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شرکت ملی گاز ایران  
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امور تدوین استانداردها

# IGS

مشخصات فنی خرید

دستگاه کاهنده صدا ( ایستگاههای تقلیل فشار گاز )

Inline Silencer ( TBS Stations )



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شرکت ملی گاز ایران



دفتر مدیرعامل

## ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۸۶۶ مورخ ۱۳۹۸/۱۲/۱۱ هیأت مدیره، نامه شماره گ/۰۰۰/۹/۱۶۲۱۶۶ مورخ ۱۳۹۸/۱۲/۰۳ آن مدیریت در مورد تصویب نهایی استاندارد به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱- مشخصات فنی خرید دستگاه کاهنده صدا در ایستگاه های تقلیل فشار گاز

IGS-M-PM-114(0)

۲- مشخصات فنی خرید دستگاه پیل پلاریزاسیون

IGS-M-EL-033(0)

۳- مشخصات فنی خرید کنتور گاز نوع التراسونیک

IGS-M-IN-104(2)

۴- دستورالعمل اجرای کابل فیبر نوری در مسیر خطوط لوله گاز

IGS-C-IT-003(2)

این مصوبه در حکم مصوبه مجمع عمومی شرکت‌های تابعه محسوب و برای کلیه شرکت‌های تابعه لازم الاجرا می‌باشد.

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## Foreword

This standard is intended to be mainly used by NIGC and contractors, and has been prepared based on interpretation of recognized standards, technical documents, knowledge, backgrounds and experiences in natural gas industry at national and international levels.

Iranian Gas Standards (IGS) are prepared, reviewed and amended by technical standard committees within NIGC Standardization division and submitted to the NIGC's "STANDARDS COUNCIL" for approval.

IGS Standards are subject to revision, amendment or withdrawal, if required. Thus the latest edition of IGS shall be checked/inquired by NIGC employees and contractors.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation from normative references and / or well-known manufacturer's specifications must be reported to Standardization division.

The technical standard committee welcomes comments and feedbacks about this standard, and may revise this document accordingly based on the received feedbacks.

## General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

- 1- "STANDARDIZATION DIV" is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.
- 2- "COMPANY": refers to National Iranian Gas Company (NIGC).
- 3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to NIGC whether as the prime producer or manufacturer or a trading firm.
- 4- "SHALL ": is used where a provision is mandatory.
- 5- "SHOULD": is used where a provision is advised only.
- 6- "MAY": is used where a provision is completely discretionary.

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## 1. Scope

This standard specification covers the minimum requirements for design, material, fabrication, testing, inspection, marking, packing and shipment of inline silencers (150, 300 and 600 class ratings), used in natural gas pressure regulating stations:

- The silencer shall reduce the noise of the regulator at least 10 dB.
- Used at an ambient temperature range from -29°C to +60°C.
- This specification is aimed at controlling the flow noise generated in regulator by utilizing passive silencers. Active and Adaptive passive noise control systems are not covered here.
- Any deviation from the specification shall be clearly stated on the technical information, submitted by the supplier.
- This specification does not supersede the accepted pressure vessel codes but only them in certain conditions which they do not fully cover.
- The silencer shall only be used wherever the equivalent sound pressure level of each line in maximum operation load condition is more than the legal limitation.

## 2. Reference Codes and Standards

Throughout this standard specification the following standards, codes and reports are referred to. The editions of these standards and codes that are in effect at the time of publication of this standard specification (2019) shall, to the extent specified herein, form a part of this standard specification. The applicability of changes in standards and codes that occur after the date of this standard specification shall be mutually agreed upon by the purchaser and supplier and/or manufacturer.

### 2.1. Normative

**2.1.1. IEC 61672-1**, “Sound Level Meter Specification”.

**2.1.2. ANSI/ASME 36.10**, “Welded and seamless wrought steel pipe”.

**2.1.3. BS EN ISO 11820** , “ Acoustic Measurements and Testing”.

**2.1.4. ANSI/ASME B.16.5**, “Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24 “.

- 2.1.5. EN ISO 14163** , “Guidelines for Noise Control by Silencers” .
- 2.1.6. ASME Boiler and Pressure Vessel Code (BPVC), Section VIII Division 1** ,  
“Rules For Construction Of Pressure Vessels” .
- 2.1.7. ASME BPVC, Section IX** , “Qualification Standard for Welding and Brazing  
Procedures, Welders, Brazers, and Welding and Brazing Operators”.
- 2.1.8 .NSI S1.4** , “Specification for Sound Level Meter “.
- 2.1.9. ASTM A105**, “Standard Specification for Carbon Steel Forgings for Piping  
Applications”.
- 2.1.10. ANSI/ASME B16.25** , “Butt welding ends”.
- 2.1.11. ASME B16.9** , “Factory-Made Wrought Buttwelding Fittings”.
- 2.1.12. ANSI/ASME B.16.11**, “Forged Steel Fittings, Socket Welding and Threaded”.
- 2.1.13. IGS-M- CH-033(0)** , “Specification for Iranian Natural Gas Quality”.
- 2.1.14. API 5L**, “Specification for line pipe”.
- 2.1.15. IGS-M-PL-001-1(0)**, “SMLS HFW Carbon Steel Pipes Grade B Sizes 0.5 to 4  
inch “.
- 2.1.16. IGS-M-PL-001-2(0)** , “SMLS HFW SAWL SAWH Carbon Steel Pipes Grades  
B” .
- 2.1.17. ANSI B.16.20**, “Metallic Gaskets For Pipe Flanges”.
- 2.1.18. ASTM A193 B7**, “Standard Specification for Alloy-Steel and Stainless Steel  
Bolting for High Temperature or High Pressure Service and  
Other Special Purpose Applications”.
- 2.1.19. ASTM A194 2H** , “Standard Specification for Carbon Steel, Alloy Steel, and  
Stainless Steel Nuts for Bolts for High Pressure or High  
Temperature Service, or Both”.
- 2.1.20. ISO 3834-2**, “Quality requirements for fusion welding of metallic materials –  
Part 2: Comprehensive quality requirements”.
- 2.1.21. SNT-TC-1A**, “Personnel Qualification and Certification in Nondestructive  
Testing”.
- 2.1.22. ANSI/ ASME B1.20.1** , “Pipe threads, general purpose (Inch)”
- 2.1.23. ASME BPVC, section V** , “Nondestructive Examination”
- 2.1.24. BS 4142**, “Method for Rating Industrial Noise Affecting Mixed Residential and  
Industrial Areas”.
- 2.1.25. ASTM B 117** , “Standard Practice for Operating Salt Spray (FOG) Apparatus”.
- 2.1.26. IGS-O-CH-042**, “Painting Procedure for Gas Industry Installations”.

