GLIS

Certificate No: GLIS/AHD/PMT/2021/08/CR-1089

GL Ref. No: 101-091-1202-12-1288

This is to Certify That the

# Mechanically Attached Tube fittings (MAF)

Manufacturer By

## PMT VAVES PVT. LTD.

Located at the Ahmedabad City Gujarat state, Country INDIA has been assessed with respect

## To ASTM F1387

All the Testing has been carried out by GLIS Is mentioned below as per the clause 4.2.2 of ASTM F1387 spec and carrying of ALL SS316 Grade Materials.

**Testing Specifications**

| **Tube Outside Diameter by Wall Thickness Combinations** | | |
|---|---|---|
| **Tube Size** *(inch)* | **Tube Rate Pressure** *(psig / bar)* | **Tube Hardness** *(HRB)* |
| 1/4 x 0.049 | 7,500 / 517 | 75 ~ 78 |
| 3/8 x 0.049 | 4,800 / 331 | 75 ~ 78 |
| 1/2 x 0.065 | 4,700 / 324 | 70 ~ 77 |
| 3/4 x 0.095 | 4,900 / 338 | 75 ~ 80 |
| 1 x 0.109 | 4,200 / 290 | 75 ~ 79 |
| 1 ¼ X 0.156 | 4,800 / 331 | 75 ~ 79 |
| 1 ½ X 0.188 | 4,800 /331 | 75 ~ 79 |
| 2 X 0.188 | 3,500 / 245 | 75 ~ 79 |
| **Tests Based on ASTM F1387 – Mandatory Tests** | | |
| **ASTM 1387 Section No.** | **Procedure** | **Comments** |
| A2 | Examination of Specimen | Done |
| A3 | Pneumatic Proof Test | Done |
| A4 | Hydrostatic Proof Test | Done |
| A5 | Impulse Test | Done |
| A6 | Flexure Fatigue Test | Done |
| A7 | Tensile Test | Done |
| A8 | Hydrostatic Burst Test | Done |
| A9 | Repeated Assembly Test | Done |
| A10 | Rotary Flex Test | Done |
| A11 | Mercurous Nitrate Test | - |
| **Tests Based on ASTM F1387 – Supplemental Tests** | | |
| **ASTM 1387 Section No.** | **Procedure** | **Comments** |
| S2 | Thermal Cycling Test | Done |
| S3 | Elevated Temperature Soak Test | - |
| S4 | Stress-Corrosion Test | - |
| S5 | Torsion Test | - |
| S6 | Shock Test | - |
| S7 | Fire Test | - |
| S8 | Vibration Test | Done |

26/08/2021

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ASTM (American Society of Testing and Materials) F1387 establishes the performance characteristics required formechanically attached fittings (MAF) for use in piping and tubing systems.

**All tests witnessed by GLIS no failure observed.**

We hereby confirm that the Above all tests have been performed as per the Procedure laid out in procedure Specification and were found to be satisfactory as per Standard requirements. Below the Procedures are in Details.

Pneumatic Proof Test Results – 3X F-1387 Requirements

All test data was measured and recorded with calibrated Gauges in accordance with ASTM F-1387 requirements.
Each spool containing specimens was submergedunder water.
Each spool was pressurized to 100 psi using Nitrogen(N2) for 5 minutes.
The first minute allowed for the dissipation ofsurface bubbles.
After 5 minutes observing no leakage, the pressure was gradually increased to 125% of the rated workingpressure of the tube, and held for 5 minutes.
No leakage was observed.
After completing the first Pneumatic Proof, each specimenwas disassembled and reassembled two times.
Steps 1 through 6 were repeated a second and third timewith no leakage.
The Pneumatic Proof test was conducted three times. ASTM F-1387 only requires one run. Additionally, the test was conducted at 125% of the rated working **pressure of the tube**. ASTM F-1387 only requires 125% of the rated working pressure of the tube or 500 PSI – WHICHEVER IS LOWER.

| Size / Test Pressure | Tube Rate Pressure | Pressure |
|---|---|---|
| 1/4"T x .049" | 7,500 PSI x 125% | 9,375 PSI |
| 3/8"T x .049" | 4,800 PSI x 125% | 6,000 PSI |
| 1/2"T x .065" | 4,700 PSI x 125% | 5,875 PSI |
| 3/4"T x .095" | 4,900 PSI x 125% | 6,125 PSI |
| 1"T x .109" | 4,200 PSI x 125% | 5,250 PSI |
| 1 ¼" X 0.156 | 4,800 x 125% | 6000 PSI |
| 1 ½" X 0.188 | 4,800 x 125% | 6000 PSI |
| 2" X 0.188 | 3,500 x 125% | 4375 PSI |

Hydrostatic Proof Test Results – 3X F-1387 Requirements

All test data was measured and recorded with calibrated Gauges in accordance with ASTM F-1387 requirements.
Each spool containing specimens was mounted in the testchamber with one end free to move.
Each spool was filled with water.
Each spool was pressurized to 100 PSI for 5 minutes.
After observing no leakage, the pressure was gradually increased to 150% of the rated working pressure of the tube, and held for an additional 5 minutes.
After observing no leakage, the spool was depressurizedand drained.
Each specimen was disassembled and reassembledtwo times.
Steps 1 through 6 were then repeated with no leakage.
Steps 1 through 4 were then repeated. The Hydrostatic Proof test was conducted three times. After the third run,no make and break was conducted as the spools were then subjected to the Hydrostatic Burst Test.

