

Standard Cab with built in galvanized pressed steel with manual tilting up to 60°. Manual doors roll down windows. Mechanical rear view mirrors, wide angle mirrors. 2-way manually adjustable driver seat with seat belt. Mechanical passenger seat with seat belt. The cab should be adequately insulated against noise, vibration, and extreme temperatures.

Additional details are required as under,

| | |
|---|---|
| Drive: | RHD |
| Seating: | 1+2 |
| Doors: | Two lockable doors, with roll-down windows |
| Dashboard: | The dashboard is equipped with all necessary gauges, pilot lamps and switches for operation of the truck chassis |
| Controls: | * Control and pilot lamp PTO engaged<br>* Control including pilot lamp for rotating beacons |
| Other: | All necessary Mirrors must be provided |

**11.0 – SUPERTRUCTURE BODY WORK & EQUIPMENT:**

**11.1 – Tank:**

The vacuum tank of the vehicle must be constructed with mild steel sheet of 6 mm thickness with cross section baffle on the inside and reinforced channels in the middle section and the tailgate to prevent collapsing. The Tank body will be designed and fabricated to with stand an external pressure of 1 Bar and internal pressure of 2 Bar. 3 sight glasses will be provided at the rear dish end of the

tank to alert the operator when the tank is almost full.The vacuum tank must be hinged to a 6 mm thick subframe. Welding must be according ASME Section 9 and fabrication as per ASME Section 8, shot blasting as per SA 2.5 inside and outside with 02 (two) coats of black coltar epoxy 100 to 150 microns on the inside and the outside 01 (one) coat of red oxide epoxy.

| | |
|---|---|
| Capacity: | Minimum 9000 liters [useable] |
| Welding Type: | Electric welding SMAW type |
| Dish End: | 6 to 7 mm thickness welded on the side facing the driver cabin with fabrication as per ASME section 8 and welding as per ASME section 9. |
| Tailgate: | The rear dish end will be hinged spherical dish end door to the main tank to discharge tank's contents fitted with one suction valve of 4" and one discharge valve of 4". The dish end is fitted with hydraulic locking system and rear hydraulic opening and closing mechanism with 2 double acting hydraulic cylinders. |
| Construction Design: | Cylindrical shape |
| Relief Valves | Adjustable vacuum relief valve to avoid tank from over vacuum and fix pressure relief valve for positive displacement of air |
| Pressure Gauge | Compound gauge for both negative and positive reading (Italy, UK, USA). |
| Suction Line Filter | To provide Vacuum pump air free of water vapors and other particles. |
| Combination Valve | Built in system |
| Primary Shutoff: | The leaf spring primary shutoff is to be welded to the tank, where the vacuum line starts. The primary shutoff is to be equipped with an "overflow" system with a stainless-steel floating ball. |
| Secondary Protection: | secondary cut off for protection of vacuum pump in case first does not work. The vertical secondary shutoff is to be installed in correspondence of the vacuum line of a decompressor designed for the creation of vacuum inside a tank. The vertical secondary shutoff is to be made of mild steel and the internal floating ball is to be made of stainless steel 316. |

| | |
|---|---|
| Tank Tipping: | Located at the front of the tank with a pressure compensated hydraulic telescopic cylinder and tank pivoted at the rear end. |
| Level Gauge: | 3 (three) glass level indicator is fitted on the tailgate. |

**11.2 – Vacuum Pump:**

a. The pump of vacuum vehicle must be an air-cooled sliding vanes pump with automatic oil lubrication of the moving parts with a piston pump driven by the rotor with an independent oil tank of 11 liters. The cooling should be obtained by forced circulation with external pump, circulating pump flow rate of 50 l/min with built-in vacuum pressure change over valve and should be able to give maximum volume of 13,000 liters/min with a maximum absolute pressure of 2 bar and volume at 60% vacuum 9,000 L/min with working pressure of 1 bar with 1300 RPM. The pump shall have maximum absolute (Relative Pressure) 2.5 Bar, Maximum Vacuum without Depression Valve -0.95 Bar, Maximum Vacuum with Depression Valve -0.82 Bar, Cooling System Air Cooled Lubrication System Built In, Lubrication Oil SAW 20 ISO 20/ISO 68 mineral, Driven PTO or Auxiliary Engine.

b. The vacuum pump shall be capable of achieving a minimum suction and discharge performance sufficient to fill a 9,000-liter capacity tank within a maximum time of 5 to 7 minutes under normal operating conditions. The pump shall be designed to maintain required vacuum pressure, flow rate, and efficiency throughout the operation without overheating or loss of performance.

**11.3 – Operation Controls:**

* Hydraulic distributor valve for hydraulic operations and vacuum pump operations
* Semi proportional 3-spool hydraulic control assembly to control the tank tipping function, the tailgate operations and tailgate locking/unlocking mechanism.
* Manual lever built-in the pump for selecting vacuum operation or ejection operations.

**11.4 – Safety Equipment:**

The vacuum tanker must be equipped with the following safety features:

* Vacuum relief valve on primary protection to secondary protection line
* Safety valve for water drainage before the pump.

**11.5 – Hydraulic Oil Tank:**

Hydraulic tank capacity must be 70 liters with the following components.

- Air breather
- Level gauge with temperature check

## 12.0 – ELECTRIC INSTALLATION

Work Lighting: 2 x work lighting [one installed at the rear of the vehicle, and one installed at the pump side]

## 13.0 – PAINTING:

Cab and superstructure: White or as per TPC approved
Frame: black acc. to truck manufacturer standard
Type plates: For GVW, chassis number, pump etc.

## 14.0 – DOCUMENTATION:

Operation and primary maintenance manual in English
Operation manual: [1] operation manual(s) will be provided in English language.

Spare parts catalogues: Spare parts list in English
[1] set(s) of spare parts catalogues will be provided in English language.

Electric wiring diagram
[1] set(s) of electric wiring diagrams will be provided.

Pneumatic connection diagram
Pneumatic diagram: [1] pneumatic piping diagram(s) will be provided.

Water piping diagram
[1] water piping diagram(s) will be provided.

## 15.0 – ACCESSORIES:

Following Accessories will be provided with each vehicle:

| S. No. | Description | Qty |
|---|---|---|
| 1. | Tool Kit | 01 No. |
| 4. | Fire Extinguisher 1 Kg | 01 No. |
| 5. | Spare Wheel Suitably Placed | 01 No. |

**16.0 – Warranty:**
warranted for one year against manufacturing defects and bad workmanship and standared warranty for vehicle.
**17.0 – Approval:** rior approval from TPC is required before proceeding with the vehicle purchase.

**Technical Specifications for Fully Automatic Auto-Prime solid handling dewatering pump sets (Non-clogging) Centrifugal Pump (Municipal Pump)**

## 1.0 General

a) This specification covers the supply of Auto self-priming, non-clogging centrifugal dewatering pump with pump with capacity not less than 2500 GPM, size 6”x6” (150mm x 150 mm) and maximum is discharging head is 40 meter and suction head is not less than 15 meter suitable for continuous operation in industrial construction, municipal, and general dewatering applications.

b) The pumps shall incorporate fully automatic compressor priming facility.

c) The pump shall be capable of handling water containing solids up to 76 mm (3 inches) in diameter, including trash and abrasive particles typically encountered in dewatering operations.

d) The pump shall be offered with complete drive arrangements as specified in the tender document, which includes trolly mounted diesel engine driven pump.

## 2.0 Pumps and Engine Technical Specifications

a) 77mm solid handling capacity
b) Standard construction with SG iron casting
c) SS316 impeller (255mm Diameter impeller) and wear plates
d) SS431 Shaft, fitted with oil cooled mechanical seal of silicon carbide
e) capable of running dry for extended periods incorporating fully automatic compressor priming facility.
f) Suction/ Discharge connections 150mm x 150mm respectively (with
g) Bauer quick connect couplers) close coupled with water cooled diesel
h) It shall be water cooled diesel engine (Perkins, Cummins or equivalent) having power not less than 60 hp with RPM up to 1500, skid-mounted with fuel tank minimum capacity of 10 hours operation, control panel and battery. Electric start with battery and engine control panel with shut down, protection against high engine RPM, Low oil pressure, high temperature complete with emergency stop complete with All safeties for engine and pumps and compressor. Engine protection against overload, high temperature, and low oil pressure. Automatic shutdown system for critical faults. Instrumentation: pressure gauges (suction/discharge), tachometer, hour meter, fuel level indicator.
i) Ambient temperature/Atmosphere Max 60oC Tropical (Hot & Humid).
j) Relative humidity Max 100%.
k) All mounted on a common fabricated steel base with single axle trailer
l) complete with Two jack stands.
m) Towing and minimum 10 hours fuel tank
n) The Capacity of Pump shall be not less then 2500 GPM at variable engine speed.
o) Minium Head 42 Meter.
p) Each unit shall be supplied with 10m x6” reinforced rubber suction hose or as per TPC approved requirement; and
q) 33m x 6” discharge PVC lay flat type hose complete with quick bauer type couplings.
r) Vibration isolators, Mechanical seal replaceable.
s) Pressure gauges suction/discharge
t) Flexible connector if required

u) Wear ring replaceable

**3.0 Pre-Shipment Inspection included to verify following:**

Third Party Inspection from International Reputable Firm (SGS, TUV, Bureau Veritas or equivalent).

**4.0 Warranty**

The self-priming centrifugal pump shall have one-year warranty from the date of commissioning, covering all parts and servicing.

# AGREEMENT

(General Condition of Contract)

# FOR

# OPERATION AND MAINTENANCE SERVICES OF GENERATORS AND ALLIED SERVICES IN PESHAWAR BRT SYSTEM

between

**TransPeshawar Company**

and

**[SERVICE PROVIDER]**

Date: XX.XX. 2025

## CONTENTS


PART A - GENERAL ..... 1
1. Preliminary Matters ..... 1
2. Appointment of Service Provider ..... 2
3. Performance Guarantee ..... 2
4. Parent Company Guarantee ..... 3
5. Payment for Services ..... 3
6. Tax ..... 3
**PART B - THE EQUIPMENTS ..... 3**
7. The Equipment ..... 3
8. Delivery, Care and Ownership of the Equipment ..... 4
**PART C - SERVICE PROVIDER RESPONSIBILITIES ..... 4**
9. General Obligations – Equipment and Operations ..... 4
10. Operations and Maintenance of the Equipment ..... 6
11. Operating Licenses ..... 7
12. Technical Staff ..... 7
13. Co-operation with Other Contractors ..... 7
14. Uniforms ..... 8
15. Monitoring of the Services ..... 8
16. Provision of Financial Information ..... 8
17. Incident Reporting ..... 9
18. Other responsibilities ..... 9
**PART D - MAINTENANCE OF EQUIPMENT ..... 9**
19. General Obligations ..... 9
20. Maintenance ..... 9
21. Reserve Fund ..... 10
22. Spare Parts ..... 11
23. Tools and equipment ..... 11
**PART E - AUTHORISED REPRESENTATIVES, PROTOCOLS AND SERVICES NOTICES ..11**
24. Authorized Representative ..... 11
25. Service Notices, Protocols and Amendments ..... 11
**PART F – LIQUIDATED DAMAGES ..... 11**

26. Liquidated Damages....11
**PART G – WARRANTIES AND CHANGE IN OWNERSHIP....12**
27. Warranties, Undertakings and Indemnities....12
**PART H - FORCE MAJEURE, NECESSARY ACTION, BREACH, TERMINATION AND DISPUTE RESOLUTION....14**
28. Force Majeure....14
29. Breach and Termination....16
30. Dispute resolution....17
**PART I - MISCELLANEOUS MATTERS....18**
31. Hazardous Substances....18
32. Intellectual Property....18
33. Insurance....19
34. Restricted Companies....19
**PART J - FINAL PROVISIONS....19**
35. Addresses and notices....19
36. Change in Law....20
37. Remedies....21
38. Confidentiality....21
39. Severance....21
40. No agency....21
41. Corruption and Fraud....21
42. Entire Agreement....22
43. No stipulation for the benefit of a third person....22
44. No representations....22
45. Amendment....22
46. Indulgences....22
47. General co-operation....22
48. Governing law....23
49. Language....23
50. Independent advice....23
51. Good faith....23
52. Survival of rights, duties and obligations....23
53. Assignment....23

54. Waiver ..... 23
55. Costs ..... 24
ANNEX A ..... 25
DEFINITIONS AND INTERPRETATION ..... 25
1. Definitions ..... 26
2. Interpretation ..... 31
**Appendix-I to Particular Condition of the Contract .....** Error! Bookmark not defined.
**PAYMENT CALCULATION SCHEDULE .....** Error! Bookmark not defined.

**THIS OPERATION AND MAINTENANCE SERVCIES OF GENERATORS AND ALLIED SERVICES IN PESHAWAR BRT SYSTEM AGREEMENT** (the "**Agreement**") is made on [••••••••••] 2025

**BETWEEN**

1. **TRANSPESHAWAR (THE URBAN MOBILITY COMPANY)**, a company incorporated with Security Exchange Commission of Pakistan on February 09, 2017 with company registration no.0105691 and whose registered address is at KPUMA Building, Chamkani, GT Road, Peshawar, KPK, Pakistan ("**TPC**"); and

2. <***Insert name of the Company***>, a company incorporated in [••••••••••••], with company registration no. [•••••••••] and whose registered address is at [••••••••••••] (the "**Service Provider**").

TPC and the Service Provider are individually referred to herein as a "**Party**" and collectively as the "**Parties**".

**WHEREAS:**

A. TPC is a corporate entity established by the Government of Khyber Pakhtunkhwa, Pakistan responsible for design, procurement, implementation and ongoing BRT operations in the Peshawar BRT System.

B. TPC intends to enter into long-term agreements based on output based or performance-based parameter with suitable Service Provider (selected through a competitive bidding process) who will provide operation and maintenance services of Generators and Allied Services in PPeshawar BRT as part of the Project.

C. The Service Provider is a special purpose company which has been set up for the purpose of entering into and performing this Agreement.

D. TPC wishes to appoint the Service Provider on a non-exclusive basis to provide the Services and the Service Provider wishes to accept such appointment and carry out the Services, in accordance with the terms and conditions of this Agreement.

**NOW THE AGREEMENT PROVIDES THE FOLLOWING GENERAL CONDITIONS OF CONTRACT:**

## PART A - GENERAL

### 1. Preliminary Matters

1.1 Definitions and Interpretation

1.1.1 The defined words and expressions set out in Clause 1 of Annex A [*Definitions and Interpretation*] hereof and the provisions relating to the construction and interpretation of the Agreement set out in Clause 2 of Annex A [*Definitions and Interpretation*] hereof shall apply to the Agreement.

1.1.2 In the event of any inconsistency between the provisions of the body of this Agreement and the Annexes, or between any of the Annexes, the conflict shall be resolved according to the following descending order of priority:

a) the body of this Agreement, including Annex A and Particular Condition;

b) Annex B [Letter of Award];

c) Annex C [Schedule of Requirements];

d) Annex D [Performance Guarantee];

e) Annex E [Request for Proposal and Proposal of Service Provider],

f) Annex F [Parent Company Guarantee];

g) Annex G [Integrity Pact]

1.2 Effect of this Agreement

1.3 The Parties hereby agree that this Agreement shall immediately be binding on them as of the Effective Date.

1.4 Conditions Precedent

1.5 TPC shall issue a Service Notice to Service Provider indicating the date upon which the Services are to commence subject to the following conditions precedent are met: -

1.5.1 Incorporation of Special purpose Vehicle;

1.5.2 Performance Guarantee;

1.5.3 Parent Company Guarantee; and

1.5.4 Signing of Agreement.

**2. Appointment of Service Provider**

2.1 Appointment

2.1.1 TPC's signing this Agreement shall indicate its appointment of the Service Provider to provide the Services. Such appointment shall only be effective as of the Effective Date.