**2.1.27. IPS-G-GN-230: 2016**, “General Standard for Basic Design Package and Recommended Practice for Front End Engineering Design”.

“ ۲۸-۱-۲ - آیین نامه اجرایی مصوب ۱۳۹۶/۱۱/۱ ماده ۲۹ قانون هوای پاک ایران مصوب ۱۳۹۶/۴/۲۵ ”

## 2.2. Informative

**2.2.1. IPS-C-TP-101 & 102**, “Surface Preparation and Painting”.

**2.2.2. IGS-M-IN-202**, “Gas Pressure Regulators for Nominal Inlet Pressure 5 to 100 bar (72-1450 psig)”.

**2.2.3. IPS-E-GN-100**, “Engineering Standards for Units”.

**2.2.4. IPS-C-IN-110**, “Pressure instruments”.

**2.2.5. IPS-E-IN-120**, “Temperature instruments”.

**2.2.6. MSS SP-97**, “The Integrally Reinforced Forged Branch Outlet Fittings, Socket Welding, Threaded and Butt welding Ends”.

**2.2.7. ASTM A53**, “Standard Specification for Pipe, Steel, Zinc-Coated, Welded and Seamless”.

**2.2.8. ASTM A216**, “Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service”.

**2.2.9. API 1104**, “Welding of Pipelines and Related Facilities”.

**2.2.10. IGS-M-RS-401(1)**, “Specification for Measuring Reducing and Measuring Cabinet Type Stations with Max Capacity up to 10000 SCM per H “.

**2.2.11. IPS-C-IN-110** , “Construction Standard for Pressure Instruments “.

**2.2.12. IPS-E-GN-100(1)**, “Engineering Standard for Units” .

**2.2.13. IPS-E-IN-120(1)**, “Engineering Standard for Temperature Instruments “.

**2.2.14. IPS-M-PI-190(3)**, “Material and Equipment Standard for Line Pipe”.

**2.2.15. NIOEC-SP-80-02(0)**, “Material Standard Specification for Painting”.

**2.2.16. EN ISO 7235**, “Acoustic Laboratory measurement procedures for ducted silencers and air-terminal units – Insertion loss, flow noise and total pressure loss”.

**2.2.17. EN ISO 11691**, “Acoustic Measurement of insertion loss of ducted silencers without flow – Laboratory survey method”.

### 3. Abbreviation and symbols

#### 3.1. Abbreviation

**BPVC:** Boiler and Pressure Vessel Code.

**dB:** Decibel.

**LAeq [dB]:** the A-weighted energy equivalent sound pressure level from 16 Hz to 20 kHz.

**NDT:** Non-destructive Test.

**N.I.G.C:** National Iranian Gas Company.

**SLM:** Sound Level Meter .

**SPL or Lp:** Sound Pressure Level/ Level of Pressure .

**FAT:** Factory Acceptance Test.

**SAT:** Site Acceptance Test.

#### 3.2. Symbols

**qv [m<sup>3</sup>/sec]:** Volume flow of gas.

**P [Pa]:** the mean-square sound pressure.

**p<sub>0</sub>[Pa]:** Reference sound pressure is equal to 20x10<sup>-6</sup>.

**[Pa]:** Upstream mean total pressure of silencer  $\overline{p_{Tu}}$ .

**[Pa]:** Downstream mean total pressure of silencer  $\overline{p_{Td}}$ .

**s<sub>d</sub>[m<sup>2</sup>]:** Silencer downstream cross-sectional area.

**s<sub>u</sub>[m<sup>2</sup>]:** Silencer upstream cross-sectional area.

**[kg/m<sup>3</sup>]:** Density of gas  $\rho$ .



## 4. Definitions

### 4.1. Source

It is a sound generator which its sound level is more than the background noise. The main source in the pressure regulating stations is regulator.

### 4.2. Background noise

Background noise is any sound, heard when all lines (Runs) of the gas station are closed. This sound not coming from source and the duct or aperture for which the silencer will operate.

### 4.3. Sound pressure level

Sound Pressure Level (SPL) is the ratio of the absolute Sound pressure to a reference pressure (usually the Threshold of Hearing, or the lowest sound intensity which can be heard by the majority of people).

$$SPL = 10 \log \frac{p^2}{p_0^2}$$

The references sound pressure ( $p_0$ ) is equal to  $20 \times 10^{-6}$  pa

### 4.4. Equivalent sound level, $Leq$

Equivalent continuous sound level,  $Leq$  preferred method to describe sound levels that vary over time, resulting in a single decibel value which takes into account the total sound energy over the period of time of interest. The width of a restricted frequency band shall be indicated for determination of  $Leq$ . For example, octave band pressure level, one-third octave band pressure level, etc.

A-weighting assigns a “weight” to each frequency. At every given frequency the weight is related to the sensitivity of the ear. In a sound level meter, the received signal passes through a filter network, which changes the”, displayed signal to  $LA_{eq}$ . “A-weighting is the most commonly system used of a family of curves defined in IEC 61672:2003 and various national standards, relating to the measurement of sound pressure level.

### 4.5. The human hearing range

generally young people’s range of hearing, which narrows with age and considerably varies among individuals, is 20 Hz to 20 kHz.