The original specimens were subjected to all three Pneumatic Proof Tests and all three Hydrostatic Proof Tests (including 10 repeat assemblies), concluding with the Hydrostatic Burst Test (destructive test). New specimens wereintroduced for each of the remaining test

| Size / Hydro Pressure | Tube Rate Pressure | Pressure |
|---|---|---|
| 1/4"T x .049" | 7,500 PSI x 150% | 11,250 PSI |
| 3/8"T x .049" | 4,800 PSI x 150% | 7,200 PSI |
| 1/2"T x .065" | 4,700 PSI x 150% | 7,050 PSI |
| 3/4"T x .095" | 4,900 PSI x 150% | 7,350 PSI |
| 1"T x .109" | 4,200 PSI x 150% | 6,300 PSI |
| 1 ¼" X 0.156 | 4,800 x 150% | 7,200 PSI |
| 1 ½" X 0.188 | 4,800 x 150% | 7,200 PSI |
| 2" X 0.188 | 3,500 x 150% | 5,250 PSI |

Hydrostatic Burst Test Results

All test data was measured and recorded with calibrated Gauges in accordance with ASTM F-1387 requirements.

The spools, having completed the third Hydrostatic Proof,were immediately subjected to the Hydrostatic Burst.

The spool pressure was gradually increased from 150% of the rated working pressure of the tube to 4 times the rated working pressure of the tube and held for 1 minute.

After observing no leakage for 1 minute at 4 times the rated working pressure of the tube, the test pressure wasgradually increased until the spool ruptured.

All ruptures took place in the tube sections.

All specimens held as promoted and expected to therupture of the tube.

Tensile Pull Test Results

The significance of this test is to apply a tensile load at a controlled separation speed to establish how much load isneeded to separate the test specimen.

The amount of tensile load applied depends upon thecross-section area and the yield strength of the tube.

Calculated tensile load = $(K_t) \times (A_p) \times (S_y)$

Where $K_t$ = tensile constant of 1.0;

Where $A_p$ = actual cross-section area of the tube, mm2 (in.2) based on wall thickness;

Where $S_y$ = minimum specified yield strengthof the tube.

The specimens pass this test when the calculated tensile load is achieved without separation of the joint. Movementwithin the area of the joint is acceptable as long as actual separation does not occur. This test is useful in determining the strength of the tube or MAF joint. Basedupon the strength of the joint, the tube material and wall thickness can be tailored to withstand failure within the adverse environments present in fluid systems for which MAF is designed.

Rotary Flex Test Results

All test data was measured and recorded with calibrated gauges and properly located strain gauges in accordancewith ASTM F-1387 requirements.

The test spool containing specimens filled with water.

A bending moment equivalent to a minimum of 35% of the ultimate tensile strength (of the tubing material) wasintroduced and locked into place.

Each spool was pressurized to 500 PSI.

The specimen was flexed in a rotary motion at a minimumof 1750 rpm for 1,000,000 cycles while maintaining the bending moment and 500 PSI pressure rating.

After 1,000,000 cycles were completed with no leakage, the specimens were then subjected to a Hydrostatic Proof test. With no leakage after completion of the Hydrostatic Proof Test, the specimens passed the Rotary Flex Test.

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## Flex Fatigue Test Results

All test data was measured and recorded with calibrated gauges and properly located strain gauges in accordancewith ASTM F-1387
Each spool containing specimens was filled with water.
Each spool was subjected to flexure while pressurized tothe maximum rated working pressure of the tube.
The specimen was subjected to a bi-directional flexure in the same plane for 30,000 cycles to a distance rangederived from the formula provided in ASTM F-1387 Section A6.3.5.
A complete cycle consisted of travel from neutral (zero strain) to the maximum positive strain position in one direction, to the maximum negative strain position in theopposite direction, and return to neutral.
At each 7,500 cycles, the spool was depressurized with the specimen being rested was disassembled andreassembled two times.
After 30,000 cycles were completed with no leakage, the specimens were then subjected to a Hydrostatic Proof test. With no leakage after completion of the Hydrostatic Proof Test, the specimens passed the Flexure Fatigue Test.

## Vibration Test Results

All test data was measured and recorded with calibrated gauges and properly located strain gauges in accordance with ASTM F-1387 requirements.
The test spool containing specimens was filled with water.
The test fixture was equipped with supports, to be attachedto the test specimen during testing. The supports were spaced in accordance with ASTM F-1387 requirements per OD size.
The test was conducted in each of the three principledirections (X,Y, and Z).
Each spool was pressurized to the maximum rated workingpressure of the tube.
Perform the following tests: Exploratory Vibration test,Variable Frequency test, and Endurance test.
The specimens successfully passed the Vibration Testafter meeting the test requirements and passing the subsequent Hydrostatic Proof Test.
No leakage was observed.



*For verification visit our registrar* www.gulflloyds.info

Date of Issue: 26/08/2021
Date of Expiry: 25/08/2024

**Issued at:**
**Ahmedabad** — **Place**

**26.08.2021** — **Date**

**K.R. Patel**
**Sr. Inspection Engineer**

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