2.1.2 The Service Provider hereby accepts the appointment by TPC and agrees to provide the Services in accordance with the terms and conditions of this Agreement.

2.2 Commencement of the Services and Term

2.2.1 The Service Provider shall provide the Services from the Commencement Date until the Termination Date.

2.2.2 Unless this Agreement is earlier terminated, the Service Provider shall continuously provide the Services contemplated under this Agreement (as may be amended pursuant to its terms) for a term as mentioned in Particular Condition **(PC**) commencing from the Commencement Date. After initial term, Agreement may be extended subject to satisfactory performance and approval of TPC for a period as mentioned in **PC**.

**3. Performance Guarantee**

3.1 The Service Provider shall ensure that it maintains with TPC a valid and enforceable Performance Guarantee until the Service Provider has fulfilled all its obligations under the Agreement. The Service Provider shall have delivered to TPC as a Condition Precedent the duly executed Performance Guarantee in the specified form and in the amount as mentioned as **PC**. The Performance Guarantee shall have a term of one (01) year and shall be renewed or replaced and delivered to TPC no later than thirty (30) days before its expiry. TPC shall return the previously provided Performance Guarantee to the Service Provider within fourteen (14) days of the receipt of the replacement of Performance Guarantee.

3.2 Subsequent to the delivery of the initial Performance Guarantee, the Service Provider shall thereafter ensure that the amount of the renewed or replacement Performance Guarantee is of amount mentioned in **PC**.

3.3 The Performance Guaranteed shall be issued in format as mentioned in **PC**.

3.4 If the Service Provider fails to provide TPC with a replacement Performance Guarantee as required under this Agreement, TPC may (without prejudice to its other remedies) immediately liquidate all or part of the Performance Guarantee.

3.5 If the Performance Guarantee is partially liquidated, the Service Provider is obliged to replenish the Performance Guarantee in full within seven (7) days of the date of any liquidation thereof. If the Service Provider fails to replenish the Performance Guarantee in accordance with this clause, this shall constitute a material breach of this Agreement and TPC shall be entitled to liquidate the remainder of the Performance Guarantee and terminate this Agreement pursuant to clause 29.

3.6 Subject to the fulfillment by the Service Provider of all of its obligations under this Agreement, the Performance Guarantee shall be released by TPC within thirty (30) days after the Termination Date.

3.7 All fees, taxes and expenses associated with preparing, providing, issuing, extending, replacing, replenishing or stamping (if applicable) of the Performance Guarantee shall be borne by the Service Provider.

**4. Parent Company Guarantee**

4.1 In the event that the Service Provider is a branch, subsidiary, affiliate or otherwise of a Parent Company, then the Service Provider shall, at its own expense, procure a Parent Company Guarantee for the benefit of TPC from its Parent Company as given in **PC**.

4.2 In the event that the Service Provider is a joint venture, partnership, consortium or other association of two or more entities or persons and any member of the Service Provider is a branch, subsidiary, affiliate or otherwise of a Parent Company, then each such member shall, at its own expense, procure a Parent Company Guarantee for the benefit of the Authority from its Parent Company.

**5. Payment for Services**

5.1 Payment to the Service Provider for the provision of the Services shall be made in accordance with procedure mentioned in **PC**.

5.2 TPC shall be entitled to adjust any amount in upcoming payment which are due to either Party.

4.3 Any payment to the Service Provider shall not constitute a waiver of any right held by TPC in respect of a breach of this Agreement by the Service Provider.

**6. Tax**

6.1 To the extent that the Services or any additional activities and/or services offered by the Service Provider pursuant to this Agreement are taxable, the Service Provider agrees to bear all Applicable taxes, charges, duties and/or tariffs by itself and, upon request from TPC, provide proof that such obligations have been satisfied in full. Sales Tax on Services, if any, shall be paid by Party as mentioned in **PC**.

6.2 Withholding of all taxes will be made as per applicable law. Services exempt from withholding of taxes, the Service Provider shall at all times be in possession of a valid tax exemption certificate and shall provide the same to TPC along with each invoice / bill for payment. In case the services are exempt from sales tax, the service provider shall furnish a valid reference of exemption from the applicable tax law.

6.3 TPC may cease all payments to the Service Provider in respect of any period during which the Service Provider is not in compliance with the provisions of clauses 6.1 and 6.2 above. Upon such compliance by the Service Provider, TPC shall effect payment of all amounts that had been withheld pursuant to this clause.

**PART B - THE EQUIPMENTS**

**7. The Equipment/ Systems**

7.1 TPC shall hand over Equipment as mentioned in SOR to Service Provider for Operation and Maintenance. Equipment is defined in SOR and **PC**.

7.2 The Equipment shall be handed over to the Service Provider at locations with details given in Schedule of Requirement (SOR) within duration as mentioned in **PC** from date of Commencement.

7.3 For the duration of this Agreement, unless agreed otherwise in writing by the Parties, the Service Provider shall use the Equipment solely for the provision of the Services in accordance with this Agreement.

7.4 Legal title to and ownership of the Equipment (including all associated tools and equipment) shall remain with TPC.

7.5 The Service Provider shall not create or allow the creation of any Encumbrance in any manner of any or all of the Equipment without the prior written consent of TPC.

7.6 TPC shall not hold Service Provider responsible to provide services outside the capability of the Equipment furnished, installed and commissioned unless mentioned in SOR.

**8. Delivery, Care and Ownership of the Equipment**

8.1 TPC shall handover the Equipment allocated to the Service Provider on the relevant Dates as mentioned in **PC** and the Service Provider shall be obliged to accept such handover in accordance with this Agreement.

8.2 The Equipment shall be properly maintained by the Service Provider in accordance with the manufacturer's standards and/or requirements.

8.3 TPC shall be entitled to conduct unscheduled inspections of each Equipment to ensure that it continues to be in compliance with the Schedule of Requirements and in satisfactory operational condition (fair wear and tear excluded). If any Equipment is found not to be in compliance with the SOR or in unsatisfactory condition, TPC shall immediately inform the Service Provider and the Service Provider shall, within a reasonable time or a time determined by TPC, effect the required repairs/replacement at its own cost.

8.4 If an Equipment requires repair/replacement and is not so repaired/replaced by the Service Provider within a reasonable time or the time determined by TPC, TPC shall be entitled to either liquidate a part or all of the Performance Guarantee for purposes of effecting such repairs/replacement for purposes of effecting such repairs/replacement or deduct from Reserve Fund.

**PART C - SERVICE PROVIDER RESPONSIBILITIES**

**9. General Obligations – Equipment and Operations**

9.1 The Service Provider shall abide by all the terms, rules and regulations in accordance with this Agreement (including the SOR) and the Applicable Law.

9.2 The Service Provider shall employ and engage trained and skilled staff (within 07 days of the award of contract) reasonably required to complete the duties of this contract to the satisfaction of TPC.

9.3 The Service Provider shall provide the list of Service provider's personnel working on stations/TPC office, along with their basic information, to TPC for issuance of permit to the BRT Corridor with sufficient details, if required. The list to be shared on monthly basis or at time when changes occurs. Furthermore, the Service provider shall provide registration details of vehicles, used for delivery and otherwise essential for the execution of services, requiring access to BRT corridor for maintenance of Equipment or Allied Services.

9.4 The Service provider shall maintain vigilant supervision over its staff at all times. Dress code is to be applied with their service I.D for their distinct recognition. Apart from generally applied moral code, the personnel of the service provider shall avoid to use any kind of toxic and narcotics, even BRT premises is a smoke free zone.

9.5 The Service Provider be responsible, at all times, for the conduct of its personnel and take prompt and strict disciplinary action against any conduct not in compliance with TPC's rules, regulations and instructions issued from time to time.

9.6 The Service Provider staff shall communicate with passengers and members of public in a customer friendly, professional and helpful manner.

9.7 The Service Provider shall ensure presence of its authorized representative(s) at any BRT site or TPC office at short but reasonable notice when so required by TPC and respond to queries of TPC in a timely manner.

9.8 The Service Provider shall be responsible for the medical and accidental insurance of its staff, payment of all dues like Social Security, EOBI in accordance with the Applicable Law. The Service Provider shall not engage staff below minimum wage as notified under Applicable Law. TPC shall not accept any responsibility of the designated personnel in the event of death, injury, disability or illness that may take place while performing/executing services required under the scope of this contract. Any compensation or expenditure towards the treatment of such injury/disability or loss of life shall be the sole responsibility of the Service provider.

9.9 The Service Provider shall be responsible that it does not engage or continue to engage any person having a criminal record/ conviction or otherwise undesirable persons.

9.10 TPC requires all Employees who are required to fulfil their duties in view of the public to wear uniforms at all relevant times during the rendering of the Services. The Service Provider shall ensure that its Employees are appropriately attired in the prescribed Uniforms. The Service Provider shall comply with the specification and/or design provided by TPC from time to time.

9.11 The Service Provider shall take prompt and reasonable action for resolution of each complaint and maintain a Log book, containing details regarding Turnaround Time (TAT), parts repaired/replaced, Service person etc., of each complaint received and resolved. TPC may prescribe a format of the Log book or established an electronic system, which shall be mandatory for the Service Provider to adopt. This includes resolution of complaints received from passengers as well as technical nature from TPC.

9.12 Agree to remove from the site, whenever required to do so by the TPC, any personnel considered by TPC to be unsatisfactory or undesirable.

9.13 Be liable to the penalty and Liquidated Damages for any loss incurred or suffered/any damage caused to movable or immovable property of TPC, on account of delayed, deficient or inadequate Services, or any actions adversely affecting warranty of the Equipment, or interruption in the smooth operations of BRT Bus Service for reasons directly and solely attributable to the Service provider.

9.14 Report immediately to TPC any kind of material incident (to the extent of scope of Service Provider required as per this Contract) including but not limited to damage to TPC property and provide photographs of the incident.

9.15 The Service Provider shall ensure their personnel do not enter into the BRT Corridor without valid entry cards/permit issued by the TPC.

9.16 The Service Provider shall ensure that the Equipment at all times is in compliance with the SOR, the requirements of any applicable specifications and the Applicable Law.

9.17 The Service Provider shall maintain detailed Equipment maintenance and repair records for the duration of this Agreement. TPC shall be entitled to audit such records upon giving the Service Provider no less than twenty-four (24) hours' notice. The Service Provider shall also provide these records (or any portions thereof) as may be reasonably requested by TPC.

9.18 Unless expressly specified in this Agreement, the Service Provider shall solely be responsible for all cost and/or expenses associated with the fit-out, furnishing, administration, office space and/or any and all operational costs associated with its operations until the Termination Date.

## 10. Operations and Maintenance of the Equipment

10.1.1 The Service Provider shall provide the Services strictly in accordance with the SOR and any further instructions of TPC given pursuant to this Agreement.

10.1.2 The Service Provider shall be obliged to log a report with TPC within fifteen (15) minutes of the occurrence (or as soon as practicable thereafter) of any incident/accident, detailing the nature and location of the incident and where applicable, details of the parties involved. Service Provide shall report any incident to TPC at station or in corridor which are even not related to Service Provider scope of work.

10.1.3 From the Commencement Date and for the duration of the Agreement, the Service Provider shall be entitled to operate the Equipment and provide services in accordance with SOR.

10.2 Temporary interruptions, delays or deviation from Services

10.2.1 The cancellation of Services by the Service Provider shall only be permitted if such cancellation is due to:

(a) weather conditions (subject to prior agreement with TPC), or any Event of Force Majeure; or

(b) immediate danger to life and/or personal injury and/or serious damage to property,

in which event, TPC and the Service Provider shall meet in good faith on an urgent basis, to agree upon the deviation from the Services to be allowed and the expected date and/or time of recommencement of the Services, or if the Parties fail to reach agreement within one (1) hour after having met for the first time, TPC's decision shall be final and binding on the Parties.

10.2.2 Where the Service Provider is of the opinion that Services should be cancelled due to boycott action, intimidation, violence, strike action or any threats of the aforegoing, either against the Service Provider or generally, the Service Provider shall refer the matter to TPC for its decision, which shall be final and binding and not be subject to the provisions of clause 30. Should TPC decide that such cancellation is justified, no Liquidated Damages shall apply. However, should TPC decide that such cancellation is not justified and the Service Provider nevertheless fails to render the Services for any period of time whilst the action or threats contemplated above continue, the Service Provider shall be penalized in accordance with clause 26 and the SOR and no payment shall be made in respect of such canceled Services.

10.2.3 The Service Provider shall inform TPC immediately of any proposed cancellation of any Services pursuant to clause 10.2.1(a) and/or clause 10.2.1(b) and the Parties shall meet on an urgent basis to agree upon the deviation to be allowed and the recommencement of the Services, or if they fail to reach agreement within a reasonable time as determined by TPC, TPC's decision shall be final and binding on the Parties and clause 30 shall not apply in relation to TPC's decision.

10.3 Skill and care in rendering uninterrupted Services

10.3.1 The Service Provider shall exercise the highest degree of skill, care and diligence in the provision of the Services to the reasonable satisfaction of TPC.

10.3.2 Without limiting the generality of the aforegoing, the Service Provider shall provide the Services at a standard which would reasonably avoid the incurring of Liquidated Damages as contemplated in the SOR.

10.3.3 The Service Provider acknowledges and accepts that it is imperative for the success of the System that the Services are rendered without interruption or delay and undertakes to do all things reasonably necessary to ensure such uninterrupted, prompt and efficient service.

10.4 Compliance with standard operating and control procedures and requirements

10.4.1 The Service Provider shall at all times comply with any standard operating and control procedures and requirements for the day-to-day administration, monitoring, control and performance of this Agreement as may be reasonably determined by TPC from time to time and the specific circumstances under which the System operates from time to time, which shall include the SOR.

## 11. Operating Licenses

11.1 The Service Provider shall maintain the validity of all Operating Licenses required for the business, if required under Applicable Law, for the duration of this Agreement and shall ensure that the terms or conditions of such Operating Licenses are not contravened.

## 12. Technical Staff

12.1 No later than 30 days before the Commencement Date, the Service Provider shall employ one or more Project Manager for coordination with TPC and dealing of day-to-day matters. They shall be fluent in the language for day-to-day communications. His name, duty, authority and any changes therein shall be communicated in writing to TPC.

12.2 The Service Provider shall hire Technical Staff who are suitably qualified and shall ensure that all Technical Staff for duration of the Services remain suitably qualified, trained and meet the requirements set out in the SOR and any Applicable Laws. TPC may implement their attendance system in their biometric system for monitoring.

12.3 Notwithstanding any Liquidated Damages that may be applied pursuant to this Agreement, in relation hereto, where a Technical Staff operates an Equipment in contravention of any Applicable Law and/or the requirements of the SOR, TPC shall be entitled to demand (and the Service Provider shall be obliged to promptly comply with such demand) that such Technical Staff is immediately removed from the System and replaced with another Technical Staff who is suitably qualified.

## 13. Co-operation with Other Contractors

13.1 Where interaction between the Service Provider and any Other Contractors/Service Providers is required in accordance with this Agreement, in practice or in accordance with a Service Notice or Protocol, for the efficient and effective operation of the BRT system, the Service Provider shall co-operate with Other Contractors/Service Providers and shall take such reasonable steps as may be required to formulate the necessary operating procedures and practices by agreement with Other Contractors, in accordance with the Service Notice or Protocol, as the case may be.