### 4.6. Octave or one-third octave bands

the range of audio frequency is divided into 8 bands with centre frequencies being  $F_c = 63, 125, 250, 500, 1000, 2000, 4000$  and  $8000$  Hz, called octave bands. One-third octave bands are formed by subdividing each octave band into three parts.

#### 4.7. Passive silencer

the noise generated by air/gas handling/consuming equipment is controlled through the use of two types of devices: (1) passive silencers and (2) Active noise control silencers. Passive silencer performance is a function of the geometric and sound-absorbing properties of their components. The commercial types of this mechanical silencer are reactive, absorptive (also called dissipative) or a combination of both (For more explanation see index 1).

#### 4.8. Active and Adaptive passive noise control systems

In active and Adaptive passive noise control silencer noise cancellation features are controlled by various electromechanical feed-forward and feedback techniques. Active noise control systems mainly consist of speaker sets driven by amplifiers with input from suitable microphones (For more explanation see index 1).

#### 4.9. Line

natural gas piping in pressure regulating stations.

#### 4.10. Run

A different term for line.

#### 4.11. Full load

The nominal flow rate through the natural gas piping in the design condition.

#### 4.12. In-Line silencer

a device which is put in the line, and the main fluid of pipe flows through it. For brevity we use silencer instead of inline silencer here.

#### 4.13. Insertion sound pressure level difference, $D_{isp}$

the difference, in A-weighted sound pressure levels measured (in dBA) at the receiver point before and after installation of silencer:

$$D_{isp} = L_{pl} - L_{pII}$$

Where

$L_{pl}$  is the sound pressure level before installation of the silencer in dBA.

$L_{pII}$  is the sound pressure level after installation of the silencer in dBA.

#### 4.14. Receiver point

The point in space where the sound level meter microphone should be placed within line noise measurements.

#### 4.15. Nominal size

a number, identifying the size of the pipe. The relationship between nominal size and outside/inside diameter is explained in ASME 36.10

**4.16. Sound level meter**

A device used to measure sound pressure level.

**4.17. Wind screen device**

A device which contains a flexible polymer porous media, covered around the microphone in windy conditions.

**4.18. Windy condition**

if human ear can hear the wind at the receiver point, the weather condition is considered windy.

**4.19. Static pressure loss of silencer**

According to BS EN ISO 11820, the static pressure loss of silencer is calculated as mentioned in Ind.2.3 (index 2).

**4.20. Type Test**

A testing performed on a typical sample to prove that the silencer is affecting the regulator acoustical performance.

**4.21. Total pressure loss,  $\Delta p_T$  [Pa]**

Difference between  $\overline{p_{Tu}}$  and  $\overline{p_{Td}}$  of the silencer

**4.22. Class ratings**

Piping Class Ratings is based on the ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard - class and the corresponding ISO 7005 PN ratings.

**4.23. End of life cycle**

The end of silencer service life at which it needs to be replaced or repaired.

**5. Requirements****5.1. Design and service conditions**

This standard covers passive silencers only. As mentioned in EN ISO 14163, silencer insertion loss is mainly due to reflective or/and dissipative mechanisms in the form of reflective or/and dissipative media, installed inside the spool. For more explanation see index 1. Such silencer shall have the general characteristics listed below:

**5.1.1.** The silencer shall be installed before the regulator sensors.



**5.1.2.** The supplier may use the reflective mechanisms, dissipative mechanisms or both in their silencer to reach the desired insertion loss.

**5.1.3.** The silencer shall be for outdoor installation and all its parts shall be resistant to atmospheric corrosion as well as the continuous attack of odorized natural gas & methanol.

**5.1.4.** The ambient temperature range for the silencer should be at a minimum -29oC to 60oC. This ambient temperature range applies to the silencer body with and without gas flow, sensing lines, etc.

**5.1.5.** The silencer shall be so designed that externally tight and internally sealed.

**5.1.6.** The silencer may be connected to the pipe by flange or welding.

**5.1.7.** End connections may be one of the following:

- a - Flanged connections in accordance with ANSI B 16.5 classes 150,300,600.
- b - Flangeless type (wafer body) suitable for installation between 2 flanges according to ANSI B 16.5.
- c - Threaded connections females, NPT in accordance with ANSI/ASME B 1.20.1 (for class 150 and sizes up to and including 2").

**5.1.8.** The inlet and outlet connections of silencer shall be in – line. Direction of flow shall be permanently embossed on the silencer.

**5.1.9.** The silencers shall be designed for full load and shall be capable of unattended and continuous performance in outdoor conditions under direct sun light and rain without the provision of special housing or shelter.

**5.1.10.** The supplier shall furnish complete operating unit (all necessary items included) to ensure satisfactory operation of silencer.

**5.1.11.** The silencer shall be designed to withstand the internal pressure load, the structure weight, the probable impact during maintenance or operation condition and earthquake.

**5.1.12.** All parts of the silencer shall be designed and manufactured in compliance with ASME BPVC Section VIII Division 1.

**5.1.13.** Suspended particles in the gas flow are one of the main reasons for silencer to malfunction. Since such problems recur and are unpreventable, supplier should install an indicator (such as differential pressure gauge) on the device to detect internal non-visible parts defects.

**5.1.14.** Supplier shall provide a maintenance instruction for repairing and periodic overhaul of the silencer.

**5.1.15.** welding procedure shall conform to requirements of ASME BPV code section IX.

**5.1.16.** Design should allow access to the internal parts of the silencer for their periodic inspection and maintenance, according to the maintenance .

**5.1.17.** Regarding the safety conditions and legal limitations according to the table 1 for the gas station noise, the silencer shall reduce the noise of the regulator at least 10 dB. In addition to the silencer, the supplier should apply other acoustic devices or instruments to reduce the noise as much as possible.

<b>Zoning Districts</b>	<b>The average level of Night Time: <math>\overline{Lp}_{Night} dB (A)</math></b>	<b>The average level of Day Time: <math>\overline{Lp}_{Day} dB (A)</math></b>
<b>Residential</b>	45	55
<b>Residential- Business</b>	50	60
<b>Business</b>	55	65
<b>Residential- Industrial</b>	60	70
<b>Industrial</b>	65	75

**Table 1: Maximum Allowable Sound Pressure Levels for Different Zoning Districts**

**Note:**

1. Day Time shall mean from 7.00 a.m. to 10.00 p.m. (15 hours)
2. Night Time shall mean from 10-00 p.m. to 7.00 a.m. (9 hours)

The day and night sound pressure levels are calculated from following relation; which  $Leq(10')$  is the equivalent sound pressure level measured over ten minutes during every hour. In this formula the n is the number of day and night hours.

$$\overline{Lp}_{Day} = 10 \log \sum_{i=1}^n \frac{Leq(10')_i}{n}, n = 15$$

$$\overline{Lp}_{night} = 10 \log \sum_{i=1}^n \frac{Leq(10')_i}{n}, n = 9$$

**5.1.18.** The silencer pressure loss shall not cause deviation in the regulator's role in regulating the downstream pressure. As mentioned in paragraph 5.1.1 the silencer shall be installed before the regulator's downstream sensors. Thus the silencer undertakes a small fraction of regulator pressure drop.

**5.1.19.** The Company shall not order any silencer for the lines if the equivalent sound pressure level of each line in maximum operation load condition is less than legal limitation.

## **5.2. Measurement Requirements**

**5.2.1.** Any Sound Level Meter (SLM) used shall be in accordance with ANSI S1.4/ IEC 61672.

**5.2.2.** Before each measurement, the SLM shall be calibrated in a laboratory, certified by international or national organizations.

**5.2.3.** All sound measurements shall be taken in full load flow rate of the line and during measuring the SPL of each line, no flow should pass through the other lines.

**5.2.4.** All the noise measurements shall be done at the receiver point.

**5.2.5.** During measurements, there shall be no obstacle or sound affecting body between the SLM and the line.

**5.2.6.** There should be no wall or sound reflecting surface near the receiver point less than 1m while measuring.

**5.2.7.** SPLs are measured in octave bands or in a narrower range such as one-third octave bands if possible.

**5.2.8.** Measurement time shall be long enough to ensure the stability of LAeq, that can be determined within an uncertainty of no more than 1 dB.

**5.2.9.** The final SPL shall be reported in LAeq form.

**5.2.10.** In windy conditions the noise caused by wind that flow around the microphone shall be suppressed by a windscreen.

**5.2.11.** All sound measurements shall be in accordance with ISO 11820 and in case of conflicts, this standard takes precedence over ISO 11820:1996.

**5.2.12.** Supplier should provide the equipment required for measuring the flow rate and upstream and downstream pressure of the silencer in the test section. It may also need to provide flow meter and differential pressure gauges.

### **5.3. Materials**

**5.3.1.** The material of body should be forged carbon steel according to ASTM A105 or seamless pipe according to ASTM A 106 Gr. B suitable for -29°C to 60°C ambient temperature (IGS-M-PL-001-1(0) and IGS-M-PL-001-2(0)).

**5.3.2.** All tubes and sensing lines shall be stainless steel type 316.

**5.3.3.** Non – metallic parts material of silencer such as "O" rings, etc. shall be resistant to odorized natural gas and not to reduce its service life or result in sluggish operation of unit at maximum and minimum temperature specified.

**5.3.4.** Installed acoustical elements inside the silencer shall have acceptable resistance against erosion and corrosion such as stainless steel or corrosion resistant plated sheet. All metallic parts shall with stand 500 hours salt spray test in according with ASTM B117 without blistering, peeling our under film corrosion.

**5.3.5.** The parts which have short life span and need to be replaced or repaired periodically, shall be marked in the data sheet by the supplier.

**5.3.6.** Material of diffuser should be the same as body. Absorber shall be made of 316 Stainless steel.

**5.3.7.** In the flange-end connections the design and manufacturing of flange fittings shall comply with ANSI B16.5 for, Gaskets shall comply with ANSI B.16.20, and bolting shall comply with ASTM A193 B7 & A194 2H.

### **5.4. Welding requirements**

**5.4.1.** In silencer fabrication, shielded metal arc welding or automatic and semi-automatic welding procedures in accordance with ASME Section IX. Electrodes shall be compatible with the silencer body materials.

**5.4.2.** Welders Qualification Test (WQT): Welder and Operator Qualification Test shall be in accordance with ISO 3834-2 or section IX of the ASME code.

**5.4.3.** The supplier shall specify the make and quality of the proposed electrodes for the silencer fabrication. Welding shall not be subjected to any other code without the prior approval of the purchaser.

**5.4.4.** The welded joints of the body shall be fabricated and tested according to ASME BPVC, section V, VIII, and IX.

**5.4.5.** All nozzles and small connections and their utilities shall be attached to the vessel with full penetrate.

**5.4.6.** In the manufacturing procedure of the silencer the welds and fittings should comply with ASME B36.10, B16.25, B16.9 and B16.11.

**5.4.7.** Buttwelded-end connections shall be made according to ASME BPVC, section IX.

**5.4.8.** Welding shall be carried out with calibrated equipment.

**5.4.9.** Repair and Re-Inspection: Defects shall be repaired in accordance with the approved repair procedures and the joint shall be re-inspected by the same methods, and re-examined to the same extent, and by the same acceptance criteria required for the original weld. All repairs shall be carried out with prior permission of the client.

## **6. Inspection, tests & certificates**

The inspection and test shall be carried out according to a Non-Destructive Testing procedure. Welding inspection personnel shall be qualified according to ISO 3834-2 or SNT-TC-1A.

### **6.1. inspection documents**

The silencer design documents such as the drawings and calculations shall be confirmed by the purchaser before production is begun.

Prior to the shipment of the product to the designer or the operator, the manufacturer shall perform the specified tests and checks on the silencers. The results of all tests and checks performed shall be documented and reported.

This report shall include minimum the following items:

At least one copy of the complete report in form of electronic file with Pdf format or hard copy shall be sent to the designer or the operator and one copy retained in the manufacturer's files.