13.2 Should the Service Provider and Other Contractors fail to reach an agreement as contemplated in clause 13.1, TPC shall be entitled to issue a Protocol to regulate their interaction or make a final determination in the event of a dispute between them, as the case may be.

13.3 In any event, notwithstanding the provisions above, TPC shall at all times be entitled to issue Protocols regulating the interaction between the Service Provider and Other Contractors/Service Providers.

13.4 The Service Provider shall be obliged to follow such Protocols, which, in the event of a conflict, shall supersede any agreement between the Service Provider and Other Contractors in accordance with clause 13.1 above.

## 14. Uniforms

14.1 The Service Provider shall ensure that its Employees are appropriately attired in the Uniforms prescribed in the Schedule of Requirements (as may be amended from time to time).

## 15. Monitoring of the Services

15.1 TPC shall be entitled to require regular written reports from the Service Provider in such reasonable form, detail and frequency as may be determined by TPC or to call meetings with the Authorized Representative of the Service Provider on reasonable notice, for any purposes regarding the performance of the Services and/or the implementation of this Agreement.

15.2 An Authorized Representative of TPC shall at all reasonable times be given access to the Equipment, Employees and any place where the Services (or any portion thereof) are being performed to satisfy itself as to the Service Provider's compliance with its obligations under this Agreement and for purposes of assessing the Service Provider's performance against agreed Key Performance Indicators (KPI`s). TPC shall be entitled to conduct random or schedule inspections of any Equipment, its component or its subsystems.

## 16. Provision of Financial Information

16.1 For the duration of this Agreement, the Service Provider shall deliver to TPC:

16.1.1 audited annual financial statements of the Service Provider within ninety (90) days after each relevant Financial Year-end; and

16.1.2 unaudited management accounts of the Service Provider (comprising a profit and loss account, balance sheet and cash flow statement), copies of which shall be delivered to TPC within thirty (30) days after the end of each Quarter of a Financial Year. Without detracting from TPC's rights under this Agreement, and in order to assist the Service Provider in taking proactive steps to ensure the sustainability of its operations and identify any negative trends which may likely impact the Services, TPC may provide the Service Provider with such feedback as it may consider appropriate from time to time arising from its consideration of the Service Provider's management accounts submitted in accordance with this clause 16.1.2.

16.2 The Service Provider shall provide TPC with all information as TPC may be required to provide to any Regulatory Bodies, from time to time.

16.3 The Service Provider's financial statements shall be prepared in accordance with IFRS (international financial reporting standards within the meaning of Companies Act 2017 as applicable in Pakistan) and fairly reflect the financial position of the Service Provider as at the date and for the period for which such statements are prepared.

16.4 The Service Provider shall furnish to TPC, within three (03) Business Days of receipt by it of written demand from TPC, all such additional information as may be reasonably required by TPC from time to time.

16.5 The Service Provider shall notify TPC in writing, immediately (but in all events within seven (7) days) upon the occurrence of any of the following events:

16.5.1 if at any time the Service Provider becomes Financially Distressed; or

16.5.2 if the Service Provider considers or resolves to seek any insolvency, bankruptcy or similar protection under Applicable Law.

16.6 If the Service Provider notifies TPC pursuant to clause 16.5, such notice shall set out the full details of the Financial Distress or the actual or proposed action, and TPC shall be entitled, without derogating from and/or diminishing any rights and/or entitlements it may have under this Agreement, under Applicable Law or otherwise, to do all things it deems necessary in order prevent any potential disruption to the Services

## 17. Incident Reporting

17.1 Should the Service Provider become aware of events or circumstances which have prevented, are preventing or will prevent the Service Provider from providing the Services, the Service Provider shall immediately after becoming so aware, advise TPC of such events or circumstances and also indicate the manner in which the provision of the Services were, are or are going to be impacted.

17.2 In addition to any obligations under Applicable Law, the Service Provider shall immediately after its occurrence notify TPC or its Authorized Representative of any accident relating to the Services (whether or not a Equipment has been involved) in which persons have been injured or killed.

17.3 The Service Provider shall be required to report all other incidents as may be further defined by a Protocol, excluding such incidents as described in clause 17.2 above, to TPC in writing within two (2) Business Days of the Service Provider becoming aware or where a prudent Service Provider should have reasonably become aware of the incident.

17.4 The Service Provider shall report any acts of vandalism or damage to Equipment to TPC within one (1) day of becoming aware of their occurrence.

## 18. Other responsibilities

18.1 The Service Provider shall be responsible for the safe disposal of waste, oil, lubricant or water containing any variation of such lubricant in accordance with the Applicable Law.

18.2 The Service Provider shall at its own cost comply with all labor, employment, occupational health and safety regulations and standards applicable to the Services.

18.3 The Service Provider shall be liable to compensate, replace, repair (whatever the case may be) as per original specification or as per work order issued by TPC for any damage caused to the property of TPC.

# PART D - MAINTENANCE OF EQUIPMENT

## 19. General Obligations

19.1 The Service Provider shall, at all times during the term of this Agreement, ensure that all Equipment utilized in rendering of the Services are kept in a state of good repair and maintained in accordance with the Equipment Supplier requirements and/or recommendations and the provisions of this Agreement. Notwithstanding anything to the contrary contained in this Agreement, the Service Provider shall:

19.1.1 be liable for any damage caused to the Equipment in accordance with its obligations under this Agreement; and

19.1.2 at all times, unless expressly stated otherwise in this Agreement, be responsible for the service, maintenance and upkeep of the Equipment.

## 20. Maintenance

20.1 The Service Provider shall at all times be required to service, maintain and repair the Equipment at its own cost and in strict accordance with the specifications, requirement and/or recommendations of the Equipment Supplier as notified to the Service Provider from time to time. The Service Provider shall not do anything which has the effect of voiding any warranty provided by an Equipment Supplier in respect of any of the Equipment. The Service Provider shall do all things required to ensure that TPC does not in any way breach its obligations under the Equipment Sale Agreement.

20.2 The Service Provider shall, at its own cost, ensure that each Equipment undergoes an Equipment Inspection Test according to Applicable Law and the results and other records relating to such tests shall be maintained and made available to TPC at its request. TPC may, in its discretion, request that the results of each such test be forwarded to TPC within seven (7) days of the completion of each such test.

20.3 If at any time Equipment is in need of service, maintenance and/or repair and the Service Provider fails to make such repair within a reasonable time, TPC shall notify the Service Provider of such failure and shall indicate in that notice the type of service, maintenance and/or repair that is required and the period within which such service, maintenance and/or repair must be completed. If such service, maintenance and/or repair is not completed within the time specified in TPC's notice, TPC shall be entitled to effect such service, maintenance and/or repair at the cost and expense of the Service Provider in which case TPC may, in its discretion, liquidate partially or fully the Performance Guarantee or deduct amount from Reserve Fund.

20.4 The Service Provider shall maintain a complete and detailed record of all service, maintenance and/or repairs (including the cost of any such service) for each Equipment and shall, upon reasonable notice, make such records available to TPC for audit and/or inspection.

**21. Reserve Fund**

21.1 The Service Provider shall establish the Reserve Fund which shall be maintained by TPC as security against amounts which may become due and payable to TPC during the term of this Agreement, if so mentioned in **PC**.

21.2 The Reserve Fund shall be built up from amounts retained by TPC from payments to be made to the Service Provider. TPC shall retain no more than three percent (3**%**) of each payment due to the Service Provider, up to the amount mentioned in **PC**. The Service Provider shall not withdraw from the account/ Reserve Fund without written permission of TPC.

21.3 Subject to clause 21.4, TPC shall be entitled to, in accordance with the express terms of this Agreement, make withdrawals from the Reserve Fund at any time after the Commencement Date.

21.4 The Service Provider shall name TPC as a co-beneficiary on the Reserve Fund account and execute all documents and do all things necessary to ensure that the bank or other financial institution with whom the Reserve Fund is established is authorized and empowered to, upon first written demand from TPC, immediately withdraw and/or transfer the demanded amounts to TPC with or without objection from the Service Provider.

21.5 Prior to making any withdrawal from the Reserve Fund, TPC shall have notified the Service Provider of the Service Provider's breach of a specific obligation under the Agreement, and shall also provide relevant details in respect of the breach (including the details of the Service Provider's failure to remedy the breach within the time agreed and/or specified by TPC).

21.6 TPC shall, prior to making a withdrawal or as soon as practicable following a withdrawal from the Reserve Fund, provide details of the amount to be withdrawn or the amount that has been withdrawn, and purpose of use. Following a withdrawal, the Service Provider shall, within the period specified by TPC or agreed between the Parties, replenish the Reserve Fund in a manner prescribed in clause 21.2. Failure of the Service Provider to replenish the Reserve Fund following a withdrawal pursuant to this clause shall constitute a material breach of this Agreement. TPC has the right to withdraw from Reserve Fund, if the Equipment are not made operational by Service Provider in a time specified by TPC or in case of loss of passenger revenue. The procedure for work or services executed at cost and risk of the Service Provider is mentioned in **PC.**

21.7 If, upon the expiry of the term of the Agreement or its earlier termination or the termination of the Service Provider's employment under the Agreement, no amounts are due and/or payable to TPC under this Agreement, then the Service Provider shall (within fourteen (14) days of such expiry or termination), be entitled to liquidate the Reserve Fund and retain any and all amounts remaining therein.

## 22. Spare Parts

22.1 The Service Provider is required to stock and secure spare parts store (at his own cost) as well as provide suitably qualified staff members to manage such store in accordance with the SOR.

22.2 To the extent any spare part is required for the performance of the Services, the Service Provider shall be responsible for providing the same at its own cost and expense.

## 23. Tools and equipment

23.1 The Service Provider is required to provide the required tools and equipment to maintain the Equipment and/or otherwise to provide the Services in accordance with the SOR.

## PART E - AUTHORISED REPRESENTATIVES, PROTOCOLS AND SERVICES NOTICES

## 24. Authorized Representative

24.1 TPC and the Service Provider shall notify each other, by no later than five (5) days after the Effective Date, of the identity and contact details of their Authorized Representatives. Each Party shall be entitled to replace such Authorized Representative by notice to the other Party.

24.2 In addition to TPC's Authorized Representative, TPC shall, by written notice to the Service Provider, be entitled to engage a System Controls Service Provider and/or otherwise delegate from time to time certain of its obligations under this Agreement. TPC shall clearly specify the responsibility(ies) and/or authority(ies) of such delegate in the notice to the Service Provider. The Service Provider agrees to cooperate fully with any such delegate as a representative of TPC.

24.3 Unless it is stated otherwise in the notice of a Party, a Party's Authorized Representative shall be entitled to bind such Party for any and all purposes connected with this Agreement.

24.4 All Service Notices and other notices required under or pursuant to this Agreement, unless expressly stated otherwise in this Agreement (or instructed in writing by the Party to whom notice is to be given) shall be directed to the Authorized Representative of such Party.

24.5 Without derogating from the generality of this clause 24, TPC and the Service Provider, as the case may be, shall be entitled to appoint further Authorized Representatives for specific matters as detailed in its notification of such Authorized Representative.

## 25. Service Notices, Protocols and Amendments

25.1 TPC shall be entitled to issue Protocols under this Agreement or for interaction with other Services Provider/Contractors or use of common facilities within BRT system or use of corridor etc.

25.2 TPC shall be entitled to issue reasonable Protocols or amend previously issued Protocols on twenty-four (24) hours' notice to the Service Provider in the case of urgent matters and on seven (7) days' notice in respect of all other matters.

## PART F – LIQUIDATED DAMAGES

## 26. Liquidated Damages

26.1 TPC shall be entitled to impose Liquidated Damages on the Service Provider in accordance with the provisions of this clause 26 and the Schedule of Requirements for the Service Provider's failure to achieve certain KPIs as indicated in the SOR.

26.2 The Parties agree that the amounts specified in this clause 26.2 and the SOR for the Service Provider's failure to achieve certain KPIs represent the likely loss to TPC as a result of any failure of the Service Provider to meet the KPIs and are reasonable and constitute liquidated damages and not a penalty. The Service Provider further waives, to the extent permitted by Applicable Law, any defence as to the validity and quantum of Liquidated Damages set out in this Agreement on the grounds that such Liquidated Damages are void as penalties or otherwise.

26.3 TPC shall be entitled to conduct audits of the Service Provider's operations at any time without notice in order to ensure the continued compliance with this Agreement and that the Service Provider continues to achieve the various indicated KPIs. Such audits may be conducted in relation to the Equipment, the Services, Service Provider's staff, Service Provider's offices (including service and performance records) and any other place where any element of the Service is being performed.

26.4 To the extent that TPC discovered an instance of the Service Provider's failure to achieve a particular KPI, TPC shall notify the Service Provider with details of the particular KPI, the details of the failure and the applicable Liquidated Damages as indicated in the SOR. TPC may at its discretion specify period and type of certain failure which should be cured/rectified in specific period.

26.5 If Liquidated Damages are imposed, then TPC shall be entitled to withhold and/or deduct the imposed amounts from the Service Provider's next payable invoice, any subsequent invoice or in increments from several subsequent invoices.

26.6 The maximum amount of Liquidated Damages that may be imposed on the Service Provider in any given month is as indicated in the SOR.

## PART G – WARRANTIES AND CHANGE IN OWNERSHIP

### 27. Warranties, Undertakings and Indemnities

27.1 Service Provider Warranties

27.1.1 The Service Provider acknowledges that TPC has entered into this Agreement relying on the strength of the warranties given to TPC by the Service Provider and that the warranties are given with the intention of inducing TPC (which has been so induced) to enter into this Agreement on the basis that such warranties are and shall be correct for the duration of this Agreement.

27.1.2 Each Service Provider Warranty shall be a separate Warranty and in no way limited or restricted by any reference to, or inference from, the terms of any other Warranty or by any other provision in this Agreement.

27.1.3 The Service Provider accordingly warrants and undertakes that:

(a) it is properly constituted and incorporated in accordance with the Applicable Law;

(b) it has conducted site inspection and examined the functionality and condition of all Equipment and requirements of Allied Services;

(c) it has thorough knowledge of the Equipment, brand, model, performance and its quality and have did site inspection of all Equipment;

(d) It has examined the specification of Equipment, required Allied Services and made all due diligence in estimation of all operation and maintenance costs of Equipment and services under the Agreement;

(e) Satisfied himself with all the economic, financial and legal variables including but not limited to foreign exchange rates, inflation rates, minimum wage rates, customs and tax rates and all related labor and legal obligations;

(f) Satisfied himself of all conditions and circumstances affecting Contract price;

(g) it is a special purpose company established in connection with this Agreement and it has not carried out any activity since the date of its incorporation as a company, other than in connection with this Agreement;

(h) it has the power, authority and legal capacity to enter into and exercise its rights and perform its obligations under this Agreement;

(i) it has taken all necessary action to authorise the execution, delivery and performance of this Agreement;

(j) the obligations expressed to be assumed by the Service Provider under this Agreement are legal, valid, binding and enforceable to the extent permitted by Applicable Law;

(k) it will on operation date hold, in cash, an amount equivalent to the acquisition cost of all required tools, equipment, furniture and other basic business materials required for the operating of its business, plus the necessary working capital required during the pre-operational and initial operational period;

(l) it is and will be in compliance with all Applicable Laws;

(m) no claim is presently being assessed and no litigation, arbitration or administrative proceedings are presently in progress or, to the best of the knowledge of the Service Provider, pending or threatened against it (including its shareholders) or any of its assets which will or might have a material adverse effect on the ability of the Service Provider to perform its obligations under this Agreement;

(n) it is not the subject of any other obligation, compliance with which will or is likely to have a material adverse effect on the ability of the Service Provider to perform its obligations under this Agreement;

(o) no proceedings or other steps have been taken and not discharged (nor threatened) for its winding-up or dissolution or for the appointment of a receiver, administrative receiver, administrator, liquidator, trustee or similar officer in relation to any of its assets or revenues;

(p) all information disclosed by or on behalf of the Service Provider to TPC is true, complete and accurate in all material respects and the Service Provider is not aware of any material facts or circumstances not disclosed to TPC which would, if disclosed, be likely to have an adverse effect on TPC's decision (acting reasonably) to award this Agreement to the Service Provider;

(q) all insurance premiums in respect of insurance obligations placed on the Service Provider in accordance with this Agreement have been timely paid and none are in arrears.