The manufacturer shall ensure that the complete report is available to the operator for 10 years.

- a. The name and address of the manufacturer.
- b. The name and address of the test facility.
- c. The model and serial number.
- d. The date (s) of the test.





- e. The name and title of the person (s) who conducted the tests.
- f. A written description of the test procedures.
- g. A descriptions of any variations or deviations from the required test conditions.
- h. Material certificates.
- i. Drawing and data sheet.
- j. The results of the tests.
- k. Guarantee and compliance certificate.

## **6.2. Tests**

### **6.2.1 Visual inspection**

Visual inspection including checking of the welded joints of the silencer body, workmanship, coating, connection, internal parts, nameplate, packing, etc.

No apparent imperfection shall be observed.

### **6.2.2. Dimensional check**

The dimensional checks are including the compliance of the silencer construction with the pertinent assembly drawing and the dimensional conformity of pressure containing parts with the applicable drawings.

### **6.2.3. Materials check**

The verification of the material used shall be carried out by the review of material certificates and test reports in compliance with this specification (section 6.3). If requested, materials shall be tested in present of inspector.

Suppliers shall give valid certificates to client to prove the conformity of raw materials with the technical specifications of this standard in accordance with the ASME BPVC Section VIII Division 1 (UG-93: Inspection of Material).

### **6.2.4. NDT (Non-destructive Test)**

**6.2.4.1.** NDT Personnel: Non-destructive testing personnel shall be certified in accordance with ASNT Recommended Practice SNT-TC-IA for the test method used approved by the Company. Only level II or III personnel shall interpret the test results.

**6.2.4.2.** NDT Procedures and Interpretation: Non-destructive tests procedures shall be prepared by the manufacturer and approved by the client in accordance with ASME Section V, and after confirmation by the level III NDT personnel and employer should be used.

**6.2.4.3.** Non-destructive tests shall be interpreted in accordance with ASME Section VIII.

**6.2.4.4.** Interpretation of the radiographic films and other non-destructive tests shall be carried out by the approved companies of the NIGC in the related field. Also, the Interpreter of the radiographic films shall be separate from the radiographer.

**6.2.4.5.** Hydrostatic test: All pressure containing parts of each silencer including those parts that may become pressure containing parts in the event of a failure, shall be pressure tested. The test shall be carried out according to the table 2 for 10 minutes. No leakage or permanent deformation shall be observed. Hydrostatic test shall be done in accordance with the ASME Section VIII Division 1.

Pressure class	Min. test pressure (PSI)
150	425
300	1100
600	2175

**Table 2: pressure values for the strength test**

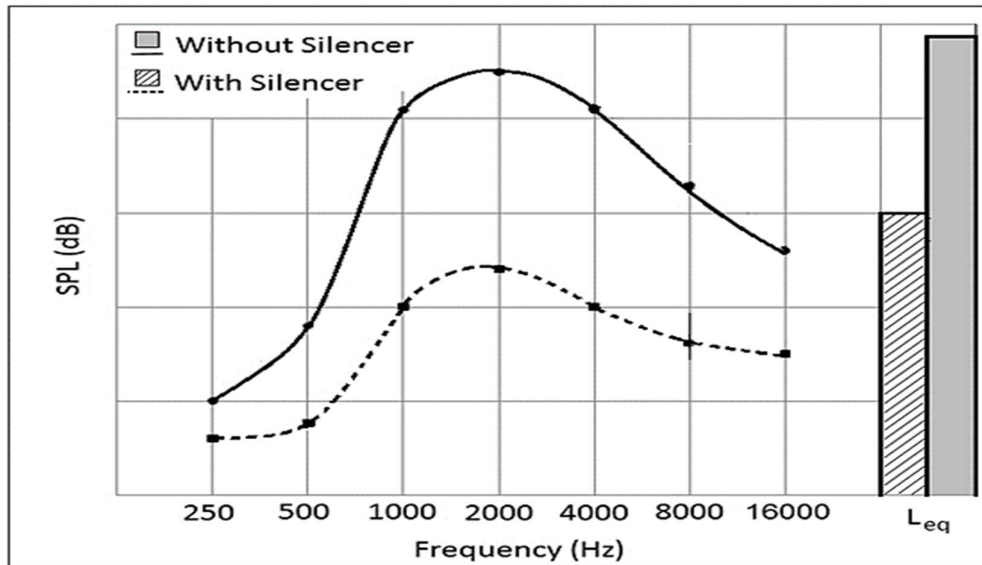
## **6.2.5. Hydrostatic & Tightness test**

### **6.2.5.1. Acoustic Performance Type Test Curve**

**6.2.5.1.1.** The acoustic performance of the typical silencer in full load condition of regulator shall be presented by spectral values of insertion SPL difference or equivalent value of sound level,  $L_{eq}$  which defined in clauses 4.13 and 4.4, respectively. The Template of acoustic performance is shown in figure 1. In this figure the spectral curves of insertion SPL difference and equivalent values of sound level,  $L_{eq}$  are shown for typical conditions with/without silencer. The scale of the vertical axis is intentionally not shown in the figure, since it can include all the silencers of this type. Also the acoustic performance of silencer can be reported in a table, include spectral or equivalent values of sound pressure level and insertion SPL difference.

**6.2.5.1.2.** Type test certificate remains valid unless the material, design, etc. of the silencer is later changed.

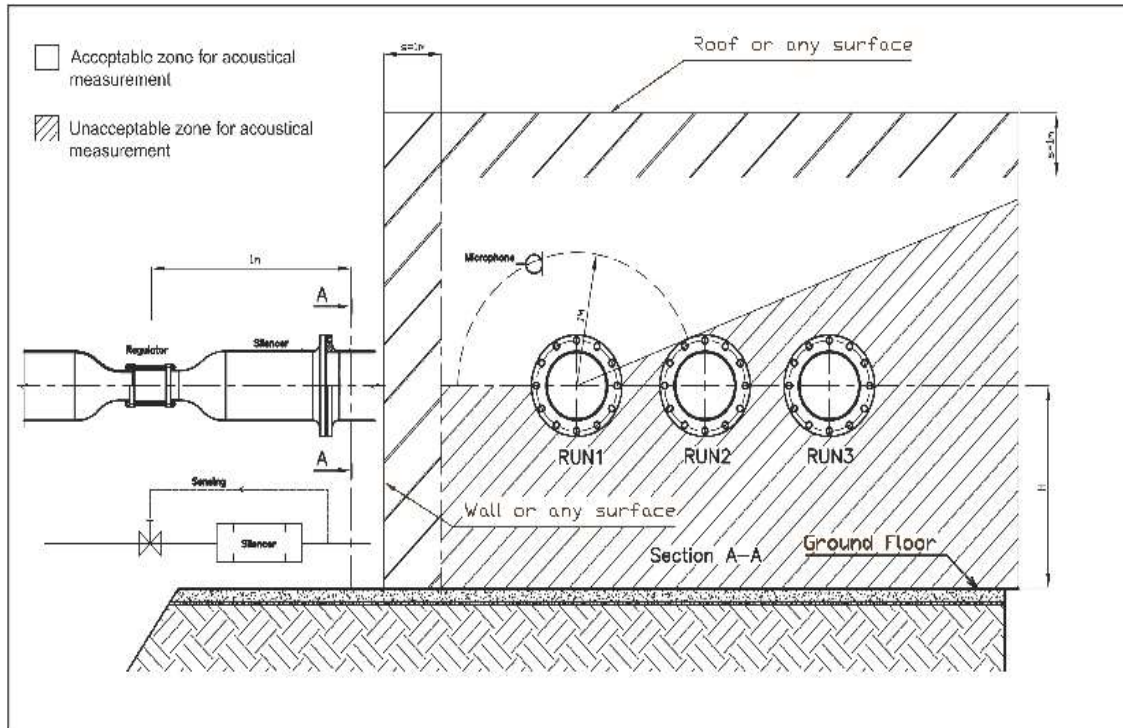
**6.2.5.1.3.** The closest configuration of patterns of BS EN ISO 11820 for the acoustic performance test of current standard is shown in fig Ind.2.1 of index 2.



**Figure 1. The spectral insertion SPL difference of the typical silencer**

**6.2.5.1.4.** According to table Ind.2.1 (index 2) the results of the measurements shall be corrected if the difference between source sound and background noise is less than 10 dB. The background noise is measured and calculated as defined in BS 4142. The background noise correction shall be taken into account if the difference between the measured sound pressure level and background noise is less than 10 decibels. Details are explained in ISO 11820 in “Correction for background noise” section. As mentioned in ISO 11820, during measurement, the difference between measured sound pressure level and background noise shall not be less than 3 decibels.

**6.2.5.1.5.** Figure 2 shows a three-run gas station. The sound level meter microphone should be placed in the receiver point across the line noise measurements. It should be placed at a height of least 1 meter above ground and at least at the same height as the line ( $\geq 1\text{m}$  and  $\geq H$ ). Both the radial distance from the line centre and longitudinal distance ( $L$ ) from regulator, shall be 1 meter ( $D=1\text{m}$ ). In addition, the measurement microphone shall be located more than 1 meter away from any acoustically reflective surface such as, a wall, roof or a barrier ( $S \geq 1\text{m}$ ). Let us assume that we want to measure SPL for Run 1 in figure.2 then the allowable area for the microphone is the area which is not hatched.



**Fig. 2 Position of sound level meter microphone to measure SPL: Allowable area of microphone for Run 1 acoustic performance test**

#### 6.2.5.2. Effect on the regulator performance

Supplier shall provide the approved documents of a theoretical or experimental approach to prove that the silencer hasn't a negative effect on the regulator performance as mentioned in clause 5.1.19. In the experimental approach, type test shall be performed at the same size and class with the same type of regulator.

#### 6.2.5.3. Aerodynamics Performance Type Test Curves

Supplier shall provide the approved documents of aerodynamics performance type test curves. Type test result is expected to include a total of three main performance curves or nominal values (flow rate versus pressure loss) under the following conditions:

- Performance curve or nominal value of the regulator in the normal condition with no silencer installed.
- Performance curve or nominal value of the regulator connected to a clean and unused typical silencer.

- Performance curve or nominal value of the regulator connected to a typical silencer at the end of life cycle. In the end of life cycle a used or manually clogged silencer installed at downstream of the regulator under following conditions:
  - Regulator is manually set at wide (fully) open.
  - Nominal flow rate passes through the silencer.
  - Differential pressure between upstream and downstream of the regulator does not exceed the nominal operating pressure loss of it, whereas the upstream pressure is the same as its nominal value.

### **6.2.6. Coating and test**

The latest version of IGS-O-CH-042 "Painting Procedure for Gas Industry Installations" shall be applied.

**6.2.6.1** The colour of paint shall be grey according to requirements as mentioned at "painting" section.

**6.2.6.2** The thickness of paint shall be measured at five points on different sides of silencer. The difference between minimum and maximum measured values of each individual point shall not exceed 20% of minimum of measured value.

### **6.3 Inspection & certificates**

**6.3.1** Prior to delivery of the Silencer, the manufacturer should make the following documents available for inspector's review: material, procedures, welding and NDE reports and certificates, pressure test reports, performance functional reports and certificates correlated to serial number and commodity compliance certificate (with NIGC purchase order requirements).

**6.3.2** The silencers of each delivery will be inspected according to terms and conditions of purchase order for 5% random samples chosen by inspector of each item (minimum one sample) (unless otherwise specified by mutually agreed inspection . Procedure base on capacity and quantity of each delivery). Required tests, inspection & checking at the inspection are as follow:

1. Visual inspection
2. Dimensional check
3. Material check (test reports should be traceable)
4. Control of NDT & reports
5. Hydrostatic test

6. Acoustic Performance test
7. Aerodynamic Performance test
8. Coating test
9. Pre shipment and final inspection

Manufacturer shall submit test certificates verified by a national bureau of test and standard institute and NIGC inspector may select the samples for these tests.