27.2 Service Provider Undertakings

The Service Provider undertakes with TPC that:

27.2.1 it will give TPC immediate notice upon becoming aware that any judicial or court proceedings, mediation, litigation, arbitration, administrative or adjudication by or against the Service Provider before any court or Regulatory Authority may be threatened or pending;

27.2.2 it will not without the prior written consent of TPC (and whether by a single transaction or by a series of transactions whether related or not) sell, transfer, lend, encumber or otherwise dispose of the whole or any part of its business;

27.2.3 it shall not without the written consent of TPC incorporate any company or purchase or acquire or subscribe for any shares in any company save where such company is involved in the provision of the Services;

27.2.4 it shall not without the prior written consent of TPC make any loans or grant any credit or give any guarantee or indemnity to or for the benefit of any person or otherwise voluntarily or for consideration assume any liability (whether actual or contingent) in respect of any obligation of any other person except as contemplated by this Agreement;

27.2.5 it shall not change or cease its business or start any other business under this Agreement;

27.2.6 it shall immediately notify TPC of any discussions and/or negotiations that may result in a change in the ownership structure of the Service Provider or its ultimate parent company (if applicable).

27.3 TPC and Service Provider Indemnities

27.3.1 The Service Provider shall take steps to ensure the safety of property and all persons while they are being conveyed on the BRT System or while they are in, entering or leaving premises under the control of the Service Provider.

27.3.2 The Service Provider shall be liable for any loss or damages resulting from damage to property including TPC property, or the death of or injury to any person which is caused directly or indirectly by an intentional or negligent act or omission of the Service Provider, its agents, Employees or sub-contractors.

27.3.3 The Service Provider indemnifies and agrees to hold TPC harmless against all claims, demands, suits, proceedings, judgments, damages, loss, costs, charges, fines, penalties, taxes and expenses, of whatsoever nature incurred by either of the Parties, or by any third party, in consequence of a failure by the Service Provider to comply with the terms of this Agreement or any Applicable Law.

27.3.4 Nothing contained in this clause 27.3 shall be deemed to render the Service Provider liable for, or require it to indemnify TPC against, any compensation or damages with respect to injuries or damage to persons or property resulting from any negligent act or omission of TPC or its agents or employees in respect of any claims, demands, lawsuits, damages, costs, charges and expenses in respect thereof or pertaining thereto and each Party hereby indemnifies the other against any claims, demands, lawsuits, damages, costs, charges and expenses incurred by such other Party in consequence of the negligent acts or omissions of the other Party's agents or employees.

27.4 All warranties, representations, undertakings, indemnities and other obligations made, given or undertaken by the Service Provider in this Agreement are cumulative and none shall be given a limited construction by reference to any other.

## PART H - FORCE MAJEURE, NECESSARY ACTION, BREACH, TERMINATION AND DISPUTE RESOLUTION

### 28. Force Majeure

28.1 If either Party is prevented in whole or in part from discharging its obligations pursuant to this Agreement as a result of an Event of Force Majeure, such Party shall, as soon as reasonably practicable, notify the other Party accordingly. The aforementioned notice shall contain the following information:

28.1.1 the obligations which are affected and the extent to which the relevant Party cannot perform those obligations;

28.1.2 a detailed description of the Event of Force Majeure;

28.1.3 an estimate of the time period which the Event of Force Majeure is envisaged to continue; and

28.1.4 the measures proposed to be adopted to remedy or minimise the effects of and costs arising from the Event of Force Majeure. If the Service Provider is the Party prevented from discharging its obligations as a result of the Event of Force Majeure and TPC is of the opinion that the measures proposed are not adequate, it shall advise the Service Provider by Service Notice. Such Service Notice may propose alternate or additional measures which in the opinion of TPC may curtail the Event of Force Majeure and/or the costs arising therefrom. Notwithstanding the provisions of this clause 28.1.4, the Service Provider shall be obliged to take all proactive steps as may be reasonably possible in anticipation of Events of Force Majeure so as to enable the Service Provider to mitigate the financial effects thereof, including but not limited to, the entering into of appropriate contractual arrangements with its Employees.

28.2 The Party prevented from discharging its obligations pursuant to this Agreement as a result of an Event of Force Majeure shall:

28.2.1 use all reasonable endeavours to remedy or minimise the effects of the Event of Force Majeure; and

28.2.2 take all reasonable and necessary steps available to it as contemplated in clause 28.1.4 to mitigate any loss suffered by such Party or the other Party or any passengers as a result of that Party's failure to discharge its obligations pursuant to this Agreement.

28.3 In the event that an Event of Force Majeure affects the Service Provider's ability to perform any of its obligations under this Agreement and to the extent that the Services, or any part thereof, are suspended, the Service Provider shall not be entitled to claim payment from TPC for such suspended Services, or any additional costs incurred by the Service Provider as a result of the Event of Force Majeure or in relation to any steps taken by the Service Provider in mitigating the effects of the Event of Force Majeure.

28.4 In the event that the Service Provider is the Party affected by an Event of Force Majeure, TPC may, in response to the notice issued by the Service Provider in accordance with clause 28.1, issue a Service Notice to the Service Provider indicating any part of the Services which should nonetheless be performed by the Service Provider for the period during which the Event of Force Majeure subsists. TPC shall in such event make payment to the Service Provider for such Services in accordance with the Payment Calculation Schedule.

28.5 If an Event of Force Majeure no longer prevents the Service Provider from performing its obligations under this Agreement, the Service Provider shall be entitled to a reasonable period, taking into account the extent to which it has wound down its operations during the period of Force Majeure, to re-establish the Services in compliance with its obligations under this Agreement.

28.6 If an Event of Force Majeure continues uninterrupted for more than one hundred eighty (180) days and continues to prevent a Party from performing all of its obligations under this Agreement, either Party shall be entitled to terminate this Agreement upon fourteen (14) days' notice to the other Party, provided that before doing so the Parties shall first have met to find a mutually satisfactory solution for remedying such Event of Force Majeure and no Party shall terminate this Agreement unless the Parties are unable to agree on a solution.

28.7 Neither Party shall have any liability to the other in respect of the termination of this Agreement as a consequence of an Event of Force Majeure or as a result of any failure to carry out any of its obligations hereunder resulting from an Event of Force Majeure.

## 29. Breach and Termination

29.1 If the Service Provider commits a material breach of this Agreement and fails to remedy the breach within ten (10) Business Days after receipt from TPC of a notice calling upon it to do so or such other time as specified by TPC then TPC shall be entitled, in addition to and without prejudice to any other right it may have under Applicable Law or in accordance with this Agreement, to seek specific performance of this Agreement or to terminate this Agreement forthwith on notice to the Service Provider and in either event, to recover such damages as it may have sustained.

29.2 For purposes of this Agreement, a material breach shall include but not be limited to the foregoing if the Service Provider:

29.2.1 fails to provide or maintain the Performance Guarantee; or

29.2.2 fails to provide or maintain the Parent Company Guarantee; or

29.2.3 fails to provide or maintain the Reserve Fund; or

29.2.4 at any time, is Financially Distressed; or

29.2.5 in the opinion of TPC, commits a Prohibited Act; or

29.2.6 sells, transfers or otherwise disposes of all or a substantial portion of its shares, assets or business, without the prior written consent of TPC; or

29.2.7 goes into liquidation, whether provisionally or finally (other than a voluntary liquidation for the purpose of amalgamation or reconstruction to which TPC has given its prior written consent); or

29.2.8 has judgment of a material nature taken against it likely to affect the Service Provider's status as a going concern and fails to satisfy or apply to have the same set aside within seven (7) days of becoming aware thereof; or

29.2.9 delegates, cedes or sub-contracts this Agreement or part thereof in contravention of the provisions hereof without having obtained TPC's prior written consent; or

29.2.10 contravenes the provisions of SOR; or

29.2.11 fails to obtain or maintain as required any of the necessary Operating Licenses/permits to be used in the rendering of the Services or has such necessary Operating Licenses withdrawn, canceled, suspended or revoked; or

29.2.12 acts or attempts to act in a fraudulent or otherwise illegal manner in obtaining or executing a contract with any government department, provincial administration, municipality, public body, company or person; or

29.2.13 violates or attempts to violate any Applicable Law or otherwise commits any criminal act; or

29.2.14 enters into any agreement or arrangement, whether legally binding or not, with any other person, firm or company to refrain from formally responding to TPC's calls for proposals or the entering into of any negotiations with TPC in relation to this Agreement; or

29.2.15 Abandons, suspend services or otherwise repudiates the Services or any of its obligations under this Agreement; or

29.2.16 consistently fails to observe any provision of this Agreement or the Schedule of Requirements (despite being given notice in relation thereto), whether or not Liquidated Damages have been imposed, with the result that the Services may be regarded by TPC as being materially defective; or

29.2.17 incurs Liquidated Damages equal to or exceeding the maximum amount of Liquidated Damages as indicated in the SOR consecutively for months as mentioned in **PC**.

29.3 If TPC:

29.3.1 commits a material breach of this Agreement (other than a breach of payment obligations) and fails to remedy the breach within ten (10) Business Days after receipt from the Service Provider calling upon it to do so; or

29.3.2 commits a breach of any payment obligation in accordance with this Agreement and fails without justification to make payment within thirty (30) Business Days after receipt from the Service Provider of a notice calling upon it to do so,

then the Service Provider shall be entitled, in addition to and without prejudice to any other right it may have under Applicable Law or under the terms of this Agreement, to seek specific performance of the terms of this Agreement or to terminate this Agreement upon sixty (60) days' notice to TPC and in either event, to recover such costs, losses and damages as it may have sustained.

29.4 In the event of termination of this Agreement:

29.4.1 TPC shall be entitled to immediately take possession of all Equipment and Service Provider shall transfer other assets required for the performance of the Services to TPC; and

29.4.2 TPC may immediately appoint auditors to check and verify all relevant books, records and other data of the Service Provider and the Service Provider shall give full cooperation in that regard and make all such information available to TPC on request.

29.4.3 Permanence Guarantee shall be forfeited in full;

**30. Dispute resolution**

30.1 Disputes

30.1.1 For the purposes of this clause 30, the term "dispute" shall be interpreted in its widest sense and shall include any dispute or difference in connection with or in respect of the conclusion or existence of this Agreement, the carrying into effect of this Agreement, the interpretation or application of the provisions of this Agreement, the Parties' respective rights and obligations in accordance with and arising out of this Agreement or the validity, enforceability, rectification, termination or cancellation, whether in whole or in part, of this Agreement.

30.1.2 Save as otherwise provided for in this Agreement, any dispute between the Parties arising in connection with this Agreement shall be resolved in accordance with the provisions of this clause 30.

30.2 Resolution by Chief Executives

30.2.1 Any dispute arising in connection with this Agreement may be referred by either Party to the Chief Executive of the Service Provider and the Chief Executive of TPC (or such other senior executives as the relevant Parties may determine) who shall attempt to resolve the matter within ten (10) Business Days of the dispute being so referred to them or within such other time as may be agreed between the Parties.

30.3 Arbitration

30.3.1 If the Parties are unable to resolve the dispute pursuant to clause 30.2, either Party shall be entitled to refer a dispute to arbitration in accordance with this clause 30 by notifying the other Party in writing of its intention to do so.

30.3.2 The arbitration proceedings shall be carried out under the procedures, rules and regulations of Arbitration Act, 1940 and its successors, and such procedures, rules and regulations shall be deemed to be incorporated into this clause 30.3 by reference. Any such arbitration shall be subject to the Applicable Law.

30.3.3 The seat of the arbitration shall be Pakistan and all arbitration hearings shall be held in Peshawar unless otherwise agreed in writing by the Parties.

30.3.4 Unless otherwise required by TPC, such arbitration shall be conducted in the English language and the award of any arbitrator or arbitral panel, together with the reasons for the determination, shall be written in the English language.

30.3.5 Unless otherwise required by TPC, all evidence, submissions or documents presented at the arbitration in a language other than in the English language shall be accompanied by a simultaneous English language translation thereof, if oral, or if written, a certified English language translation.

30.3.6 The arbitrator or arbitral panel shall have full power to open up, review and revise any determinations, decisions or findings in relation to the dispute.

30.3.7 The obligations of the Parties shall not be altered by reason of the arbitration being conducted during the term of the Agreement.

30.3.8 Any monetary award in any arbitration shall be denominated and payable in PKR.

30.3.9 The Parties agree that all interim or final decisions and/or awards of the arbitrator or arbitral panel shall:

a) be binding on the Parties and shall be given effect and implemented forthwith by them; and

b) be subject to the confidentiality restrictions in this Agreement and except as provided by agreement between the Parties, may not be publicised or otherwise disclosed provided always that nothing in this clause shall prevent either Party from applying to any court of competent jurisdiction to enforce the award.

30.3.10 The Parties hereby expressly agree irrevocably to waive all rights and recourse to appeal or challenge, and neither Party shall request the local courts to open up, revise or review, the final award of the arbitrator or arbitral panel save and except in the specific instances set out in Arbitration Act, 1940.

30.3.11 Reference of a dispute to arbitration shall not in any way vitiate nor invalidate the Agreement neither shall it be grounds for the Service Provider to cease performing its obligations nor for TPC to terminate the engagement of the Service Provider under the Agreement and the Service Provider shall proceed with its obligations with all due diligence.

## PART I - MISCELLANEOUS MATTERS

### 31. Hazardous Substances

31.1 The Service Provider shall ensure that any hazardous materials or equipment used or intended to be used in the provision of the Services are stored safely and in safe keeping in accordance with all Applicable Law, ensure that all such materials are properly and clearly labelled on their containers, promptly inform TPC of all such materials being used or stored and comply with any other reasonable requirement of TPC in respect of such materials and equipment.

### 32. Intellectual Property

32.1 The Service Provider acknowledges that it shall not acquire any right, title or interest in or to the Intellectual Property of TPC and that all Intellectual Property developed pursuant to this Agreement (other than Intellectual Property belonging to the Service Provider or any third party) shall vest exclusively in TPC, save to the extent that the Parties otherwise agree in writing.

32.2 Should the Service Provider acquire title to any Intellectual Property of TPC or which is developed pursuant to this Agreement by operation of law (thus, where TPC in effect pays for its development) such Intellectual Property (other than Intellectual Property belonging to the Service Provider or any third party) shall be deemed to have been assigned by the Service Provider to TPC.

**33. Insurance**

33.1 The Service Provider agree to, at their own costs, establish and maintain no less than the minimum types and levels of insurances that are required by Applicable Law. It is mandatory that the insurance with respect to public properties shall be effected only through the National Insurance Company Limited (NICL) of Pakistan.

33.2 The Service Provider shall arrange for all kinds of insurance of Spare Parts/E&M Equipment/Maintenance Equipment/Monitoring Tools according to this Contract. Any amounts related to Spare Parts/E&M Equipment/Maintenance Equipment/Monitoring not insured or not recovered from the insurers shall be borne by the Service Provider.