## **7. Marking**

### **7.1. General requirements**

Each silencer shall carry markings containing at least the following data:

- Manufacturer and/or registered trade-mark
- Purchase order No
- Silencer type
- Serial number
- Year of manufacture
- Nominal size DN and class rating
- Allowable pressure
- Design pressure
- Design temperature

If a nameplate is used it shall be permanently legible and attached at a clearly visible place. The technical details listed above shall be repeated in operating instructions.

### **7.2. Marking of built – in safety devices**

The safety devices shall be marked according to the relevant standard. These inscriptions must be directly visible, easily legible and indelible under the normal condition of use of the silencer.

## **8. Packing, Packaging and Shipment**

For each silencer, packing shall be in accordance with N.I.G.C protection, packing, marking and dispatching instruction in accordance to IPS-G-GN-230.

**A-** Each silencer shall be put in a plastic bag with all openings such as inlet, outlet covered, by plastic caps.

**B-** Each silencer in plastic bag shall be housed in a wooden support.

**C –** The wooden supports shall be housed in wooden cases according to NIGC packing instructions under protection, packing, marking and dispatching.

## **9. Documentation**

### **9.1. With technical quotation**

The manufacturer is required to complete, sign and submit the attached data sheet (s) according to index 4 and as well as 2 sets of the following documentation in English together with technical quotation.

All documentation should be dated.

**9.1.1.** A description of the silencer, giving the technical characteristics and the principle of its operation.

**9.1.2.** A perspective drawing or photograph of the silencer

**9.1.3.** A nomenclature of parts with a description of constituent materials of such parts.

**9.1.4.** An assembly drawing with identification of the component parts listed in the nomenclature.

**9.1.5.** A dimensioned drawing

**9.1.6.** A drawing showing the location of verification marks and seals

**9.1.7.** A dimensioned drawing of metro logically important components

**9.1.8.** A drawing of any auxiliary devices

**9.1.9.** Instructions for installation, operation, periodic maintenance and trouble – shooting

**9.1.10.** Maintenance documentation including third – party drawings for any filed repairable components.

**9.1.11.** Documentation that the design and construction comply with applicable components safety codes and regulations.

**9.1.12.** A list of the documents submitted

**9.1.13.** Recommended two years parts list

**9.1.14.** Manufacturer standard (informative)

**9.1.15.** Type test certificate

**9.1.16.** List of spare parts and their lifetime

## **9.2. After receipt of order**

The manufacturer should furnish specific silencer outline drawings, including overall flange face to face dimensions, inside diameter.

The manufacturer should provide a recommended list of spare parts.

## **10. Guarantee and After-sell Services**

**10.1.** Manufacturer shall guarantee the compliance of material and performance of the supplied equipment with this specification.

**10.2.** The guarantee period shall be one year after equipment goes on stream or 24 months from date of shipment, whichever occurs first.

**10.3.** Supplier should agree to repair on site or replace any part, equipment or unit which proves to be defective during the above mentioned period free of charge.

**10.4.** Manufacturer shall supply the spare parts of silencer for at list 10 years after selling it.



### **Index 1: [EN ISO 14163 Guidelines for Noise Control by Silencers]**

According to the dominant attenuation mechanisms involved, silencers may be classified as: dissipative silencers, reactive silencers, including resonator and reflective silencers, blow-off silencers, and active silencers.

#### **Ind.1.1. Dissipative silencers**

These provide broad-band sound attenuation by conversion of sound energy into heat with relatively little pressure loss. Precautions shall be taken to prevent coating or clogging of the surface of the absorbent material when dissipative silencers are used in ducts carrying gases contaminated with dust or encrusting material. Porous absorbers made of fine fibrous material or thin-walled structures may be mechanically destroyed by high amplitudes of alternating pressure.

#### **Ind.1.2. Resonator silencers (reactive)**

These reduce the conversion of gas pulsations and oscillations into sound energy and absorb sound. Single resonators are mounted as side branches in duct walls. Groups of resonators are used as duct linings or splitter elements (baffles) in ducts, thus causing a limited pressure drop. Resonances are mostly tuned to low and intermediate frequencies, where attenuation is needed. The performance is limited to a narrow frequency band, is sensitive to grazing flow and may (under certain unfavorable conditions) be negative so that a tone is generated.

#### **Ind.1.3. Reflective silencers (reactive)**

These reduce the conversion of gas pulsations and oscillations into sound energy. They are usually chosen for their robustness in applications where purely dissipative silencers are less suitable, and where greater pressure loss is permissible. This is the case, for example, with gas flows carrying dust, or with higher flow velocities and pressure pulsations, and for applications with strong mechanical vibrations. The maximum attenuation and the frequency where it occurs will be affected by the flow. It is possible that in some frequency bands only little or even negative attenuation is encountered.

#### **Ind.1.4. Blow-off silencers**

These are mounted on steam and pressurized air release lines and are effective by reaction on the source of sound, such as a valve, and by lowering the exit flow velocity through an expanded surface area while conversion of sound into heat is usually of little significance. Large pressure losses require the silencer to have a good mechanical stability. Its performance can be affected by material carried by the gas. There is also a danger of icing.

#### **Ind.1.5. Active silencers**

Silencer providing for the reduction of sound through interference effects by means of sound generated by controlled auxiliary sound sources. These mainly consist of speaker sets driven by amplifiers with input from suitable microphones. Active

silencers are most effective at low frequencies where passive dissipative silencers offer little attenuation. These are specialist devices not dealt with in this Standard.

**Ind. 1.6. Adaptive passive Silencer**

Silencer with passive sound-attenuating elements dynamically tuned to the sound field. In Adaptive passive silencer noise cancellation features are controlled by various electromechanical feed-forward and feedback techniques.