33.3 The Service Provider shall also effect and maintain passenger and public liability insurance in relation to the operation of the Equipment. Such insurance shall, among other things, provide cover in respect of loss or damage suffered by reason of damage to property or death of or injury to any person resulting from any act or omission by Service Provider, the Drivers or their agents or Employees in connection with the operation of the Equipment in the provision of the Services. The TPC shall be a co-insured party under such insurance and the Service Provider shall be liable for and payment of all premiums in respect of such insurance.

33.4 The Service Provider shall effect and maintain full comprehensive Equipment insurance (including passenger and public liability) in respect of the Equipment from insurance company having a minimum rating of AA in long term (Public property shall be through NICL) on behalf of TPC within 30 days from acceptance of Equipment, on terms and conditions to TPC's reasonable satisfaction. The Service Provider shall be liable for and pay all premiums in respect of such insurance which includes theft, damage, faults, burglary etc. The Service Provider shall ensure that TPC is registered as co-insured under such insurance policy and provide proof of the insurance to TPC on demand.

33.5 The Service Provider shall procure and submit evidence of insurance cover within twenty-eight (28) days from the effectiveness of the Contract. The effective date of the coverage shall be the Commencement Date of this Contract. Failure to procure Insurance for Equipment from NICL, TPC shall procure shall insurance from NICL at the cost and risk of Service Provider.

33.6 The Service Provider shall be liable for any claims for passenger liability or public liability which are repudiated by TPC's insurer's due to any act or omission of the Service Provider, its directors, agents or Employees in providing the Services.

**34. Restricted Companies**

34.1 Restricted Companies and/or their shareholders shall not:

34.1.1 be a shareholder in the Bus Operator or subcontractors of the Bus Operator, or

34.1.2 be a party to a partnership, joint venture, subcontractor, consortium, arrangement with the ITS Contractor regarding any other work relating to services provided by the System Control Service Provider.

**PART J - FINAL PROVISIONS**

**35. Addresses and notices**

35.1 The Parties choose for the purposes of this Agreement the following addresses:

TPC: Chief Executive Officer, TransPeshawar (The Urban Mobility Company), KPUMA Building, Chamkani GT Road, Peshawar, Pakistan. E-mail: ceo@transpeshawar.pk

The Service Provider: [•].

35.2 Any legal process to be served on any of the Parties may be served on it at the physical address specified for it in clause 35.1 and it chooses that address for all purposes under this Agreement.

35.3 Any notice required by this Agreement to be given in writing shall, if given by email or cell phone-based short message service ("sms"), be regarded as having been given in writing for purposes of this Agreement, provided that the Parties may only utilise sms notification for operational authorizations in circumstances where operational action is required immediately and other changes to operations contemplated in this Agreement due to an emergency or such similar urgent operational matters.

35.4 Where operational authorizations are required, TPC will issue and log an authorization number and any relevant notice in accordance with this clause 35 shall quote such authorization number.

35.5 A notice to any of the Parties which is sent by registered post in a correctly addressed envelope to the address specified for it in clause 35.1 shall be deemed to have been received (unless the contrary is proved) within fourteen (14) days from the date it was posted, or which is delivered to the Party by hand at the physical address specified for it in clause 35.1, shall be deemed to have been received on the day of delivery, provided it was delivered to a responsible person during ordinary business hours.

35.6 Any notice by email to a Party at the email addresses of its Authorized Representatives shall be deemed to have been received (unless the contrary is proved) within twenty (20) minutes of transmission if transmitted at any time during which the Services are ordinarily rendered and if transmitted outside such time, within ten (10) minutes of recommencement of the rendering of the Services.

35.7 Any notice by sms to a Party at the mobile numbers of its Authorized Representatives shall be deemed to have been received (unless the contrary is proved) within twenty (20) minutes of transmission if transmitted at any time during which the Services are ordinarily rendered and if transmitted outside such time, within twenty (20) minutes of recommencement of the rendering of the Services.

35.8 Any notice in accordance with this clause 35 given by sms shall be followed by email confirming the contents and date of transmission of such sms.

35.9 Notwithstanding anything to the contrary in this clause 35, a notice or other communication actually received by any of the Parties (and for which written receipt has been obtained) shall be adequate notice or communication to it notwithstanding that the notice was not sent to or delivered at its chosen address.

35.10 Any Party may by a notice to the other Parties change its physical or postal address,email address or mobile number for the purposes of this clause 35 to any other physical or postal address, email address or mobile number provided that the change shall become effective on the seventh ($7^{th}$) day after the receipt of the notice.

**36. Change in Law**

36.1 The Service Provider acknowledges and agrees that it shall take full risk and responsibility for a Change in Law occurring. Notwithstanding the foregoing, if a Change in Law occurs or is imminent that affects the rights and obligations of the Service Provider under this Agreement, the Service Provider shall notify TPC within fourteen (14) days of the date of such Change in Law occurring or (if earlier) coming to the attention of the Service Provider.

## 37. Remedies

37.1 No remedy conferred by this Agreement is intended to be exclusive of any other remedy which is otherwise available at law, by statute or otherwise. Each remedy shall be cumulative and in addition to every other remedy given hereunder or now or hereafter existing at law, by statute or otherwise. The selection of any one or more remedy by any of the Parties shall not constitute a waiver by such Party of the right to pursue any other remedy.

## 38. Confidentiality

38.1 Each Party shall at all times keep in confidence the Confidential Information of the other Party which it may acquire for the purposes of or in connection with this Agreement (whether prior to or after the Commencement Date) and shall not use or permit the use of such Confidential Information and shall procure that its employees shall not use the Confidential Information, for any other purpose and shall not disclose such Confidential Information to any third party.

38.2 Notwithstanding clause 38.1, a Party may disclose the Confidential Information of the other Party to such former Party's employees or Authorized Representatives to the extent that such employees or Authorized Representatives need to know the Confidential Information and shall ensure that such employees or Authorized Representatives are aware of and comply with, the confidentiality obligations contained in this clause 38.2.

38.3 Each Party shall take all such steps as may be reasonably necessary to prevent the Confidential Information of the other Party from falling into the hands of an unauthorized third party.

38.4 The Service Provider shall not make any comments to the media relating to this Agreement and any related matter nor shall it respond to any queries from the media without the prior written approval of TPC.

## 39. Severance

39.1 In the event that any provision of the Agreement is held by any judicial or other competent authority to be illegal, invalid or unenforceable that provision shall be severed to the extent necessary to make the Agreement enforceable, and it shall not affect or impair the validity, legality or enforceability of any of the other provisions of the Agreement.

## 40. No agency

40.1 No provision of this Agreement shall be construed as constituting an agency, partnership, or joint venture between the Parties and neither Party shall have any express or implied TPC to bind the other Party in any way or to represent the other Party unless specifically provided to the contrary in this Agreement, and, for the avoidance of doubt, this clause 40.1 shall not affect or otherwise derogate from the obligations and powers of the Service Provider in relation to handing over of the Equipment to other authorised parties as contemplated in this Agreement.

40.2 The Service Provider is an independent contractor performing the Agreement. The Service Provider is not an employee or agent of TPC.

## 41. Corruption and Fraud

41.1 The Service Provider warrants that in entering into the Agreement it has not committed any Prohibited Act.

41.2 In the event that the Service Provider is contacted by a Public Official requesting or suggesting that the Service Provider act in a manner which would constitute a Prohibited Act, the Service Provider shall immediately provide TPC in writing with full details of the request (including the identity of the Public Official making the request).

41.3 Without prejudice to clause 41.2, the Service Provider shall ensure that its staff undertaking activities in connection with the Agreement are subject to similar obligations to those set out in this clause 41 and the Service Provider shall enforce such obligations.

41.4 In the event that the Service Provider fails to comply with the requirements of this clause 41 TPC shall be entitled to terminate the Agreement pursuant to clause 29.

41.5 The Service Provider shall sign affidavit of Integrity Pact attached as Schedule 8 in Request for Proposal.

**42. Entire Agreement**

42.1 This Agreement constitutes the entire agreement between the Parties in relation to all matters contained herein, including all understandings, rights, responsibilities, duties and obligations and supersedes all prior arrangements, representations, communications, negotiations, agreements and contracts (whether written or oral) made between or entered into by the Parties with respect thereto prior to the Effective Date. None of the Parties shall have any claim or right of action arising from any undertaking, representation or warranty not included in this Agreement.

**43. No stipulation for the benefit of a third person**

43.1 Save as is expressly provided for in this Agreement, no provision of this Agreement constitutes a stipulation for the benefit of a third person which, if accepted by the person, would bind any Party in favour of that person.

**44. No representations**

44.1 A Party may not rely on any representation which allegedly induced that Party to enter into this Agreement, unless the representation is provided in this Agreement.

**45. Amendment**

45.1 Except as set out elsewhere in this Agreement, no modification, amendment, addendum or variation to the Agreement shall be effective or binding, unless it:

45.1.1 is made in writing; and

45.1.2 expressly sets out the modification, amendment, addendum or variation to the accordance with the Agreement; and

45.1.3 refers to the Agreement; and

45.1.4 is signed and dated by a representative of each Party.

**46. Indulgences**

46.1 The grant of any indulgence, extension of time or relaxation of any provision by a Party under this Agreement shall not constitute a waiver of any right by the grantor or prevent or adversely affect the exercise by the grantor of any existing or future right of the grantor.

**47. General co-operation**

47.1 The Parties shall co-operate with each other and shall each execute and deliver to the other Party such other instruments and documents and take such other actions as may be reasonably requested from time to time in order to carry out, evidence and confirm their rights and the intended purpose of this Agreement.

47.2 Each of the Parties undertake at all times to do all such things, perform all such acts and take all such steps within its power and control, as may be necessary for and incidental to the putting into effect or maintenance of the terms, conditions and import of this Agreement and ensuring that the Services are rendered consistently at the highest possible standard expected by TPC.

47.3 Each Party agrees to provide all information reasonably requested by the other in the exercise of their respective rights and performance of their obligations under this Agreement, subject to the confidentiality provisions of clause 38 of this Agreement.

**48. Governing law**

48.1 This Agreement is to be governed, interpreted and construed in accordance with the laws of the Islamic Republic of Pakistan.

**49. Language**

49.1 Unless expressly notified in advance by TPC, the primary language of the Agreement shall be English. All documents and communications issued between the Parties shall be in English. Unless expressly notified in advance by TPC, all minutes of meetings shall be issued in English.

**50. Independent advice**

50.1 Each of the Parties hereby respectively agrees and acknowledges that:

50.1.1 it has been free to secure independent legal advice as to the nature and effect of each provision of this Agreement and that it has either taken such independent legal advice or has dispensed with the necessity of doing so; and

50.1.2 each provision of this Agreement (and each provision of the Annexes) is fair and reasonable in all the circumstances and is part of the overall intention of the Parties in connection with this Agreement.

**51. Good faith**

51.1 The Parties shall, at all times, act in good faith towards each other and shall not bring the other Party into disrepute.

**52. Survival of rights, duties and obligations**

52.1 The Surviving Provisions will survive termination or completion of the Agreement.

52.2 In the event that the Agreement is terminated or completed, neither Party shall be liable to the other Party except:

52.2.1 under the Surviving Provisions; or

52.2.2 in respect of any breach of the Agreement occurring before such termination or completion; or

52.2.3 any rights or liabilities between the Parties that were pre-existing as at the date of termination or completion.

**53. Assignment**

53.1 The Service Provider shall not cede, assign, delegate or transfer any of its rights or obligations under the Agreement, or any part of it, or any benefit or interest therein, to any third party or Entity without the prior written consent of TPC.

53.2 Notwithstanding anything to the contrary stated in this Agreement, TPC shall be entitled, without requiring the consent of the Service Provider, to cede, assign, delegate or transfer any rights and/or obligations under this Agreement to any third party.

**54. Waiver**

54.1 Subject to clause 54.2, no relaxation, forbearance or delay by a Party in enforcing the Agreement will prejudice, affect or restrict the rights, responsibilities, obligations, powers or remedies of that Party nor shall any waiver by either Party of any such rights, responsibilities, obligations, powers or remedies, or of any breach of the Agreement, be deemed to be a waiver of any other right, responsibility, obligation, power or remedy, or of any later or continuing breach of, the Agreement.

54.2 Any waiver of a Party's rights, responsibilities, obligations, power or remedies arising out of, under or in connection with the Agreement shall be in writing, dated and signed by the representative of the Party granting such waiver, and shall specify the right, responsibility, obligation, power or remedy and the extent to which it is being waived. No waiver of a breach of a term of the Agreement operates as a waiver of any other breach of that term, or of a breach of any other term, of the Agreement.

**55. Costs**

55.1 Any costs, including all legal costs of an attorney and own client basis and taxes, incurred by a Party arising out of or in connection with a breach by another Party shall be borne by the Party in breach.

IN WITNESS WHEREOF the TPC and the Service Provider have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

| **For and on behalf of the TransPeshawar** | **For and on behalf of the Service Provider** |
|---|---|
| • Signature: _____ | • Signature: _____ |
| CNIC: _____ | CNIC: _____ |
| Name: | Name: _____ |
| Designation: Chief Executive Officer | Designation: _____ |
| Company: TransPeshawar (The Urban Mobility Company) | Company: |

| **Witnessed by:** | **Witnessed by:** |
|---|---|
| • Signature: _____ | • Signature: _____ |
| CNIC: _____ | CNIC: _____ |
| Name: _____ | Name: _____ |
| Designation:_____ | Designation: _____ |

## ANNEX A
## DEFINITIONS AND INTERPRETATION

## 1. Definitions

1.1 In the Agreement, the following words and expressions shall have the meanings set out below:

1.1.1 "**Abandon**" means wholly or substantially cease to carry out the Services for ten (10) consecutive days or during thirty (30) days (whether consecutive or not) in any year, except when relieved of the obligation to do so by the express provisions of this Agreement;

1.1.2 "**Agreement**" means this agreement as amended from time to time and including the Annexes;

1.1.3 **"Allied Facilities/ Services"** means subsystems or subcomponent or other Equipment mentioned in SOR for operation and maintenance or services which are required to operate Equipment for its intended purposes or mandatory works which are part of the SOR;

1.1.4 "**Annexes**" means the annexes attached to this Agreement;

1.1.5 "**Applicable Law**" means any constitution, statute, ordinance, treaty, decree, proclamation, rules, regulations or subordinated legislation or other legislative measure, as amended from time to time, including all national and provincial statutes and legislation and all municipal by-laws, as well as the common law and customary law and any judgment, decision, order or rule of any court or tribunal with relevant jurisdiction and any decision made by judicial or administrative bodies in accordance with any of the aforegoing;

1.1.6 "**Authorized Representatives**" means persons authorized in writing by TPC and the Service Provider respectively, as contemplated in accordance with clause 24;

1.1.7 "**BRT System**" means the bus rapid transit system in Peshawar known as Peshawar Sustainable BRT Corridor System or any other name that should be assigned to the Peshawar bus/transit system and includes associated systems;

1.1.8 "**Bus Operator"** means any BRT vehicle operator aappointed by TPC to operate public transport services as a part of the BRT System;

1.1.9 "**Business Day**" means any day other than weekend or public holiday in Pakistan as notified by Government of KPK;

1.1.10 "**Commencement Date**" means the date on which the Services shall commence as notified by TPC by way of a Service Notice referred to in clause 2;

1.1.11 "**Confidential Information**" means all information, without limitation, of whatsoever nature:

(a) relating to the Disclosing Party's business, operations, processes, drawings, sketches, plans, models, product information, know-how, market opportunities, customers and business affairs;

(b) relating to the relationship of the Disclosing Party with its customers and suppliers; or

(c) relating to the contents of this Agreement and any other information received pursuant to this Agreement,

but excludes information which:

(a) constitutes an Operational Data; or

(b) is required to be disclosed under any law or regulation, or by any Regulatory Body, including any stock exchange on which a Receiving Party may be listed, provided that the Receiving Party in question shall first consult with the Disclosing Party before making any such disclosure, statement or announcement; or

(c) is in the public domain or enters into the public domain in any way, provided that the entry of such information into the public domain did not entail a breach of this Agreement by the Receiving Party; or

(d) the Receiving Party can show it was within its possession or knowledge, such information being in its use or having been recorded in its files, computers or other recording media, prior to receipt thereof from the Disclosing Party and which information was not previously acquired by the Receiving Party under any obligations of confidence or unlawfully; or

(e) is disclosed by the Receiving Party with the prior written approval of the Disclosing Party; or

(f) was disclosed by the Disclosing Party to a third party without restriction on disclosure or use, including without limitation, by way of a patent specification; or

(g) is hereafter disclosed or made available in good faith to the Receiving Party from a source other than the Disclosing Party, without breach by the Receiving Party of any obligation of confidentiality or non-use owed to the Disclosing Party or without breach by such other source who, to the knowledge of the Disclosing Party, is not subject to an obligation of confidentiality or non-use owed to the Disclosing Party; or

(h) is developed independently by the Receiving Party without reference to the Confidential Information;

1.1.12 "**Corridor**" means dedicated lanes from Chamkani Station to Karkhano station which includes stations, roads turning points, terminals, feeder route ramp etc.;

1.1.13 "**Disclosing Party**" means the Party disclosing Confidential Information to the Receiving Party;

1.1.14 "**Effective Date**" means when this Agreement has been signed by each Party, the latest of the dates upon which this Agreement was signed by any Party;

1.1.15 "**Employees**" means the employees of the Service Provider, or of any subcontractor contracted by the Service Provider to perform a part of the Service and include Technical Staff who maintain and operate equipment;

1.1.16 "**Encumbrance**" means:

(a) any mortgage, pledge, lien, assignment or cession conferring security, hypothecation, security interest, preferential right or trust arrangement or other encumbrance securing any obligation of any person or any other charge (whether equitable or otherwise) of whatsoever nature or howsoever described; or

(b) any arrangement under which money or claims to, or for the benefit of, a bank or other account may be applied, set off or made subject to a combination of accounts so as to effect discharge of any sum owed or payable to any person; or

(c) any other type of preferential agreement or arrangement (including any title transfer and retention arrangement), the effect of which is the creation of a security interest;

1.1.17 "**Entity**" means association, business, close corporation, company, concern, enterprise, joint venture, trust, undertaking, voluntary association, body corporate and any similar entity;

1.1.18 "**Event of Force Majeure**" means an act of God or public enemy, fire, explosion, earthquake, perils of the sea, flood, storm or other adverse weather conditions, war declared or undeclared, act of terrorism, civil war, revolution, civil commotion or other civil disorder, sabotage, riot, blockade, embargo, strikes (excluding strikes by Service Provider staff), lock-outs or other labour disputes, sanctions, epidemics, act of any Government, compliance with law, regulations or lawful demands of any Government or Governmental agency;

1.1.19 "**Equipment Sale Agreement**" means the agreement of sale and/or supply entered into, or to be entered into, between Peshawar Development Authority, on the one hand, and an Equipment Supplier/manufacturer/Civil Work Contractor, on the other hand, in relation to Equipment;

1.1.20 "**Equipment Supplier**" means such entity which sells or otherwise supplies Equipment to TPC or supplied to Peshawar Development Authority (PDA) in accordance with an Equipment Sale Agreement;

1.1.21 "**Financially Distressed**" means that:

(a) it appears to be reasonably unlikely that the Service Provider will be able to pay all of its debts as they become due and payable within the immediately ensuing 6 Months; or

(b) the Service Provider's liabilities exceed its assets by more than fifteen percent (15%) at any time, and "**Financial Distress"** shall have a corresponding meaning;

1.1.22 "**Financial Year**" means, at any time, the financial year of the Service Provider starting on January and ending on 31 December;

1.1.23 "**ITS Contractors**" means the contractor (or any member of the consortium making up the System Control Service Provider) who shall be responsible for designing, implementing, maintaining and operating the Intelligent Transport System (ITS) equipment on the BRT Vehicles and at the Stations, as well as management, maintenance and control of the Stations in accordance with the System Control Service Provider Agreement signed with TPC;

1.1.24 "**Intellectual Property**" means any and all intellectual property rights of any nature anywhere in the world whether registered, registerable or otherwise, including patents, utility models, trademarks, registered designs and domain names, applications for any of the foregoing, trade or business names, goodwill, copyright and rights in the nature of copyright, design rights, rights in databases, moral rights, know-how, trade secrets and any other intellectual property rights which subsist in computer software, computer programs, websites, documents, information, techniques, business methods, drawings, logos, instruction manuals, lists and procedures and particulars of customers, marketing methods and procedures and advertising literature, including the "look and feel" of any websites;

1.1.25 "**Invoice**" means a valid tax invoice as contemplated in clause 4;

1.1.26 "**KPI**" means the key performance indicator;

1.1.27 "**Liquidated Damages**" means the amounts to be deducted from the monthly payments for the Service Provider pursuant to particular service level failures as set out in the Schedule of Requirements and in accordance with clause 26 or otherwise paid by the Service Provider to TPC;

1.1.28 "**Month**" or "**Monthly**" means a calendar month;

1.1.29 "**Operating Licence**" means any licence, consent or permit required by the Service Provider to enable it to provide the Services under this Agreement;

1.1.30 "**Operational Data**" means any operational data defined as such in the SOR or identified as "Operational Data" by TPC, which shall include, among others, location of Equipment, running hours, and which will be available to the Service Provider, Other Service Providers and the System Control Service Provider;

1.1.31 "**Schedule of Requirements**" means the schedule annexed hereto explaining scope of services or "services";

1.1.32 "**Other Contractors**" means collectively, the System Control Service Provider or any subcontractor of the System Control Service Provider (or any member of the consortium making up the System Control Service Provider) and/or Service Provider of PSDs, Generator, Elevator, Escalator and Allied Services (excluding Other Service Providers) appointed by TPC in connection with the BRT System;

1.1.33 "**Other Service Provider**" means any other Equipment Service Provider appointed by PDA to install Equipment or appointed by TPC to operate public transport services as a part of the BRT System or Service Provider of TPC;

1.1.34 **"Other System"** means system as mentioned in SOR;

1.1.35 "**Party**" means a party to this Agreement;

1.1.36 "**Payment Calculation Schedule**" means the payment calculation schedule detailed in **PC**;

1.1.37 "**Parent Company**" means an entity (excluding any individual persons who are Employees of the Service Provider):

(a) of which the Service Provider (or any member if the Service Provider is joint venture, partnership, consortium or other association of two or more entities or persons) is a branch, subsidiary or other similar related entity; or

(b) which directly or indirectly exercises management control over the Service Provider (or any member if the Service Provider is joint venture, partnership, consortium or other association of two or more entities or persons);

1.1.38 "**Parent Company Guarantee** means the guarantee to be provided to TPC by the Parent Company of the Service Provider pursuant to clause 3 and the specimen form provided in Annex F;

1.1.39 "**Performance Guarantee**" means the unconditional, irrevocable on-demand performance guarantee in the specimen form attached as explained in **PC** also interchangeably used as Performance Security;

1.1.40 "**PKR**" means Pakistani rupee;

1.1.41 "**Prohibited Act**" means:

(a) offering, giving or agreeing to give to a Public Official a gift or consideration of any kind as an inducement or reward for:

(i) doing or not doing (or for having done or not having done) any act; or

(ii) showing or not showing (or for having shown or not shown) favour or disfavour to any person,

in relation to the award or performance of the Agreement or any other agreement with TPC; or

(b) entering into an agreement for which commission has been paid or has been agreed to be paid by the Service Provider or on its behalf, or to its knowledge, unless before the relevant agreement is entered into, particulars of any such commission and of the terms of any such agreement for the payment thereof have been disclosed in writing to TPC; or

(c) committing any offence under the Applicable Law creating offences in respect of fraudulent acts; or

(d) defrauding, attempting to defraud or conspiring to defraud TPC;

1.1.42 "**Project**" means the Peshawar Sustainable BRT Corridor System project carried out by TPC;

1.1.43 "**Protocol**" means a protocol and/or a standard operating procedure issued from time to time by TPC indicating how, among other things, Services are to be rendered, the manner in which the Service Provider and Other Service Providers should work together, the exact procedures to be followed in order to comply with service level requirements set out in the Schedule of Requirements and any other ancillary matters;

1.1.44 "**Public Official**" means an official or employee of a government owned or controlled enterprise or any Regulatory Body and shall include any individual defined as a public official in an Applicable Law;

1.1.45 "**Quarter**" or "**Quarterly**" means a consecutive period of three (3) Months commencing from the start of a Financial Year or calendar year, as the case may be;

1.1.46 "**Receiving Party**" means the Party receiving Confidential Information from the Disclosing Party;

1.1.47 "**Reserve Fund**" means the fund to be established as a security in accordance with clause 21;

1.1.48 "**Restricted Companies**" means Bus Operators and/or ITS Contractor;

1.1.49 "**Regulatory Body**" means any governmental, semi-governmental, administrative, fiscal or judicial ministry, department, commission, authority, tribunal, agency, municipality or body, and shall include the provider of electricity, gas, water, wastewater, telecoms and other such public services, and anybody with a regulatory function under the Applicable Law;

1.1.50 "**Service Notice**" means a notice given to the Service Provider by TPC in accordance with this Agreement;

1.1.51 **"Staging Facility"** means the staging area used by the Bus Operator or the Service Provider in the provision of the Services as described in respective contract, or as otherwise authorized by TPC for temporary parking of BRT Vehicles / emergency vehicles in day and/or night time at Dabgari Garden and is top floor of Dabgari Commercial Centre which includes two level building;

1.1.52 "**Stations**" means the stations described in the Schedule of Requirements; and which are intended as passenger embarkation and disembarkation points and Station means any one of them;

1.1.53 "**Surviving Provisions**" means clauses 1 (Preliminary Matters); 29 (*Breach and Termination*); 30 (*Dispute resolution*); 32 (*Intellectual Property*); 35 - 55 (*Part J - Final Provisions*) and this Annex A;

1.1.54 "**Termination Date**" means the fifth ($5^{th}$) anniversary of the Commencement Date or the date on which an earlier termination pursuant to the terms of the Agreement takes effect;

1.1.55 "**Uniform**" means the uniform to be worn by those Employees of the Service Provider required to fulfil their duties in view of members of the public, as prescribed in the Schedule of Requirements and includes the name tag issued to each Employee by Service Provider;

1.1.56 "**Warranty**" means the warranties and undertakings given to TPC by the Service Provider, set out in clause 27;

1.1.57 "**Week**" or "**Weekly**" means the period commencing at 00h00 on Monday and ending at 24h00 on Sunday each calendar week;

**2. Interpretation**

2.1 In the Agreement:

2.1.1 in the event of conflict between the Annexes and the provisions of this Agreement (excluding the Annexes), the provisions of the Agreement shall prevail;

2.1.2 any definition in this Agreement, shall bear the same meaning and apply throughout this Agreement including Annexes hereto, unless otherwise stated or inconsistent with the context in which it appears;

2.1.3 the singular includes the plural and vice versa;

2.1.4 a reference to a statutory provision includes any subordinate legislation made from time to time under that provision and includes those provisions as amended, consolidated, re-enacted or replaced from time to time;

2.1.5 a reference to a document includes the document as modified from time to time and any document replacing it, in each case in the manner permitted by the Agreement;

2.1.6 a reference to a gender includes the other genders;

2.1.7 a reference to any government agency or body, if that agency or body ceases to exist or is reconstituted, renamed or replaced or has its powers or functions removed ("defunct body"), means the agency or body that performs most closely the functions of the defunct body;

2.1.8 a reference to an "agent" shall mean any person with a contractual relationship with a Party and carrying out activities or obligations on behalf of that Party;

2.1.9 a reference to a "subsidiary" shall be a reference to a subsidiary as defined in the Companies Act, 2017;

2.1.10 references in this Agreement to "clauses" or to "Annexes", are to clauses of and Annexes to this Agreement;

2.1.11 references to notices or requests made or received by any of the Parties shall, unless expressly provided otherwise in this Agreement, refer to notices or requests in writing;

2.1.12 references to "agree" or "agreed" shall require the agreement to be recorded in writing and signed by the authorised representatives of the Parties;

2.1.13 no rule of construction shall be applied to the disadvantage of a Party to this Agreement because that Party was responsible for or participated in the preparation of this Agreement or any part of it;

2.1.14 unless otherwise provided, any number of days prescribed shall be determined by excluding the first and including the last day or, where the last day falls on a day that is not a Business Day, the next succeeding Business Day;

2.1.15 references to day/s, month/s or year/s shall be construed as Gregorian calendar day/s, month/s or year/s, as the case may be;

2.1.16 if a definition imposes substantive rights and obligations on a Party, such rights and obligations shall be given effect to and shall be enforceable, notwithstanding that they are contained in a definition;

2.1.17 a reference to a Party includes that Party's successors and permitted assigns;

2.1.18 the use of the word "including" followed by a specific example/s shall not be construed as limiting the meaning of the general wording preceding it and it shall be construed as if it were followed by "without being limited to".

**Annex-F**

**PARENT COMPANY GUARANTEE**

**<*Insert name of Parent Company*>**
(*To be printed on Judicial Stamp Paper of Prescribed Fee)*

**(GUARANTOR)**

**IN FAVOUR OF**

**TRANSPESHAWAR (THE URBAN MOBILITY COMPANY)**

**(TPC)**

---

**PARENT COMPANY GUARANTEE**

---

## CONTENTS


**1. PRELIMINARY MATTERS ..... 1**

1.1 Definitions and Interpretation ..... 1

**2. GUARANTEES AND INDEMNITIES ..... 1**

2.1 Guaranteed Obligations ..... 1

2.2 Indemnity by Guarantor ..... 1

2.3 Additional Security ..... 2

2.4 Payment ..... 2

**3. RIGHTS AND OBLIGATIONS ..... 2**

3.1 Waiver of Defences ..... 2

3.2 Rights and Obligations of the Guarantor ..... 2

3.3 No Reduction of Obligation ..... 3

**4. COMMENCEMENT AND EXPIRY ..... 3**

4.1 Commencement and Operation of the Guarantee ..... 3

4.2 Expiry ..... 3

**5. NOTICES, DEMANDS OR OTHER COMMUNICATIONS ..... 3**

5.1 Form of Notice ..... 4

5.2 Delivery and Receipt ..... 4

**6. DISPUTE RESOLUTION ..... 4**

6.1 Disputes under the Agreement ..... 4

6.2 Dispute Resolution ..... 5

**7. GENERAL PROVISIONS ..... 5**

7.1 Governing Law and Language ..... 5

7.2 Entire Agreement ..... 5

7.3 Severability ..... 5

7.4 Amendment ..... 5

7.5 Waiver ..... 5

7.6 Assignment ..... 5

7.7 General Representations and Warranties ..... 6

7.8 Limit on Reliance ..... 6

7.9 Counterparts ..... 6

**APPENDIX 1 ..... 1**

**1. Definitions ..... 1**

**2. Interpretation ..... 1**

**APPENDIX 2 ..... 2**

**THIS PARENT COMPANY GUARANTEE** (the "**Guarantee**") is made on <*Insert date*> 2025

**BETWEEN:**

(1) **TRANSPESHAWAR (THE URBAN MOBILITY COMPANY)**, a company incorporated in February 09, 2017 with Security Exchange Commission of Pakistan, with company registration no.010569 and whose registered address is at KPUMA Building, Chamkani, GT Road, Peshawar, KPK, Pakistan ("**TPC**"); and

(2) <***Insert name of the Parent Company***>, a company incorporated in [•], with company registration no. [•] and whose registered address is at [•] (the "**Guarantor**").