## Index 2: BS EN ISO 11820 -Acoustic-Measurement on Silencer in situ- Installation Conditions

### Ind. 2.1 installation configurations for transmission loss measurements

Potential installation conditions in which either the transmission loss or the insertion loss may be determined are schematically illustrated in Fig. Ind.2.1. There are 16 different installation configurations for transmission loss measurements and 4 for insertion loss measurements and the configuration of figure Ind.2.1 is the closest one to current standard object.

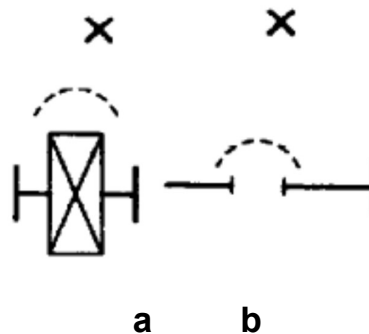


Fig. Ind.2.1 Position of sound level meter microphone to measure SPL (BS EN ISO 11820: 1996) a. Piping without silencer b. Piping with silencer

Table Ind. 2.1. Corrections for background noise (values in decibels)

Difference between sound pressure level measured with sound source operating and background sound pressure level alone	Corrections to be subtracted from sound pressure level measured with sound source operating to obtain sound pressure level due to sound source alone
<3	Measurement invalid
3	3
4	2
5	2
6	1
7	1
8	1
9	0.5
10	0.5
>10	0

### Ind. 2.2. Measured results correction

If the difference between sound coming from source and the duct or aperture for which the silencer will operate and background noise would be less than 10 dB according to table Ind.2.1 the measured results shall be corrected.

### Ind. 2.3. Calculation of pressure loss of silencer

Where the inlet and outlet areas of a ducted silencer differ, but the temperature of the gas does not vary markedly, the static pressure difference  $\Delta p_s$  is related to the total pressure difference  $\Delta p_T$  by:

$$\Delta p_s = \Delta p_T - \frac{\rho q_V^2}{2} \left( \frac{1}{s_u^2} - \frac{1}{s_d^2} \right)$$

Where the total pressure loss,  $\Delta p_T$  (of a silencer) is the difference between mean total pressure upstream,  $\overline{p_{Tu}}$ , and downstream,  $\overline{p_{Td}}$  of the silencer.

$$\Delta p_T = \overline{p_{Tu}} - \overline{p_{Td}}$$



### Index 3: Silencer Datasheet

To be filled by purchaser		To be filled by manufacturer / supplier	
Inquiry No:		Quotation No. :	
Item No:		Item No:	
Inquiry Date :		Quotation Date :	
NIGC Standard:		Catalogue No.	
The data sheet is provided by		Manufacturer <input type="checkbox"/> supplier <input type="checkbox"/>	
General	Subject	To be filled by purchaser	To be filled by manufacturer
	Tag No.	_____	.....
	Application	.....	_____
	Upstream/downstream Line size ( IN)	.....	_____
	Model No		
P&ID (Attached)	To be provided by purchaser	To be sent comment if any	
Process Data	Fluid	Natural Gas	.....
	Capacity [SCMH]	.....	.....
	Line noise: [dB]	.....	.....
	Attenuated noise by silencer at full Load: [dB]	.....	.....
	Ambient temperature range :	<input type="checkbox"/> - 29oC to +60oC	<input type="checkbox"/> - 29oC to +60oC
	Maximum silencer working pressure : [Pa/psig]	.....	.....
	Standard condition	1.01325 bara & 15.560 C (14.696 PSIA& 600 F)	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Maximum pressure loss at $Q_{max}$ for unused silencer: [Pa/psig]	-	< 7% Regulator Reduced Pressure [pa/psig] <input type="checkbox"/> < 15% Regulator Reduced Pressure [pa/psig] <input type="checkbox"/> ..... [pa/psig] <input type="checkbox"/>



Process Data	Subject	To be filled by purchaser	To be filled by manufacturer
	Maximum pressure loss at $Q_{max}$ for used silencer (End of life cycle): [Pa/psig]	-	< 10% Regulator Reduced Pressure [pa/psig] <input type="checkbox"/> < 20% Regulator Reduced Pressure [pa/psig] <input type="checkbox"/> ..... [pa/psig] <input type="checkbox"/>
	Maximum Velocity at main path of device: [m/s]	-	<= 20 [m/s] <input type="checkbox"/> <= 50 [m/s] <input type="checkbox"/> > 50 [m/s] <input type="checkbox"/> .....[m/s]
	Type	Reactive <input type="checkbox"/> Absorptive <input type="checkbox"/> Combined <input type="checkbox"/> Other <input type="checkbox"/>	Reactive <input type="checkbox"/> Absorptive <input type="checkbox"/> Combined <input type="checkbox"/> Other <input type="checkbox"/>
	Acoustic performance curve:	Type test (attached) <input type="checkbox"/> delivery test <input type="checkbox"/>	Type test (attached) <input type="checkbox"/> Delivery test <input type="checkbox"/>
	Connection type: Flanged-ends R.F. serrated finished acc. to ANSI B16.5	Other, ..... <input type="checkbox"/>	Other, ..... <input type="checkbox"/>
	Material: Body		Carbon St. A 106 Gr B <input type="checkbox"/> Other <input type="checkbox"/> .....
	Material: Diffuser		Stainless Steel ..... <input type="checkbox"/> Corrosion resistant plated steel <input type="checkbox"/> Other <input type="checkbox"/> .....
	Material: Absorbent		Stainless Steel ..... <input type="checkbox"/> Corrosion resistant plated steel <input type="checkbox"/> Other, <input type="checkbox"/> .....
	Dimensions: Length & Tolerance	.....[mm/inch] ..... ± [mm]	.....[mm/inch] ..... ± [mm]
	Dimensions: Inlet inside diameter	..... [mm/inch]	
	Dimensions:Outlet inside diameter	..... [mm/inch]	
	Dimensions:		
	Dimensions:		
	List of spare parts and their lifetime		Gaskets <input type="checkbox"/> One time Cartridge <input type="checkbox"/> ..... Years Other , <input type="checkbox"/> .....