The TPC and the Guarantor are individually referred to herein as a "**Party**" and collectively as the "**Parties**".

**WHEREAS:**

A. <*Insert name of the BRT Company*> (the "**Service Provider**") has been awarded by TPC an agreement relating to operation and maintenance services for Generators and Allied Services in Peshawar BRT (the "**Agreement**").

B. The Service Provider is a <*State relationship with the Guarantor (branch, subsidiary, affiliate or other relationship*)> of the Guarantor] / [The Service Provider is an Association of Persons and <*Insert name of member of Service Provider* > (the "**Member**") is a <*State relationship with the Guarantor (branch, subsidiary, affiliate or other relationship*)> of the Guarantor.]

C. Under the Agreement, the Service Provider is required to procure a parent company guarantee from its parent company to guarantee the Service Providers' performance of its duties and obligations arising under, out of or in connection with the Agreement.

D. The Guarantee is being delivered by the Service Provider to TPC in fulfilment of the Service Provider's obligation to deliver a parent company guarantee to TPC under the Agreement.

E. The Agreement is entered into by TPC in reliance upon the undertakings of the Guarantor to TPC contained in the Guarantee.

**NOW THE GUARANTEE PROVIDES:**

## 1. PRELIMINARY MATTERS

### 1.1 Definitions and Interpretation

1.1.1 The defined words and expressions set out in Clause 1 of Appendix 1 [*Definitions and Interpretation*] and the provisions relating to the construction and interpretation of the Guarantee set out in Clause 2 of Appendix 1 [*Definitions and Interpretation*] shall apply to the Guarantee.

## 2. GUARANTEES AND INDEMNITIES

### 2.1 Guaranteed Obligations

2.1.1 The Guarantor irrevocably and unconditionally guarantees the performance and discharge by the Service Provider of the Guaranteed Obligations at the times and in the manner provided or contemplated in the Agreement.

2.1.2 Except as otherwise expressly provided in the Guarantee, the Guarantee shall not impose on the Guarantor any duties, obligations or liabilities greater than those assumed by the Service Provider under the Agreement.

2.1.3 The Guarantee shall be binding upon the successors and assignees of the Guarantor and shall extend to and ensure for the benefit of the successors or assignees of TPC.

### 2.2 Indemnity by Guarantor

2.2.1 If the Guaranteed Obligations are, or become, unenforceable, invalid or illegal (in whole or

in part), the Guarantor indemnifies and holds harmless TPC, its personnel and agents, in full against and from any and all liabilities, claims, damages, loss, expenses and costs (including legal fees and expenses) which arise out of, under or in relation to any failure of the Service Provider to perform or discharge any or all of the Guaranteed Obligations.

2.2.2 The Guarantor, as separate and independent obligation from its duties, obligations and liabilities under Sub-clause 2.2.1, indemnifies and holds harmless TPC, its personnel and agents, in full against and from any and all liabilities, claims, damages, loss, expenses and costs (including legal fees and expenses) which arise out of, under or in relation to, any failure of the Service Provider to perform or discharge any or all of the Guaranteed Obligations.

2.3 **Additional Security**

2.3.1 The Guarantee shall be in addition to, and independent of, any other security which TPC may hold from time to time in respect of the discharge and performance by the Service Provider of its duties, obligations and liabilities (including the Guaranteed Obligations) arising out of, under or in relation to with the Agreement.

2.4 **Payment**

2.4.1 The Guarantor agrees to make any payment due hereunder upon first written demand without set-off, deduction or counterclaim and without any legal formality such as protest or notice being necessary and waives all privileges or rights which it may have as a guarantor, including any right to require TPC to claim payment or to exhaust remedies against the Service Provider or any other person.

2.4.2 Any payment made under the Guarantee shall be made free and clear of, and without deduction for or on account of, any present or future taxes, levies, imposts, duties, charges, fees, deductions or withholdings of any nature whatsoever and by whomsoever imposed.

**3. RIGHTS AND OBLIGATIONS**

3.1 **Waiver of Defences**

3.1.1 The duties, obligations and liabilities of the Guarantor under the Guarantee shall not be reduced, discharged or otherwise adversely affected by:

(a) any act, omission, matter or thing which would have discharged or affected the liability of the Guarantor had it been a principal debtor and obligor instead of a Guarantor or indemnifier; or

(b) anything done or omitted to be done by any person which, but for this provision, might operate to exonerate or discharge the Guarantor or otherwise reduce or extinguish its liability under the Guarantee.

3.2 **Rights and Obligations of the Guarantor**

3.2.1 The Guarantor agrees that TPC shall not be obliged and the Guarantor waives any right it may have to require TPC (or any agent on its behalf)) to:

(a) take court, arbitral or other dispute resolution proceedings or to enforce any judgment or award against the Service Provider; or

(b) pursue any other right or claim (including the enforcement of any other security held by TPC) against any person,

before claiming from the Guarantor under the Guarantee.

3.2.2 Subject to the limits of liability set out in the Agreement, if any, the Guarantor indemnifies and holds harmless TPC, its personnel and agents, in full against and from any and all liabilities, claims, damages, loss, expenses and costs (including legal fees and expenses) which TPC incurs in connection with:

(a) the preservation, exercise and/or enforcement of any rights arising out of, under

or in relation to the Guarantee or any attempt so to do; and

(b) any discharge or release of the Guarantee.

3.2.3 Until all amounts which are or may become due from the Service Provider under the Agreement have been irrevocably paid in full, or unless TPC directs otherwise in writing, the Guarantor shall not exercise any security or other rights which it may have against the Service Provider by reason of performance by it of its obligations under the Guarantee, whether such rights arise by way of set-off, counterclaim, subrogation, indemnity or otherwise.

3.3 **No Reduction of Obligation**

3.3.1 The duties, obligations and liabilities of the Guarantor under the Guarantee shall not be reduced or discharged by any:

(a) alteration in the relationship between the Guarantor and the Service Provider; or

(b) arrangements between the Service Provider and TPC; or

(c) amendments to the provisions of the Agreement; or

(d) alteration, with or without the knowledge or consent of the Guarantor:

(i) in the extent or nature of the services to be performed under the Agreement; and/or

(ii) to the time for performance of the Service Provider's duties and obligations; and/or

(iii) to any other duties, obligations or liabilities of the Service Provider arising under, out of or in connection with the Agreement; or

(e) forbearance or indulgence by TPC towards the Service Provider or the Guarantor, whether as to payment, time, performance or otherwise; or

(f) other act or omission which, but for this provision, might exonerate or discharge the Guarantor from liability under the Guarantee; or

(g) invalidity or unenforceability of the Agreement or the insolvency, bankruptcy, winding up or reorganisation of the Service Provider or any other person.

3.3.2 The Guarantor agrees that the Service Provider and TPC may do or agree to any of the matters referred to in Sub-clause 3.3.1(b), Sub-clause 3.3.1(c), Sub-clause 3.3.1(d) or Sub-clause 3.3.1(e), all of which shall be likewise guaranteed by the Guarantor in accordance with the provisions of the Guarantee.

**4. COMMENCEMENT AND EXPIRY**

4.1 **Commencement and Operation of the Guarantee**

4.1.1 The Guarantee shall come into effect when the Agreement comes into effect.

4.1.2 Without prejudice to Sub-clause 4.1.1, the Guarantee shall come into effect in favour of TPC as soon as it has been executed by the Guarantor, notwithstanding that TPC may not have executed the Guarantee and in such case the Guarantee shall take effect as a unilateral declaration by the Guarantor in favour of TPC and shall be deemed accepted by TPC.

4.2 **Expiry**

4.2.1 The Guarantee shall continue in full force and effect until all duties, obligations and liabilities of the Service Provider arising under, out of or in connection with the Agreement have been fully performed and discharged in accordance with the provisions thereof, at which time the Guarantee shall expire and be returned to the Guarantor.

**5. NOTICES, DEMANDS OR OTHER COMMUNICATIONS**

5.1 **Form of Notice**

5.1.1 Any notice, demand or other communication under or pursuant to the Guarantee shall be:

(a) in English; and

(b) in writing; and

(c) state the Clause or Sub-clause under or pursuant to which the notice, demand or other communication is given, issued or made.

5.1.2 Subject to Sub-clause 5.2.4, and except as otherwise expressly provided in the Guarantee, all notices, demands or other communications shall be delivered or transmitted by hand, registered courier or electronic transmission (being either facsimile or email) to the Contact Details of the addressee.

5.2 **Delivery and Receipt**

5.2.1 Where a notice, demand or other communication is delivered by electronic transmission, the sender shall, within seven (7) Days after the electronic transmission is delivered, deliver a copy of the electronic transmission by hand or registered courier to the Contact Details of the addressee.

5.2.2 Subject to Sub-clause 5.2.3, a notice, demand or other communication shall be deemed to be duly given to the addressee:

(a) in the case of facsimile transmission, on the date and at the time shown on the transmission report by the machine from which the facsimile was sent, subject to the machine producing a report that the facsimile was sent in its entirety to the Contact Details of the addressee; and

(b) in the case of email:

(i) at the time of receipt by the sender of an email acknowledgement from the intended addressee's information system showing that the email has been delivered to the email address of that addressee; or

(ii) if no email acknowledgement is received, then at the time the email enters an information system which is under the control of the intended addressee (and the addressee shall make available at the request of the sender, evidence of such time); and

(c) in the case of delivery by hand or registered courier, at the time of and on the date of delivery.

5.2.3 In the event that a notice, demand or other communication is received after 3:00 pm at the physical address of the addressee stated in its Contact Details, it shall be taken to have been received by the addressee at 8:00 am on the next Day.

5.2.4 The Parties may each change their respective Contact Details for the purposes of Sub-clause 5.1 [*Form of Notice*] by giving notice to each other in accordance with the procedures for the giving, issuing or making of communications set forth in Sub-clause 5.1 [*Form of Notice*] not less than fourteen (14) Days before such change is to take effect. Any notice of such new Contact Details shall only be effective for the purposes of Sub-clause 5.1 [*Form of Notice*] after it is deemed received pursuant to Sub-clause 5.2.2 and Sub-clause 5.2.3.

**6. DISPUTE RESOLUTION**

6.1 **Disputes under the Agreement**

6.1.1 The settlement or resolution of any dispute arising under, out of or in connection with the Agreement shall be final and binding on the Parties and the Parties shall not reopen, revisit or otherwise dispute that settlement or resolution and the subject matter of that settlement or resolution.

6.2 **Dispute Resolution**

6.2.1 A Party may refer any dispute arising out of, under or in connection with the Guarantee to the Pakistani court of competent jurisdiction.

6.2.2 Without prejudice to Sub-clause 6.2.1, nothing in the Guarantee shall prevent the Parties from referring a dispute to arbitration by mutual written agreement.

## 7. GENERAL PROVISIONS

7.1 **Governing Law and Language**

7.1.1 The Guarantee shall be governed by, interpreted and construed in accordance with the Laws of the Islamic Republic of Pakistan.

7.1.2 Unless expressly notified in advance by TPC, the primary language of the Guarantee shall be English. All communications issued between the Parties shall be in English. Unless expressly notified in advance by TPC, all meetings shall be conducted in English, and minutes of meetings shall be issued in English.

7.2 **Entire Agreement**

7.2.1 The Guarantee constitutes the entire agreement between the Parties in relation to all matters contained herein, including all understandings, rights, responsibilities, duties and obligations and supersedes all prior arrangements, representations, communications, negotiations, agreements and contracts (whether written or oral) made between or entered into by the Parties with respect thereto prior to the date hereof.

7.3 **Severability**

7.3.1 In the event that any provision of the Guarantee is held by any judicial or other competent authority to be illegal, invalid or unenforceable that provision shall be severed to the extent necessary to make the Guarantee enforceable, and it shall not affect or impair the validity, legality or enforceability of any of the other provisions of the Guarantee.

7.4 **Amendment**

7.4.1 No modification, amendment, addendum or variation to the provisions of the Guarantee shall be effective or binding, unless it:

(a) is made in writing; and

(b) expressly sets out the modification, amendment, addendum or variation to the provisions of the Guarantee; and

(c) refers to the Guarantee; and

(d) is signed and dated by a representative of each Party.

7.5 **Waiver**

7.5.1 Subject to Sub-clause 7.5.2, no relaxation, forbearance or delay by a Party in enforcing the Guarantee will prejudice, affect or restrict the rights, responsibilities, obligations, powers or remedies of that Party nor shall any waiver by either Party of any such rights, responsibilities, obligations, powers or remedies, or of any breach of the Guarantee, be deemed to be a waiver of any other right, responsibility, obligation, power or remedy, or of any later or continuing breach of, the Guarantee.

7.5.2 Any waiver of a Party's rights, responsibilities, obligations, power or remedies arising out of, under or in connection with the Guarantee shall be in writing, dated and signed by the Representative of the Party granting such waiver, and shall specify the right, responsibility, obligation, power or remedy and the extent to which it is being waived. No waiver of a breach of a term of the Guarantee operates as a waiver of any other breach of that term, or of a breach of any other term, of the Guarantee.

7.6 **Assignment**

7.6.1 The Guarantor shall not assign or transfer any of its rights or obligations under the Guarantee or any part of it.

7.6.2 Subject to giving the Guarantor seven (7) Days' prior written notice, TPC may assign or transfer the Guarantee or any part of it or any benefit or interest in or under the Guarantee.

7.7 **General Representations and Warranties**

7.7.1 The Guarantor represents and warrants to TPC that:

(a) it has full power and authority to enter into and perform its obligations under the Guarantee;

(b) it has taken all necessary action to authorise the signing, delivery and performance of the Guarantee in accordance with its provisions; and

(c) the Guarantee constitutes the Guarantor's legal, valid and binding obligations and is enforceable in accordance with its provisions.

7.8 **Limit on Reliance**

7.8.1 No Party has entered into the Guarantee relying on any representation, warranty, promise or statement made by another Party, or any other person acting on behalf of a Party, other than the representations, warranties, promises and statements set out in the Guarantee.

7.9 **Counterparts**

The Guarantee may be executed in any number of counterparts, each of which, when executed, shall constitute a duplicate original, but all the counterparts shall together constitute one Guarantee.

**SIGNED** for and on behalf
of TPC

_____ Witness: _____

<*Insert name and position of signatory*> <*Insert name and position of witness*>

**SIGNED** for and on behalf
of the Guarantor

_____ Witness: _____

<*Insert name and position of signatory*> <*Insert name and position of witness*>

## APPENDIX 1

## DEFINITIONS AND INTERPRETATION

### 1. Definitions

1.1 In this Guarantee the following words and expressions shall have the meanings set out below:

1.1.1 "**Agreement**" has the meaning given to it in recital A.

1.1.2 "**Association of Persons**" means an unincorporated joint venture, partnership, consortium or other association of two (2) or more persons.

1.1.3 "**Clause**" or "**Sub-clause**" means a clause or sub-clause of this Guarantee.

1.1.4 "**Contact Details**" means the contact details of a Party stated in Appendix 2 [*Agreement Particulars*] or such other contact details as may be notified pursuant to Sub-clause 5.2.4.

1.1.5 "**Guarantee**" means this parent company guarantee, including the recitals and Appendix 1 [*Definitions and Interpretation*] and Appendix 2 [*Agreement Particulars*].

1.1.6 "**Guaranteed Obligations**" means the duties and obligations of the Service Provider arising under, out of or in connection with the Agreement, including the discharge of any indebtedness, monies and/or liabilities due, owing or incurred by the Service Provider to TPC arising under, out of or in connection with the Agreement.

1.1.7 "**Law**" means all national or public legislation, decrees, ordinances, rules and regulations relevant to this Guarantee as issued and in force within the Islamic Republic of Pakistan.

1.1.8 "**Member**" has the meaning given to it in recital B.[1]

1.1.9 "**Service Provider**" has the meaning given to it in recital A.

### 2. Interpretation

2.1 In this Guarantee:

2.1.1 Clause and Sub-clause headings are for convenience only and shall not be taken into consideration in the interpretation of this Guarantee.

2.1.2 The following rules shall apply to the interpretation of this Guarantee:

(a) the singular shall include the plural and vice versa;

(b) a reference to a gender shall include the other genders;

(c) a reference to a law shall include that law as amended, consolidated, re enacted or replaced from time to time;

(d) a reference to "**Days**" means calendar days;

(e) the word "**person**" shall include a natural person and any body or entity whether incorporated or not;

(f) the words "**written**" or "**in writing**" shall include any communication sent by letter, facsimile transmission or email;

(g) wherever "**include**" or any form of that word is used, it shall be construed as if it were followed by "**without being limited to**"; and

(h) a reference to an "**agent**" shall mean any person with a contractual relationship with a Party and carrying out activities or obligations on behalf of that Party;

(i) a reference to "**time**" shall be a reference to time in Peshawar, Islamic Republic of Pakistan.

[1] Delete if the Service Provider is a single entity.

**APPENDIX 2**

**CONTRACT PARTICULARS**

| **Contact Details** |
|---|
| For the TPC:<br>CEO TransPeshawar (The Urban Mobility Company),<br>First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan<br><br>Tel: *0092-91-2621393-5*<br>Email: ceo@*transpeshawar.pk*<br>For the Attention of Chief Executive Officer, TransPeshawar (The Urban Mobility Company) |
| For the Guarantor:<br><*Insert Guarantor's Name*><br><*Address line1*><br><*Address line2*><br><*Address line3*><br>Tel: <*Insert Guarantor's telephone number*><br>Fax:<*Insert Guarantor's fax number*><br>Email:<*Insert Guarantor's email address*><br>For the Attention of <_____> |

## PARTICULAR CONDITION OF THE CONTRACT

| | |
|---|---|
| **Definitions** | "**Equipment**" means as defined in Schedule of Requirements; |
| **2.2.2** | The Term of initial Agreement is five (05) years. Further extension for three years or any other term subject to mutual agreement. |
| **3.1** | Rs. 30,000,000.00 (Thirty Million Pakistan Rupees) issued by the Scheduled Bank of Pakistan having minimum Credit Rating of AA in long run. |
| **3.2** | Rs. 30,000,000.00 (Thirty Million Pakistan Rupees) issued by the Scheduled Bank of Pakistan having minimum Credit Rating of AA in long run. |
| **3.3** | Format as attached in Bidding documents |
| **4** | Parent Company Guarantee attached as **Annex-F** to the Agreement |
| **5.1** | Payment Calculation Schedule attached as **Appendix-I** to Particular Condition of the Contract |
| **6.1** | The Sales Tax on Services shall be paid by TPC and added to invoice in monthly service payments/ performance payments. |
| **7.2** | The handover of Equipment is within 7 days from the Date of Commencement. |
| **8.1** | Same as Clause 7.2 |
| **21.1** | The Reserve Fund shall be deducted. |
| **21.2** | The maximum amount of Reserve Fund is PKR. 15 million (Fifteen Million Rupees). |
| **21.6** | TPC, if decided to execute the Works/ Services at the cost and risk of Service Provider, shall get three quotation/ bid through email from potential bidders with seven (07) days response time and award to the lowest bidder. |
| **29.2.17** | Five months in one year. The year for the purpose of this clause shall be counted from date of commencement and end at subsequent anniversary. |

## Appendix-I to Particular Condition of the Contract
## PAYMENT CALCULATION SCHEDULE

**1. Monthly Payment**

1.1 For each Month (m), the Service Provider shall be entitled to a payment (**Monthly Payment**) calculated in accordance with the following formula:

$$\textbf{Monthly Payment}_{\textbf{m}}\ (\textbf{MP}\boldsymbol{m})$$

$$= \textbf{Monthly Service Payment} \times (\mathbf{1} - \textbf{PP}\%) - \textbf{RF}$$

where:

**Monthly Service Payment** means Monthly Service Payments in Pakistani Rupees (PKR [•]) offered in Financial Offer and updated as result of adjustments in accordance with Article 1.3 of Payment Calculation Schedule.

**PP%** means the Performance Payout Percentage, which shall be ten percent (10%).

**RF** means any amount to be retained in relation to the provisioning of the Reserve Fund.

1.2 The Service Provider shall raise an invoice to TPC for an amount equivalent to the Monthly Payment for Month (m) (plus any applicable Sales Tax on Services) after completion of the month. The Monthly Payment for Month (m) shall be made by the TPC within ten (10) days after receipt of invoice by TPC.

**1.3 Adjustment to Monthly Service Payment**

The relative weighting within the cost structure of the Monthly Service Payment is described in the table and shall be used to calculate the variation of cost for Monthly Service Payment. Calculation of adjustments is subjected to variation in base values, which for various categories shall be taken as follows: -

- For adjustments in Operation and Maintenance costs, base price shall be taken as of July, 2026. Monthly Payment will change with increase or decrease in base price.
- For adjustments in Salaries, base price considered shall be the minimum wage of PKR.40,000/month.

The adjustments in the Monthly Service Payment will be subject to subsequent variations in the base values and procedures laid down in the coming sections.

a) The parameters established for calculating the cost basket are estimates and therefore, failure to actually meet the same will not entitle any party to request adjustments in the calculation procedure of Monthly Service Payment nor in the economic compensation of any kind.

b) The Adjusted Monthly Service Payment for monthly payment shall govern irrespective of whether it is higher or lower than the original Financial Offer.

| Categories | Factor in Monthly Charge |
|---|---|
| **Operation and Maintenance Costs = OM** | 55 |
| **Salaries = S** | 45 |

Percent increase or decrease applicable to all categories = PI

Where,

PI = [(New Value – Previous Value) / Previous Value] x 100

| | |
|---|---|
| ΔOM | ΔOM = (PI $_{CPI}$ x OM x Original Monthly Service Payment) / 10,000<br>The Operation and Maintenance Cost will be adjusted Annually (year-on-year) on the basis of General Consumer Price Index (CPI) variation mentioned in Price Statistics published by Pakistan Bureau of Statistics, Government of Pakistan. |
| ΔCS | The Salaries will be adjusted from the date as and when change are notified by Government of Khyber Pakhtunkhwa in Minimum Wage.<br>ΔCS = (PI$_S$ x S x Original Monthly Service Payment) / 10,000 |

**Adjusted Monthly Service Payment = Previously Adjusted Monthly Service Payment + $C_{TN}$**

Where,

$C_{TN}$ =ΔOM +ΔCS

ΔOM = Increase / Decrease in Operation and Maintenance Cost in Monthly Service Payment

ΔCS = Increase / Decrease in Salaries cost in Monthly Service Payments

**2. Monthly Performance Payment**

2.1 For each Month (m), the Service Provider shall be entitled to a payment (**Monthly Performance Payment**) calculated in accordance with the following formula:

$$\textbf{Monthly Performance Payment}_{\mathbf{m}} = (\mathbf{1} - \mathbf{PD}\%_{\mathbf{m}}) \times \mathbf{MP}_{\mathbf{m}} \times \frac{\mathbf{PP}\%}{(\mathbf{1} - \mathbf{PP}\%)} - \mathbf{RF}$$

where:

**$MP_m$** means the Monthly Payment which the Service Provider is entitled to for Month (m) excluding Reserve Fund.

**$PD\%_m$** means the Performance Deduction Percentage applicable to the Service Provider for Month (m). **The sum of Performance Deduction percentages applicable for all events of non-compliance with KPIs occurred during that month subject to a maximum of hundred percent (100%).**

**PP%** means the Performance Payout Percentage, which shall be ten percent (10%).

**RF** means any amount to be retained in relation to the provisioning of the Reserve Fund.

2.2 Within fifteen (15) days from start of the month, TPC shall notify the amount of the Monthly Performance Payment. The Service Provider shall raise an invoice to TPC for an amount equivalent to the Monthly Performance Payment for Month (m) (plus any applicable Sales Tax on Services). The Monthly Performance Payment for Month (m) shall be made by the TPC within ten (10) Business Days of TPC receiving such invoice.

**3. Payment of Fuel Supplied in Generators**

3.1 The procedure for payments of Diesel Supplies to the Service Provider shall be as under:

a) The price of Diesel shall be paid on the regulated Diesel price of the respective petrol pump on actual basis.

b) Payment of Diesel invoice shall be made within 07 days of receipt of the invoice. The payment shall be made on monthly basis. However, the invoice would be processed only if it is accompanied by reports required in Operation Specification Schedule.

# Section 8 - Contract Forms

This section contains forms which, once completed, will form part of the Contract. The forms for Performance Security, when required, shall only be completed by the successful Service Provider after contract award.

## Table of Forms

**Notification of Award**..... **8-**Error! Bookmark not defined.

**Performance Security** .....**8-3**

# Notification of Award

[*on letterhead paper of the Procuring Entity*]

[*date*]

To: [*Name and address of the Service Provider*]

Subject: [*Notification of Award for the name of the Contract.*]

This is to notify you that your proposal dated ---------- for [*name of the contract and identification number, as given in the Data Sheet*] for a contract price of [*amount in words and figures and name of currency*] is hereby accepted by TransPeshawar (The Urban Mobility Company) as per breakup provided in the proposal on terms and conditions mentioned in the Agreement.

2. Under Clause ITB 34.3 of RFP and 27.1.3 (h) of the Agreement, you are required to establish a special purpose company in connection with the Project and ensure that it has not carried out any activity since the date of its incorporation as a company, other than in connection with or for the purposes of the Project.

3. Further, as per Clause 36 of the RFP and Clause 3 of the Agreement, the Service Provider/ Special Purpose Company shall maintain with TransPeshawar a valid and enforceable Performance Security to the amount of PKR…… (in words) in shape of Bank Guarantee issued by a Schedule Bank of Pakistan having minimum Credit Rating of AA in long run on a prescribed format **(attached as Annex-A)** or submit a Demand Draft or Call Deposit Receipt in favor of Chief Executive Officer TransPeshawar as per terms and conditions of the Service Agreement.

4. In accordance with Clause 34.5 of RFP and Clause 4 of the Agreement, you are also required to submit Parent Company Guarantees as per the format provided in the RFP.

5. You are therefore, required to deliver to TransPeshawar, within twenty-eight (28) working days of issuance of this Notification of Award, the duly executed Performance Security to the amount of PKR ------- , duly signed Parent Company Guarantee in favor of newly established special purpose company.

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Procuring Entity: .....

# Performance Security

***[TO BE ISSUED ON JUDICIAL PAPER OF PRESCRIBED FEE BY SCHEDULE BANK OF THE ISLAMIC REPUBLIC OF PAKISTAN]***

This **Performance Guarantee No.** <*Insert No.*> is made on <*Insert date*> (the "**Guarantee**")

**Ref:** RFP for Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System advertised on dated <*Insert date*> and Notification of Award No. ……..dated <*Insert date*>

**Beneficiary:** TRANSPESHAWAR (THE URBAN MOBILITY COMPANY), a Public Limited Company incorporated with Security Exchange Commission of Pakistan in February 09, 2017, with company registration No.0105691 and whose registered address is at TransPeshawar Building, Chamkani, GT Road, Peshawar, KPK. ("the **TPC**")

**1. GUARANTEE**

1.1 We <*Insert name of Bank*> Bank (the "Guarantor") have been informed that <*Insert name of the Successful Bidder*> has been declared Successful Bidder relating to reference tender of Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System (the "Services").

1.2 The <*Insert name of the Successful Bidder*> has established a special purpose vehicle <*Insert new BRT company name.*> hereinafter called (the "Service Provider") relating to the Operation and Maintenance Services of Generators and Allied Services in Peshawar BRT System. The <*Insert new BRT company name.*> is obligated to sign agreement (the "Agreement") with TPC relating to the operation and maintenance services.

1.3 The Guarantor hereby irrevocably and unconditionally undertakes to pay to the TPC on its first demand for payment, without regard to any objections or defences to TPC's demand from the Service Provider or any other person, an amount or amounts not exceeding in total PKR ----- (in words).

**2 TIME FOR PAYMENT**

2.1 Any amount demanded by the TPC shall be paid by Guarantor to the TPC within seven (07) days of receipt of the TPC's demand for payment stating that the Service Provider is in breach of its obligations arising under, out of or in connection with the Agreement and the Guarantor shall have neither the right nor the duty or obligation to challenge the accuracy or sufficiency of such statement or the amount specified in the demand.

**3 VALIDITY OF GUARANTEE**

3.1 This Guarantee shall come into force on the date hereof and shall remain valid until <*insert date*> whereupon this Guarantee shall expire and be returned to the Guarantor.

**4 PAYMENT FREE OF DEDUCTIONS AND WITHHOLDINGS**

4.1 Any payment under this Guarantee shall be made free and clear of, and without deduction

for or on account of, any present or future taxes, levies, imposts, duties, charges, fees, deductions or withholdings of any nature whatsoever and by whomsoever imposed.

**5 Notices and Demands for Payment**

5.1 Any demand for payment made under this Guarantee shall be delivered by hand or registered courier and be deemed to be duly made at the time of, and on the date of, delivery.

**5.2 Any notice given under this Guarantee shall be deemed to be duly given:**

A. in the case of facsimile transmission, on the date and at the time shown on the transmission report by the machine from which the facsimile was sent, subject to the machine producing a report that the facsimile was sent in its entirety to the contact details of the addressee stated in Schedule 1 (the "**Contact Details**"); and

B. in the case of email:

(A) at the time of receipt by the sender of an email acknowledgement from the intended addressee's information system showing that the email has been delivered to the email address of that addressee; or

(B) if no email acknowledgement is received, then at the time the email enters an information system which is under the control of the intended addressee (and the addressee shall make available at the request of the sender, evidence of such time); and

C. in the case of delivery by hand or registered courier, at the time of and on the date of delivery.

5.3 Any notice or demand given or made by TPC or the Guarantor relating to this Guarantee shall be in English.

**6 DISPUTE RESOLUTION**

6.1 This Guarantee shall be governed by, interpreted and construed in accordance with the laws of the Islamic Republic of Pakistan. Each Party consents to the jurisdiction of the courts in the Islamic Republic of Pakistan.

**EXECUTED** for and on behalf of
**[***GUARANTOR***]**

……

(signed)

……

Name

## SCHEDULE TO THE PERFORMANCE GUARANTEE

| |
|---|
| For the TPC:<br>CEO TransPeshawar (The Urban Mobility Company),<br>First Floor KPUMA Building Near Main BRT Depot, Chamkani, GT Road, Peshawar, KPK, Pakistan<br><br>Tel: *0092-91-2621393-5*<br>Email: ceo@*transpeshawar.pk*<br>For the Attention of Chief Executive Officer, TransPeshawar (The Urban Mobility Company) |
| For the Guarantor:<br><*Insert Guarantor's Name*><br><*Address line1*><br><*Address line2*><br><*Address line3*><br>Tel: <*Insert Guarantor's telephone number*><br>Fax:<*Insert Guarantor's fax number*><br>Email:<*Insert Guarantor's email address*><br>For the Attention of <_____> |